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THE
Model Engineer
And Electrician.
A JOURNAL OF PRACTICAL MECHANICS AND ELECTRICITY.

EDITED BY PERCIVAL MARSHALL A.I.MECH.E

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A Model Electric Locomotive.

By F. MILLER.

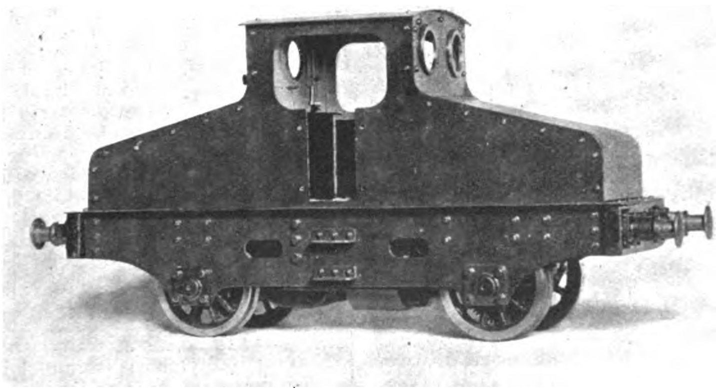


FIG. 1.—MR. F. MILLER'S MODEL ELECTRIC LOCOMOTIVE.

THE accompanying photographs show a model electric locomotive with the following leading dimensions:—Length over buffers, 14½ ins.; breadth over footplate, 4½ ins.; height from rails, 6¾ ins.; diameter of wheels, 2¼ ins.; wheelbase, 6½ ins.; frames, 1-16th in. steel plate; gauge of rails, 2¾ ins.

The frames are held together at each end by steel buffer plates. Stretchers are fixed to the frames to carry the gear bracket, motor, and pony truck. The driving axle-boxes are fixed direct to the frames, there being no springs on the driving wheels. The trailing axle-boxes are only dummy. As the builder's conveniences for making a railway are too limited, some way of running the model without rails was necessary. This was done by mounting the trailing wheels on a sort of pony truck, which can be swivelled round to a certain angle, depending on the diameter of the circle the model has to travel round, and fixed there by a nut. When run on the floor, it will travel round a 7 ft. diameter circle. Of course, the arrangement would not do for running on rails as the flanges would bind. The driving motor is a No. 2 Avery tramcar motor. This drives through a mitre gear and a pinion on to a spur wheel fixed to the driving axle. The cab and top structure are made of 1-32nd in. steel plate, fixed at the corners to small angles. Inside the cab is fixed the combined starting and reversing switch. One handle performs both operations. As the model is not run on a permanent-way, the current is conveyed to the motor by a flexible wire, which is supported by a long rod above the centre of the circle round which the model travels. A swivelling joint on the supporting rod at this point prevents the wires from getting twisted.

The locomotive runs fairly well, but owing to the ratio of the gearing being rather high, unless a heavy current is available there is a little trouble in starting.

For the Bookshelf.

[Any book reviewed under this heading may be obtained from The Model Engineer *Book Department, 26–29, Poppin's Court, Fleet Street, London, E.C., by remitting the published price and the cost of postage.]*

Modern Electricity. By J. Henry and K. J. Hora. London: Hodder & Stoughton. Price 5s. Postage 4d. extra.

Originally produced in America, this book is now being published for English readers by Messrs. Hodder & Stoughton. In view of the fact that in the preface the authors disparage the works of other writers on electrical engineering, and inform the reader that their own book will be found eminently practical, scientific, and accurate, we are led to expect something very much in advance of the ordinary text-book. In this, however, we must confess to disappointment. The book covers the usual ground of lighting, power, telegraphy, telephones, *x*-rays, and traction, but possesses no superiority of treatment over that adopted in many excellent text-books already on the market. In its favour it may be said that it is very well and clearly printed, is convenient in size, and is issued in a neat and tasteful cloth cover.

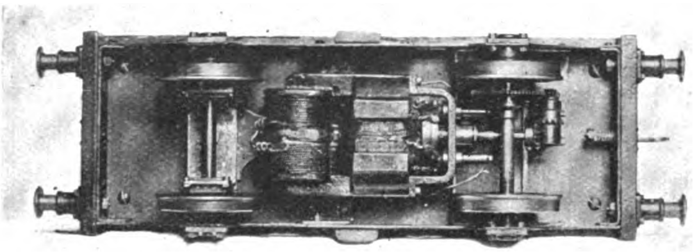


Fig. 2.—Underside View of Model Electric Locomotive.

(*See front page.*)

Lead Poisoning.—With a view to diminishing the danger of lead poisoning now run by the diamond cutters at Amsterdam, the Dutch Government have offered a prize of 5000 florins for a satisfactory substitute for the lead-tin alloy now used for embedding the diamonds in whilst they are being cut. The prize is open to competitors of all nationalities, and full particulars as to the conditions to be met can be obtained on application to Mr. H. Jen Marten, secretary to the Commissie Prijsvraag Doppenmetal, Delft, Holland.

Workshop Notes and Notions.

*[Readers are invited to contribute short practical items for this column, based on their own workshop experience. Accepted contributions will be paid for on publication, if desired, according to merit. All matter intended for this column should be marked "*Workshop*" on the envelope.]*

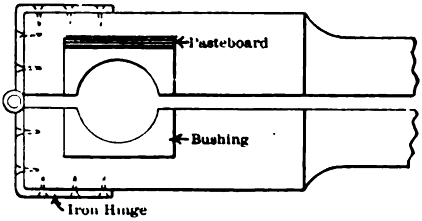
To Prepare Emery for Fine Lapping.

Emery for very fine lapping work must be sifted and re-sifted. Place 2 lbs. of flour-emery in a linen cloth a foot square, tying the edges together so that no emery can escape. Sift the emery on a clean sheet of paper by easily rapping the bag on the paper so that only the finest grains will work through. Put the sifted emery into a glass with about four times as much good lard oil, mix well, and let stand for ten hours. After this settling, run the fluid carefully into another glass, leaving the deposit of the heavier grains of emery behind. Repeat this two or three times, and the result will be an extra fine preparation for lapping the finest plugs, rings, etc.

An Improved Polishing Clamp.

By C. B. C.

The sketch shows a convenient polishing clamp. The jaws, or levers, swing upon an ordinary iron hinge, the ends of which are bent to conform to the shape of the lever ends, making a much more reliable job than the usual leather strip tacked on to the wood. In the place of clamping the levers together and boring a hole which will fit only one size of shaft, which hole will also be soon worn so as to fit nothing, the levers are cut out to snugly fit a square block of a standard size. These square blocks can be readily cut in large or small quantities, and bored with ordinary bits in a wood-turning lathe, or by hand, and then sawed longitudinally. One polishing clamp thus made will then be adaptable to a large number of such bushings with holes of different sizes. When the hole in one set of bushings becomes worn by use, so that



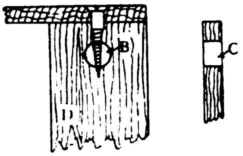
An Improved Polishing Clamp.

the lever handles meet, all that is necessary is to replace the old with new bushings, or to pack in pieces of cardboard between bushing and clamp. There is practically no wear out to such a clamp, and the satisfaction resulting in its use is complete.—*American Machinist.*

Pattern-Making Hints.

By J. H. P. Boldero.

When putting a screw in the end grain of wood, a good fastening can be obtained if a small hole is



A Pattern-Making Hint.

bored, as shown at B, about twice the diameter of the screw. Now make a plug of the same wood to fit this hole, having the grain at right angles to the grain of the side D, and drive into the hole as at C. Now screw home the screw, and a good hold will result.

Driverless Trains.—Salt from the mines at Stassfurt is carried on trains of thirty half-ton trucks, each train having a 24 h.-p. electric locomotive. No engineer rides on the train, which is stopped and started instantly by an attendant at each of the five stations along the line.

German Fuel. — The world's peat centre is not in Ireland—which, however, has more than 3000 square miles of bog—but in the north of Germany and the adjacent parts of Denmark and Holland. A square mile of bog 10 ft. deep is estimated to have a heating power equal to more than 300,000 tons of coal. Single bogs in Friesland are found to cover 1,500 square miles, and Germany has more fuel in peat than in coal.

A Simple Model Locomotive.

By R. W. C.

The two photographs reproduced illustrate a simple model locomotive which I have designed for a friend to build, and, as will be seen, is nearly completed. It is unique in many respects, as, apart from being very simple in construction, it is almost entirely built of scrap material and without the aid of a lathe, except the wheels, which are turned on a friend's lathe. The front carriage or bogie is made in one piece of sheet steel the axle-boxes sliding into slots cut into frame, the axle-boxes just being nicked on each side with a small flat file. The wheels, boxes, and chimney are all gunmetal. The boiler is copper

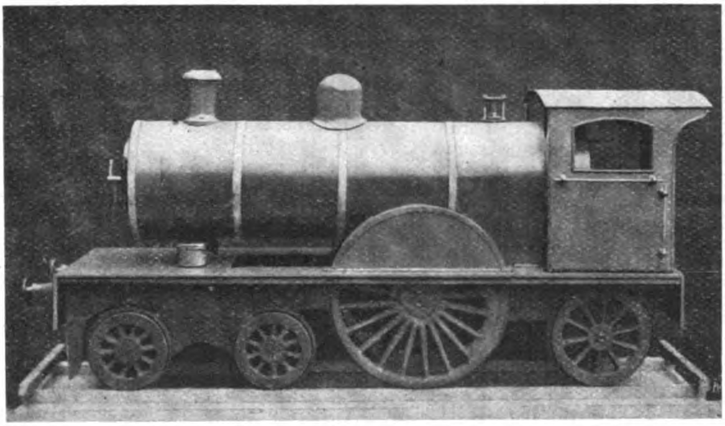


Fig. 1.—Side View of Simple Model Locomotive.

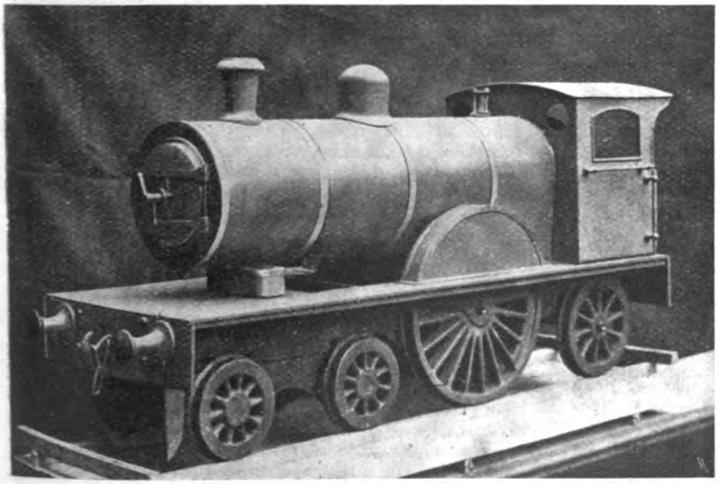


Fig. 2.—Front View.

riveted, with one large tube and cross tubes. Cylinders built up of tubing, flanges brazed on, and are 1-in. bore by 2-in. stroke, the model being built to a scale of 1-in. to the foot. The boiler is 4 ins. diameter and 18 ins. long; frame, 24 ins. in length; driving wheels, 7 ins. diameter; front bogie, 3 ins. diameter; and trailers, 4 ins. diameter; gauge, 4¾ ins. The safety valve is made with an ordinary bicycle ball, ground into a seating and pressed by a single spring. The tender is 8-wheeled, two bogies working on central pivots. I am busily engaged in the construction of a model loco from the same design, although my boiler is set slightly higher and I have a shorter chimney. The castings were all done at a local foundry, and were beautifully clean.

The comparative efficiency of two model steam engines can be arrived at by measuring the amount of fuel and water consumed for the power generated in a given time. Contributors when testing models should therefore take note of these factors, and in describing the performances of their engines, give accurate data.

The Latest in Engineering.

Comparative Tests of Steam and Electric Trains.—According to the *Railway Gazette*, a series of tests on the rates of acceleration attainable with steam and with electric trains were carried out by the New York Central Railroad and the General Electrical Company, at the end of April last. A piece of track, 6 miles long, laid with 80-lb. rails, was reserved for the trials. In this length are included gradients of 5 ft. to 19 ft. per mile, and amongst the curves is one of 2 degs. 17 min., whilst the longest tangent measures 7,565 ft. The steam locomotive was a twelve-wheels six-coupled engine, weighing, with its tender, 342,000 lbs., whilst the weight available for adhesion amounted to 141,000 lbs. The electric locomotive was also mounted on twelve wheels, of which eight were drivers. Its total weight was 200,500 lbs., of which 142,000 lbs. rested on the driving axles. The test trains in different cases consisted of eight or of six cars. The weight of the eight-car trains was 513 tons, and of the six-car trains 407 to 427 tons, the former being the weight of the electric trains. In these total weights are included the weights of the locomotives, which accounts for the weight of the six-car train being heavier in the case of the steam locomotive. The paying load was, however, substantially greater with the electric trains. Taking the corresponding runs for both the steam and the electric trains, the following results were obtained :—

	Steam.	Electric.
Length of locomotive over all ..	67 ft. 7¾ ins.	36 ft. 11¼ ins.
Total weight ..	342,000 lbs.	200,500 lbs.
Maximum load on one axle	47,000	35,500
Paying load	256 tons	307¼ tons
Average acceleration up to 50 miles per hour, in miles per hour per second	0·246	0·394
Time taken to reach 50 miles per hour	203 seconds	127 seconds

In some of the runs with the eight-car train the steam locomotive at the outset accelerated the faster of the two. This was due to insufficient area in the temporary conductor supplying the electric train, the voltage drop in this being from 700 down to 325 volts. Even then, however, the average rate of acceleration up to the maximum speed was substantially greater in the case of the electric train. In some further experiments, in which the electric locomotive ran light the speed reached was 85 miles per hour.

A Motor Car Buffer has been introduced by the Simms Manufacturing Company, Ltd. It consists of two pneumatic cushions fixed in front of the car, so as to shield the wheels, lamps, and mud-guards. The cushions are mounted on spring extensions of the frame, and should prevent such minor accidents as scratched varnish, broken lampholders, &c., when a car gets "pinched" in traffic. It is also claimed that as most accidents to pedestrians occur when the car is moving at speeds of from five to ten miles an hour, the buffer will diminish the severity of any injuries inflicted in collisions. At a recent demonstration a car fitted with the buffer was driven in succession against a wooden post, a small hand milk cart, and a man. The actual speed at the moment of collision in the latter cases appeared to be about three to four miles per hour, and in these no damage was done. In the collision with the post the car was running at a higher speed, and flung it some feet to one side.

Single-phase Locomotive for Swedish State Railways.—Experiments are to be carried out on the application of electric power to the main line railways in Sweden, and for this purpose an electric locomotive has been built to the specification of Mr. Robert Dahlander, the director of the electrical department of the State Railways. In external appearance it is similar to other electric locomotives. It takes current from an overhead conductor, and is designed to work at a line pressure of 18,000 volts as a maximum, though arrangements are made to use several lower pressures, the lowest being 3000 volts. The locomotive carries an air-cooled auto-transformer to reduce the pressure for the motors, and the circuit-breaker, of course, is the oil type. The electro-pneumatic control system is used, a compressor driv n by a single-phase motor supplying air for all auxiliary power purposes, such as switching, braking, sanding, &c. The locomotive and equipment weighs 25 tons, and is carried on four 41-in. wheels. Each pair of these is driven by a 150 brake horse-power single-phase motor at 25 periods, with a gear reduction of 18 to 70. The locomotive will handle a 70-train at 40 miles an hour, and has been supplied to the Swedish railways through the British Westinghouse Company, Ltd., of Manchester.

The New Dieter Steam Engine.—This engine, manufactured by the Dieter Steam Engine Company, of 106, Liberty Street, New York, is a four-cylinder, single-acting steam motor, constructed closely upon gas engine lines. Fig. 1 is a view looking along the crankshaft, with one cylinder shown in section, and Fig. 2 is a section through two cylinders in the crankshaft axis. The motor consists of two pairs of cylinders, the individual members of each pair having their axes inclined at right angles, and their connecting-rods acting upon the same crank of the two-throw crankshaft. The two cylinders, which have the same angular relation to the crankshaft, are cast integral, and thus two castings suffice for all four cylinders. The crank case is split in a horizontal plane along the axis of the crankshaft, the cylinder castings being bolted to the upper section. As each cylinder is developing power during each down stroke, and as the two cranks are set at 180 degs. apart, two cylinders (one of each pair) are always doing work. Trunk pistons are used, exactly as employed in gas engines, and these are packed by three expanding metal rings above and one below the wrist pin. **H** section connecting-rods are made use of, and as the two rods of each cylinder pair must be attached to a common crank pin, one connecting-rod tip is made forked, and the tip of the other rod occupies the portion of the pin between the fork of the other. This is plainly shown in Fig. 2. The bore of these cylinders is $2\frac{1}{2}$ ins., and the stroke $3\frac{1}{2}$ ins., and the engine is stated to develop 13 h.-p. at 600 revolutions per minute, with 250 lbs. boiler pressure and to be able to run at 1,200 revolutions per minute safely with a nearly corresponding increase of output. In this engine cam actuated poppet valves are used both for admission and exhaust. A live steam chamber is formed around the cylinder heads, and below this an exhaust chamber completely surrounding the cylinder. A single port in each cylinder between these two chambers communicates with the head end of the cylinder. The inlet and exhaust valves of each cylinder are directly over one another—the inlet valve being above, controlling the communication from the live steam space to the port; and the exhaust valve springs are so placed as to be out of the influence of undue heat. In addition to the poppet valve exhaust, each cylinder is provided with two auxiliary exhaust ports, which are uncovered by the piston at the extreme lowest point of its travel. These auxiliary ports are located upon opposite sides of each cylinder, and communicate directly with the exhaust spaces, and are shown in the sectional view, Fig. 1. A feature of this engine is its ready reversibility—a result which is attained by changing the valve timing by shifting the cam shaft longitudinally in its bearings. In this manner the different cam surfaces may at will be brought into contact with the valve push rods. The construction here adopted is such that by a progressive sliding movement of the cam shaft the point of cut-off for forward operation may be varied from three-fourths to one-fifth stroke. The neutral position may then be reached where no valve movement takes place, and a further motion of the cam

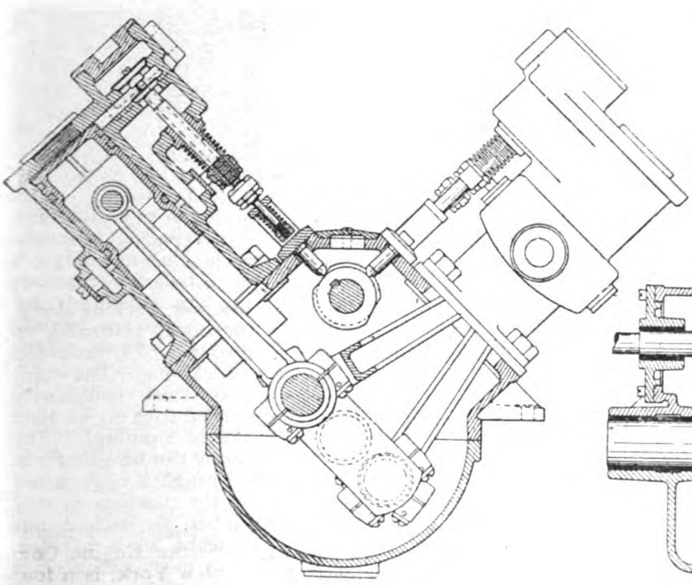


FIG. 1.—END VIEW, ONE CYLINDER IN SECTION.

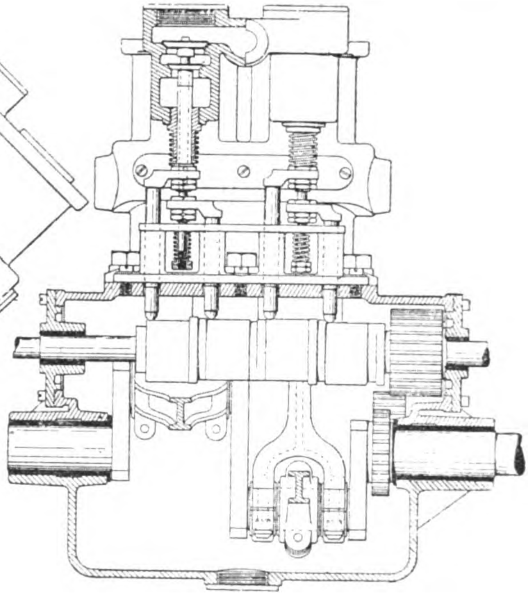


FIG. 2.—PART LONGITUDINAL SECTION.

THE NEW DIETER STEAM ENGINE.

below, controlling communication between the port and the exhaust space. The exhaust valve has a hollow stem through the hole in which passes the stem of the inlet valve above. Owing to the inlet valve being larger than the exhaust, the latter is capable of being withdrawn through the seat of the former, and both are removable through a hole in the top of the valve chamber, which is normally closed by a screw cap. The cam shaft is carried in bearings in the upper half of the crank case, and is driven at the crankshaft speed by means of enclosed spur gears. As the stems of the inlet and exhaust valve of each cylinder are concentric, they require to be moved by means of offset push rods. In Fig. 2 the inlet push rod is shown at the left and the exhaust rod at the right in each cylinder. These push rods are well guided, and at their upper extremities carry horizontal projections which directly operate their respective valves. The shaft places the engine on the reverse with a fixed cut-out. By removing a cover plate forming the top of the crank case between the two cylinders, the cam shaft may be inspected. Splash lubrication is relied upon for the lubrication of all parts of the motor. One important advantage claimed for this motor is its adaptability to the use of highly superheated steam, which results from the fact that no non-metallic packing is used in its construction, and there is, therefore, nothing to become deteriorated by the intense heat. The cylinders are lagged with asbestos to reduce radiation. Its weight complete with direct driven oscillating feed water pump is stated as 145 lbs.—*The Horseless Age.*

NEW L.C.C. MOTOR BOATS.—Sixteen motor boats have been ordered by the London County Council. These are to be attached to the various piers under the Council's control.

Lessons in Workshop Practice.

XIX.—Mechanical Details of Dynamos and Motors.

By A. W. M.

(*Continued from page* 606, *Vol. XII.*)

BEWARE of using a file to finish off the spindle at the bearings; it is such a convenient tool, and so helpful to the amateur or novice, that he is likely to be too lavish in its use in the lathe. Remember that a spindle bearing should be perfectly round; if it is elliptical, or has a number of flats on its surface, it will not run well. You may find, on fitting up the bearings, that the spindle is quite free for half a revolution, and then is stiff for the next half revolution; this means that the spindle and bearing bush are not quite circular, or that the spindle is bent. If on testing it between centres it is found to be straight, then you may conclude that the bearing part is not round; this may be tested by applying a calliper, which will be found to slip easily over the spindle at the smallest diameter. If you use a file too much, and without care, to fit the spindle into the bearing bushes, you destroy the circular cut of the turning tool, and produce an elliptical surface or a number of flats. The file used should be very smooth, and applied with slow, even strokes whilst the spindle is revolved at fast speed. The turning tool should have reduced the spindle to such a near fit that the file does little more than effect a final polish.

Lubrication of the bearings is another point where difficulties arise with small machines. For very small motors running for short periods, perhaps the plain oil hole and a drop of oil is as satisfactory as anything, and has the merit of simplicity. As soon, however, as we deal with dynamos or motors of, say, from 30 or 50 watts and upwards, required to run for stretches of one to eight hours, or more, this system becomes unsatisfactory, as the oil is thrown out at the ends of the bearing, and the spindle soon becomes dry. The self-lubricating ring system has become almost the universal type for large machines.

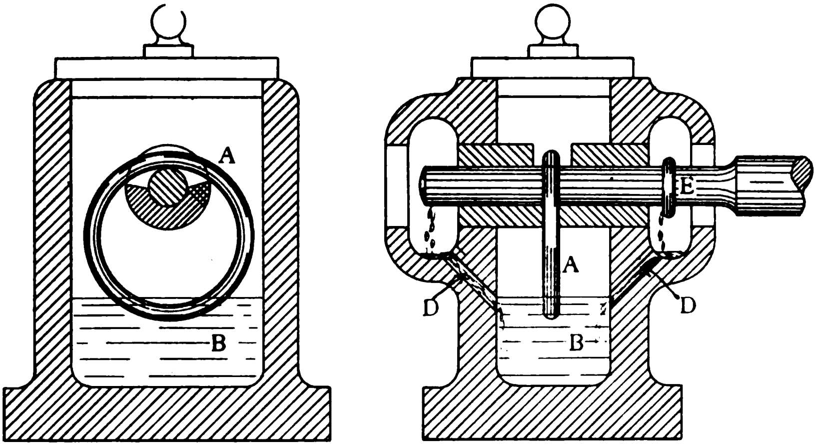


FIG. 8.

Fig. 8 shows a section of a bearing made on this system. A ring (A) is threaded over the bearing bush, and rests upon the shaft, a part of the upper side of the bush having been cut away to allow it to do so. The lower part of the ring dips into a chamber containing oil. As the spindle revolves, it acts like a pinion inside an internally toothed cogwheel, and causes the ring to revolve also, so that each part of it comes to the top of the spindle. As the ring is covered with oil, it deposits a certain amount continuously on to the shaft, some of the

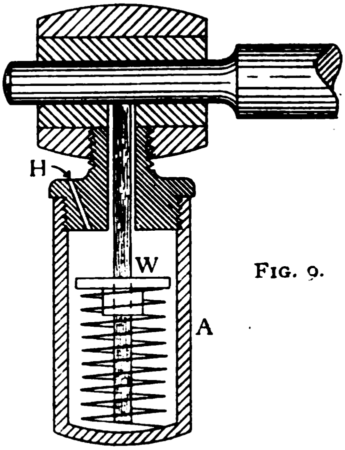


FIG. 9.

oil finds its way into the bearing, and, working along, comes out at each end of the bush, returning to the oil-chamber by way of the drains D D provided in the casting. The spindle is thus constantly drenched with oil as long as it is running. The dirty oil can be either run off through a cock fitted into the bottom of the chamber, or sucked out by means of a syringe. Two or more oiling rings are frequently used, but one suffices for any size up to 1000 watts.

This type of bearing gives good results when properly made; but it is not so easy to make as would appear, as the ring has a way of refusing to go round, or else goes round at such a speed that it constantly jumps away from the spindle; the oil works on to its outer edge, and is thrown out through the joints of the lid at the top. It has another trick of working to one side and sticking there, or of jumping up on to the bush, where it hangs useless.

The following are some of the points to attend to when making this type of bearing:—

The ring must be perfectly true; it may be flat or round in cross section, but if it is not a true circle, or has an uneven or flat place, it will not go round. It should be fairly large and heavy, and should be made of non-magnetic material, such as brass; if made of iron or steel, it is liable to be attracted by any stray magnetism in the bearing standard and stick to one side. The drains for the oil to return by should be of ample size, and the casing should form a recess at each end of the bush, to catch and contain the oil as it works through. There is yet one thing more to attend to, and that is the oil. It must be thick enough to cling to the

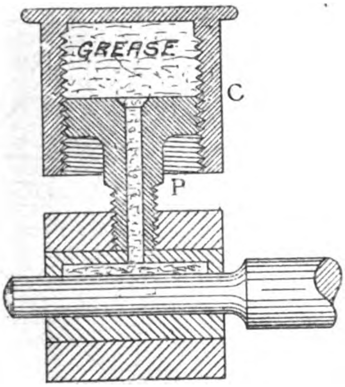
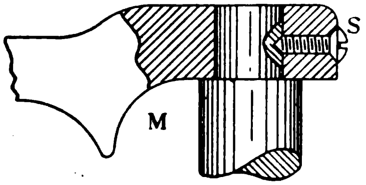
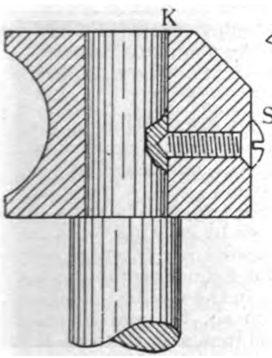


FIG. 10.

ring, and yet not so thick as to stop it from going round. To prevent oil working along the spindle to the armature, a small collar (E) is sometimes fitted to the shaft. The oil rises to the highest part of the collar, and is then thrown off. One disadvantage of the ring oiling bearing is that the oil chamber obviously must always be underneath, or





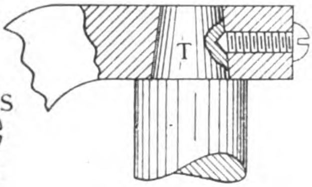
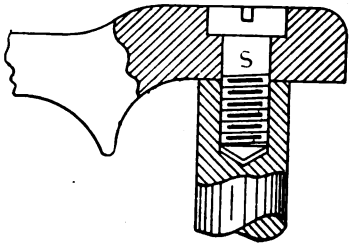


FIG. 11.

the oil will run out. This may be an awkward objection if the machine is likely to be fixed upside down on a ceiling, or under a machine, or sideways against a wall. Some machines with circular magnet yokes are intentionally planned so that the bearings can be rotated and fixed in any position to get over this objection. The type shown in Fig. 5 could be easily arranged in this way, but with some designs it is impracticable.

A self-acting lubricator which is largely used for small fan motors is shown in Fig. 9. It is screwed underneath the bearing, and consists of a tube (A) screwing on to a plug, which is tapped into the bearing boss; a stiff wick (W) dips into the oil, and is pressed upwards against the spindle by means of a spring; the oil soaks into the wick, and works its way upwards when the spindle rotates. This is a very good method of lubricating the bearings of small machines up to about 150 watts size. The best material to use for the wick is felt, and an air-hole (H) should be drilled through the plug.



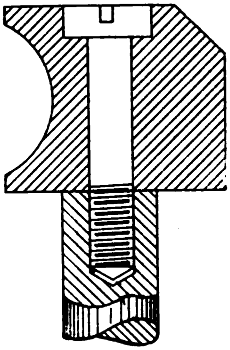


FIG. 12.

The size of tube A may be about $\frac{3}{8}$ in. diameter by 1 in. long, and wick about 3-16ths in. diameter; spring should be as weak as practicable.

Another good system, and one which is universally applicable to machines of all sizes and patterns, is the use of solid grease, generally known as the Stauffer grease lubricator system (see Fig. 10); a plug (P) screws into the bearing boss, and a cap (C) screws over the plug. The cap is filled with grease, which is compressed and forced through a hole in the plug into the bearing, when the cap is screwed down, a turn being given to the cap from time to time when lubrication is required. At first consideration this may seem to be a method requiring constant attention, but in practice one turn of the cap will keep the bearing lubricated for hours, if good grease is used, as the lubricant stays in the bearings for a long time, instead of running out like oil; and one lubricator full of grease will last for weeks at a time. Users frequently make the mistake of screwing down the cap too much and too often; a quarter of a turn at a time is sufficient, and about once in four or five hours. It is necessary to cut a short groove in the bearing brass to allow it to run along the spindle—say, three-fourths of the length of the bearing will do.

Various patterns of these lubricators can now be obtained, some having spring-feed arrangement; but the plain screw-cap is easily made, and works very well. Two sizes, say, with caps ½ in. and ¾ in. diameter will cover the whole range of sizes from 30 to 500 watts; make the length of cap about one-and-a-quarter times the diameter, hole in plug small, and thread in cap of fine pitch. Should the bearing run hot, the idea is that the heat will melt the grease, which will run down (if the lubricator is on top) and flood the bearing, preventing it from seizing. These lubricators work equally well in any position, and to a large extent get over the trouble of leaking and flying oil, which takes place when ordinary syphon or drop-feed lubricators are used on the simple bearings usual with machines of small size.

A difficulty which sometimes presents itself to the novice is that of fixing wrought-iron magnet cores to the pole-pieces. The best practice is to insert the core into a hole in the pole-piece (see Fig. 11), which shows a Manchester type (M) and overtype of Kapp pattern (K) treated in this way: the core is held firmly in place by means of a setscrew (S), the point being countersunk into the core. When making such a joint, the core should only be reduced in diameter enough to form a slight shoulder. As it is necessary for magnetic as well as mechanical reasons that the core should be a good fit in the hole, it often causes trouble when the pole-piece or yoke has to be taken off, the core sticking in the hole. This may be obviated by turning the core slightly taper, and boring the hole in the pole-piece to suit it (Fig. 11, T). This makes a good job, but takes more time and care.

A common practice is to make a butt joint (Fig. 12). This is not so good magnetically when the core is wrought iron and the yoke cast iron, but can be used without very much detriment. In this case the screw S should be of wrought iron, should be a good fit in the yoke, and fill the tapped hole

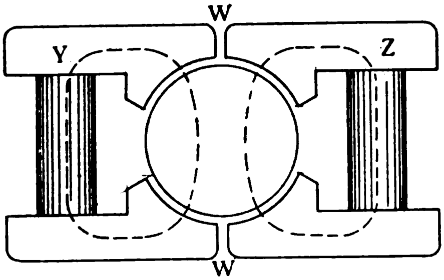


FIG. 1 .

in the core as much as practicable. It can be of large size, as it helps to transmit the magnetism from the core to the yoke, and it is well to sink the head into the yoke or pole-piece to minimise leakage, as magnetism tends to leak away at points and edges. The same plan would be followed for the internal poles of ironclad or multipolar machines.

In any joint in a magnetic circuit the surfaces should be in close contact all over, chipping strips, or any method of removing the central portion so as to make a firm joint as practised in ordinary engine construction, is not admissible. The joint, however, need not be made to have close contact, if it occurs at any point where two magnetic circuits run side by side. For instance, in a Manchester, or similar pattern machine having a field-magnet composed of two castings (Y and Z, Fig. 13) the joint at W W may be quite rough, or need not make contact at all, as no magnetism passes through it. The magnetic circuits are shown by the dotted lines.

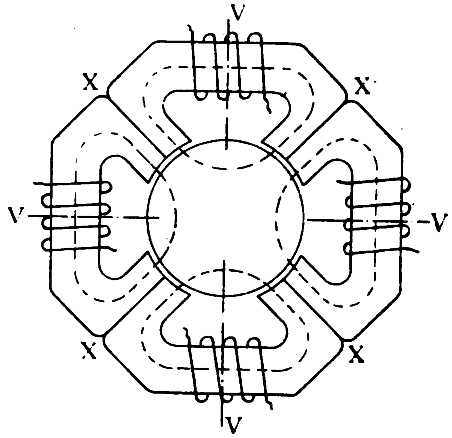


FIG. 14.

Fig. 14 shows a four-pole machine in which four castings are used. The joints X may be quite imperfect without detriment. If they had occurred in the centre of the field-magnet coils at the points V, it would be necessary to make them as good as possible, as they would be then each right across the path of a magnetic circuit, as shown by the dotted lines.

(To be continued.)

MAGNETITE ARC LAMPS.—There are now 300 magnetite arc lamps in use for street lighting at Jackson, Mich., U.S.A. It is stated that these are giving every satisfaction. Tests show that a given size of type can be read by these lamps almost twice as far as by the 6·6 amps. enclosed series alternating arc lamp which the company has now in use in some of its other plants. The magnetic lamp uses 4 amps. at 80 volts.

GERMAN RAILWAY EXPERIMENTS.—During the past year an extensive series of experiments were carried out in Germany, on the military line between Marienfelde and Zossen, with a view to ascertaining the highest speeds at which trains of bogie carriages could be drawn by existing German express locomotives. These were of different types but were mostly two- and four-cylinder compounds, with a heating surface which in the smallest engine, weighing 52 tons, was 1,220 sq. ft., and in the largest, an engine weighing 88 tons, was 2,650 sq. ft. The highest speed reached was 137 kilometres (85 miles) per hour, the engine used being the largest of those tested. The weight behind the tender was 109 tons, and the draw-bar pull at the tender was 1·3 ton. On putting on the brakes the train was brought to rest in 62 seconds, the distance run being 4,200 ft.

Notes on Locomotive Practice.

By Chas. S. Lake.

Tank Locomotives on British Railways.

(*Continued from page* 512, *Vol. XII.*)

A DEVELOPMENT of the 4—4—2 type is that in which the single pairs of trailing wheels are replaced by a four-wheel bogie—that is, the 4—4—4 type, a very unusual arrangement, only found on two small railways—viz., the Wirral and Midland & South-Western Junction. This wheel arrangement is well calculated to meet the conditions met with on lines abounding in sharp curves, but the writer has been informed, and by a competent authority connected with a leading locomotive building firm, that such engines are very bad for slipping of the coupled wheels, as with a four-wheeled bogie at either end to take the weight, it often happens that on an irregular piece of road the coupled wheels are freed from their load, and undue slipping takes place as a natural consequence. However this may be, it is certain that the type of engine has never met with anything like the same amount of favour accorded to other types.

Fig. 20 illustrates one of the engines designed by Mr. Eric Barker for the Wirral Railway, a short-distance passenger line in the Birkenhead district. Inside cylinders are used, and the boiler is fitted with a Belpaire firebox, and the engine is generally of a modern design throughout. It was built (with others) by Messrs. Beyer, Peacock & Co., Ltd., of Gorton, near Manchester, to whom the writer is indebted for the photograph. The leading particulars are as follows :—

Cylinders, 17 by 24.
Coupled wheels, 5 ft. 2 ins.
Heating surface total, 1021·5 sq. ft.
Grate area, 21·5 sq. ft.
Working steam pressure, 170 lbs.
Weight loaded, 59·16.

For working unusually heavy suburban passenger trains many railway companies employ tank locomotives having three pairs of coupled wheels in place of four. Such engines are of two different main types in this country—viz., 2—6—2, or double-ender, and 0—6—2, or six-coupled radial types, the latter being so described owing to the presence of a pair of "radial" wheels behind the firebox—*i.e.*, wheels having radial axle-boxes, the three coupled axles being placed ahead of the firebox. A few engines are running in which the trailing axle is replaced by a four-wheeled bogie truck ; but this is a very rare design on British railways. Every railway possesses tank locomotives having three pairs of wheels all coupled, without any other wheels ; but these are principally employed for shunting and local goods traffic, although on the Great Eastern Railway such engines are regularly employed on suburban passenger work.

Figs. 21 and 22 illustrate large tank engines of the 2—6—2 type employed on the Great Western and L. & Y. Railways respectively. In the first-named case the cylinders are outside the frames, and the engine generally is of decidedly original design. It is quite a recent addition to the locomotive stock of the railway referred to, and has all the latest features coincident with the practice of the line—

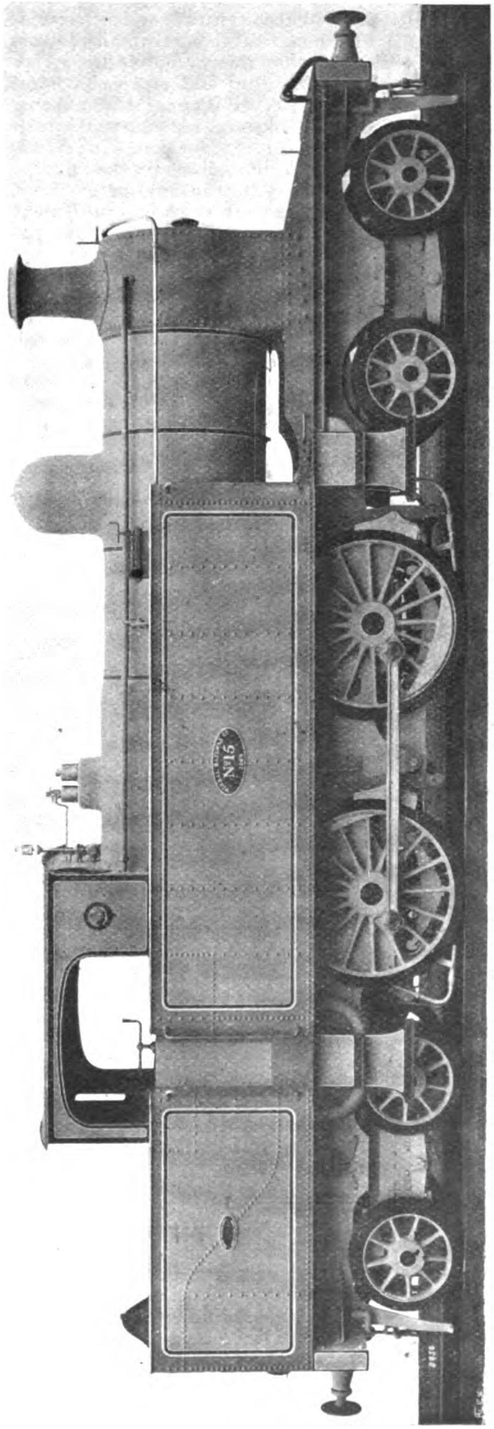


Fig. 20.—Double Bogie Tank Engine, Wirral Railway.

viz., taper boiler, extended smokebox carried in a cast-iron saddle, long-stroke cylinders, solid bushed big-end connecting-rod, cylinder centre line *higher* than the wheel centres, and other features not usually met with on home railways. Engines of this class work heavy goods trains between Swindon and London, and *vice versa*; and the writer recently observed one of the number hauling forty loaded trucks and a goods brake near Reading.

The cylinders are 18 ins. diameter by 30 ins. stroke; coupled wheels, 5 ft. 8 ins. diameter; total heating surface, 1,518 sq. ft.; grate area, 20·35 sq. ft.; working steam pressure, 195 lbs.; weight load, 72 tons 3 cwt.

The L. & Y.R. locomotive (Fig. 22) is of especially large proportions, and it, with others of its class, were specially designed for dealing with the very heavy suburban traffic around Manchester, Liverpool, and other centres on the line; also for passenger train hauling on the difficult and congested main line, where the conditions are more than usually severe, as those who are acquainted with them well know. In this design the cylinders are inside, and Joy's gear is employed for actuating the valves which work above them. An immense boiler, possessing over 2,000 sq. ft. of heating surface, and pitched with its centre line 9 ft. above rail level (the highest in Great Britain), is provided, other dimensions being as follows:—Cylinders, 19 ins. by 26 ins.; coupled wheels, 5 ft. 8 ins. diameter; total heating surface, 2038·64 sq. ft.; working steam pressure, 180 lbs.; total weight loaded, 77 tons 10 cwts.

(*To be continued.*)

A Good Motor Run.—A convincing test of the all-round excellence of the "Lacre" van has just been carried out. one of them having travelled from London to Swansea, nearly 214 miles, without a stop, in eighteen hours. The van weighed 15 cwt., was of 16 h.-p., and consumed only a little over 8s. worth of fuel for the whole journey. The result was all the more worthy of praise because the roads were heavy, many hills had to be negotiated, and the van carried driver, a passenger, and goods to a total weight of close upon 17 cwt.

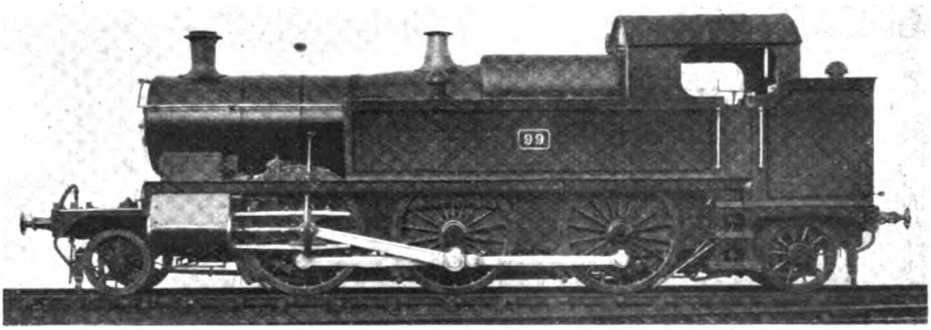


Fig. 21.—Great Western Railway 2—6—2 Type Tank Engine.

A Sensitive Galvanometer.

In a paper presented to the Académie des Sciences, M. Einthoven describes a new form of sensitive galvanometer which he has devised, together with some experiments which he carries out by applying this very sensitive method of measuring electric currents to the study of the electrical condition of the human body. In the latter case it is especially the electric effects produced by the heart which he observes.

The new galvanometer is one of the most sensitive which is known, and at the same time very precise, so that the smallest variations of current can be measured down to 10^{12} amp. It is formed of a silvered quartz fibre which is stretched like a violin cord between the poles of a powerful electromagnet. When a small current passes in the wire it is deflected perpendicular to the lines of the field, and the deflection can be measured directly by means of a microscope carrying a micrometer.

The sensitiveness of the instrument can be regulated by adjusting the length of the wire, so that it will measure in the region of 0·001 down to 10^{11} amp. The movement of the wire and its variations can be registered by the photographic method. The image of the middle of the cord, magnified 600 diameters, is projected upon a slit which is placed perpendicular to the image. In front of the slit is a cylindrical lens whose axis lies perpendicular to the slit. A photographic plate receives the image, which is thus concentrated to a point, and by moving the plate a curve is obtained which corresponds to the current variations. The image of a scale is projected on the plate at the same time, in order to measure the curves.

The new instrument allows of making measurements which could only be observed heretofore with the electrometer. One of these is the study of radium, which is now made with a gold-leaf electrometer. It will prove especially useful in physiological work for studying the nerve currents. In the case of a frog we observe the currents of the sciatic nerve, for instance. The electric action of the human heart has been observed heretofore with the Lippman electro-capillary instrument. The muscular shocks of the heart-beats are known

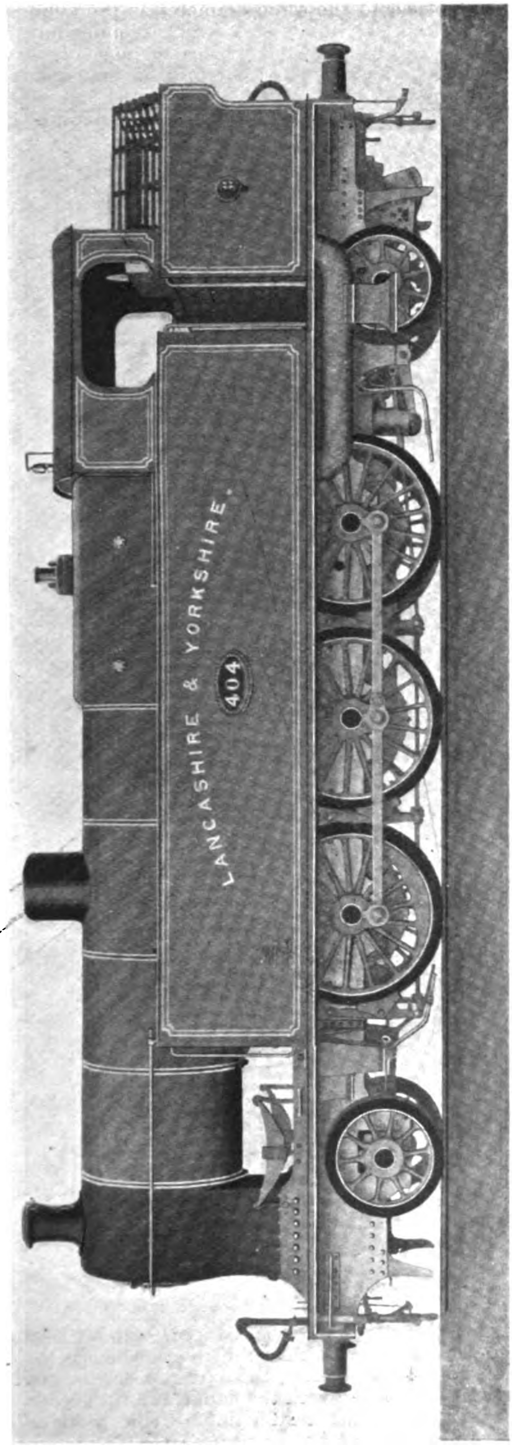


Fig. 22.—Heavy 2—6—2 Type Tank Locomotive, Lancashire and Yorkshire Railway.

to produce variations in the electric potential of the organism, and this was brought out by Waller in 1899. The currents are registered with the Lippmann instrument, but this has many disadvantages owing to the inertia in the oscillations of the mercury column. The present instrument is more sensitive and works more quickly, as the light quartz fibre, in spite of its length, has but little inertia, and can register the variations of current more exactly; and again, the displacement is proportional to the current.

M. Einthoven has obtained a series of curves in the shape of regular waves which correspond to the heart-beats, and show how the electrical effect varies. The effect is, in fact, quite considerable, and indicates the great variation of electric potential in the different parts of the body which accompany the muscular shock of the heart. The waves he obtains are similar in form to those of the Marey cardiograph register.

High-Speed Engines.

By H. Muncaster.

(Continued from page 569, Vol. XII.)

THE vertical type of high-speed engine seems to have become quite a favourite, as it has many points to recommend it. It is customary to make it for actual use, when of considerable power, with the working parts entirely enclosed, with the object of preventing the lubricant from being thrown about. As, however, it is not suitable for model-making to have the parts shut up out of sight, spoiling the model of its educational value as an object lesson, as well as depriving us of the pleasure of seeing it working, we do not intend giving any details of the enclosed types. We give herewith illustrations of a familiar pattern of vertical engine, of which Fig. 7 shows the side elevation with the valve spindle and gland; also the eccentric and rod removed to enable the main bearings and the connecting-rod to be more clearly seen. Fig. 8 gives the front elevation. In this case the valve spindle and eccentric gear are shown, but the stay is removed from the front of the engine so as not to confuse the details of the motion. Particulars are given to suit an engine with a cylinder diameter of 3 ins., and a stroke of 3 ins., intended to run at about 1000 revolutions per minute. This speed is not excessive, as it keeps the inertia of the piston group well within the load on the piston, due to the initial pressure at 50 lbs. per sq. in., assuming a weight of 6 lbs. total for piston, piston-rod, crosshead, and connecting rod. $6 \times 1000^2 \times \cdot 125 \times \cdot 00034 = 255$ lbs. inertia of reciprocating parts; 3 ins. diameter (7 sq. ins. area) at 50 lbs. steam pressure = 350 lbs. initial pressure on piston. It will thus be seen that the inertia of the parts is considerably under the load on the piston at the speed and the pressure given.

The governors are not shown, as we prefer to go into the question later, giving alternative designs suitable for this engine.

The bedplate shown is of rather unusual shape, having its upper surface sloping down towards the front. This looks very effective when finished, but as it may not be to the liking of all, the details will therefore be made out for a bed having the upper surface level as an alternative.

A thin plate (not shown) will be desirable in front of the connecting-rod, to prevent the oil that is thrown off by the crank flying about the room. The plate is fitted inside the front stay, and extends down a little way into the crank race. At the bottom of the crank race is a zinc or tin tray, in which all the waste oil is collected.

Figs. 9 and 10 give details of the cylinder. It will be noticed that the lower cover, with the stuffing-box, is not cast on to the cylinder, as is

than the flange on the standard, which is turned and finished to the same diameter as the cylinder cover—viz., 5⅛ ins. This will accommodate a sheet steel covering over the lugging of, say, 20 gauge, which is fitted carefully in between the covers, and is held by spherical heated screws, as shown in the general elevation. The flanges of the

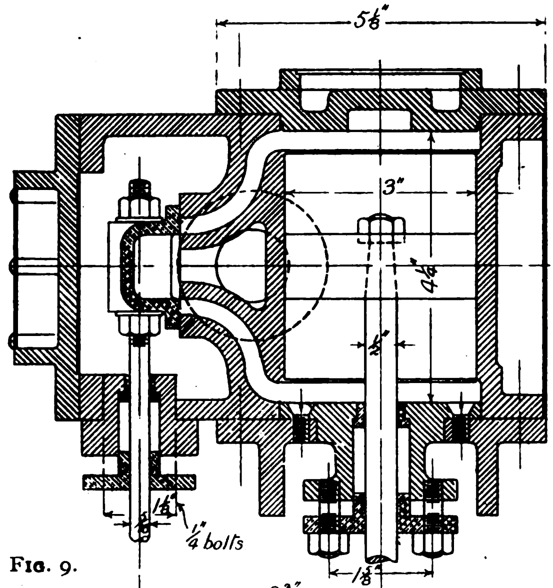


Fig. 9.

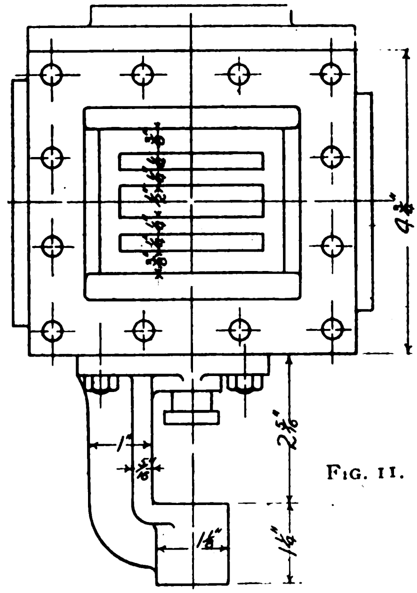


Fig. 11.

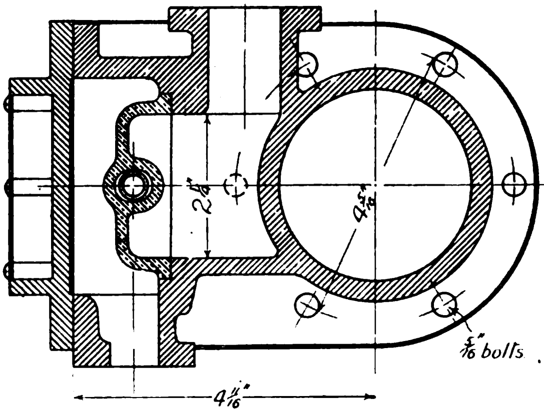


Fig. 10.

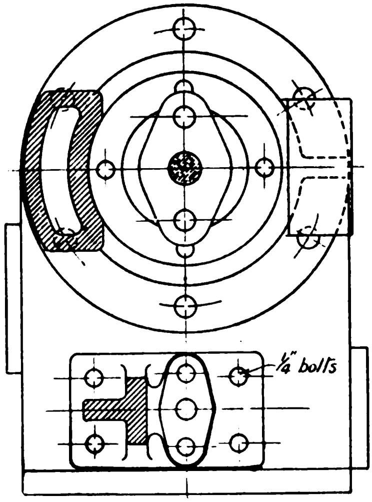


Fig. 12.

Details of High-Speed Engine Cylinder.

often the case in this class of engine; it is thus easier to bore the cylinder true. After boring, the cylinder can be mounted on a suitable mandrel, and the ends faced so as to be absolutely true to the bore. The stuffing-box for the valve spindle is also cast separately; this allows both ends of the cylinder to be faced all over. The flanges are dressed down to about 1-16th in. less in diameter

steam chest are also to be reduced to about 1-32nd in. on each side less than the cover, which is to be faced to 5⅛ ins. across; the extra size in the cover hides the joint between the flange and the sheeting, and makes a much neater finish to the work. In the case of the chest cover, it is a good plan to make two of the bolts to fit the holes, so as to act as steady pins, and assure the cover being accurately

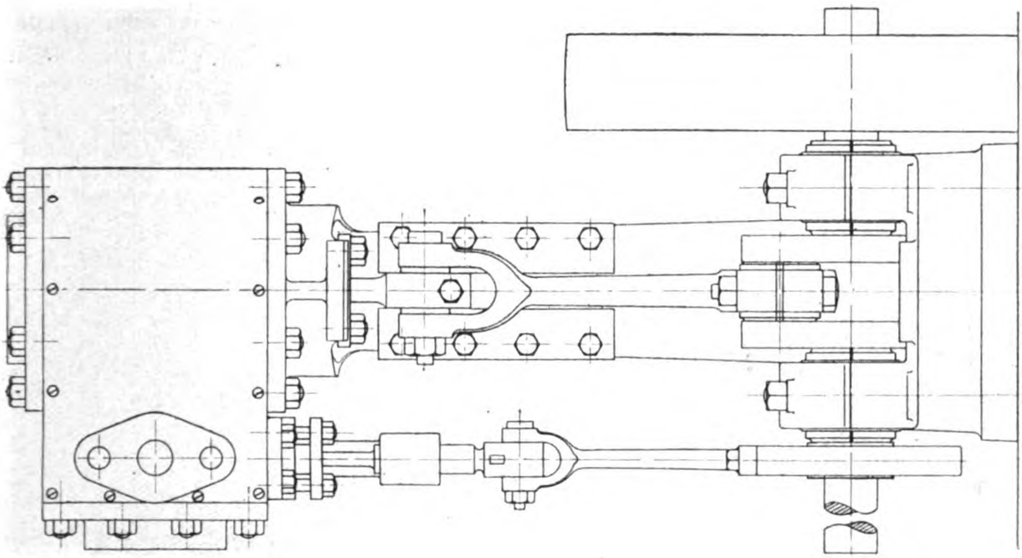


Fig. 8.—Front Elevation (Stanchion Removed).

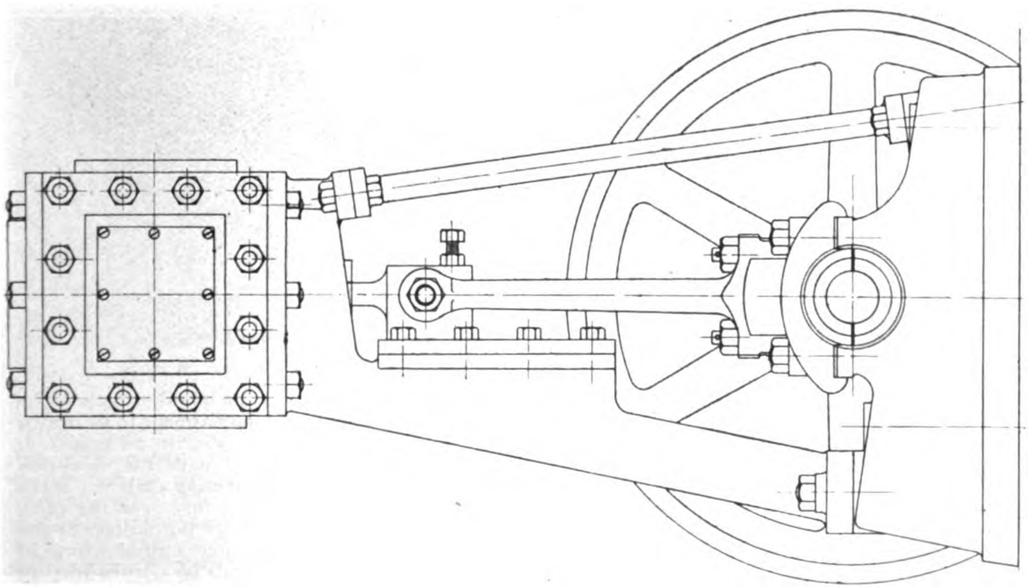


Fig. 7.—Side Elevation (Valve Gear Removed).

HIGH-SPEED ENGINES. (Scale: ½ full size.)

By H. Muncaster.

For description] [see pages 11—14.

replaced when taken off for any purpose. These points may seem of little importance, but they add much to the neatness and finish of the work. "Trifles make perfection, and perfection is no trifle." The steam ports are 2¼ ins. by ¼ in., and the exhaust 2¼ ins. by ½ in.; the valve face, 2⅞ ins. wide. If an engine of much smaller dimensions be made on the same lines, on account of the small space available, it will not be wise to cast on the steam chest, as it will be found very difficult to true the faces. The metal in the cylinder barrel is 5-16ths in. thick, and the flanges ⅜ in. thick; the cover bolts and studs, 5-16ths in. diameter.

The stuffing-box is separate from the cylinder, and may be of cast iron or gunmetal. In machining it will be first bored out, then mounted on a mandrel, and turned to a good fit in the counter bore of the cylinder; this will ensure the piston-rod being central. The gland is to be oval, the greater dimensions of which are more than the hole in the standard it has to pass through. To get the stuffing-box into place, it may be tilted so as to allow one lug to be first pushed under the internal flange in the standard, when the gland can be passed through. This must be done before the studs are fixed, or a small piece may be cut out between the bolts on each side to allow the complete gland to pass. In fitting the stuffing-box, care should be taken to have the gland bolts at the sides. Otherwise, if they be arranged front and back, some difficulty will be found in screwing the nuts up when packing. On each of the covers a steel plate is to be fitted as shown, about 20 gauge, to protect the lagging. The space behind the plate may be filled in with slag wool, or any such suitable non-conducting material.

The gland and the guide for the valve spindle are in one piece, which is bored and then turned on a mandrel. The guide will be bored to ⅝ in. diameter. The stuffing-box should be bored with the same tool. As it is to be bolted to a face already trued to the bore of the cylinder, there will be no difficulty in getting the valve spindle parallel to the piston-rod. Four ¼-in. bolts or studs (preferably the latter) will be used to bolt the casting to the cylinder. In the inverted plan of the cylinder (Fig. 12) the view may appear to be drawn to the wrong hand; it is intended to be as seen in a mirror, so as to correspond with the elevation (Fig. 11). The slide-valve will have a lap of 3-16ths in. at each end, making it 1⅞ ins. over the face. The recess will be 1 in. wide, giving no lap to the exhaust edge. As the valve has a total travel of ¾ in., the opening for steam will be 3-16ths in. In setting the valve, a lead of about 1-32nd in. should be given—a little more will do no harm. The amount of cushioning given by this valve will be suitable for running at a tolerably high speed under a fair load.

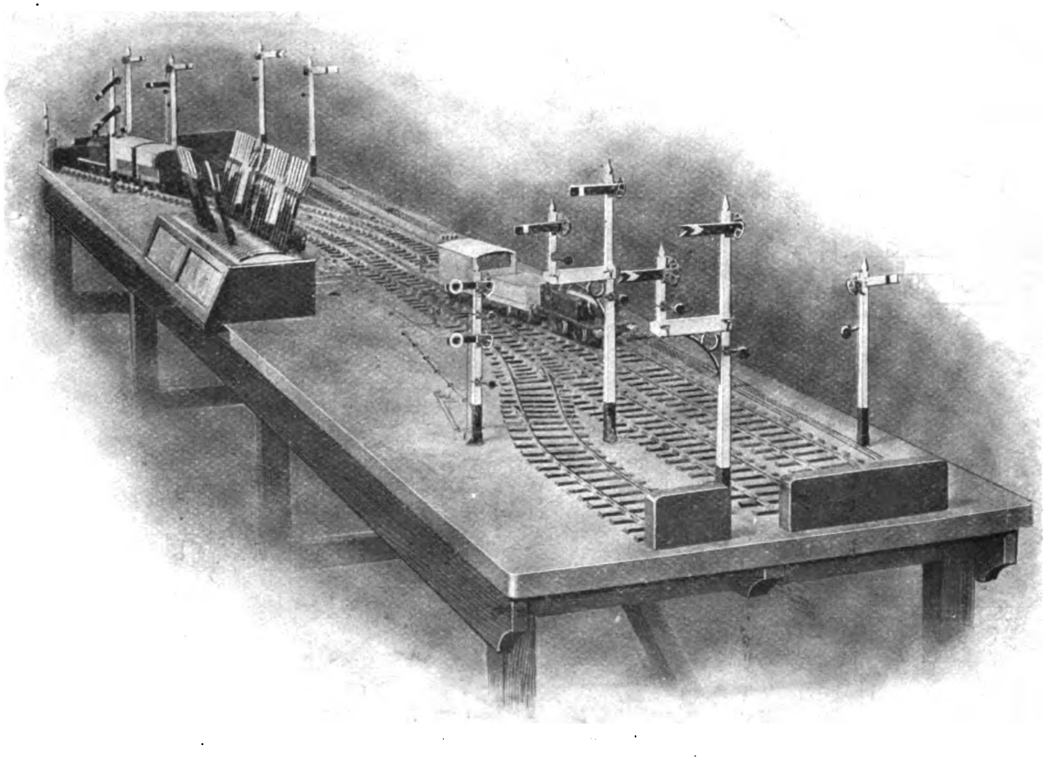


FIG. 1.—THE GREAT WESTERN SIGNALLING INSTRUCTION MODEL MADE BY MESSRS. W. J. BASSETT-LOWKE & CO.: GENERAL VIEW.

(To be continued.)

A Signalling Instruction Model for the G.W.R.

It is well known that engineering classes for apprentices and others have existed at Swindon for many years, and, in fact, similar facilities exist at the locomotive and carriage works of other large railways—viz., at Crewe, Horwich, York, &c.; but the establishment of classes for the technical instruction of the clerical portion of the staff is of more recent growth.

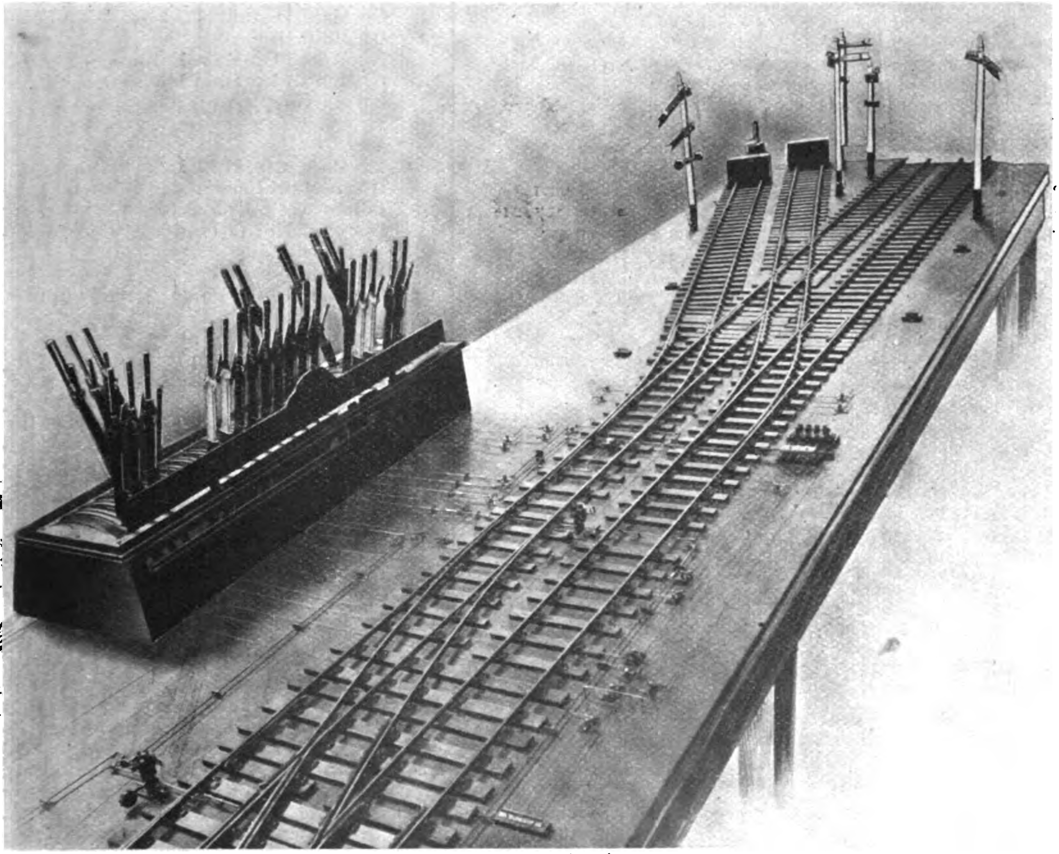


Fig. 2.—G.W.R. Signalling Instruction Model. A View of the Junction and Locking Frame.

It was felt, however, that these lectures, admirable in their way, were scarcely practical enough for the railway men of to-day, and as an experiment, therefore, "Schools of Railway Signalling" have been established by the directors of the company, with the object of familiarising the main body of the clerks with the fundamental principles of railway working.

On no railway in the United States, nor on the Continent, can be found such a practical scheme of education, assisted by excellent models, as exists in the school we are describing.

The earlier model installed was made by the company, but recently they placed in the hands of Messrs. W. J. Bassett-Lowke & Co., of Northampton, further orders for models of the same kind. The model we illustrate is the first of those Messrs. Bassett-Lowke are making, and, we understand, has gone to the Birmingham district. In the details the scale of the railway is ¾ in. to the foot, the standard models of permanent-way and signals made by the firm being used, and the whole of the work is of the highest character. Two dummy trains are provided, one a model of a passenger train, and the other of a goods train. The levers are interlocked in the orthodox way, and the model has the usual ground locking gear and detectors.

The plan of the line is shown in the accompanying diagram, and in the classes four students are chosen each evening and placed in the various boxes—viz., the central or junction box (A), up main line (B), down main line (C), branch line (D). Here what had been learned in the lecture was put to practical test. The various signals of: "Is line clear?" "Line clear," "Train on line," "Train out of section," are given and received. The miniature trains are then put in motion, signals lowered or put to danger, shunting performed, and all possible combinations or emergencies gone through. Problems are set and practically explained by means of the model.

The model, as will be seen from the illustrations, is in every respect a reproduction in miniature of a main line junction, and almost every problem which presents itself at the latter can be worked out on the former.

	Locking Table.			Description of Signals.	
	Locks in Normal Position.	Reverse Position.	Releases.		
1		2 5		1	Up Main Distant
2	8 12		1	2	Up Main Home
3		4 5		3	Branch to Up Main Distant
4	12	8	3	4	Branch to Up Main Home
5	8 12 13	8 12	1 3	5	Up starting
6				6	x
7				7	x
8	2	9	4	8	Up Main x from Branch
9	16 24		8 17 21	9	Down Main Facing x to Branch
10	9	9	13 16 17 21 24	10	Points No. 9 Unlocked x Locked
11	9 10	9 10 12		11	Disc for No. 12 Points x Backing from Down Main
12	2 4 15 21 24		11 13	12	Main x Crossover
13	5	10 12		13	Disc for No. 12 Points x Backing from Up Main
14	9 10 16 17 20 23	9 10 15		14	Disc for No. 15 Points
15	12 21 24		14 16 17	15	Down Main x Down Refuge Siding
16	9 14	10 15		16	Down Refuge Siding to Down Main Starting.
17	14	9 10 15		17	Down Refuge Siding to Branch Start'g
18				18	x
19				19	x
20	9 10 11 12 14 15	9 10 12 15	22	20	Branch Starting
21	12 15	9 10	22	21	Down Main to Branch Home
22		20 21		22	Down Main to Branch Distant
23	9 10 11 12 14 15	9 10 12 15	25	23	Down Main to Branch Starting
24	9 12 15	10	25	24	Down Main to Branch Home
25		23 24		25	Down Main to Branch Distant

Large Railway Bell.—The *Electrical Times* describes one of the most powerful electric bells ever made. The gong is 19½ ins. in diameter, and weighs 90 lbs.; the weight of the complete bell is about 1½ cwts. The heavy iron clapper, 2 ins. in diameter, is of sufficient size and weight to produce loud clear notes, the number of strokes per minute being about 100–120. The motion parts are entirely enclosed in a water-tight cast-iron box, the pull rod for actuating the clapper coming through a packed gland. The current required to operate this bell is ¾ amp. at 18 volts, and can be furnished by twelve ordinary size dry cells. The bell was made under Macleod & Plato's patents, by Messrs. Fuller, Macleod & Co., Ltd., of Norfolk House, Laurence Pountney Hill, E.C., primarily for railway working, but, of course, it is applicable to many other purposes.

Nickel-Plating.

A NON-ELECTRICAL process of nickel-plating is known as the Mitressey process, recently introduced in France. Instructions given for the successful use of this process are as follows:—Clean the objects in 5 kilogrammes of American potash per 25 litres of water. (For rusted pieces use 2 litres of chlorhydric acid per 1 litre of water.) Now put 250 grammes of sulphate of copper in 25 litres of water; after the sulphate is dissolved, add a few drops of sulphuric acid, drop by drop, stirring the liquid with a wooden stick until it becomes as clear as spring water. Immerse the pieces in this, attaching them to leaves of zinc. When they have assumed a red tint, pass them into the nickelling bath, which is composed of cream of tartar, 20 grammes; sal ammoniac in powder, 10 grammes; kitchen salt, 5 grammes; oxychlor-hydrate of tin, 20 grammes; sulphate of nickel, single, 30 grammes; sulphate of nickel, double, 50 grammes. Remove the pieces from the bath for a few minutes, and rub them with fine sand on a moist rag. This is to get a brilliant deposit. To improve the appearance of the plating, it is advisable to rub with a brass wire brush, and if convenient finish off on a piece of buff glued on a wooden wheel, and smeared with red stuff.

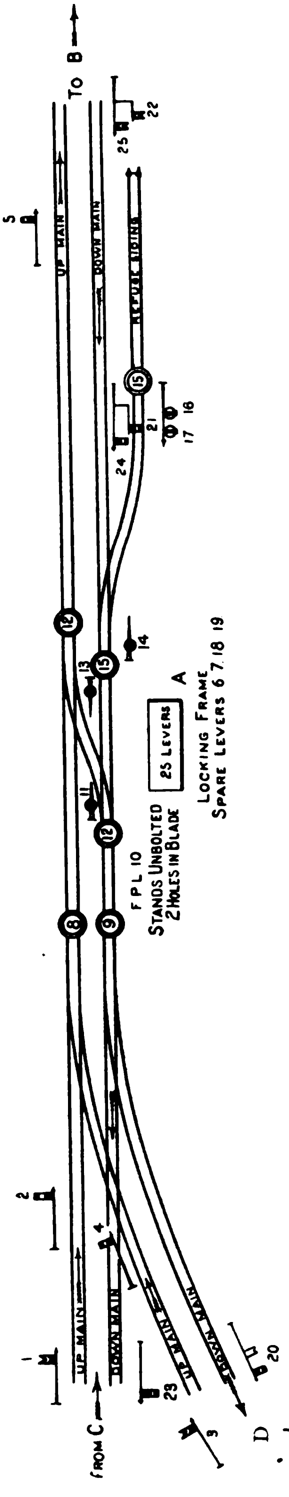


Fig. 3.—Signal Diagram, Great Western Railway Signalling Instruction Model.

[see pages 15–16.

For description]

Model of the New Liner "Port Kingston."

An exceedingly handsome model of the Imperial Direct West India mail liner *Port Kingston* was recently on view at Liverpool. Though the internal arrangements of the magnificent vessel, of course, are not shown, the hull and all exterior fittings are set out in proportion. The beautiful lines of the vessel are very noticeable, these supplying an explanation why this popular steamer has been able to reduce the distance between Great Britain and Jamaica to a ten days' trip. The model is painted similarly to the liner she represents, viz., cream top sides and light chocolate bottom colour. All superstructures are white, and give the ship a most imposing appearance, together with quite an idea of coolness. That the *Port Kingston* is first and foremost a passenger liner is evident from the tiers of decks and the deck erections superposed one on another. So far as can be seen from the model, there is nothing to desire that is not provided in the way of promenade and deck space. The internal arrangements of this vessel are extravagantly spacious and luxurious. In the saloons, music rooms, boudoirs, and cabins *en suite* nothing has been omitted to please the eye and gratify the taste of the most fastidious; and as regards ventilation and lighting, nothing is left to desire. As a cargo carrier, the *Port Kingston* is unique, and her holds are all specially fitted for the conveyance of large quantities of fruits, the products of the West Indies. These insulated spaces are cooled by special process. Sir Alfred Jones has expressed his intention of adding more steamers of the *Port Kingston* type to his West India line, and when this programme is completed it will be safe to say that a very complete and new steamship service will effectually link Jamaica and her sister colonies to the Mother Country. Messrs. Stephens, of Glasgow, are the builders of the *Port Kingston*.

The Society of Model Engineers.

London.

Launch Trip.—Members are reminded that Saturday, July 8th, is the last day for sending cash for tickets retained and returning those not required.

Excursion to Chatham.—The annual all-day excursion will take place on Thursday, July 27th, when a visit will be paid in the morning to the Dockyard at Chatham, and in the afternoon to the works of Messrs. Aveling & Porter, Ltd., at Rochester. The Secretary will be glad to receive as early an intimation as possible from those members who wish to join the party, which will be made up of those members who have signified their intention of being present by Saturday, July 22nd. Provided the party numbers at least ten, the railway company will issue special tickets at the rate of 3s. 2d. each (third class) for the return journey. Cash for the tickets must accompany the intimation of any member to be present, or be sent to me on or before July 22nd. The party will travel by a fast train leaving St. Paul's Station at 9.57 a.m., returning from Chatham at 7.37 p.m.—Herbert G. Riddle, Hon. Sec., 37, Minard Road, Hither Green, S.E.

An Ingenious Governor for Small Gas Engine.

By L. B. T.

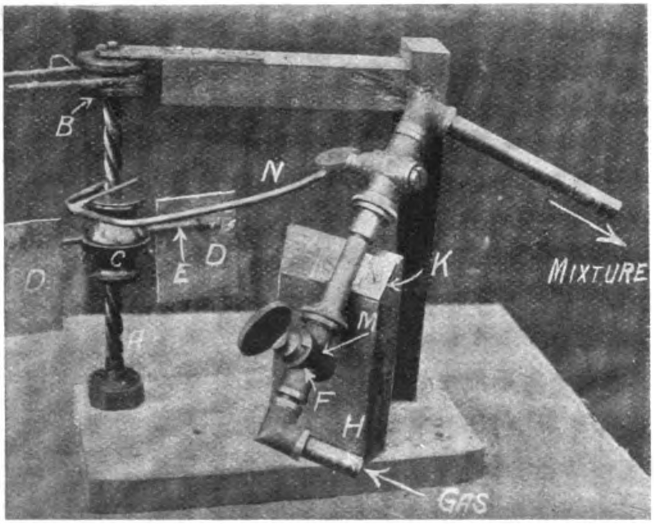
BEFORE a small gas engine can be used with any satisfaction to do work which is subject to variation, such as driving a lathe or grindstone, it must be fitted with some sort of governor.

The governor described below was designed by the writer for a ¼ h.-p. engine which drives a 3-in. centre lathe, and it has proved in every way successful.

A is a portion of an Archimedian drill spindle (6½ ins. by 7-16ths in.), mounted vertically in bearings, and fitted at the top with a small wood pulley B (1½ ins. diameter).

The nut C is capped by a brass plate, and carries two tin air vanes D D (2¾ ins. by 2 ins.), which are adjustable along the radial brass rods E E (2 ins. long by 3-16ths in. diameter), by two small set-screws.

There are two full-way ½-in. gas cocks, mounted



GOVERNOR FOR A SMALL GAS ENGINE.

on the wood upright H by the short brass tube joining them, which is sweated to the brass plate K.

F is the mixture tap, adapted by drilling and filing the air port M. The throttle tap is operated by the bent brass lever N (the leverage being equivalent to a straight lever 5 ins. long). The lever is forced up by the nut C when the latter rises, and falls again by its own weight.

The whole is mounted on a wood base (9 ins. by 5 ins. by ⅞ in.), and both uprights are glued and screwed to the base.

The pulley B is driven by a short piece of ⅛ in. round gut from a suitable small wood pulley, simply attached to a flywheel of the engine.

The resistance of the air on the vanes D D is sufficient to begin to cause the nut C to rise and operate the throttle when the speed of the pulley B exceeds 500–700 revolutions per minute, according to the adjustment of the vanes.

The dimensions given will be useful as a guide, but need not, of course, be rigidly adhered to. A suitable Archimedian drill may be purchased for 1s. 9d., and the gas cocks cost about 1s. 3d. each.

Practical Letters from our Readers.

[The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a nom-de-plume *if desired, but the full name and address of the sender* MUST *invariably be attached, though not necessarily intended for publication.]*

Lucrative Model Making.

TO THE EDITOR OF *The Model Engineer*.

DEAR SIR,—*Re* some interesting models in your issue of June 15th by Mr. Joseph Seel, he says that for some years, in his spare moments (evenings and Saturdays) he earned from £100 to £150 per year making models. If it is not taking up too much space in your valuable paper, I would like to ask that gentleman to give us less fortunate comrades an insight how to get rid of our models when we have made them. There are, I might say, hundreds of model makers who would be delighted at the prospect of getting enough out of it to go for a week's holiday each year. If model-making paid so well as our astute friend "blows" about, I don't think you would get so many advertisements in your valuable paper of people who have beautiful lathes and working models for sale at one-third the cost, who have worked tooth and nail to make both ends meet.

I have been a model maker in the ship line--all sorts, from clippers to smacks—for eighteen years, and have been told by those who know, they were as good as could be seen anywhere; but when you came to ask a price, it's a bird of another colour. I am sure some—I might say hundreds of—comrades would like to learn how the game is played. At £100 to £150 a year some of the splendid mechanics who are walking about without employment would have a glorious future assured.—Yours truly, E. BLAMFIELD.

Stratford, E.

Model Railway Design.

TO THE EDITOR OF *The Model Engineer*.

DEAR SIR,—I quite agree with the remarks of "Charon" that the working of model railways by signals and points from a lever frame is more interesting, so that shunting and marshalling of trains can be done without crossing the rails to hand-points, &c.

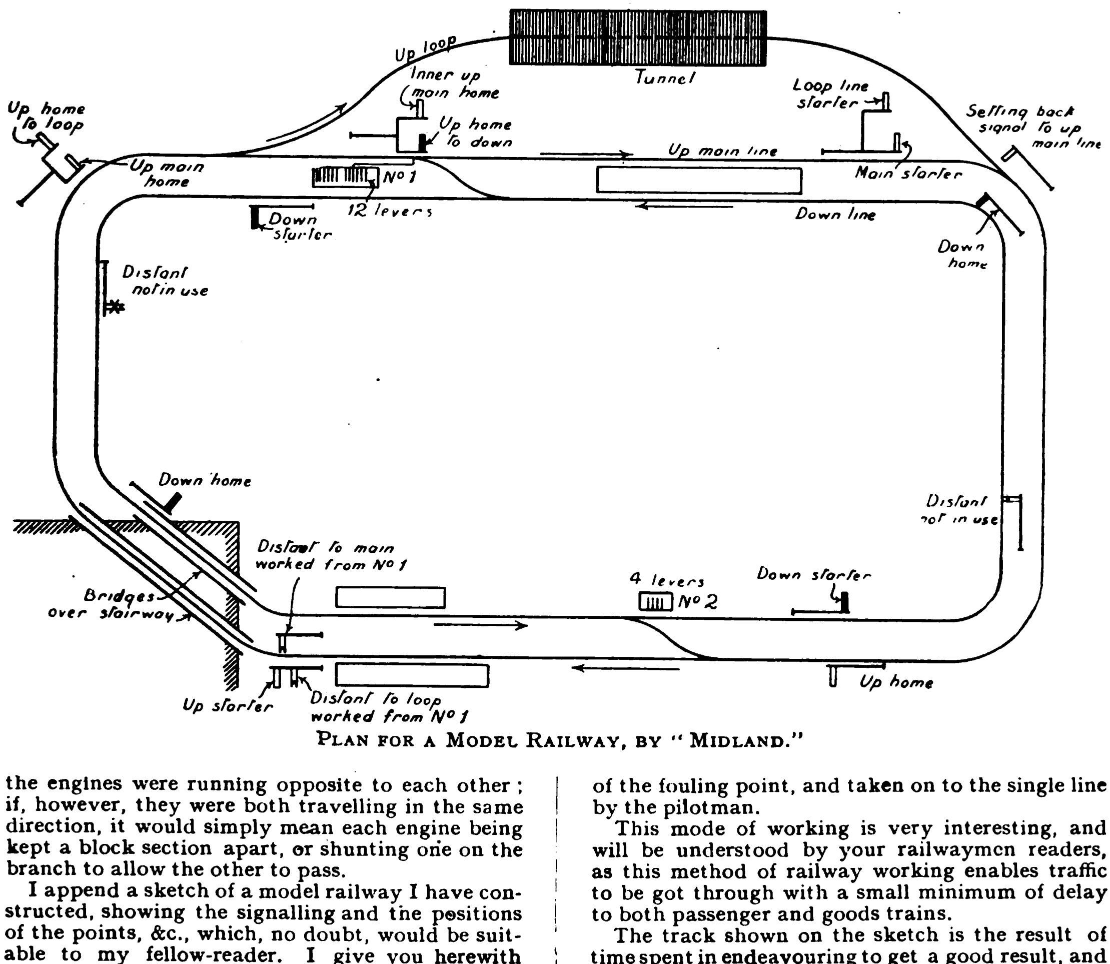
The best form to lay a model railway is, in my opinion, a double line up and down, with sidings, or, if a single line, with good turnouts and sidings, and not having a circular railway, as the binding on the flanges of the wheels is too great to admit of locos and trains getting up a good speed.

Mr. Greenly's design is not in the form of a circular railway, as I have his design before me, which is given in your issue of June 1st, 1901; but is a single line with plenty of straight rails and easy curves, as well as siding accommodation, and thus you will see that "Charon's" remarks are incorrect.

With regard to Mr. Hy. Lea's model railway, which is a circle of single line, with a branch of straight track, it is all right when one engine only is running; but if two were running, one would have to shunt on the straight road until the other had completed the circle, and the first engine return to the circle and proceed on its journey, whilst the latter was shunted, and remained on the branch. This course would be adopted if

The down line is connected to the up line again at station B, which has both up and down platforms. If, however, the trains were not run according to the rules of the road, the facing connections of the cross-over roads would become trailing; and in model railway working I like to get realism as much as possible to that which is done on the large railway of a standard English company.

Another reason why I advocate a double line of railway in the model is because, should either the up or down main line require repairs between the two cross-over roads, the system of working (if the model enthusiast goes in for working his railway according to rules and regulatons respecting train working as in the prototype) single line by means of a pilotman could be adopted, which would enable trains to be worked on the up and down line short



PLAN FOR A MODEL RAILWAY, BY "MIDLAND."

the engines were running opposite to each other; if, however, they were both travelling in the same direction, it would simply mean each engine being kept a block section apart, or shunting one on the branch to allow the other to pass.

I append a sketch of a model railway I have constructed, showing the signalling and the positions of the points, &c., which, no doubt, would be suitable to my fellow-reader. I give you herewith a description of the line.

The up line is the outside one, and has a loop through a tunnel near to station A, which has an island platform, and the station buildings upon it. The cross-over road to the down line from the up main has facing connections instead of trailing, as obtains on the prototype.

of the fouling point, and taken on to the single line by the pilotman.

This mode of working is very interesting, and will be understood by your railwaymen readers, as this method of railway working enables traffic to be got through with a small minimum of delay to both passenger and goods trains.

The track shown on the sketch is the result of time spent in endeavouring to get a good result, and admits of the trains running in opposite directions without collisions; also admits of shunting on the loop line and up main line without interfering with the down line, or shunting from the down to the up line, and re-marshalling trains whilst the others pass over the loop line.

In conclusion, I may say that this line consists of over 60 ft. No. 1 gauge tin, constructed on a spare bedroom floor, with two bridges (shown on the sketch) which pass over the stairs, which adds a realistic appearance to the line.

As I am interested in this class of work, I shall be pleased to see some views from other readers. Hoping I have not taken up too much space in your very instructive and interesting magazine,—Yours faithfully, "MIDLAND."

To the Editor of *The Model Engineer*.

DEAR SIR,—For some time past I have thought of sending you a short description of a small model railway I have built up, but feared, being a "toy," it might not be interesting enough. However, seeing in a recent issue something of the same class, I venture an account of mine.

The gauge is 2½ ins., which I decided upon owing to more boiler space on this size engine, thereby allowing longer steaming without the trouble of refilling. The track is composed of two ovals, inner and outer, laid on stained deal boards supported on trestles 2 ft. from the floor. The lines, which are partly tin and partly brass, are laid in chairs, which are fixed to sleepers about 1½ ins. apart, and the ends joined together with fishplates, making a firm track to stand the rather heavy weight running on it.

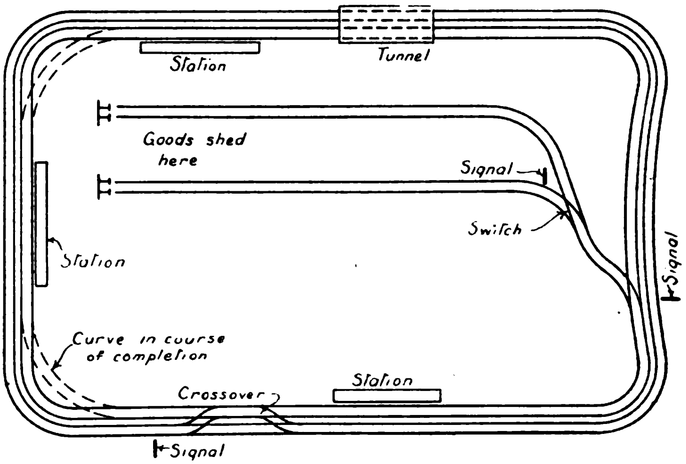
The two tracks together measure over 50 ft. circumference, so you can imagine the task of placing chairs, holding-down spikes, keys and sleepers together, and getting the gauge correct, took some time. Several times the curves had to be altered to get a good result, and many of the lines were spoiled in the bending; even now the curves are too sharp, and a new curve is now in course of completion.

The locos are two—a "Dunalastair," with three water tubes and tender, with tank and connection for a continuous supply of spirit; and a model contractor's four-coupled loco. The rolling-stock is partly home-made, and includes eight four-wheeled trucks and guard's van; the whole of these have been hauled by the contractor's loco for thirty minutes with one stop, when a truck jumped the metals. By itself, running light, this loco has run without a stop for forty-five minutes. The "Dunalastair" goes too fast for safety, as the track, being fitted in a spare bedroom, chance of fire from an overturned engine has to be guarded against.

There are sundry signals (which work automatically), stations, goods shed, and a realistic home-made tunnel. I have expended a great deal of time making the track, &c., but it is a constant source of interest.

I also have another system of 1¼-in. gauge fitted on boards, and contains many points, crossings, etc., and a large assortment of rolling-stock, three steam and two clockwork engines, but these take a second seat to the larger model, although the system is more elaborate.—Yours faithfully,

Forest Hill. C. P. FRESHWATER.



PLAN FOR SMALL MODEL RAILWAY, BY MR. C. P. FRESHWATER.

Queries and Replies.

Attention is especially directed to the first condition given below and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-hand corner of the envelope "Query Department." No other matters but those relating to the Queries should be enclosed in the same envelope.

Queries on subjects within the scope of this journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied, wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed, and also a "Queries and Replies Coupon" cut out from the advertisement pages of the current issue. (4) Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of Replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor,* THE MODEL ENGINEER, *26–29, Poppin's Court, Fleet Street, London, E.C.*

The following are selected from the Queries which have been replied to recently:—

[14,234] **500-watt Dynamo Construction.** R. C. (Lower Broughton) writes: Kindly answer me the following queries:—(1) I have to make a 500-watt Avery dynamo as described in the "A B C of Dynamo Design." I suppose the wire used has to be double cotton-covered? (2) If I was to bring the two vulcanised discs carrying the driving horns outside the tunnel, would the voltage be raised? (3) Would the gas engine drive the above dynamo? The dynamo will need to run at 2,220 revolutions Can I get this speed direct from a 1 h.-p. gas engine?

(1) Double cotton-covered wire should be used for the armature, but single cotton-covered will do for the field coils—in fact, is preferable to double covered for a gauge not larger than No. 18, as you will get more turns on. (2) The vulcanised fibre discs should be outside the tunnel; the whole of the core inside the tunnel ought to be iron. (3) You can get the speed but may not be able to get full output with 1 b.h.-p., owing to the loss in driving belt. Have a long drive and soft belt running as slack as possible.

[14,219] **Electrical Engineering Profession.** F. S. Y. (Cliftonville) writes: I should esteem it a great favour if you would be kind enough to answer the following queries? Wishing to take up some scientific profession, I should like to know (1) Do you think electrical engineering is overdone? (2) Is there much chance of getting into a position worth having without going abroad? (3) What branch of science could I take up, involving chemistry? I may add that I am nearly 16 years old, and have a fair knowledge of mathematics, mechanics, chemistry, French and German, and am hoping to pass the London Matriculation

Examination next June. Do you think any others are needed after I have completed my course?

(1) Electrical engineering is at present very much crowded, and pay is generally small; there is a very wide field, however, which is increasing and room with good pay at the top. (2) Depends entirely upon personal skill and energy, but without the strength to work very hard and considerable natural talents, the prospects are very moderate, but then these remarks apply to all trades and professions. (3) Iron and steel manufacture, electro-metallurgical and chemical works, dyes and allied products, mining, analytical work, the manufacture of artificial manures and chemical substances in general—all these present openings for good chemists. As regards study, you must certainly take up electricity and magnetism and experimental physics, if you are to undertake engineering work of any kind. Then the most valuable training of all is that of practical work; you must have experience before you can hold a responsible position. If you have a liking for chemistry, we should say decidedly keep to chemical work.

[14,220] **High Voltage Hand Dynamo.** W. C. M. (Johnstone) writes: I am making a small hand dynamo with permanent magnets, two in number, 4½ ins. high, 1½ ins. broad, ⅜ in. thick, very strong, with soft iron pole-pieces. I have an eight-cogged laminated drum armature. I would like to wind it in eight sections, if you would kindly give me size and quantity of wire to obtain 100 and 250 volts. The driving gear is 8 to 1. I might say that I want it for testing lamp and motor circuits. If you will kindly give me the required information for the two voltages I would wind two armatures. I have a lot of new No. 36 D.C.C., if it would be of any use.

The only advice we can give you is to wind the armature with very fine wire and try what voltage you can get. Use No. 38 gauge s.s.c. wire. We cannot say what weight, as you do not state size of armature. If it is about 1½ ins. diameter, then 4 ozs. of wire should be near the amount; get on as much as you can. The voltage will be proportional to the speed; the current about 1-5th amp. The machine may answer your purpose for insulation testing. Do not try and get two windings on one armature, but make two armatures and try one first before winding the other so that you can decide whether to use finer or thicker gauge wire for the second one. We doubt if you will get sufficient turns on if you use cotton-covered wire, and advise you to use single silk-covered.

[14,235] **Electro-Magnets.** W. S. (Glasgow) writes: What shape of electro-magnet is the most compact for lifting a load of 1 lb.? The current available is from four 2-volt cells. Kindly give me a near estimate of the number of turns of wire necessary and the size of the iron core. What is the relation between the current and the weight lifted?

If you mean lifting the weight by the magnet sticking to it, that is merely holding on. We recommend the simple horseshoe pattern; try one having a core ⅜ in. diameter. You will find rules for calculating winding in Fowler's "Electrical Engineer's Pocket Book," price 1s. 9d. post free. If you wish for further information, please refer to our Expert Service Department, stating exactly what you require to know, when a fee will be quoted to you. Some experimenting may be necessary on your part.

[14,147] **Small Power Flash Steam Generators.** T. P. (Horsforth) writes: I should be very much obliged if you would answer me the following questions. Referring to your article in THE MODEL ENGINEER of March 23rd and 30th, "A Small Power Flash Steam Generator," could you tell me (1) what volume of steam could this generator generate per minute at 400 lbs. per sq. in.? (2) What size engine pump would be required to keep the generator supplied with water? (3) Where could I get a "Cremorne" paraffin oil burner, and the approximate cost?

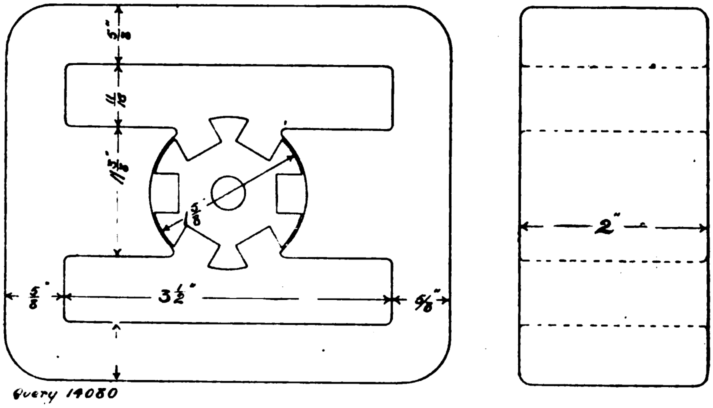
(1) The approximate weight of steam the small power steam generator will produce per minute, at 400 lbs. per sq. in., is 1·5 lbs. (2) Engine pump required is one with ¼ in. diameter ram by ⅜-in. stroke. (3) "Cremorne" paraffin burners to suit the above steam generator can be obtained from Bolsover Bros., Ltd., Eaglescliffe, co. Durham, price £1 10s. each.

[14,285] **Small Gas Engine Trouble.** H. P. (Workington) writes: I have made a gas engine, 1-in. by 2-in. cylinder (British Model and Electrical Co., Staffs.), and all I can get out of it is an odd explosion, but no power. When I revolve shaft the compression often blows out the burner flame. What does this mean? Gas supply is house piping about ½-in. bore, but this reaches engine by ¼-in. pipes. Machine was made with help of a fitter. Valves have been overhauled, piston is good fit. Is gas-bag necessary? Can you give me recipe for a cement to hold brass grid on earthenware (glazed) sink? The brass will rest, however, on spread end of leaden pipe. I have tried marine glue and Portland cement with plaster-of-Paris without success. I fancy red lead is used but how?

You cannot expect to get any appreciable power out of this class of engine if it is, as we understand from your letter, a two-cycle engine without compression. It is a matter of careful adjustment to prevent the ignition flame being blown out. Lower the flame nozzle so that only the tip of the flame plays over the small port or hole. A gas-bag would certainly be an advantage. Regulate the supply of gas till you get the maximum speed out of engine. *Re* sink. Try a mixture of red and white lead, mixed in usual way with oil. A fairly thick mixture is required.

[14,080] **Avery-Lahmeyer Dynamo.** A. B. (Glasgow) writes: I have purchased a set of dynamo castings from a friend, but got no wiring instructions. They are, I think, for a No. 1 Avery-Lahmeyer dynamo. Please say what amount and gauge of wire would be required for armature and field coils to give 8 volts. I have enclosed an outline sketch of the magnet casting; also the outline of one of the armature laminations.

Wind armature with No. 23 gauge D.S.C. copper wire and field-magnet with about ½ lb. No. 22 gauge S.C.C. copper wire on each pole—more if you can get it on—both coils to be joined in series with each other and in shunt to the brushes. About 5 ozs. of wire will be required for the armature, which should be wound with six coils (two in each slot), and a commutator with six sections. Speed about 3000 r.p.m. The voltage can be adjusted by running at higher or lower speed. Output about 30 watts.



FIELD-MAGNETS FOR AN AVERY-LAHMEYER DYNAMO.

[14,276] **Celluloid.** E. W. (Glasgow) writes: I shall be greatly obliged if you can answer me with the undermentioned questions, viz.: What is *celluloid* composed of, and where can it be obtained? That is, the same material, I mean, that some drawing tee squares I have are made of (the squares referred to are transparent, and *quite flexible.*) Can this material be coloured, say, pure white? If so, would you kindly say how this is done, and how to manipulate it, or work it into shape; and, if possible, the probable price per lb. in bulk.

It is composed of guncotton and camphor combined with the aid of chloroform, and it takes dyes very readily. It can be manipulated and worked in the lathe, we should say, fairly easily. The Discose Syndicate, 5, New Court Carey Street, W.C., make a similar material, but one which would, perhaps, suit your requirements better. Write them for particulars. Fitch & Co., Fulwell Rents, Holborn, W.C., would either supply you with the celluloid or inform you where it can be had.

[14,270] **Paraffin Blowlamp.** J. J. (Limerick) writes: I have just finished paraffin brazing lamp, as per instructions in *M.E.* of May 21st, 1903. Sorry to say I am unable to get it to work properly. It starts all right, flame about 12 ins. long; but as it gets hotter the flame shortens; also starts a pulsating noise like exhaust of a locomotive engine. The flame shortens to about 2 ins., and then goes out. If I put a lighted engineer's hand-lamp to air holes at side, the pulsating ceases, flame lengthens, and works very well, being very hot and clear. Is the cause of the pulsating caused by there not being enough vapour passing through the nipple, or not the right kind of paraffin? Will you please give me some idea where to look for faults, as I have not much time for experimenting, and would not like to spoil any of the work done?

The trouble seems to be due to the air holes in the flame tube not being the most suitable size. Try enlarging some of them, and if that is not successful, make them smaller, and watch the results. Blowlamps often pulsate if there is not enough oil in the reservoir—*i.e.*, when they are nearly empty. We do not think the oil (quality of it) is the cause of trouble. You will *have* to experiment somewhat with it, if the above suggestions are not cause of pulsating.

[14,231] **Windings for Small "Simplex" Motor.** D. R. Gomshall) writes: I have a large quantity of wire marked No. 1, and a small quantity marked No. 2. (1) Could you tell me what gauge they are, and would they do to wind a small dynamo (under-type "Simplex") with H-armature? (2) If so, what quantity of each, and what would be the probable output? I want dynamo to run as a motor as well.

(1) The thick wire in No. 1 envelope is No. 18 gauge; the thin wire in No. 2 envelope is No. 24 gauge. You do not say what size the dynamo is; presuming it has an armature, say, 1¼ ins. diameter by 2 ins. long or smaller, we should not advise you to use the thick wire at all, but to use the No. 24 gauge for both armature and field coil. (2) Get on as much wire as you can; output, perhaps 10 volts 1½ amps.; we cannot say definitely without more particulars of machine. Connect field coil in shunt to brushes. This pattern of armature should be used with a series winding for motor purposes, but you can run it as a motor with a shunt winding. It will be rather wasteful of the current. A single layer of the thick wire on the field to be used as an additional winding in series with the armature would help matters as regards motor work.

[13,614] **Telephone Connections.** F. C. H. (Glasgow) writes: Can you give me a diagram of connections for four telephones, so that each one can call the home instrument?

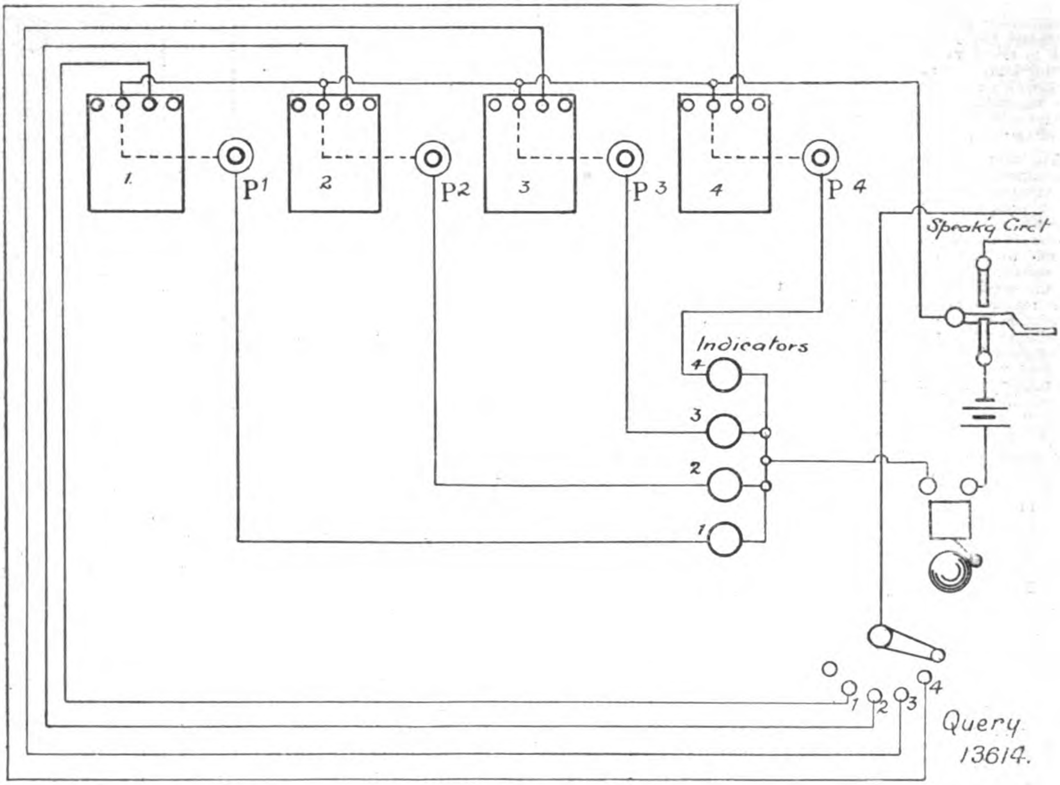


DIAGRAM OF TELEPHONE CONNECTIONS.

We append a diagram showing the arrangement you can follow. The various instruments make themselves known by the indicator, the home instrument switching on to whichever one is calling up.

[14,227] **Dynamo Failure.** T. G. B. (East Greenwich) writes: I should be much obliged if you could tell me what is wrong with my dynamo. I give you rough sketch of windings (not reproduced). It is a Kapp type machine supposed to give 10 volts 7 amps. at 2,880 revolutions per minute. The magnets are wound with No. 20 gauge D.C.C. copper wire. I think there is ½ lb. on each pole. Sizes are as follows: Wiring space 2 ins. by 2 ins. by ⅞ in. The armature is 1⅞ in. diameter by 2¼ ins. long, wound in eight sections with eight-part commutator. There are 448 conductors altogether, the gauge being 22 D.C.C. I have connected the finishing ends of magnets to a resistance (7 yds. of 26 gauge iron wire, I think; about 5 or 6 ohms in nine steps). The starting ends of magnets I connected to brushes, and am now running as fast as I can with a 2¼ by 5-in. stroke engine and 40 lbs. of steam, and all the resistance in the field circuit. I can light three 10-volt lamps, but they only get 6 volts. Dynamo going about 2,700, and if I cut resistance out it quickly pulls engine up, so by the time it is all out engine is nearly stopped, but goes on again when I put resistance in circuit again. There is violent sparking at the brushes in any position, showing large current in machine. Should it take such a large power to drive it, or could I alter it in any way? I found N. and S. Poles with a compass, and positive and negative with pole-finding paper.

Owing to the small dimensions of the field-magnet cores of this machine, we doubt if you will get 10 volts at less than 3000 revs. per min. No. 22 gauge wire on the armature would be suitable for an output of 5 amps. If there is only 1 lb. of No. 20 gauge wire in all on the field-magnet it is not sufficient, and the resistance would only be about 2 ohms; therefore, it would take a great deal too much current. This is proved by your experiments with the wire resistance in series with the field coils. When you cut the resistance out the field coils take practically the whole output of the machine. Try rewinding the field-magnet with No. 22 gauge s.c.c. copper wire; get on as much as you can, and we think you will find an improvement. With regards to the sparking, if this does not disappear or nearly so, examine the armature to see if there is a broken connection or anything wrong with the commutator also give some attention to setting the brushes in best position, and to make good contacts.

[14,223] **Engineering Training.** H. G. C. (Stoke Newington) writes: Being anxious to go in for electrical engineering, but my education being neglected, especially in mathematics, I write to ask if you would kindly inform me (1) What amount of mathematics would be required for one whose ambition is to be, for instance, a chief engineer in a generating station? If it is not too much, I would hope to learn it by means of evening tuition and studies. (2) Could you make me any kind suggestion as to the way to proceed to work my way up without paying a premium? I am 15½ years of age.

(1) There is no definite line to be drawn as regards the amount of mathematical knowledge required to fit anyone for such a position; experience is of far more importance than mathematical training. With good experience and practical knowledge of mechanical and electrical work, a very small amount of mathe-

matical knowledge indeed would suffice. When applying for positions, the test question is not what can you do, but what have you done? Most certainly a working knowledge of practical mathematics is of considerable value and is almost necessary if you wish to undertake original research work. It will enable you to understand the mathematical reasoning of others; but as an engineer in a generating station you will not require to use advanced mathematics. (2) We advise you to try and get into the mechanical engineering workshop of some electric power station, or the factory of a mechanical engineer making steam engines, and serve as apprentice for several years, during which time you should study the theory of electrical work, steam engine, mechanics, and mathematics, &c., at evening classes and laboratories. When your apprenticeship is finished at the workshop, you will do well to work as a mechanic in the workshops of several firms making steam engines and dynamos, continuing your evening studies, especially as regards electrical testing and measurements. Then try and get a position as assistant engineer in an electric light or power station, from which you may advance as chances occur. Do not be in too great a hurry to become a chief engineer; there is plenty of worry and responsibility attached to such a position which can only be successfully carried after years of careful preparation. The Finsbury Technical College, Leonard Street, E.C., would be a good institution at which to commence your evening studies; they would advise you also as to the most useful mathematical training to follow.

[14,277] **Trembler Coil Winding.** H. M. (York) writes: Kindly give dimensions and windings for ½-in. non-trembler coil for motor cycle. The coil to fit into box the following size: 4½ by 2½ by 2 ins. inside measurement, the box to be filled with wax and the terminals to be mounted at the end.

You will find dimensions and particulars of spark coils given on pages 62 and 63 of our handbook No. 11. From these you can design a coil to suit your dimensions, which, however, are apparently too small for a ½-in. spark coil. In your case the make-and-break on the engine is used instead of the trembler on the coil; a condenser is required.

[14,271] **Daniell Cells.** P. S. (Aughrim, co. Galway) writes: I have six Daniell gravity cells, 3-pint size, as supplied by the General Electric Co. I can get each cell to register 1 volt, but when I connect the six in series, the voltmeter will only register a little over 3 volts. I think the voltmeter is correct, as it registers 6 volts for three Fuller cells. The chemicals used are correct, I think. The sulphate of copper is 98-99 per cent. purity, and the specific gravity of the sulphuric acid is 1·843. I have tried several ways to get 6 volts, but they were all failures. The zincs were perfectly clean and well amalgamated. Perhaps I did not make up the solution right. Please let me know (1) Correct sulphuric acid solution and amount of sulphate of copper for each cell? (2) Is ½ oz. of No. 32 platinoid wire sufficient resistance for the six cells? (3) If cells are used frequently, when is it necessary to renew sulphuric acid solution?

Are you sure that you have connected the cells properly; that is, zinc terminal of one cell to copper terminal of the next, and so on? Try each cell separately with the voltmeter; if each gives 1 volt approximately, then they must give 6 volts if all are joined in series. Perhaps you have allowed them to remain standing on open current after putting in the solutions. A feature of the gravity Daniell cell is that the liquids tend to mix, so that copper deposits upon the zinc and polarises the cell. This may have happened to your cells. If so, it would explain the drop in voltage. To prevent this mixing of the liquids, the cells should always be kept on a closed circuit; when not doing work the circuit should be of high resistance, to permit of a very small current only flowing. (1) Sulphuric acid 1 part, water 10 parts; copper solution to be saturated—that is, put in an excess of sulphate of copper, so that some crystals always show. (2) Scarcely, for a permanent circuit. You could try it. (3) Impossible to say; perhaps after sixty hours total work; depends upon amount of current used.

[14,251] **4-in. Spark Coil.** C. A. B. (Liverpool) writes: I am about to make a 4-in. spark coil as described in your handbook, and shall be glad if you will enlighten me on the following points:—(1) Would the paper upon which this letter is written be suitable for the section divisions and condenser? (2) If I use five bichromate cells to work coil, what should be the area per cell of compressed carbon plates and zincs? (3) I want to use wood for the coil ends. Would ½-in. teak be satisfactory if the primary and core were completely enclosed in an ebonite tube, as I intend to use a separate mercury break? (4) Would not the mercury break described in your handbook vibrate rather slowly? How could it be quickened if necessary? (5) Would two layers of No. 16 S.W.G. do as well as three of No. 14, or would self-induction be too great?

(1) If used for the section divisions we advise four sheets between each pair of sections; it can be used for both coil and condenser; must be soaked in paraffin wax. (2) The larger the cells are the better, but plates should be at least 6 ins. by 2 ins. each for the size of the plate which is covered by the solution; one zinc plate between two carbon plates in each cell. (3) We do not recommend you to use wood, but if you do it should be well boiled in paraffin wax; ½-in. teak would do if you are inclined to try it. (4) The rate of vibration can be varied by adjusting the contact screw in the same way as the vibration of the hammer of an electric bell is adjusted. To get the highest rate of vibration, you should keep the vibrating arm short and its attachments as light as practicable. (5) We advise you to keep to the three layers of No. 14; you can, however, easily try two layers of No. 16. If core is made removable it can easily be rewound if necessary.

[14,262] **Polarised Accumulators.** J. C. F. (Wimbledon) writes: In charging 4-volt accumulators, containing three 4 by 4 plates in each cell, from six Daniell cells (1) I want to know if you could give me an idea how long one such accumulator should take to charge. After leaving on for forty-eight hours, it lit a 4-volt lamp up very brightly, but when connected with other accumulators to work a 3-in. spark coil, it seemed to run out with only several minutes' working; but after two or three hours' rest, it again lit the lamp brightly and appeared fully charged, only to quickly run out again. I presume it is possible to fully charge one suitable for working a 3-in. spark coil, accumulators from Daniell's. I see they are mentioned in your handbook on batteries as being suitable. Could you tell me if anything is wrong? (2) Am I fully charging, or (3) is something wrong with the discharging?

(1) You are discharging the accumulator at too great a rate; the plates are of too small a size to give the current required by a 3-in. spark coil. The result is, that the cell runs down very quickly, and though it will recover slightly after a rest, it is practically in a completely discharged condition; such treatment is very bad for the cell. It is not practicable to charge accumulators of a size suitable to run a 3-in spark coil by means of primary batteries of the Daniell pattern, unless you make very large size cells, and allow the charging to go on for several days at a time.

The News of the Trade.

[The Editor will be pleased to receive for review under this heading samples and particulars of new tools, apparatus, and materials for amateur use. It must be understood that these reviews are free expressions of Editorial opinion, no payment of any kind being required or accepted. The Editor reserves the right to criticise or comment according to the merits of the goods submitted, or to abstain from inserting a review in any case where the goods are not of sufficient interest to his readers.]

**Reviews distinguished by the asterisk have been based on actual Editorial inspection of the goods noticed.*

The Weston Electrical Instrument Company.

We are advised by this firm of the establishment of a branch office and laboratory in London, at Audrey House, Ely Place, Holborn, E.C., under the management of Mr. A. Davy. Mr. Davy has had large experience in their works, and will be pleased to assist in any way possible, by consultation or otherwise, customers who may desire to take up with them any problems in connection with the subject of electrical measurements. Specially designed scientific apparatus has been installed in this laboratory, for the purpose of calibrating, adjusting and standardising electrical measuring instruments of all kinds, and contains some of the most modern appliances known.

The Result of a Competition.

The Liverpool Castings and Supply Company, of 5, Church Lane, Liverpool, have written saying that they would be very glad if we would draw the attention of our readers to the result of the competition they instituted in January last for the best made model of one of their high-speed vertical engines. While they were sorry to find that many competitors were unable to finish their models in time, they were not able, in justice to those who conformed to the regulations, as announced in January, to extend the period. The successful competitor is Mr. Ernest Yole, of 17, Chapel Street, Tavistock, whose model is exceedingly well-made, and does him great credit. He receives (at his own choice), a 5-in. 4-jaw independent chuck, the model still remaining his own property.

New Catalogues and Lists.

Archibald J. Wright, Ltd., 318, Upper Street, Islington, N. —We have received a new illustrated list of automobile electrical accessories and instruments which we can recommend to all our readers who ever require such supplies. The leaflet includes prices and particulars of ignition accumulators in transparent celluloid cases, plates, terminals, and other component parts for accumulators, pole-finding paper, charging batteries, coils, plugs, voltmeters, and ammeters, resistance coils and detectors. List one penny post free.

William Hanson, 11, Queen's Crescent, London, N.W.— We have received several leaflets from Mr. Hanson illustrating his engineer's lathes. These lathes range from 4 to 6-in. centres, and comprise single-geared, back-geared, and back-geared screw-cutting and surfacing tools—all of which are said to be of the best English design and workmanship. All the designs are supplied either as power or foot lathes.

The Editor's Page.

IN view of the arrival of the holiday season, we have decided to offer a prize to every reader who sends us a description and original photographs of anything of engineering or model-making interest he may encounter during his vacation which shall be sufficiently good to warrant insertion in our journal. The prizes will vary in value from 5s. to 10s. 6d., according to merit. We anticipate seeing some interesting results from this competition, for, in the first place, the very wide scope which every competitor has open to him will allow him to deal with subjects with which he is best acquainted; and secondly, there will probably be greater opportunities during the holidays of discovering something of special interest than at any other period of the year. There are innumerable examples of the model maker's art, as well as other items of technical interest, scattered about the country, which are not easy of access in the ordinary way, but which the model engineer on his holidays may be able to unearth, to his own and his fellow-readers' mutual advantage.

* * *

The rules of the competition are similar to those of the recent "Gauge" Competition, except that instead of directly despatching the prize, we will forward all winning competitors a notice of the value of the prize awarded, when they may choose the tools or other articles they may wish sent to them. All entries should be accompanied by a separate letter, marked on the envelope "*M.E.* HOLIDAY COMPETITION." This letter should include the title of the article and any other information not necessary for publication. The article should be written *on one side of the paper only*, with the name and address of the sender on the back. The photographs and separate sketches enclosed with the contribution should similarly bear the name and address of the sender, otherwise delay may arise in the awarding of the prizes. It is essential in this, as in our other competitions, that the copyright of the photographs must be the property of the senders, and the covering letter should contain a declaration to this effect. The competition will close on October 16th.

* * *

In connection with the "Coming of Age" of the Institution of Junior Engineers, we may mention that the proceedings of the Summer Meeting were inaugurated by a reception of the members and their friends by the Lord Mayor and Sheriffs of the City of London in the Council Chamber of the historic Guildhall. The Institution received a most hearty welcome and congratulations from the Corporation, and also from the representatives of the learned Societies present at the function. The Junior Engineers very much appreciated the recognition of their Institution by the civic authorities and will, we hope, be encouraged to proceed with renewed vigour to the full attainment of their objects. Mr. W. J. Tennant, A.M.I.Mech.E., one of the oldest members of the I.J.E., delivered an interesting paper on the history of the Institution, extracts from which we shall at a later date publish in the pages of this journal, together with some particulars of the places of engineering interest in and around London visited by the members during the week following the reception at the Guildhall.

Answers to Correspondents.

F. H. (Birmingham).—Your letter received, but it is hardly of sufficient general interest to warrant publication.

H. G. C. (Catford, S.E.).—A design for a heliograph appeared in our issue for September 1st, 1904.

Notices.

The Editor invites correspondence and original contributions on all amateur mechanical and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected or not, and all MSS. should be accompanied by a stamped addressed envelope for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

This journal will be sent post free to any address for 13s. per annum, payable in advance. Remittances should be made by Postal Order.

Advertisement rates may be had on application to the Advertisement Manager.

HOW TO ADDRESS LETTERS.

All correspondence relating to the literary portion of the paper, and all new apparatus and price lists, &c., for review, to be addressed to THE EDITOR, "The Model Engineer," 26—29, Poppin's Court Fleet Street, London, E.C.

All correspondence relating to advertisements and deposits to be addressed to THE ADVERTISEMENT MANAGER, "The Model Engineer," 26—29, Poppin's Court, Fleet Street, London, E.C.

All subscriptions and correspondence relating to sales of the paper and books to be addressed to Percival Marshall & Co., 26—29, Poppin's Court, Fleet Street, London, E.C.

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Contents.

[*The asterisk (*) denotes that this subject is illustrated.*]

THE
Model Engineer
And Electrician.
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EDITED BY PERCIVAL MARSHALL, A.I.MECH.E.

VOL. XIII. NO. 220. JULY 13, 1905. PUBLISHED WEEKLY.

A Working Model Loom.

By J. FINNINGHAN.

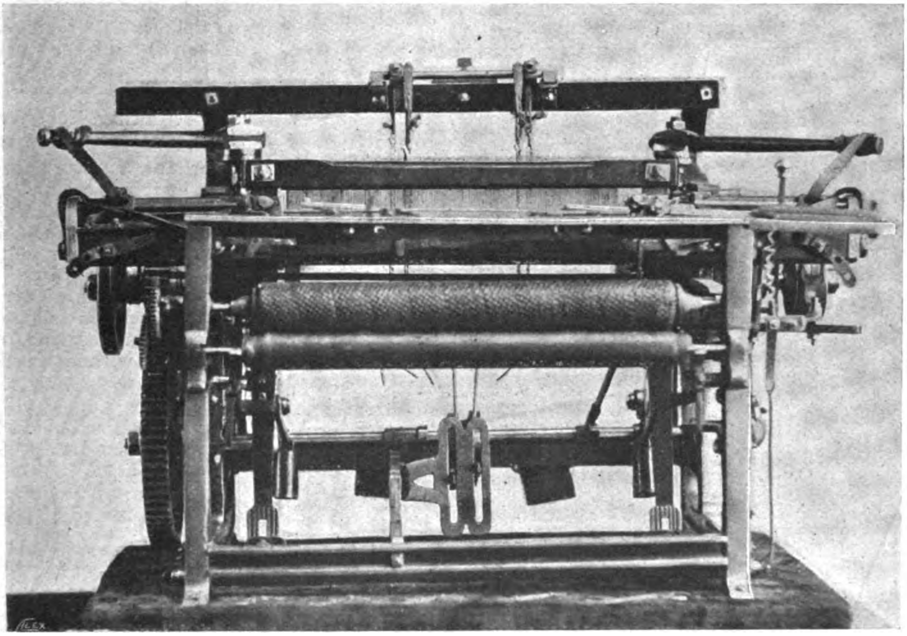


FIG. 1.—FRONT VIEW OF A WORKING MODEL LOOM.

THE accompanying photographs show a model loom which I have made from scrap in my spare time, extending over four years, with nothing but a small single speed lathe to work with. The reed space is 7½ ins., and the machine is made to a scale of ¼ in. to the foot. It is perfect in every detail, the crank being cut out of a solid piece of soft steel, and will weave cloth running at the remarkable speed of 600 to 800 picks per minute.

The photograph (Fig. 1) gives a front view of the loom as it runs, and Fig. 2 gives a back and side view, showing the taking-up motion, top driving wheel, tappets, weft and picking motions with chains for weighting warp. At the bottom of the rear side is shown the warp, which is made of silk, with healds on top. Last summer it was exhibited at the Edinburgh Industrial Exhibition for the first time, where it obtained the first prize of the particular section in which it was entered.

Workshop Notes and Notions.

[Readers are invited to contribute short practical items for this column, based on their own workshop experience. Accepted contributions will be paid for on publication, if desired, according to merit. All matter intended for this column should be marked "WORKSHOP" on the envelope.]

A Holder for Small Work.

By G. W. BURLEY.

The accompanying description is of a tool which, in the opinion of the writer, will facilitate the execution of small work which has to be performed on such machines as "Universal" and other milling machines, grinders, shapers, slotters, and planers. It is a holder for small work, especially such work as cutter blanks, on which it is required to cut teeth; for work other than that through whose centre a hole has been drilled it is clearly useless. Its chief quality lies, however, in the fact that it provides greater security from slipping than if the work

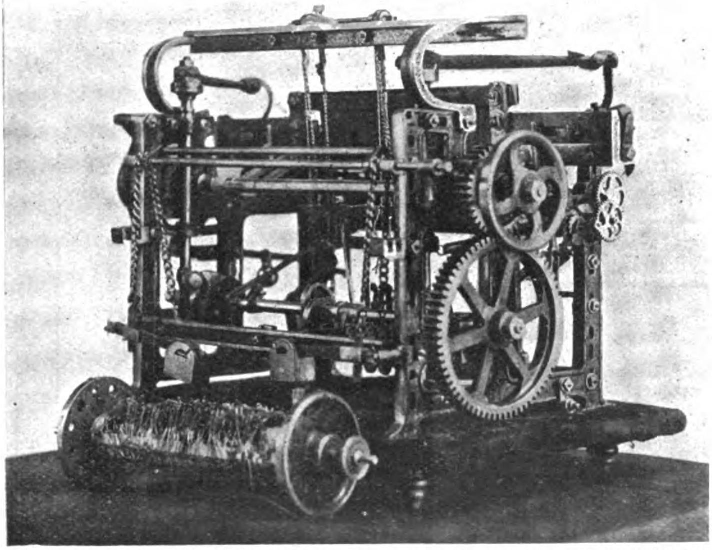


FIG. 2.—MR. J. FINNINGHAN'S MODEL LOOM, BACK AND SIDE VIEW.
(*For description see front page.*)

were forced on to an ordinary mandrel. Also, it offers greater facility, so far as engagement and disengagement of the work is concerned, this being done by means of a nut.

The holder consists essentially of four parts, shown in Fig. 1, in which A is the stock or prime holder fastened to the machine, B is the holder of the work, C is a forcing tapered pin, and D is a nut for the purpose of drawing up the pin C. The exact form and size depends entirely upon the machine on which the holder is to be used, as well as upon the size of work. In the figure, the holder A is one which is used on a Universal miller. As will be seen, it is tapered, the tapered portion fitting into a special kind of chuck. In every case, however, A should be made of such form as to suit the machine. On B the cutter blank, or other work, fits, the diameter of the hole of which is about 1-1000th in. larger than the diameter of B. This piece B is slotted in four places, the slots traversing about one-half of the length of B. This is tapered to fit in A. Several of these can be made for various sized holes, each having the same taper; C is also

FIG. 1.

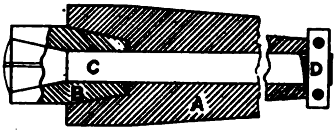
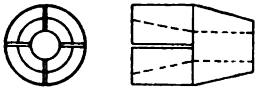


FIG. 2.



A HOLDER FOR SMALL WORK.

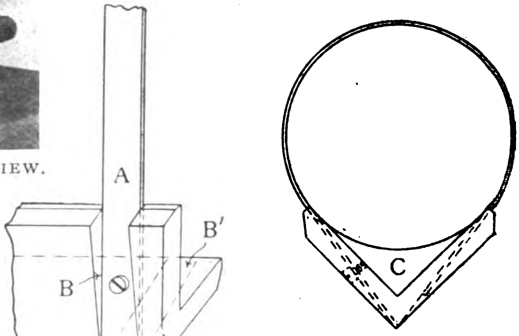
tapered, and fits in B. When D is screwed, the pin C is forced into B, and this opens out B slightly, thus gripping the work securely. B is also forced into A, thus making a rigid connection of the work with the holder. To remove the work, slacken D, and the work can then easily be taken off B.

Making Eccentrics.

By R. AKESTER.

Perhaps many amateurs have thought it impossible, as I did, to completely finish an eccentric in a self-centreing chuck, but I have just finished a pair of the pattern used in THE MODEL ENGINEER Locomotive in this way.

The eccentric should first be turned from a casting, or from the round bar, without any hole for the



A CYLINDRICAL SQUARE.

shaft. Two of the jaws should then be put in the chuck, and the scroll allowed to make a complete revolution before the third jaw is inserted. If the eccentric is now gripped with the larger diameter outwards, it will be found to be out of the centre. The amount of eccentricity can be varied minutely by inserting a strip of brass between the eccentric and the third jaw. A large amount of eccentricity can be obtained by allowing the scroll to make two revolutions before inserting the third jaw.

A Cylindrical Square.

By "Round Square."

I have no doubt many of my fellow-readers have experienced great difficulty in sawing a piece of metal tube or rod in the vice off square, as they have no means of marking it off. What is needed is a round-square. The following is a simple way to convert your box square into one. All that is needed is a thin flexible steel blade and small cheese-headed screw. This blade A must be parallel its whole length. Now cut slots B B′, which must be directly in line with each other, and at right angles to either edge of square. It will be noticed by sketch C that this slot tapers towards the edge; this is to bring blade close to work being marked off, which is done by drawing blade round the work into the slot in the opposite side, and scribing off.

Fig. 8.—At the Trials at Eaton Hall.

Aluminium Foil.—This is used largely as a substitute for tinfoil. One kilogramme (2·2040 lbs.) of the metal is spun into 32 square metres of thin sheet. Some of the sheets adhere together, and these are worked into powder.

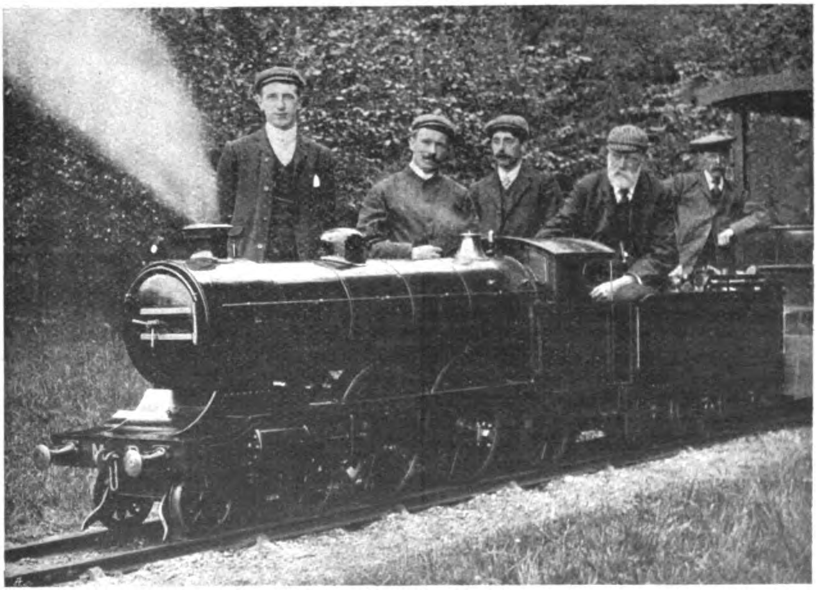
New Locomotives for the Miniature Railways of Great Britain, Ltd.

(*Continued from page 584, Vol. XII.*)

Stephenson link motion is employed—with long eccentric rods—and is reversed by means of a screw and wheel in the orthodox manner. The lifting links and the weighbar shaft are of cast steel. The intermediate valve spindle guides are of gunmetal, with capacious oil boxes on the top, and are attached to a motion plate of cast steel. The bogie is of the ordinary Adams type, and has a gunmetal slide block and cast steel stretchers. The equaliser is of cast steel and is slung on three spiral springs.

The axle-boxes are properly designed padded boxes, with white metal run into the bearings and oil boxes on the top. The trailing axle-boxes have ⅛ side play, and are supported on spiral springs acting through a lever, which is pivoted on the main frames and rests at the opposite end to the fulcrum on a bar which connects the two axle-boxes. This bar causes the two axle-boxes to move laterally in unison. The axles of the driving wheels are 2 ins. in diameter; those of trailing tender and bogie being 1½ ins. diameter. The wheels are cast steel, and for the smaller wheels metal patterns were used, the larger ones being cast from a built-up pattern, in which every spoke is a separate piece of wood.

The boiler is of mild steel, ¼ in. in thickness, and in the barrel measures at its largest diameter 15 ins. The heating surface is 5000 sq. ins., and the firebox is 2 ft. long, giving a grate area of 22½ sq. ins. The boiler is provided with 37 brass tubes, 3 ft. 3½ ins.



Mr. W. J. Bassett-Lowke. Mr. James Mackenzie. Mr. Henry Greenly. Mr. Henry Lea, M.I.C.E. Mr. F. Smithies.

Fig. 9.—A Group taken at the Official Trials.

long, and was tested to 210 lbs. per sq. in. water pressure, and 150 lbs. steam pressure. The safety valve is set to 120 lbs. per sq. in., the average working pressure ranging between 100 and the blowing-off pressure mentioned above. The boiler is lagged with asbestos, with a sheet iron covering. The smokebox is attached to the barrel by a heavy gunmetal ring, part of which is visible in the finished locomotive, and is polished bright. The fittings include a 1¼-in. safety valve of "The *M.E.* Locomotive" type, with polished gunmetal casing, a Klinger water gauge, blower, and two injectors, steam cocks, and check valves.

The regulator is of the Stroudley pattern, and is contained in the dome. The smokebox contains a superheater, and the chimney and petticoat pipes are of scientific design. The front plate and door are of cast iron, and the cross bar of cast steel. The the cocks for the feed. The tender contains a 1¼-in. bore hand feed pump for use in the case of emergencies. The engine was built by Mr. James Mackenzie, the works manager of the company, who is to be congratulated on the excellent workmanship and finish of the locomotive.

The whole engine is painted Midland colours—*i.e.*, a rich red, with black and straw-coloured lining.

The official trials took place at Eaton Hall on June 3rd, and the company are much indebted to his Grace the Duke of Westminster for granting the free use of the whole of his railway on that day. The Duke's railway is, as many of our readers know, about four miles in length, and the main line runs from Balderton Station (Great Western Railway, Birmingham and Chester line) to the Duke's mansion, Eaton Hall. The gauge is the same as that adopted by the company.

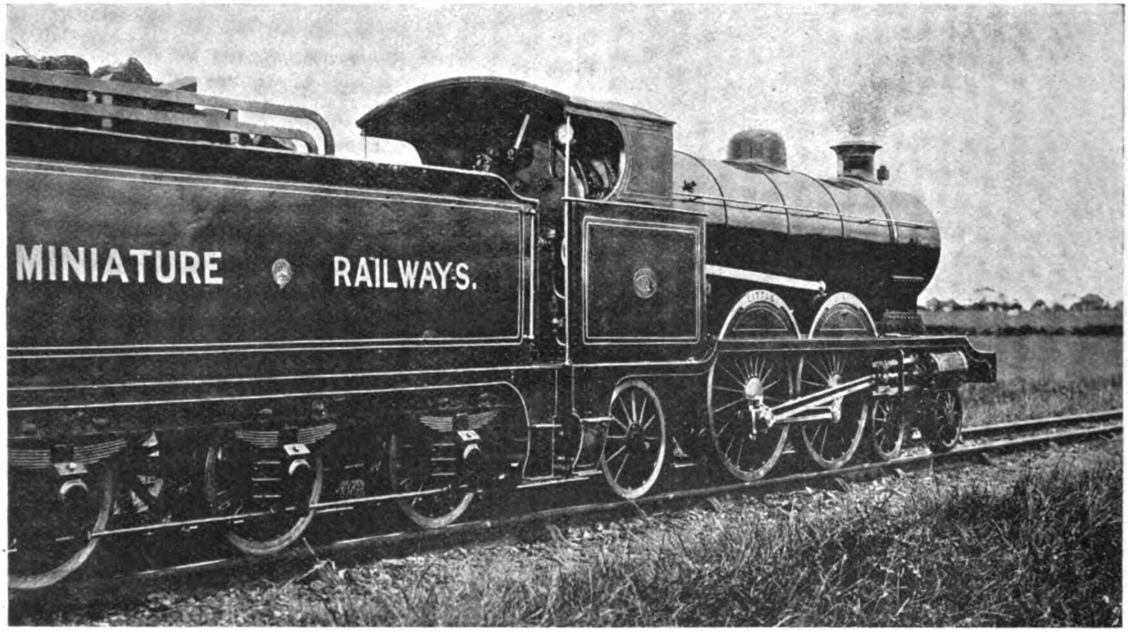


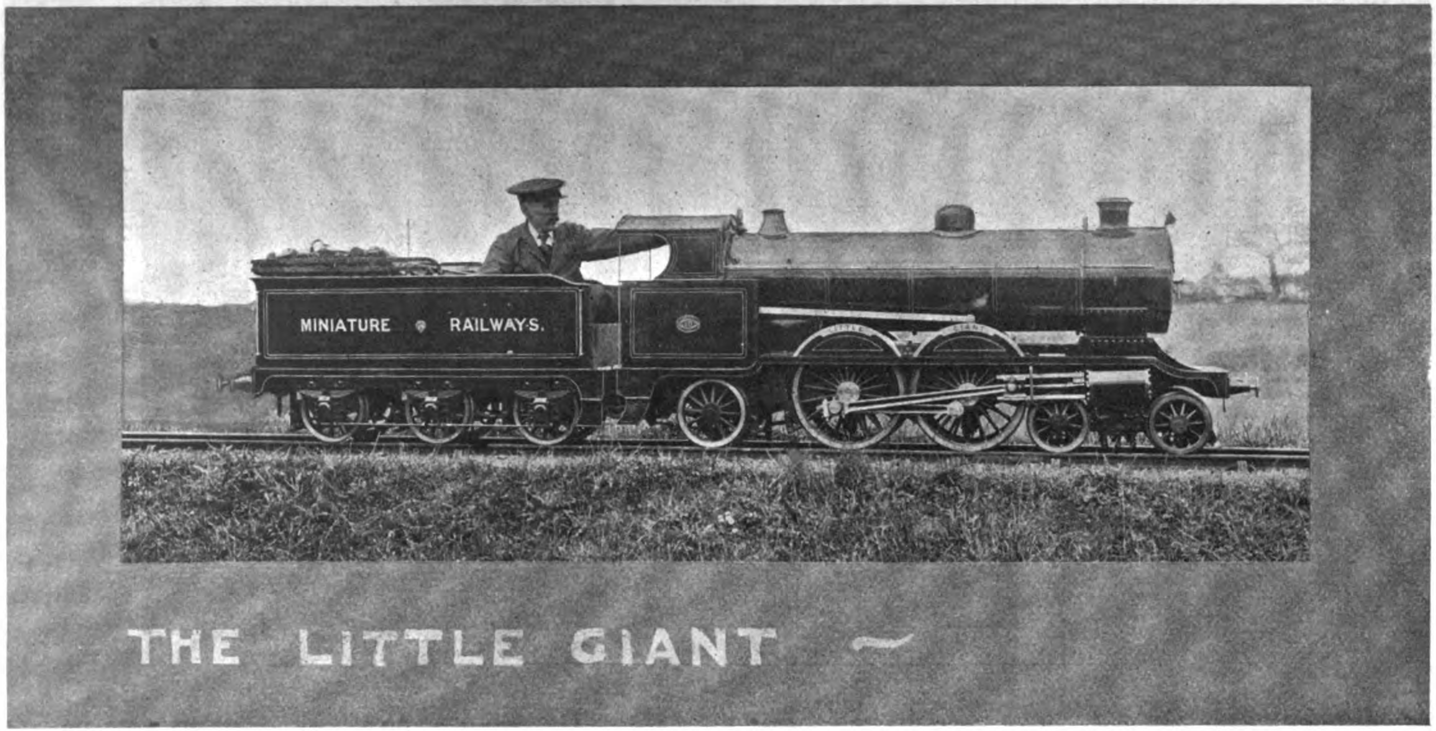
FIG. 10.—THIS VIEW GIVES AN IDEA OF THE ACCURATE PROPORTIONS OF THE "LITTLE GIANT."

blower is of the ring pattern, with blast nozzle combined.

The engine is fitted with a steam brake acting on three pairs of wheels. This brake has a driver's valve giving three positions—*i.e.*, warming, brake on, and brake off, the cylinder, which is jacketed, being placed under the footplate.

The tender is ingeniously arranged. The framing is of oak, and the horn blocks and dummy springs are of cast iron. The latter (six in number) are cast off one pattern, and are attached to the wood framing with coach bolts. This makes a very cheap and strong framing, and saves the costly slotting out of steel frames. The tanks are an entirely separate construction, and are fixed to the top of the wooden framing. A well, the bottom of which is considerably lower than footplate level, is provided for the driver's feet. In this well is a foot brake acting on all the tender wheels, and also

The five or six hours at the disposal of the engineers were enough to show the capabilities of the "Little Giant," and to prove its speed and haulage capabilities. Five and a half tons net weight behind the tender were taken to Eaton, with ease, up a continuous rise, the gradients varying from 1 in 100 to 1 in 75. A load of 12 tons (eight times the weight of the engine and tender) was moved from a dead start, and for the short distance of level line available was maintained at a speed of about five miles per hour. At the speed test, the locomotive attained the average rate of 22½ miles per hour (one mile in 162 seconds) for the mile, the two middle quarters being traversed in 34 seconds, therefore, for half a mile the average was 26½ miles per hour, the speed touching 30 miles per hour at points. This is a very high rate of speed for a model, and proved quite an exciting experience. Calculating on this, the scale



THE MINIATURE RAILWAY LOCOMOTIVE FOR BLACKPOOL.

(Mr. F. Smithies, Driver.)

Scale of model, 3 ins. to the foot; cylinders, $3\frac{1}{4} \times 6$ ins.; driving wheels, 18 ins. diameter on tread; bogie wheels, $9\frac{1}{4}$; trailing and tender wheels, 11 ins. diameter; weight in working order, 1 ton, 10 cwts.; gauge, 15 ins.

Designed by Mr. Henry Greenly, and Built at the Works of the Miniature Railways of Great Britain, Ltd., Northampton. Erector, Mr. James Mackenzie.

speed of a full-size "Little Giant" would be 106 miles per hour. The load was 2½ tons behind the tender, and the gradients were in favour of the engine. At the highest speeds the locomotive travelled with perfect smoothness, and the engineer, who was driving, says that he could have got a

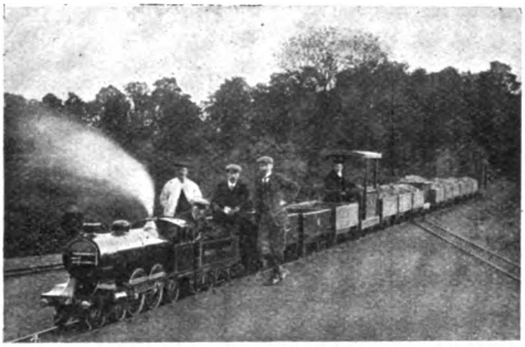


Fig. 11.—This Load, with the Duke of Westminster's Engine, "Shelagh," which itself weighs 4½ tons, hitched on behind, was Started from Rest by the "Little Giant." (*Total weight of train, 13½ tons.*)

much higher average had he been better acquainted with the road. (It takes about one-fifth of a mile to pull the locomotive up when travelling at the top speed.) However, the regulator was not at any time more than half open, and the engine was well linked up. The firedoor was open, and one of the injectors on during the greater part of the run. The trials were conducted under the superintendence of Mr. A. G. Robins, M.I.Mech.E., whose kindly co-operation in this matter was much appreciated by the directors of the Miniature Railway Company. Mr. Henry Lea, M.I.C.E., a gentleman whose name is well-known to our readers, was also present.

(*To be concluded.*)

Determining the Moisture in Steam.

At the recent meeting of the American Society for the Advancement of Science, Professor D. S. Jacobus, of Stevens Institute, described a method of determining the dryness of steam at atmospheric pressure employed by him in an investigation of the performance of steam separators. The method adopted was to mingle a known weight of superheated steam at a given temperature with a known weight of the saturated steam at atmospheric pressure. The steam after being mingled was still superheated and its temperature was measured. From data thus obtained the amount of moisture in the saturated steam was determined. This method is similar to that employed by Mr. G. H. Barrus, and it permits of accurate measurement.

The Latest in Engineering.

Hematite Ore Discovery.—The Barrow correspondent of the *Times* states an important discovery in the iron ore fields of Furness is reported from Park, the royalty of the Barrow Steel Company. These fields were regarded as practically exhausted, but the company have been boring to greater depths and have come upon a body of rich ore.

Acetylene Gas Buoys.—The Canadian Government has adopted acetylene gas buoys in preference to those having compressed gas, which are liable to explode. The new buoys carry a charge of carbide, which when the buoy sinks to a certain depth, comes into contact with the water, and generates acetylene gas for lighting the buoy. A certain pressure of gas cuts off the water, but when more gas is wanted, the water is automatically admitted again to the carbide, so as to generate it. The pressure of gas is not over 3 lbs. on the sq. in.

Separately Operated Steam Engine Valves.—This is the invention of Mr. Enoch Richardson, Australia. A cylindrical steam chest fitted with reciprocating piston valves is attached to the side of the main cylinder and axially parallel therewith. The two steam valves are fixed to one rod, and reciprocate together one at each end of the cylindrical valve chest. The piston exhaust valve is placed between the two steam valves, the steam valve piston-rod passing through it and sliding within it. The exhaust valve rod similarly passes through and slides within one of the steam piston valves. This rod also passes through an extended sleeve having a gland at the end, which reciprocates with the first steam valve. The two steam piston-valves are operated by one eccentric and the exhaust piston valve by another eccentric.

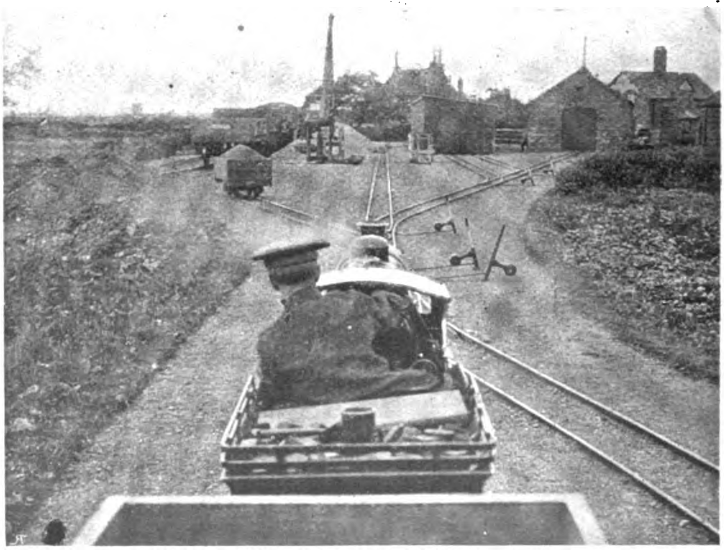


Fig. 12.—Returning to Balderton Junction after the Trials.

A Tangent Galvanometer.

By G. H. Wood.

THE tangent galvanometer described herewith is one of my own make, and is an instrument which I have found to be very useful. It is made of well-seasoned mahogany, as this wood does not shrink much when once seasoned.

The stand (Fig. 1) is made of $\frac{3}{4}$-in. material, and is nicely French polished, which gives it a smart and workmanlike appearance. I may here say that *all* the screws used must be *brass*, and on no account iron, or they will affect the working of the instrument. The circular piece is wound with three layers of No. 22 D.S.C. copper wire B. It is essential that there should be a known number of turns (complete) on here for purposes of calculation.

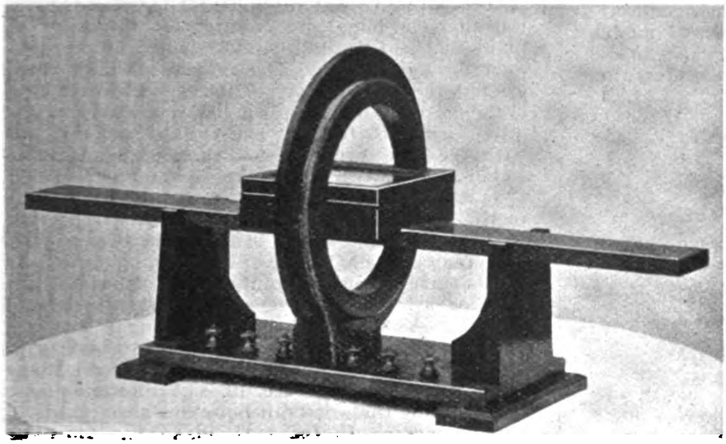


FIG. 1.—A TANGENT GALVANOMETER.

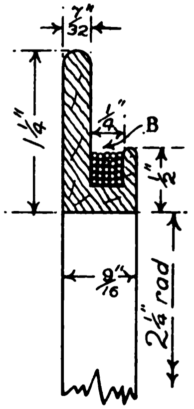
The two ends of each layer are connected to two binding screws fitted on the baseboard; hence there are six binding screws, one or more coils being used as required.

The needle is constructed in what I think is a very good way. A piece of fine glass tube was closed at one end in a Bunsen frame, taking care not to have too much glass at the end. About 1·5 cms. was then cut off the tube from this end.

Two pieces of watch spring, about 2·5 cms, long, were softened in a bright fire, bent to the shape of the glass tube, and hardened again. These pieces were then strongly magnetised with a bar magnet, the ends bound together (with like poles in contact) with fine copper wire, and the glass tube inserted between them, the space being filled with sealing-wax. An aluminium pointer was then drilled and fitted tightly on the glass tube (see Fig. 3). The needle is suspended on a fine sewing needle point just smeared with vaseline. As will be seen, there is practically no friction with this arrangement. The scale is divided up into degrees in four parts, reading from 0 to 90 degs. When using the instrument, the pointer is adjusted until the two ends each come over the zero marks on the scale. When a deflection occurs, the reading is taken at both ends of the pointer, and the average of the two results taken.

As will be seen, the needle and pointer are fitted in a box on a long wooden arm, which is free to be moved laterally. The reason for this is that the needle and pointer can be moved away from the magnetic field, and so a small deflection can be got for a strong current. However, I find it better to put one or more of the layers of wire in series by connecting the terminals together for a strong current than the above method, but, of course, there are cases where both methods have to be combined.

FIG. 2. CIRCULAR FRAME AND WINDINGS.



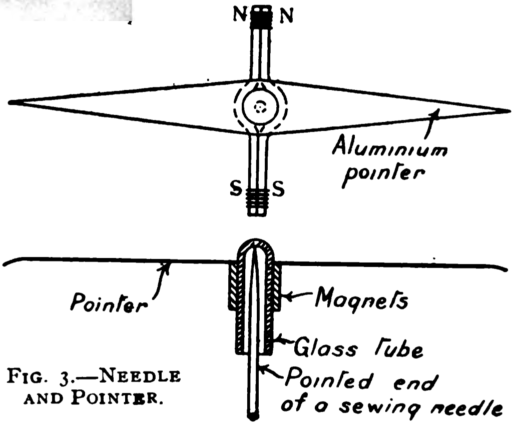


FIG. 3.—NEEDLE AND POINTER.

The constants, K, for my instrument—*i.e.*, the number by which the tangents of the angles of deflection must be multiplied by to give the current being measured in amperes vary according to the number of layers of wire put in series at a time. They are as follows:—

For one layer = ·0803.
For two layers in series = ·1606.
For three layers in series = ·2409.

i.e., $C = K \tan a$.

∴ Current in amps. = ·0803 *or* ·1606 *or* ·2409 × tangent of the angle of deflection.

An instrument like the one here described could be used in connection with the proving of Ohm's Law, the finding of the efficiency of an incandescent lamp, and Faraday's Laws of electrolysis, etc.

Should any reader like to know how to find the constant K, I shall be pleased to describe the method to him through the *M.E.*

Practical Notes on Model Boat Building.

By T. Lochore.

AMONGST the foremost of out-door hobbies and pursuits is model yachting. There are three kinds of model craft: (1) The exhibition model, with all its expensive fittings, everything to or very near scale, and which is only fit for show; (2) the sailing model; and (3) the steam model.

It is the two last-named that interests model makers who aim at practical results and who do not care so much for dummies. These readers the

Fig. 4.

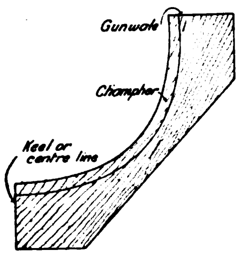


Fig. 3.

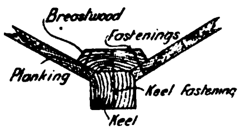


Fig. 5.

writer principally addresses in the following notes on model boat building.

To start a plain dug-out model, square your block of wood, mark on the section lines (taking care to reproduce them when one side or another of the block is cut for sheer or plan shape), then take your sheer or profile drawing, lay it on the side of your block of wood, and prick the lines through with a pin or needle; pencil the pricked lines on the block, cut out to shape (you always cut out the profile or elevation first), then lay on your deck plan on the top of the block, prick the lines through pencil, and cut out to shape. The work is now ready for the sectional shapes of the boat. These are taken off the body plan; the easiest way to do it is by cutting thin template wood to the shape of sections as in Fig. 3, thinning the shaped edge down so as to get accuracy in applying it to the block of wood. Take your gauge, and at the respective lines shown on the block gauge out to suit your template shape. Having done so, chip and pare off the wood between the sections, being careful not to go deeper than the line of the sections, the gauged out sections acting as a guide to the shape of the boat, then finishing with spokeshave and sandpaper.

In digging out, mark on the thickness line on the deck and gauge out to it. It is a tedious business and requires care in working the gauge; try the thickness with your thumb and forefinger, and latterly by holding up to the light. The benefit the halved dug-out model has over this method is that being split through the keel you can pull it apart when you come to dig out, and dig out and shape the inside much easier and more evenly. By leaving a little extra wood round stem, keel, and stern, you can fix it up very lightly again, as in Fig. 4, white lead filling up any irregularity of same. I should mention that to keep the two halves together when shaping the boat, the easiest and best way is to use short dowels.

The "bread and butter" style of building has already been described in this magazine, and one or two points about it are worth noting. They are: (1) That the cross grain of the ends of the model will try to come apart when you start to cut the inside out; (2) the cross grain of the wood at ends will give trouble when caulking the many seams, and you will find that this method of working is not much cheaper than clamping the two portions of the halved dug-out work.

In designing a built-up model there is one important thing to watch; and that is, not to make too sharp a bilge and counter for the sake of planking. But the built model has two advantages over the dug-out: (1) The avoidance of the cross grain in the wood; (2) the tedious process of digging out. On the other hand, it has the disadvantage of requiring greater care and skill. To commence with, the keel should be made; and it is advisable to build this in two parts—the keel and breastwood—as in Fig. 5. You could, of course, make a rebate in the keel, but clinching the two pieces together with shoemaker's sprigs is the easier way. The stem may be made by one or two methods, the best is, of course, being to obtain a piece to shape—oak, elm, or ash being most suitable wood for this portion. You cut a rebate for planking in the piece taking care to angle this correctly, according to shape of the boat, getting the angles and shape either by sections or water-lines at different points and working the wood fair between those points.

In attaching to the keel, make the joint by leaving wood on the stem to overlap, if possible avoiding a third piece—a knee piece called the

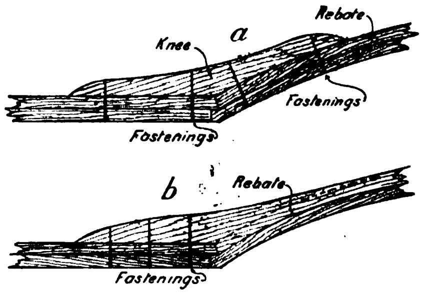


Fig. 6.

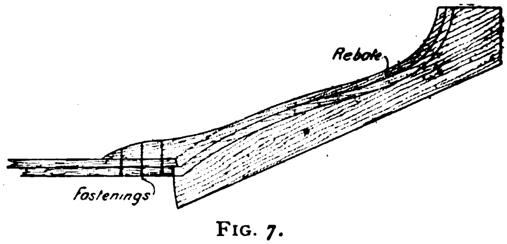


Fig. 7.

"deadwood"; this being done in either case as shown in Fig. 6, *a* and *b*. Another very good way to make the stem is by shaping a piece of wood to the inside shape of stem, leaving on the outside for strength's sake, till the boat is finished as shown in Fig. 7, then cutting it to outside shape. The stern is, perhaps, still harder to make, being unavoidably in three pieces (unless, of course, you get

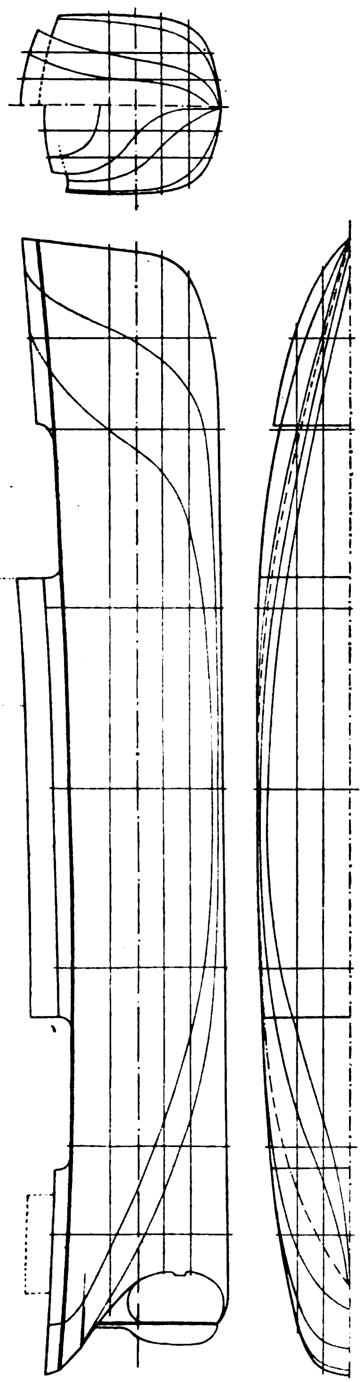


FIG. 1.—A DESIGN FOR A MODEL MERCHANTMAN. (Length, 3 ft. 6 ins.; Beam, 7 ins.; Depth, 6 ins.; Draught, 3¼ ins.)

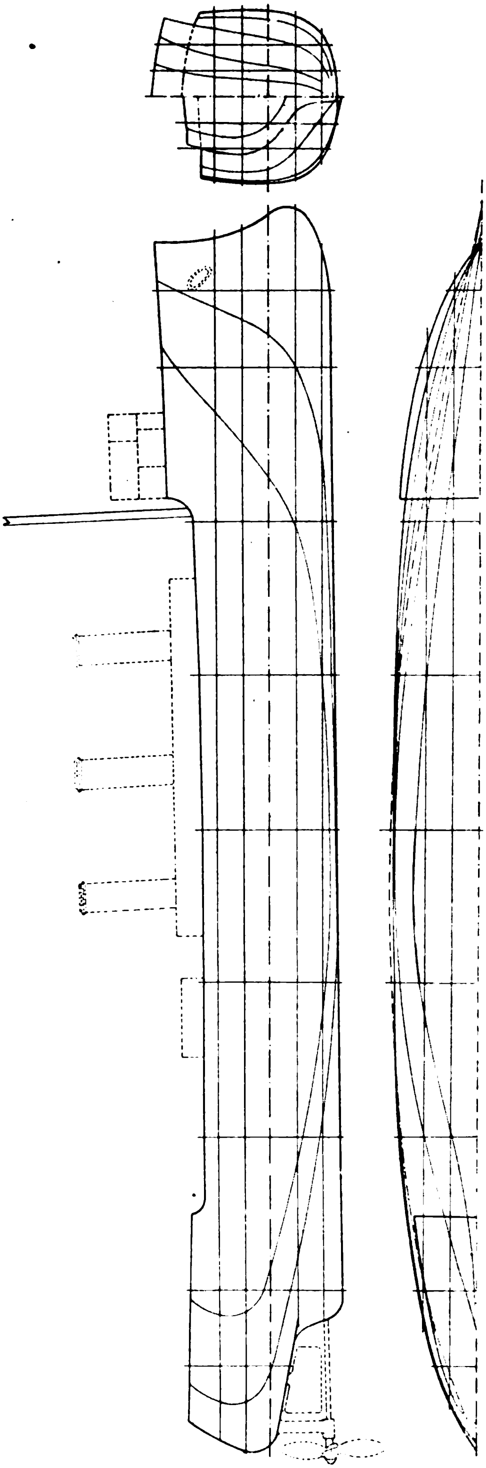


FIG. 2.—A DESIGN FOR A MODEL FLEET SCOUT. (Length, 4 ft.; Beam, 6½ ins.; Depth, 5 ins.; Draught, 2½ ins.)

MODEL BOAT BUILDING. (By T. LOCHORE.)

For description]
[see pages 32–34.

a natural crook in the wood), viz., the stern-post, the counter, and counter-piece. The best way is to arrange the stern-post to be a piece joined to the nearest frame, making the frame to suit, as in Fig. 8. The counter is a difficult portion, and may be screwed on to the top of the stern-post, leaving a solid piece standing up the thickness of the planking to allow the stern tube to come through. The rest of the counter is left without a rebate, the planking butting in the centre and on the counter-piece, which may be a small piece of yellow pine screwed on for that purpose, finishing

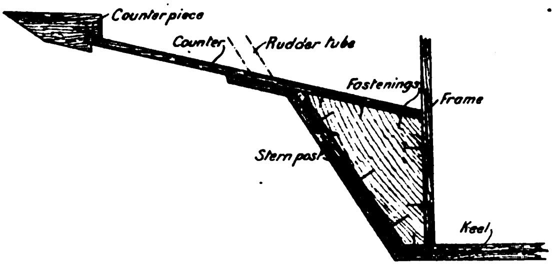


FIG. 8.

the counter. This is the usual method of construction in large yachts.

Having got the keel, stem, and stern-post ready, the frames come next, and without doubt the built frame is the best and also the easiest construction in the end. Paste your body plan on to a piece of wood, shape the frames to the respective lines on the plan, taking care to mark on the deck line and centre of keel on each. The frames may be in four pieces, as shown in Fig. 9, and held together with shoemaker's sprigs clenched or plied. I have found this method an excellent one. Watch the

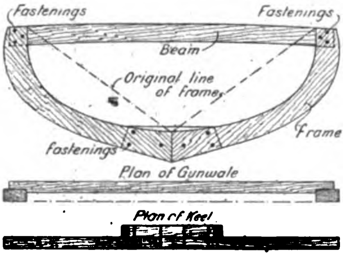


FIG. 9.

direction of grain of the respective pieces as there is a purpose in this—namely, that a screw nail does not hold in end wood; therefore, the grain of the lower joining piece or strap will allow joining it to the keel.

(To be continued.)

AIR WASHING.—Gratifying results are said to have followed the installation of an air washing apparatus in connection with the heating and ventilating system of the office building of a company in Pittsburg, Pa. The fan, heater, and motor are installed in the basement in conjunction with the washer, which consists of a metal-supporting frame filled with broken coke, over which water is allowed to trickle.

Railway Signals and Signalling.

By CHAS. S. LAKE.

III.—SIGNAL MECHANISM.

(Concluded from page 614, Vol. XII.)

FIG. 30 is an interesting photograph showing the interior of a signal cabin, and Fig. 31 shows the mechanism and connections below the floor. The interlocking mechanism is not shown in either photograph.

The levers themselves do not require description, except that they work through the curved guides shown, and are fitted with spring catches which hold them in either of their extreme positions. In practice the levers are always labelled, and on these labels the numbers of other levers which have to be moved before the lever in question can be operated are given. The levers are also coloured variously to assist distinction—one colour being used for signals, another for points, another for levers which are only included for locking purposes; and up and down, fast and slow line, sidings, and disc signal levers are further differentiated. A few spare levers, prepared for future additions and alterations, are also generally included; and these are painted white, and can easily be identified in Fig. 30.

Below the floor the various rods and levers extend from the levers, *via* wires and pulleys, bell crank levers and rods, &c., to the outside wires and rods which connect with the signals and points outside. The counterweighted arms and some of the pulleys shown relate, mostly, to compensating gear.

Yet, interesting as the ordinary signal mechanism is, far greater interest attaches to interlocking apparatus.

The object of interlocking apparatus is to ensure that conflicting signals and points cannot be operated, and it is due to the perfection and almost universal introduction of interlocking mechanism that the safety of railway travelling is obtained.

Simply expressed, interlocking apparatus comprises nothing more complicated than a rod or device which, when a lever is operated, acts to prevent the rods or devices of all other levers whose operation would clash from being moved. Several detail variations of such devices are in use, but for most signal frames the essential part comprises a rod for each signal lever which has a series of notches or inclines which, when the rod is moved lengthwise, act to cause long bars extending along the signal frame to move a short distance longitudinally. These latter bars have notches, or projections, on them, and the notches, inclines and projections are so arranged on the respective rods of bars, so that as a lever rod is moved, one or more of the locking bars is or are moved so that the various notches or projections upon them take up positions which prevent the rods relating to conflicting levers from being moved.

In a large locking frame there may be a large number of these locking bars, and in some cases one locking bar may engage with the large majority of the lever rods in the frame to lock them; but whatever the size of the frame, the principle is the same, the mechanism being multiplied over and over again. As the movement of each signal or

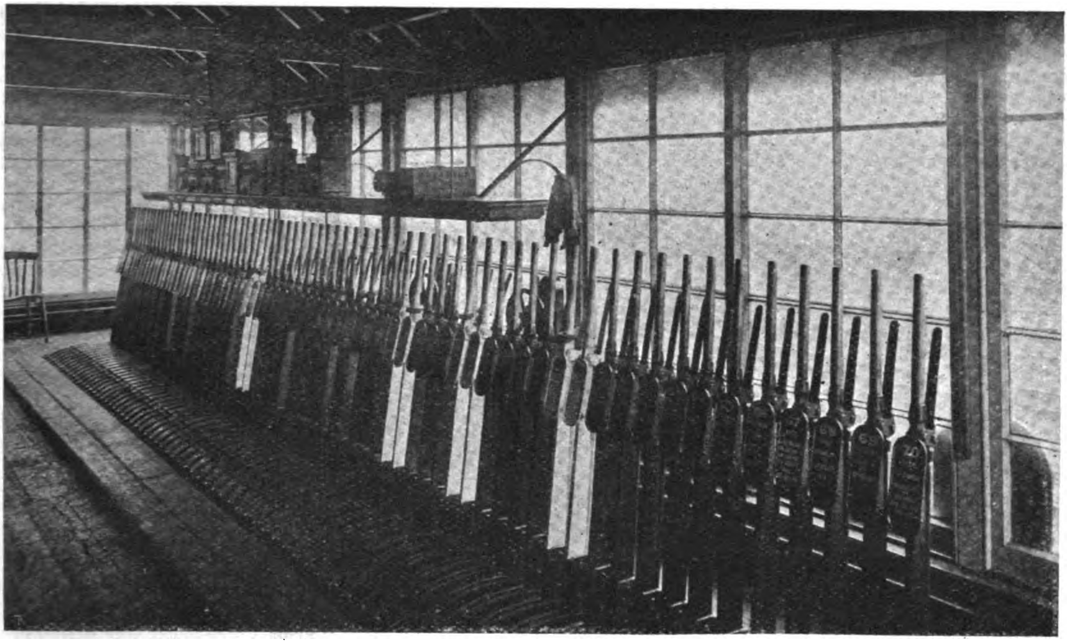


FIG. 30.—INTERIOR OF A RAILWAY SIGNAL BOX.

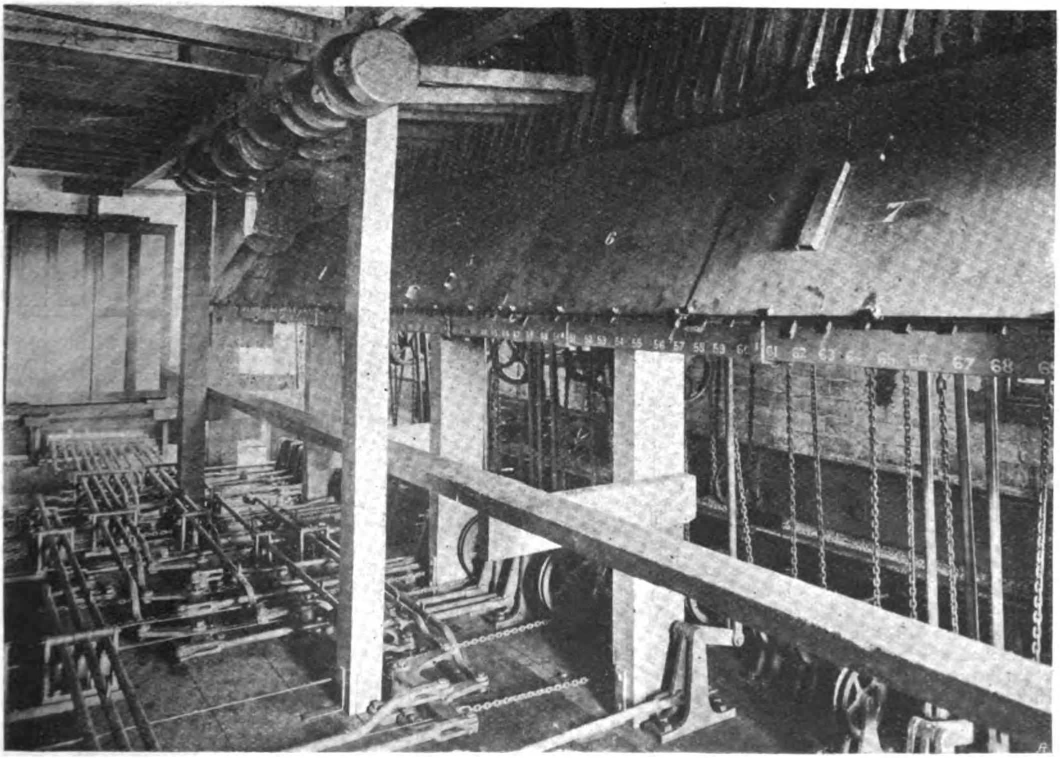


FIG. 31.—INTERIOR OF A SIGNAL BOX SHOWING THE MECHANISM BELOW THE FLOORS.

For description] [*see pages* 34–39.

point lever is comparatively large, it is usual now to employ cam or like gear operated by the levers, but which give a reduced movement of two or three inches, this being sufficient to give the required movement of the locking bars.

Fig. 32 is a most interesting illustration (reproduced from Messrs. MacKenzie & Holland's catalogue), showing the large locking frame fitted at Liverpool Street terminus (Great Eastern Railway), and this will serve as a good example of the apparent complication which results in the case of a large frame, though in reality all is simplicity, the complication arising merely from extensive multiplication.

This frame, as fitted in the main signal cabin at Liverpool Street, is shown in Fig. 33. There are 244 levers comprised in the two sets, and although there is another important signal box in the station

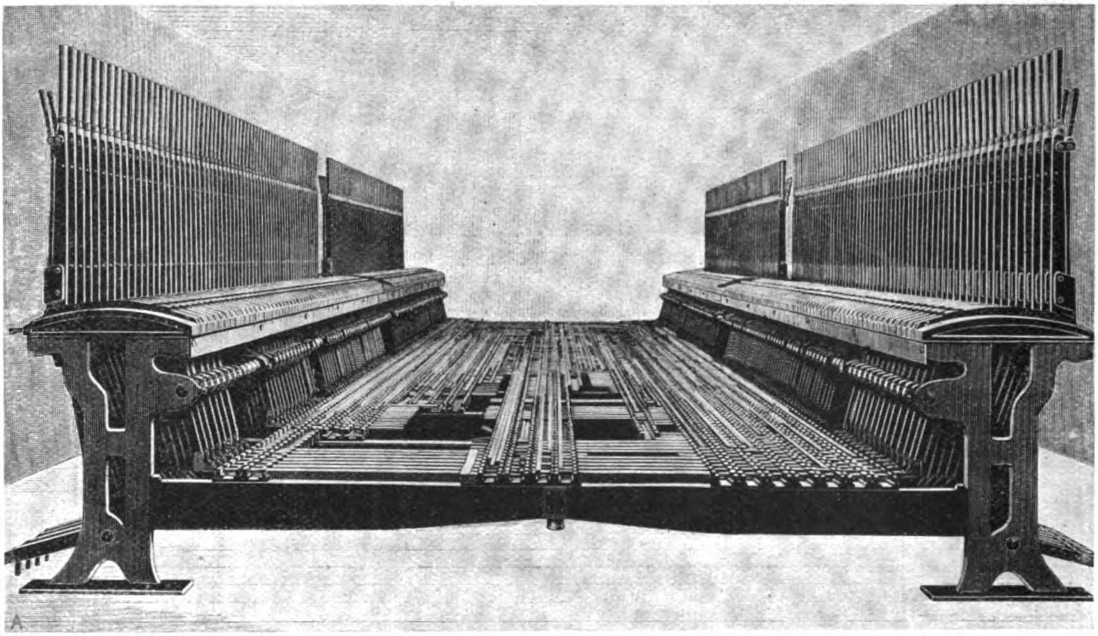


FIG. 32.—LOCKING FRAME EMPLOYED AT LIVERPOOL STREET STATION, G.E.RLY.

—in the Eastern, or new, section—the main box really controls all trains entering or leaving the station, for no train can enter or leave the new portion of the station without permission from the main box.

It is stated of the locking apparatus which was removed to make way for the present apparatus when the station was enlarged in 1893-4, that the old frame was in constant use for over twenty years, that an estimated total of 76,800,000 lever movements had been made upon it, and that although superseded, the old frame was adapted for another large station, where it is still in use.

So far, nothing has been said about electrical appliances used in connection with signalling; but nowadays the employment of electricity for other than telegraphic purposes is a very important factor in the safe conduct of heavy traffic on crowded lines.

One of the most generally employed systems of electric locking (apart from wholly electrically operated signal installations) is that known as Sykes' "lock and block," and the following description in reference to Fig. 34 sets forth the main features of the system. It should also be explained that the treadles are located at the end of each block section, and, therefore, at the commencement of the next section, and they consist of specially constructed bars arranged alongside one of the rails so that it is depressed by the flanges of the wheels of a train to complete an electric circuit. These treadles are made sufficiently long so that there are always at least two wheels upon it; therefore, the treadle is kept down until the whole of a train has passed over it. These treadles are also employed for the various lines of a terminal station so that as long as a train occupies a line an electric lock is imposed on all levers and instruments relating to signal and points governing access of another train to that line. In the case of a platform where one train is allowed to enter behind another, two or more of these treadles would be employed. At some stations notices are exhibited instructing drivers of engines when occupying a platform line, to take up a position upon the locking treadle to ensure that he is properly protected.

Fig. 34 represents diagrammatically a section of double track line with three signal-boxes A, B, and C, but includes only the mechanism and the essential signals of one track.

The small semaphore arm over instrument, when down, shows section in advance clear, while the upper opening in instrument shows ("locked)" the starting signal lever is locked. A has a train for B, and tells him so on his bell instrument; B, when ready to receive the train, presses the plunger M,

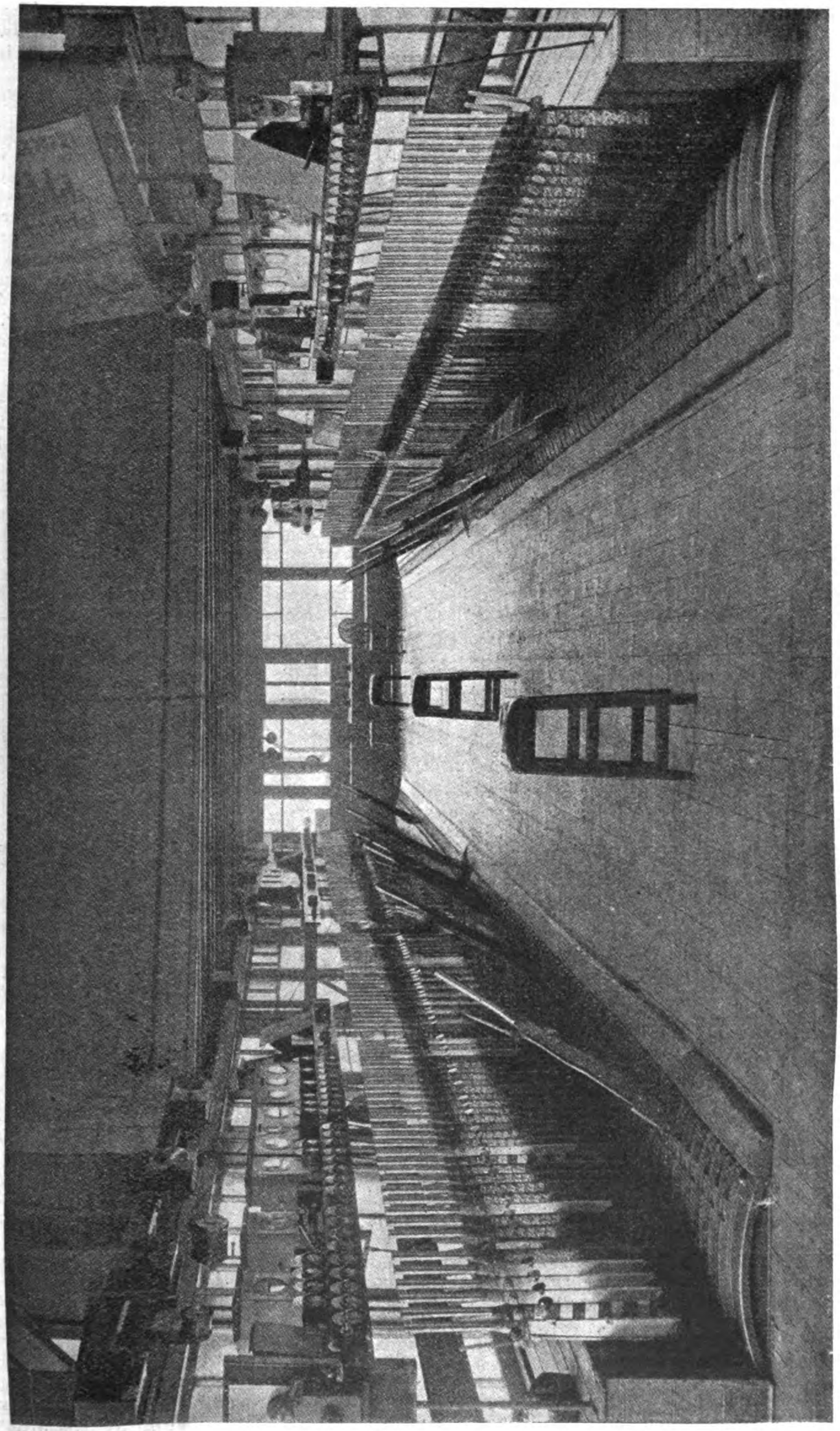


FIG. 33.—THE INTERIOR OF THE MAIN SIGNAL CABIN, LIVERPOOL STREET (LONDON) TERMINUS.

GREAT EASTERN RAILWAY.

(From this Box there are controlled 1,200 trains per day, the heaviest traffic of any station in the world.)

For description] [*see pages* 35—39.

this causes the words "train on" to appear at the lower opening in B's instrument; the word "locked" to disappear from the upper opening in A's instrument, and the word "free" to take its place; it also unlocks A's starting signal lever. A lowers his starting signal, and the train goes on to B. B's plunging also raises the semaphore arm over A's instrument to "danger." The lowering of A's starting signal causes the word "free" to disappear from the upper opening in his instrument, and brings forward the word "locked." A, when train has passed over treadle, which is a train's length beyond starting signal, raises his signal to danger behind the train, and cannot lower it again without B's permission. Before B can lower his starting signal for the train to pass towards C, C must do for B what B did for A. This being done, B can lower his starting signal, but the train must pass over treadle (T), and the signal raised behind the train before he can permit A to send on another train.

Thus it is impossible for two trains to be in the same section.

With ordinary block working, practically infallible as it is in theory, there is a considerable tax upon the signalman's memory, and this system steps in just where human nature is liable to fail to prevent mistakes being made.

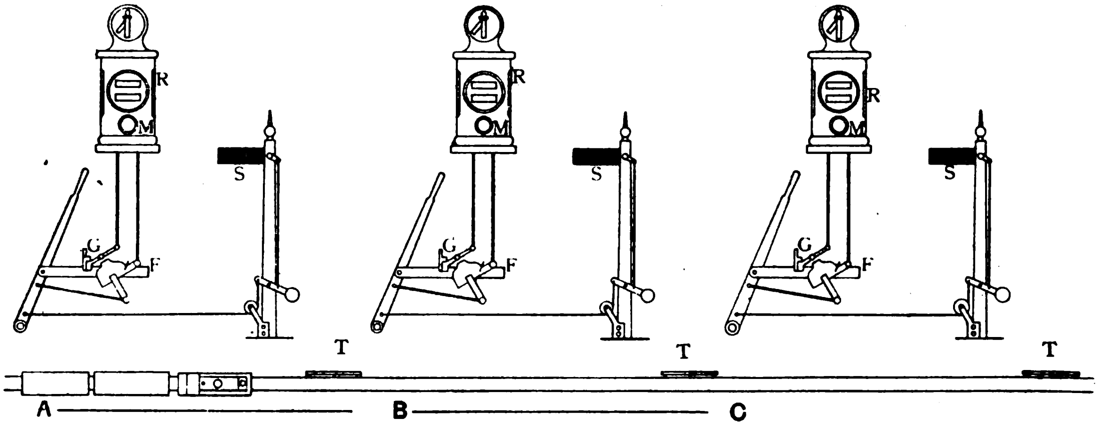


FIG. 34.—DIAGRAM OF SYKES' ELECTRIC LOCK AND BLOCK APPARATUS.

As regards the instruments employed in a signal-box, they include primarily telegraphic instruments, bells and gongs, by which the necessary messages are passed by one signalman to another, according to the code in force (these messages are usually conveyed by so many rings or a combination of rings and pauses, thus: — —, — — —, or — — — —; or — pause — —, — — pause — —, or sometimes — pause — — — pause — —, and so on; the code being sometimes an elaborate one); instruments which by their indications serve the same purpose (these are generally employed when electric locking is fitted, in which case the circuits connecting the instruments also include locking devices which lock signal levers, other instruments or the "plungers" by which many operations are effected, in the fashion already described with reference to Fig. 34); "repeaters," which are small reproductions of signals to show the position of a signal, especially when the signal itself is not easily visible by the signalman; lamp indicators which show whether a signal lamp is burning properly when the signalman cannot see the light himself; and various other devices used according to circumstances.

A few remarks in reference to single line working must conclude this section.

The essential condition of single line working is that it must be rendered impossible for two trains to occupy a stretch of single line simultaneously, particularly when travelling in opposite directions.

There are many short branch lines where the rule is that "only one engine in steam or two engines coupled together (they must not be worked independently, except for shunting, under any circumstances) are allowed to occupy the line at once"; but under these conditions all is plain sailing.

On most lines, however, more trains than one may be in use, and then some protective means is necessary.

The most frequently employed controlling means for this purpose is the "train staff." This is a specially shaped and marked metal rod, one being employed for each section of the line. As no engine is allowed to occupy a section unless the driver is in possession of the proper staff, it is manifestly impossible for two trains to occupy the section at once.

But the train staff does not altogether meet requirements, for it may often happen that two trains may require to proceed in the same direction before one returns to bring the staff back for the second train, and so a system of "tickets" is employed in conjunction with the staff. When a second train has to follow another in the same direction, the stationmaster prepares a "ticket" which he gives to the first driver and *shows him the staff*, thus giving him permission to proceed; and the second driver, or the last of a series, takes the staff itself. This system is very extensively employed, but still has the disadvantage that should traffic become disorganised, and the staff become "hung up" at the wrong end of the section, everything is at a standstill until the staff can be brought either by a messenger on foot or horseback, or travelling *via* platelayers' lorry, or by waiting until a train or engine is available to proceed through the section. On a Bank Holiday Saturday in

August, the writer was witness of traffic being blocked on an important branch line about thirty miles from London for 1½ hours through trains arriving from London out of order, so that the staff became blocked at the wrong end of the section.

Occasionally private sidings are located about the middle of a section, and the work does not require a signalman in charge of the signal-box (if there is one), or the levers for controlling the points, and it is usual to lock the signal-box or the ground levers for operating the points by means of an "Annett's" key. This key is usually formed on the staff itself, so that it is absolutely impossible for these points to be operated without the staff, and according to the general rule, the station-master who then possesses the staff, must himself proceed with the engine and take control of the shunting operations involved.

The train staff and ticket system has proved suitable for controlling comparatively heavy single line traffic, but on busy lines Tyer's Electric Train Tablet apparatus has superseded it with advantage in many places. Essentially, this comprises two sets of electric apparatus, one at each end of a section, and between these two instruments a certain number of "tablets"—say twelve—are distributed. The twelve tablets can be divided in any way, but the electric mechanism is so arranged that though either apparatus can issue a tablet, never more than one can be out at a time, and the remaining eleven must be safely locked up in one or other of the apparati; and another cannot be withdrawn until the previously issued one has been reinserted in one of the machines. This mechanism also protects trains following one another, as well as trains travelling in opposite directions, whereas with the train staff and ticket it is possible for a train taking the staff to overtake a train in front with a ticket.

With the tablet apparatus, as soon as a train has cleared the section, another tablet can be issued for either direction, and for as many trains in either direction as may be necessary within the capacity of the instruments, so long as all but one of the tablets are safely locked up.

In practice, the tablets are placed in small satchels having large looped holders by which the tablets can be easily caught over the driver's or station-master's arm without stopping the train, even at considerable speeds, while it requires considerable dexterity to change a staff or ticket at speed. On some railways the train staff or tablet is automatically picked up and delivered by special apparatus fixed on the locomotives and to a convenient post at the stations. By this means collection of the new tablet and the delivery of that for the section just passed is often effected at speeds of 50 miles per hour.

In a few cases, especially over single line bridges, a pilotman is employed, and he has to accompany every train over his section. This method is also employed when it becomes necessary to introduce temporary single-line working, in case of accident on a double track line or for special purposes.

In some places electric locking is made to take the place of train staff or tablet apparatus for single line working, but this is very seldom used in this country.

The writer is indebted to the firms mentioned in the course of this article for valuable assistance, in preparing this short review of signalling methods and mechanism.

High-Speed Engines.

By H. Muncaster.

(*Continued from page* 14.)

Before leaving the details of the cylinder, the writer wishes to express himself in a way that will not be misunderstood regarding the necessity of having sufficient port area in the steam cylinder, if any work is expected to be done by an engine. It is generally an easy matter to find fault in a way that discourages without doing any good; we hope that our readers will take it as an honest endeavour to explain the reason for the most common cause of failure amongst small steam motors, viewed from a moderate standard of efficiency.

A great number of sets of castings and parts of engines, mostly of the single-acting type with enclosed cranks, suitable for powers of, say, 2 to 4 brake-horse, are on the market, and being made up to details given by the makers. It has been our lot, at different times, to examine several of these in progress of construction by enthusiastic amateurs as well as by trained mechanics, and invariably we have found that the steam inlet and egress, especially the latter, have been woefully deficient in capacity. Unfortunately, the idea prevails that these motors represent the most recent and approved practice in steam engineering, and any doubt one may express as to the efficiency and economy of the motor is only accepted as a proof of one's ignorance. Subsequent events may, of course, have, to some extent, served to modify this opinion.

Mushroom valves of small diameter are used for steam inlet, and seem to work with satisfaction. The exhaust is, however, left to take care of itself, and a small hole in the side of the cylinder made for its escape during the short period this is uncovered by the piston. A little reasoning will make it plain that it is more important the exhaust should escape freely than it is that the steam should have a free admission; assuming the same power in each case, the former will be most conducive to economy of steam.

In designing the slide-valve, we aim first at giving a free exhaust, the release commencing early, and the valve allowing a large area of opening during a great proportion of the stroke. In the case of the engine under consideration, the exhaust will have at the beginning of the stroke (assuming 1-32nd in. lead and 3-16ths in. lap) an amount of opening equal to 7-32nds in., the valve allowing a full port of ¼ in. during about six-tenths of the stroke. As the port is 2¼ ins. long, the area equals ·56 sq. in., and the area of the cylinder being 7 sq. ins., the proportion of exhaust area to cylinder area is about 1 to 13 during this period, giving an average speed to the exhausting steam of 6,500 feet per minute (nearly). Under these conditions there should be no difficulty in obtaining, with this engine, 2 b.h.-p. at 1000 revolutions per minute, and a boiler pressure of 50 lbs., and this with perfect smoothness and steadiness in running.

In the case of model engines, a small port is due to the fact that it is difficult to get a port in any other way than by drilling a small hole. Where the engine is merely running lightly there is no reason why it should be otherwise, but where even a small amount of load is applied—as, for instance, in the case of a small locomotive working on a track—an extra allowance of port area at once gives a decided improvement in running.

A pair of model engine cylinders (trade make), ¾ in. diameter, are now on the writer's desk, the ports of which have been drilled 1-16th in. diameter, a ratio of 144 to 1, or only 1-11 of the proportion given by the writer in the example of a 3-in. diameter cylinder.

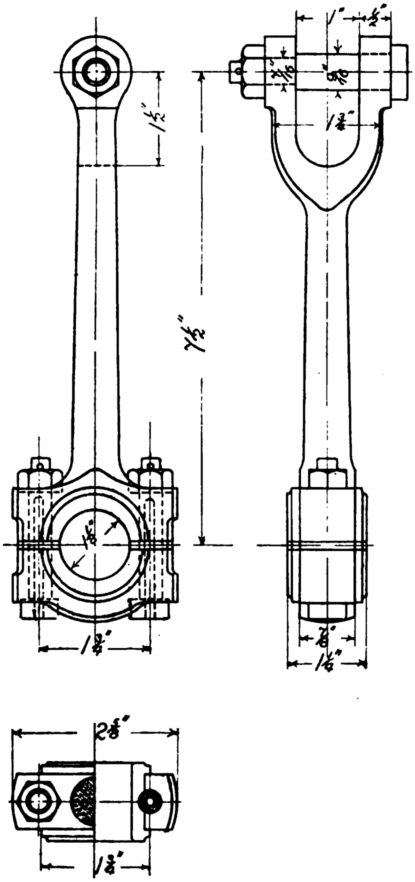


FIG. 15.—DETAILS OF CONNECTING ROD.

In very small work it has been the writer's method to cut first a suitable groove of an oblong shape for the ports, and carefully drill a hole as large as practicable from each end of the cylinder in cases where a good supply of steam was demanded. As an illustration. If the cylinder be 1 in. diameter, a steam passage of 3-16ths in. diameter will equal one-twenty-eighth the area of the cylinder (nearly), which is ample for most purposes. A groove of 3-32nds in. wide by 5-16ths in. long, cut into the valve face, will form a suitable steam port, the exhaust port being about ⅛ in. by 5-16ths in.

The bed and standard shown in detail (Fig. 14) are of a type most common in vertical engines, and very suitable for small work, being simple in construction, and allowing the various parts to be easily accessible. In the larger sizes the standard is made of the box section, but in the engine we are illustrating it will be best to make it with an opening in front, so as to save core-making, as the pattern will form its own core.

In the patterns the part forming the guides should be made loose to come away in the sand; also the front half of the hood and flange for bolting the cylinder to. The moulder will, of course, prefer to have it to divide in halves down the centre of the standard, and having the necessary prints for taking the core and a separate core-box in which to make the core in one piece. If it is intended to make more than one casting off the same pattern, the latter will be the better method of constructing it. Allowance must be made for facing and turning the flange, facing the foot, facing the guides, and the attachment to the front stay. The pattern for the bed will be like the casting: enough taper must be given, as shown on sketch, to allow it to draw easily from the sand. The facings for the flanges of the bearing brasses must be loose, and will be left in the sand when drawing the pattern from the mould. Allowance should be made for facing the bottom of the bed, as well as the parts to be machined. Except in special cases, there is no need to cut down the thickness of metal in these castings, as the extra dead-weight will assist in absorbing the vibration.

In machining the standard, the most important point to observe is to get the guide surfaces perfectly square with the flange to which the cylinder is bolted. For this reason it will be better to machine the slides before boring the flange. If the boring or cutter bar be true in the lathe, it may serve to set the standard by gauging the position from the machined portion of the guides.

After machining the bottom of the bed, the caps for the bearings of the main shaft should be fitted, and the seats for the brasses bored and faced, taking care that the boring is parallel to the base. If then the bed be set on a level plate, the standard can be fitted by levelling the flange. The bolts at the base of the standard may have a little play in the holes to allow a slight adjustment. After being set to its proper position, the standard should be tightly bolted to the bed, and two holes for ¼ in. diameter steady pins drilled from underneath, and pins fitted. Care should be taken not to drill through, so as to expose the heads of the pins. The steady pins will enable the standard to be replaced, as it will be desirable to remove it when fitting the slides, cylinder, &c.; also the brasses and the crankshaft.

The step brasses shown are intended to be bored and turned on a mandrel. It will be necessary to solder the halves together for turning; this makes a much more satisfactory job than turning them out of one piece and splitting with a saw. A brass peg, as shown, keeps the step from rotating; a piece of tube in the pedestal cup answers the same purpose. By the aid of a bit of yarn in this tube an excellent means of lubrication for the bearing is provided. Some may prefer to fit square brasses to the bearing, as in the example on page 225 (Vol. XII); this is, perhaps, a better way, but the round brasses can be so readily turned that they save much time, both in the fitting and polishing.

The details of the connecting-rod are shown in

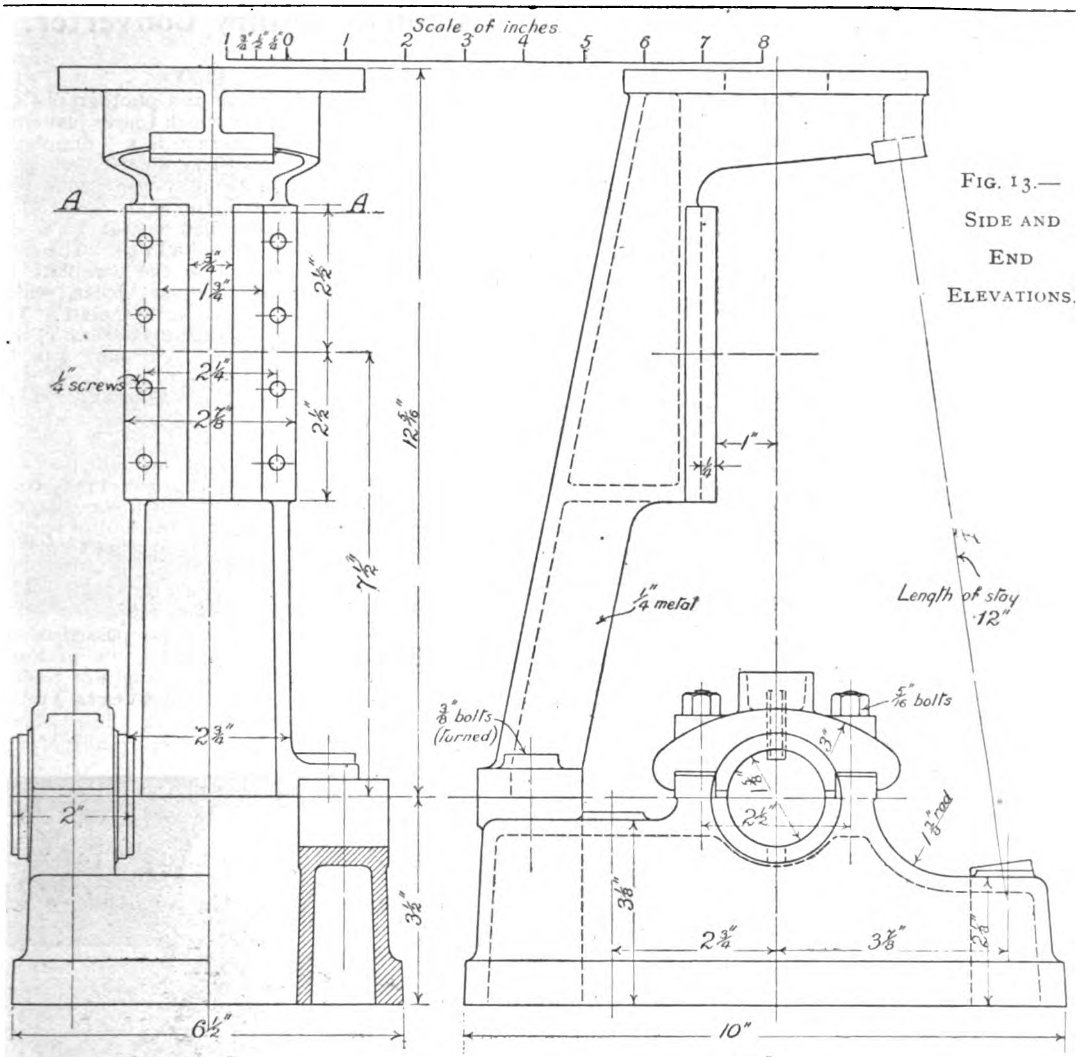


FIG. 13.—SIDE AND END ELEVATIONS.

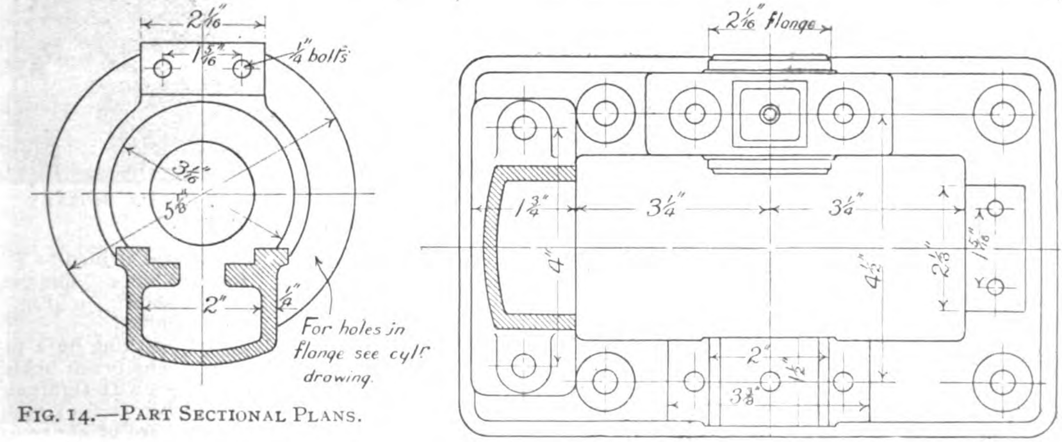


FIG. 14.—PART SECTIONAL PLANS.

DETAILS OF ENGINE BED AND STANDARD FOR SMALL HIGH-SPEED ENGINE.

Fig. 15. This is made of mild steel. The rod is, first of all, turned; a hole, 1 in. diameter, is next drilled at the crutch of the fork, and a cut at each side made with a hacksaw to meet the hole. The jaw is then filed out to shape, the holes for the cross-head being carefully drilled; the end is then shaped round the bosses at the forked end, and the flat sides of the large end trued up. The holes for the cap bolts can now be drilled, and the hole for the brasses bored out to 1½ ins. diameter. The builder will also note that, when bored, the centres of the connecting-rod will be 1-16th in. short of the finished length.

When this is satisfactorily done, the cap may be sawn off. The brasses will be turned in one piece to fit in their place, but must not yet be bored. The brasses will be split, and one half fitted in the end of the rod, filed up when in place flush with the rod. The other half will be fitted into the cap, and treated in a similar manner. Two brass liners ⅛ in. in thickness are roughly shaped, drilled to suit the bolt ⅜ in. diameter. The end is now bolted up with the brasses and liners in place, and the bearing for the crank-pin bored out to 1⅛ ins. diameter. In the case of a large rod, the bolts would have a hole drilled up the centre, so as to reduce the effective area of the bolt to slightly under the area at the bottom of the screw thread; in this case a hole of ⅛ in. full is shown in dotted lines on the drawing (Fig. 15, page 41).

To adjust the step when the engine has been at work, the liner must be occasionally reduced to suit the wear of the brasses, the bolts being tightly screwed home when in working order; no lock-nuts are thus required. A split pin, however, is desirable to keep the nut from working back, if it happens to shake loose.

(To be continued.)

A Small Rotary Converter.

By J. G. Perry.

THE following description and photographs are of a rotary converter which I have just completed. The field-magnet is a "Simplex" undertype, 20-watt size. The single bobbin is wound with 14 ozs. of No. 22 D.C.C., the bobbin ends being cast with the field. The tunnel was accurately filed out, as I am not in the possession of a lathe. The casting is fastened to the baseplate by being bolted to brass blocks, which are in turn bolted to baseplate. The armature is a laminated drum, 1½ ins. by 1½ ins., having eight slots, ⅛ in. by ⅛ in. The slots were insulated with brown paper and wound with 2½ ozs. of No. 22 D.C.C. wound in four sections.

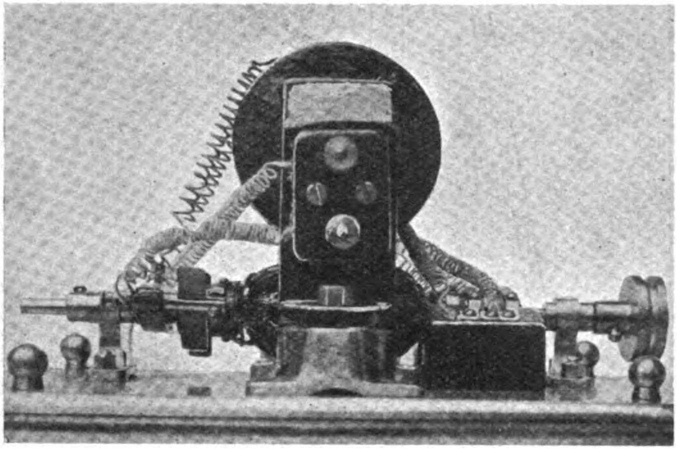


Fig. 1.—Mr. J. G. Perry's Small Rotary Converter.

The commutator is a four-part one made of 1 in. length of brass tube, forced on a wood bush, screwed and split. On the opposite end of spindle are the four slip rings. These are of the same diameter tube as the commutator, and are also forced on a wood bush, no screws being employed. The wires from the rings are passed to the armature in channels cut in bush. The spindle is a 9-in. length of 5-16ths inch steel rod turned down to ¼ in. at the bearings.

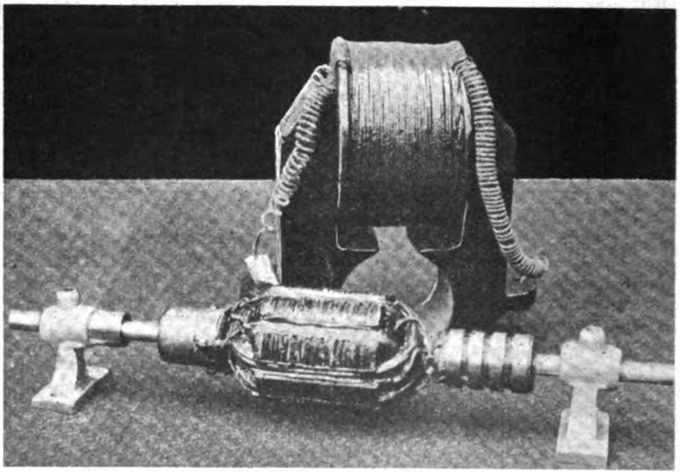


Fig. 2.—Armature and Field-Magnets of Small Rotary Converter shown separately.

The bearings are of cast gunmetal, drilled to ¼ in. and bolted to base by 3-16th in. bolts. The field, armature, and bearings are shown in Fig. 2 separately before they were assembled.

The brush rocker is of wood, working on a projection of one of the bearings. The brush holders are of brass rods, slotted and fitted with tightening screws at one end, and on rocker end of which terminals are screwed. Brushes are of gauze and spring brass.

The alternating current collectors are of spring brass screwed on two wood blocks, which are fixed to base. These brushes are each fitted with a pressure screw.

The pulley is cast brass, 1½ ins. diameter, fitted with an ⅛ in. setscrew, and on the other end of

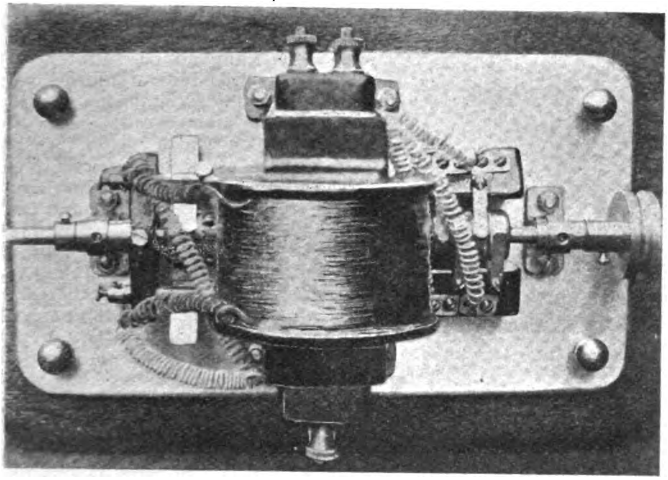


FIG. 3.—PLAN VIEW OF SMALL ROTARY CONVERTER.

spindle a ¼-in. German ring, fitted with a similar screw, is fixed. The base is solid brass, 9½ ins. by 5½ ins. by ¼ in. thick. To this everything is bolted,

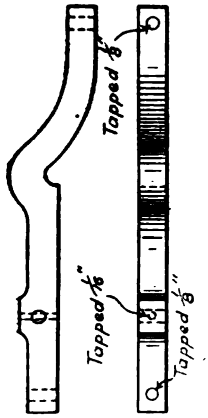


FIG. 1.

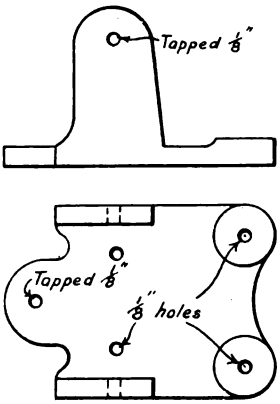


FIG. 2.

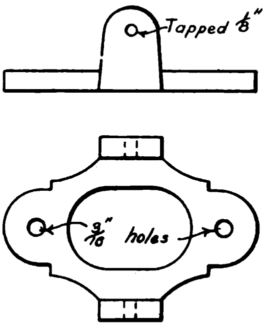


FIG. 5.

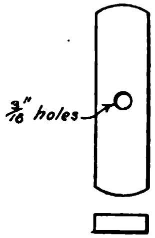


FIG. 3.

DETAILS OF TELEGRAPH KEY AND SOUNDER.

and this in turn is bolted to a polished mahogany base.

Terminal boards are screwed to sides of field casting by 3-16ths in. screws, and have two and four terminals for the continuous and alternating current, respectively. The field casting is enamelled chocolate, and all windings red. All bright metal parts are polished and lacquered.

Fig. 3 shows a top view of machine. I have not had it running much as I have not the available power; but without load it runs beautifully, not making the slightest noise.

The winding tables, &c., were taken from THE MODEL ENGINEER handbook on "Small Dynamos and Motors." I must say that in some of the difficult parts, as in the brass blocks, base, &c., I have been helped by my father, as I am only fifteen and not yet as expert as I should like in model engineering work.

An Electric Telegraph Sounder.

By W. H. A.

THE following brief description and photograph is of an electric telegraph sounder which I have made, with the help of a friend, in my spare time. The sounder castings (Figs. 6 and 4) are in brass, and Figs. 2 and 3 are in iron, Fig. 3 being annealed. Both bases are walnut, 4 ins. by 6 ins. by ½ in., French polished. The bobbins are 1 in. long by ¾ in. diameter, wound with No. 30 silk-covered wire. The cores are screwed to the casting by ⅛-in. screws; the casting is then screwed to the base. Fig. 4 carries the armature, and is balanced between two setscrews, with a spring at the back; the opposite end is furnished with a setscrew, which taps on to the anvil, shown in Fig. 6. The anvil is screwed to the base by ⅛-in. screws, and has a setscrew on top. Fig. 3 is the soft iron piece, screwed to Fig. 4. This completes the sounder.

Figs. 1 and 5 are for the key—No. 1 in brass, No. 5 in iron. The brass casting is balanced by two screws, similar to the sounder, except that the screws are smaller. It has a setscrew at one end for regulating the contact screws; at the other end is an ebonite knob, fastened to the casting by the top contact screw. A spring slightly to this side of the centre point completes the instrument. All connections are made under the base.

The Society of Model Engineers.

[Reports of meetings should be sent to the offices of THE MODEL ENGINEER *without delay, and will be inserted in any particular issue if received a clear nine days before its usual date of publication.]*

London.

EXCURSION TO CHATHAM.—The annual all-day excursion will take place on Thursday, July 27th, when a visit will be paid in the morning to the Dockyard at Chatham, and in the afternoon to the works of Messrs. Aveling & Porter, Ltd., the well-known manufacturers of road rollers and traction engines, at Rochester. The Secretary will be glad to receive an intimation as early as possible from those members who wish to join the party, which will be made up of those members who have signified their intention of being present by Saturday, July 22nd. Provided the party numbers at least ten, the railway company will issue special tickets at the rate of 3s. 2d. each (third class) for the return journey. Cash for the tickets must accompany the intimation of any member to be present, or be sent to me on or before July 22nd. The party will travel by a fast train leaving St. Paul's Station at 9.57 a.m., returning from Chatham at 7.37 p.m.—HERBERT G. RIDDLE, Hon. Sec., 37, Minard Road, Hither Green, S.E.

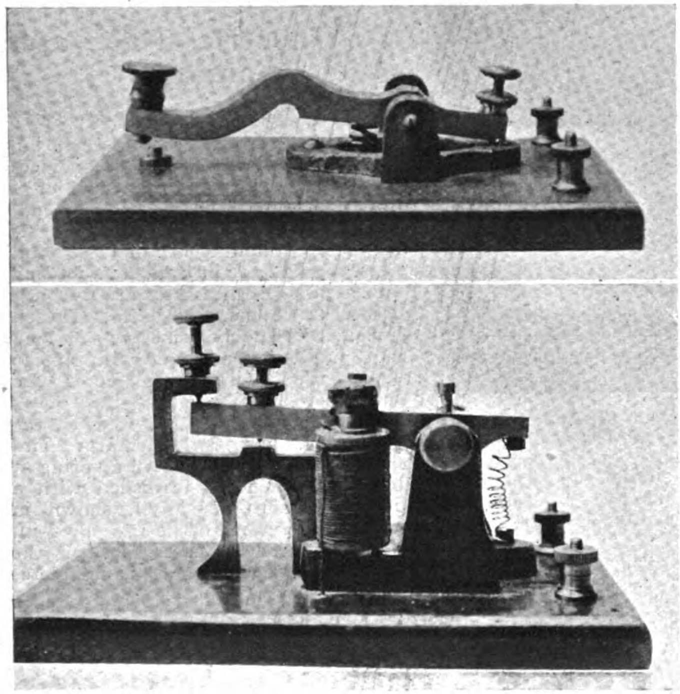


FIG. 7.—THE COMPLETE TELEGRAPH KEY AND SOUNDER.

For description] *[see page* 43.

THE MUNICH TECHNICAL MUSEUM.— It is announced by the secretary that the Hon. C. A. Parsons has made a present to the Munich Technical Museum of one of his first turbines.

Rendering Celluloid Incombustible.

IN order to overcome the undesirable quality of celluloid to ignite, a French chemist has adopted the following method:—An ether-alcohol solution of celluloid is made; then an ether-alcohol solution of ferric perchloride. The two solutions are mixed, and a clear, syrupy liquid is obtained, of yellow colour, yielding no precipitates. The liquid is poured into a suitable vessel and is left for spontaneous evaporation, and a substance of shell-colour is produced, which, after washing and drying, gives the desired result. The celluloid thus treated loses none of its properties of pliability and transparency, and is not only uninflammable, but is also incombustible. Another method by which celluloid may be rendered uninflammable, based on the same principle, consists in mixing bromide of camphor with cotton powder, adding castor oil to soften the substance, so that it may be less brittle. This product, though more easily prepared, is, however, not incombustible like the former preparation.

BICHROMATE CELLS.—Old dry cells will make good flask bichromate cells, if the bottoms are cut off and the filling and paper lining, if any, are removed. Be careful not to break off the carbon rod. After removing the filling, remove the paper lining as follows: Drill an exhaust hole through the cement in the top of the cell, stand the cell in a watertight receptacle, and fill the latter with water to within ¼ in. of the top edge of the cylinder. Let it stand until the paper lining is loosened and can be entirely removed. The electrolyte to be used is 7 ozs. of bichromate of sodium dissolved in 1 qrt. of water. Add very slowly ½ pt. strong sulphuric acid, stirring the mixture slowly with a glass rod all the while. When the mixture is cool, pour it into a glass battery jar and add 1 oz. bi-sulphate of mercury, which will amalgamate the zinc cylinder and keep it amalgamated. The solution should be

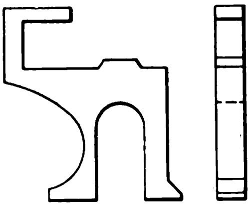


FIG. 6.

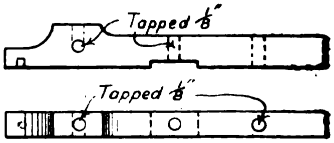


FIG. 4.

DETAILS OF TELEGRAPH KEY AND SOUNDER.

sufficient in quantity to extend up the zinc cylinder for three-fourths of its height. When not in use, take the cylinder out of the solution. If while working with the batteries any of the acid or the solution should get on the hands or clothes, rinse off immediately with clean water.

Queries and Replies.

[Attention is especially directed to the first condition given below and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-handed corner of the envelope, "Query Department." No other matters but those relating to the Queries should be enclosed in the same envelope.

Queries on subjects within the scope of this journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied, wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed, and also a "Queries and Replies Coupon" cut out from the advertisement pages of the current issue. (4) Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of Replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor,* THE MODEL ENGINEER, *26-29, Poppin's Court, Fleet Street, London, E.C.]*

The following are selected from the Queries which have been replied to recently:—

[14,247] **750-watt Dynamo.** H. L. (Stoke Newington) writes: Will you kindly help me in the following matter? I am building a 750-watt (50 volts 15 amps.) dynamo, with an exactly similar armature as that described by Messrs. F. L. and F. P. Spicer in their prize design of February 5th and 12th, 1903, but wish to construct a shunt-wound bi-polar dynamo only, with fields built up of steel forgings as enclosed print, which I believe is known as Kapp type pattern. Will you please give dimensions of field-magnets to get the above output, with an armature 5½ ins. long by 4½ ins. diameter? I presume the same gauge wire (18 B.W.G.) for armature, and No. 22 for fields, will be correct, as in Mr. Spicer's design? All windings for armatures shown in your book, "Small Dynamos and Motors," are even number sections. Will you please advise winding for 25-slot armature in twenty-five sections for above bi-polar machine?

The winding arranged for the armature designed by Mr. Spicer is not suitable for a two-pole machine. You should take twenty-four slots or some even number. If you intend to use former wound coils, the shape will be quite different. They will be of similar shape to those described in THE MODEL ENGINEER for May 26th, 1904, page 494. The former will require to be shaped to suit the proportions of your armature. If you have already made your armature core with 25 slots, then you must leave one slot empty and wind 24 coils into 24 slots; fill up the empty slots with any insulating substance, such as vulcanised fibre. You will find rules for calculating size of magnet and windings given in our handbook, "The A B C of Dynamo Design," price 1s. 2d. post free. We shall be pleased to criticise your design. For a dimensioned sketch and information as to windings, we must refer you to our Expert Service Department, where a fees will be charged depending upon the amount of information asked for.

[14,280] **Electrical Engineering as a Profession.** F. A. H. (Eastbourne) writes: I shall value your advice on following:—I have been in trade with my father for eight years as carpenter and staircase builder, and am, of course, getting top pay, but have never set my mind to carpentry or any woodwork. Ever since I can remember I have always had an inclination for electricity, and that, coupled with the future uncertainty of my present trade, has decided me to go right in for that work which I know I can put my mind on—that is, electrical engineering. Now, how do you advise me to prepare myself for the calling, which I am too old to apprentice myself to, being 23, and at the same time to earn my living? I cannot leave my job until I am sufficiently advanced to command at least living pay in the electric line. Do you advise a course of about three years of "Engineering Taught by Correspondence," or do you think that would be waste of time and money? If you think above reliable, please let me know which are the better instructors—the English or American? I shall appreciate any practical information or suggestions you may forward that will tend to help me out of my present difficulties.

We must warn you that electrical engineering is a crowded business, and that rates of pay are low, though there is room for first-class men, and an extending field. Whilst theory plays a very important part, practical training is also of great importance, and your chance of obtaining employment would be much better if you could obtain some practical experience in the handling of electrical machinery, and in testing and measurement. It would appear, therefore, that your plan should be to obtain employment at your present trade in a large town possessing technical institutions, such as London, Birmingham, Manchester or Glasgow, and to devote yourself to evening work in the class-rooms and laboratories of a technical institution for, say, three winters, and then to try and obtain some post with a small electrical firm where for a very small rate of pay or none at all at first you could get some experience in practical work. Your trade in woodworking should help you in this; then after a time you may succeed in getting a footing with some large electrical concern. You could contemplate the prospect of going abroad on the chance of getting electrical employment in a mill or mine, as in out-of-the-way places there is less prejudice, and a man is judged by what he can do instead of, as here, "What have you done?" You could rely upon your present trade as well to get a living in the meantime, if nothing electrical turns up. We doubt if correspondence tuition would be sufficient in your case; you want some laboratory work as well. We advise you to look at things from a somewhat humble point of view, and not to have visions of a responsible position with high salary in the very near future, but to be prepared for a long and plodding career for some considerable time. Electrical engineering is not all brilliant experimenting; there is a great deal of digging trenches, oiling bearings, and file and hammer work as well, and some brain-wracking worry; but there is also a tendency to specialisation—that is, a man becomes a central station engineer, a telegraph or telephone engineer, and so on, and new and special work occurs from time to time where the operatives must be trained, in which case, if you have a fair working knowledge of electricity, your chance is as good as anybody else has at the start. If you cannot leave your present address, then you must make the best of correspondence tuition, and do as much practical work as you can at home. As to which correspondence institute you should join, we can only advise you to get and study the various prospectuses, and see which you prefer. We shall be pleased to advise you further on this point if we can.

[14,258] **Electrical Recording Instrument; Armature Winding.** H. A. W. (Kenley) writes: I should esteem it a great favour if you could inform me where I can obtain an instrument to count a series of electrical impulses—*i.e.*, every occasion on which a circuit is closed, the *total* number of such to be shown on a dial or stamped on a tape, preferably the latter. Speed about 300 to 400 per min.; voltage on circuit, 2 to 4 volts; amps., ·25 to ·5. Is it possible to wind a 16-slot drum armature for an 8-section commutator? If so, should two slots on each side be wound together as one coil? The machine is a Kapp dynamo, 50 volts 6 amps.

(1) Perhaps a "Morse" tape telegraph instrument would suit you. In this apparatus a paper tape is passed by clockwork under an electro-magnetic ink marker; every impulse would be shown by a dot on the tape in ink. An inexpensive pattern of this apparatus can be obtained from Messrs. John J. Griffin & Sons, Ltd., 26, Sardinia Street, Lincoln's Inn Fields, London. Of course, this would require an additional mechanism to indicate the totals. Perhaps the makers could add this for you, or you could arrange your contact-making device to complete the circuit through the Morse apparatus at every 500th impulse, or according to your requirements. For further information we must refer you to our Expert Service Department, through which a fee would be charged according to the extent of the information required. Mr. A. Cole, of 111, Clapham Park Road, London, S.W., would, perhaps, design and make an apparatus to meet your wants. (2) A 16-slot armature core will exactly take eight coils if one coil only is wound into a slot because every coil must go into two slots. You will find the system of winding shown in Fig. 42, page 34, of our handbook on "Small Dynamos and Motors," in which four coils are wound into an 8-slot core.

[14,261] **Small Motor for Driving a Fan.** C. C. C. (Leicester) writes: During the hot weather I should like to cool my bedroom with a small electric fan, to be driven from the Corporation supply, which is 100 volts, and to take the smallest amount of current possible. I have read one or two books but cannot find anything so small to run off 100 volts, and should be much obliged if you would help me by giving the proper dimensions. I notice in a recent *M.E. & E.* an article on "Three Easily-made Electro Motors," but as I want it to run off the main supply I don't think they would do. I intend to arrange it to work a quarter of an hour in every hour by a clock-controlled switch.

The small electric motors referred to would not be suitable. A design which would answer your purpose is described in THE MODEL ENGINEER for January 8th, 1903, reply to Query No. 6,953, pages 45 and 46. The windings given will probably be about correct. Such a motor would drive a 9-in. diameter fan very well, taking about as much current as a 32-c.p. lamp. It is necessary, for you to make a motor which is suitable for working with alternating current, and which has a proper drum or ring armature, and is also well-made and insulated. It is necessary for the field-magnet to be built up with soft iron stampings in the same way as the armature core. The watts consumed by the motor will be considerably less than the figure obtained by multiplying the amps. taken by the pressure in volts, as the two are not exactly in phase; probably the equivalent of a 16 c.-p. lamp in consumption of energy should be about the amount, or even less.

[14,259] **Electric Light Wiring, &c.** F. W. C. B. (Oxford) writes: I must thank you for your replies to my last queries. They have helped me considerably. (1) I am going to fit up our house with electric light. We have got gas pipes laid under the floors and to the walls, but the brackets and meter have been taken away. I want to know if I can utilise these pipes to carry the wires to the electric brackets, which I shall fit to the walls close to the pipes. Is there any difficulty in doing this? I have

got your handbooks on the subject. By doing this I shall save buying a quantity of casing. (2) I propose using accumulators to start with, and then use a dynamo. I should like to know what kind of lead to buy for making the plates. Can I get it at any ironmonger's? Would scrap lead, such as is used for roofs, etc., do? Also sheet copper for charging cells? Is zinc easy to melt? Can it be melted in an ordinary fire? Will perforated zinc or scrap from any ironmonger do for the charging gravity cell? (3) Please tell me how fires are caused through a defect in the installation. I am very anxious that there shall be no chance of a fire or fusing of wires. I shall use ten 2-volt accumulators of about 60 amps. hours capacity. This, I think, means that I shall get 1 amp. for sixty hours, two for thirty hours, or ten for six hours, and so on. Am I right in thinking that the amps. I take from the accumulators are governed by the lamp I am using? For instance, I use a 20-volt lamp taking 1 amp., not more than 1 amp. can be taken from the accumulator, and consequently the wire connecting lamp to accumulator must be of such a gauge as to safely carry the number of amps. the lamps are taking. If I put two lamps together, I suppose I take 2 amps. from accumulator, and that the wire will have to carry 2 amps. and so on in comparison? (4) I enclose a sample of wire (black) I intend using for the purpose. What gauge is it? Is it suitable for my purpose? I shall not use more than two lamps H.E. at once from one wire—that is, in one room. Will this wire safely carry 20 volts 3½ amps.? (5) When you speak of a 60-volt 16-c.p. lamp and a 100-volt 16-c.p. lamp, or a 200-volt 16-c.p. lamp, what is the difference between these three as regards the length and gauge of filament? What amps. do each require? Can you obtain any voltage lamp for 8 or 16-c.p.? What candle-power can you get for 20 volts? (6) *Re* fuses. I read there are always fuse wires in ceiling roses. Does this wire fuse when an excess of current is passing through wires from dynamo to rose, or from rose to lamp? Should there be fuse wires in brackets? (7) Is there any difficulty in nailing casing to ceilings? Does it have to be nailed to joists or anywhere to the ceiling? Is there any danger when a ceiling has a number of cracks all over it? (8) Is there any danger whether wires are carried in iron or lead gas pipes? (9) How are ring armatures mounted on armature spindle? (10) Please tell me what enclosed wire (white and green) is suitable for, and what gauge? (11) When you speak of a certain wire carrying 3 amps., does it matter whether it is 10 volts 3 amps. or 100 volts 3 amps.? Will the same wire carry either? Shall I have to obtain the permission of the landlord if I instal the light through the pipes? There is no written agreement. (12) Please show me how the wires are carried.

(1) Yes, the pipes can be used as conduits for the wires; you must be very careful not to scrape off the insulation from the wires when drawing them into the pipes. (2) Lead should be of best quality obtainable, preferably from a lead merchant. We do not advise you to use scrap lead. Sheet copper can be obtained from Bertrand Garside, Golborne Street, Warrington. Zinc melts easily, almost as readily as lead; it is necessary to use care, as it catches fire and burns with a green flame, producing white oxide of zinc. The best way is to melt it in a fireclay crucible with a lid. It is advisable to procure the zinc for battery from a dealer in electrical supplies. You can try any scrap piece, and hope that it is fairly pure. (3) Fires are caused by an arc starting between two bare wires which have come into contact through stripped insulation, or defects in the covering, or mechanical rough usage. There is little risk when the wires are run in iron piping. Your other remarks are correct, except that there is a maximum rate of discharge beyond which the accumulator should not be worked. See our handbook on "Small Accumulators." (4) The black covered wire could be used for a pressure of 20 volts. It is No. 20 gauge, and will carry a current of 2½ amps. safely. (5) The filament is made longer the higher the voltage, but not in any definite proportion. You can reckon to take the following figures as a guide, but the amount of current varies according to the efficiency of the lamp: 60 volts, ·9 amp.; 100 volts, ·56 amp.; 200 volts, ·28 amp.; 16-c.p. lamps are not made, as a rule, below 30 volts; 8-c.p. lamps can be obtained as low as 15 volts. (6) Yes; for information on fuses, see our one shilling handbook on "Private House Electric Lighting." (9) See MODEL ENGINEER for June 2nd, 1904, page 510. (10) Green wire would do for electric bell or telephone work; is No. 20 gauge. (11) Yes; size of wire is not affected by the voltage. As far as we are aware the permission of the landlord would not be necessary; it would be advisable to acquaint the Fire Insurance Company if the house is insured, though with so small an installation and low a pressure the risk is practically nothing, but it is just as well to keep on the safe side of the policy. (12) See our handbook.

[14,260] **Motor for Small Electric Car.** L. C. (Brondesbury) writes: I am going to make a small electric motor car to have in the garden. Will you please answer the following questions? I am making the car oblong. (1) I want it to go a fairly fast walking pace. What motor should I need, and at what voltage? What price if I got it new? I should advertise for one cheap if the new one is too dear. (2) Must I have one or two motors? I should like one best (reversible). (3) How many accumulators to last for five hours, and at what voltage should I want them altogether? (4) What sort of wheels should I have? I want them with solid tyres. I have never built anything before like this. I have got a good idea of things from your MODEL ENGINEER.

(1) Any pattern of motor, but preferably one having a wrought iron field-magnet. Get one of about 150 watts size, wound to take 12 volts 8 amps. at 1,500 revolutions per minute approximately. For price apply to one of the firms advertising electrical goods in THE MODEL ENGINEER, or see the "Sale and Exchange" columns. (2) One motor will do; it should be series wound, not shunt wound. See our handbook No. 14. (3) Six accumulator cells in series to give 12 volts; cells to be of 30 amps.-hour capacity; size about 9 ins. by 6 ins. by 30 ins. total space; total weight about 70 lbs. (4) Wheels of bicycle pattern, with large solid or pneumatic tyres, about 24 ins. diameter; the motor to be geared to the driving axle by any convenient form of gearing in the ratio of twenty-five revolutions of the motor armature to one revolution of the wheels. It is necessary to have a differential gear between the driving wheels if more than one wheel is to be driven. An old tricycle axle would do for this. If you cannot arrange for a differential gear, then the motor should drive one wheel only, and the other on the same axle allowed to run loose. The object of this is to allow the wheels to run at different speeds when turning corners or running on a curve.

[14,275] **Cells for Running Small Motor.** F. B. writes: I have a dynamo which gives an output of 20 volts 2 amps., and which also runs very well as a motor. It is same type as Fig. 8, page 18, in your sixpenny handbook on "Small Dynamos and Motors," and has Siemens' H-armature wound with 4 ozs. No. 20 D.C.C. wire, and magnets 1 lb. No. 22 D.C.C. wire. I want to run it as a motor (with a fan fixed on end of shaft) from a battery. Would you be so kind as to answer me the following questions:—(1) Which is best and cheapest form of cell to make: Fuller, bichromate, or Bunsen? (2) If Fuller, state percentage of sulphuric acid to water in porous jar (not mentioned in handbook, page 24). (3) If Bunsen cell, state percentage of nitric acid to water in porous cell (given in book as strong nitric acid, page 48). (4) State size of cell and of plates, and also how long will the one you choose run the motor at a stretch, and how long must it rest before it will give maximum current again so as to run at intervals? (5) How long will battery fluid last (*a*) when in use as stated, (*b*) when left idle? (6) Is fresh fluid to be used when run down, or may crystals or acid be added? (7) Which is best way to clean zinc plates that came from Leclanché cells and are covered with crystals? (8) Can zinc plates be used until they almost fall to pieces, or does the action of the chemical so act as to make them useless when only a few pits are eaten in, and can carbons be used over and over again, as they do not eat away? (9) Could agglomerate blocks that have been used for two years in Leclanché cells be used again, crushed for dry cells? (10) What size fan shall I make for my motor, and how many blades? I should be much obliged if you would answer these questions, and many thanks for the promptness with which questions have been answered in the past.

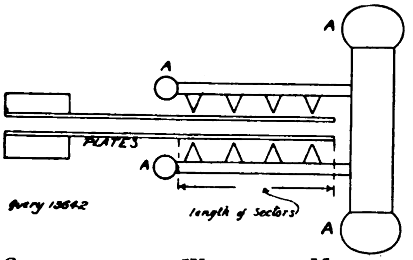
(1) All much about the same; perhaps the simple form of bichromate cell, but we recommend the Fuller pattern or the non-polarising bichromate, described in Chapter IV of our handbook No. 5; this is practically a Fuller cell. (2) One part acid to ten parts water approximately. (3) We do not advise a Bunsen battery, as it gives off fumes. (4 and 5) Make your battery plates and cells as large as you can afford; the larger they are the better. The cells will only partially recover when resting. As soon as you approach the limit of the solution, the voltage and current will drop and gradually die away, when new solutions must be put in. You must find out length of time by experience. (6) New solutions are usually required, though you should also try the effect of adding both acid and crystals until you find by experience the best way to manage your battery. (7) Scrape the crystals off and wash the zincs clean, then re-amalgamate them with mercury. (8) Carbons can be used indefinitely; it is the zinc which is consumed; it can be used so long as there is any of it left. (9) Not worth trying; the compound is probably exhausted. (10) About 9 ins. diameter; four blades will do; use a fine pitch, and allow the motor to run fast, say—1,500 revolutions per minute. We advise you to connect the field coils of machine in series with the armature to economise the current, as the present winding is of rather a high resistance comparatively. You should either rewind the magnet with, say, No. 18 gauge wire, or connect the present winding in parallel, in order to reduce the total resistance. A shuttle armature is more suited to a series than a shunt-winding when used as a motor. Shift the brushes until you get best results.

[14,301] **Construction of Small Overtype Dynamo.** R. G. R. (Thornaby-on-Tees) writes: I am making a small two-pole overtype dynamo for 35 volts 6 amps., 2,600 revolutions, of the following dimensions:—Armature is 5 ins. long by 3 ins. diameter. It is built up of 140 laminations of twenty-four cog drum type; each slot is 0·5 in. by 0·125 in.; each lamination is separated with paper and varnished each side. I am wiring the armature as Fig. 47 in your MODEL ENGINEER Series No. 10, a 24-part for a 12-part commutator, and as I have made a mistake in not allowing enough winding space between the armature end and commutator, I can only get twelve conductors in each slot, or 44 yds., which equals 1 lb. of 18 S.W.G. D.C.C., instead of sixteen conductors or 64 yds., which equals 1·5 lbs. of 18 S.W.G., D.C.C. Will this make much difference to the working of the machine if I run at a higher speed? The field-magnet is of soft cast iron, wound with 5.5 lbs. of No. 20 S.W.G., D.C.C.; the diameter of yoke is

2·375 ins. by 3·25 ins. Are the dimensions right? The armature is running within 0·0625 in. of the pole faces.

With a lesser number of conductors in the slots it simply means that you will be obliged to run at higher speed to obtain the required voltage in proportion to the difference between the numbers of the conductors, that is, half the number of conductors double the speed and so on. We advise you to try the machine and see what voltage it gives at about 2,400 revolutions per minute. You may get 35 volts or near it if the iron is good; if not, the best thing to do is to decrease the gap between the armature and pole faces as much as practicable, and try again. If the core dimensions are equal or near to the yoke dimensions, the machine should do very well. We should prefer to use No. 22 gauge wire for the field coils if you intend to work at 35 volts, as being more economical as regards current. You could use No. 20 gauge wire for the armature, and get a few more turns in if necessary. It will carry the current quite safely.

[13,642] **Four-plate Wimshurst Machine.** H. S. (Devonport) writes: I want to build a four-plate Wimshurst machine. Having read Mr. Tole's description in your issue of November 17th, 1904; Mr. Percy Bown's description of February 9th, 1905; and replies to queries at various periods, I am at a loss to decide upon



COLLECTORS FOR WIMSHURST MACHINE.

the following points, and would be grateful to have your advice. (1) Presuming that glass plates are better than ebonite, how are they fixed to spindle? They can be bought with central hole, but if screw holes are also provided, would this be a satisfactory attachment? (2) What cementing material could be used to fix thin sheet tin sectors to glass or ebonite? (3) Should the collectors be of pointed brass, as per Mr. Tole, or of flexible brushes, as per Mr. Bown? If the latter, should the brushes touch the sectors? (4) Would the arrangement of supports to collector arms shown on tracing herewith be suitable? Two glass supports as shown seem to give greater rigidity than a tube through the neck of one bottle. I propose the condenser to form one of each pair of supports, and to consist of a glass tube, 1¼ ins. outside diameter. Is there any objection to plaster-of-Paris 1 in. deep at bottom of tube, then 2 ins. of small shot on top of same? I propose the outer coating to be of tinfoil, 2 ins. high, with a narrow band of brass at the bottom to form a finish, and also for attachment of terminals. I propose to insert the discharger rod in the tops of the ⅞ in. diameter tubes.

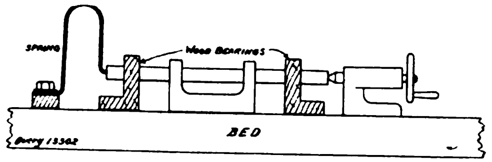
(1) Refer to THE MODEL ENGINEER of January 7th, 1904, page 23, for method of fixing plates. It is a good plan to use a washer of very thin sheet rubber between each side of the plate and the boss and clamping ring. (2) Shellac varnish. (3) The collectors must be points which are very near to and point towards the tinfoil sectors, but do not touch them; it is not usual to have only a single point as shown in your drawing, and also by Mr. Tole, but to have several, as per sketch herewith. Mr. Tole, however, seems to be satisfied with his results. It is important to avoid all points, except where the electricity is collected, so as to minimise leakage; hence the knobs A A. Brushes must be used on the neutralising rods; they should be of tinsel brass, so as to very gently brush against the sectors. Mr. Tole has omitted the collectors in his side elevation drawing. What he shows are the neutralising rods; his collectors are shown in Fig. 5. (4) Your arrangement will do very well, but the glass tubes for Leyden jars should have a glass bottom, so as to form a complete glass jar. You can try different capacities of jar by varying the height of the inner and outer coatings; the capacity will effect the character and rapidity of the spark.

[14,291] **Alloy; Charging Cells; Dynamo Windings.** W. A. G. writes: (1) Could you give me a recipe of an alloy suitable for making commutator bars of small dynamos? (2) In THE MODEL ENGINEER handbook No. 1, page 34, there is a diagram for connecting up cells to charge them in parallel. In several answers to queries in THE MODEL ENGINEER lately I have noticed it is considered not good practice to do so, and that the cells should be charged in series. I have been charging a small 4-volt pocket accumulator in parallel with two Leclanché batteries several times. In what way will it affect the cells? (3) Kindly give windings for the dynamo described in "The A B C of Dynamo Design" for an output of 15 volts 2 amps. The armature will be wound as Fig. 10. (4) Please explain the meaning of an accumulator gassing? (5) I have cracked an ebonite cell; the crack is about ½ in. long. How can I repair same? The cell is fitted with a wooden lid cemented in. I have tried filling up crack with cement, but the acid works through in time.

(1) The best material is rolled copper; next cast copper or gunmetal containing a large proportion of copper; either of the last two can be obtained from any good brass foundry. A very smal proportion of silver in the copper assists in ensuring soundness. When copper is cast it has a tendency to contain air holes. (2) We cannot understand why you should try to charge Leclanché batteries; they are not accumulators. If the back E.M.F. and resistance of the Leclanché cells were approximately the same as that of the accumulator, it should receive its share of the current. When accumulators are charged in parallel it is necessary to watch that each set not only receives its proper current, but does not discharge into the other cells; therefore, always charge in series if you can. (3) The winding for 15 volts 2 amps. is given in Chapter VI of "A B C of Dynamo Design," this being the output selected in the example as worked out. No. 24 D.S.C. is given as the armature winding, and No. 22 S.C.C. for the field-magnet. We should be inclined, however, to use No. 23 gauge. Get on as much as you can for both armature and field; about ½ lb. for armature and 1 lb. for field-magnet will be approximate weight. (4) When an accumulator is being charged and reaches the fully charged condition, the liquid becomes filled with small bubbles of gas, so much so that it has a milky appearance, and spits acid at the surface as if boiling; this condition is called gassing. It does not hurt an accumulator to continue charging when this gassing is going on; it rather improves it. (5) Ebonite is difficult stuff to deal with. Try marine glue or pitch. The usual remedy is a new cell.

[13,302] **Fitting New Bearings to Lathe.** W. H. C. (Dee Banks) writes: I have been presented with a second-hand lathe, which has seen a good deal of service. It is a screw-cutting lathe of American pattern, with raised vees on straight bed, 4½-in. centres mandrel runs in split parallel bearings, and here there is a great deal of play, so that accurate work seems impossible. The headstock has been raised at some time by inserting strips about ⅛ in. thick on top of vees, apparently to bring up centre to correct height after brasses had worn. I have filed the brasses a little, but this has only partially mended matters, as the caps are now hard down, and I do not care to touch them. Any hints which you may be able to give me with regard to the best way of going about the job would be very welcome. I may say that I am quite a beginner at lathe work, and the only way I have thought of is to obtain a boring bar, made a good fit to the tailstock, and with this to carefully bore out the brasses (after having been filled with white metal) in position, working the bar by hand; but I do not feel at all sure that this is practicable.

Having filled your brasses, place headstock in centre of bed and rig up a pair of strong wood standards each side of it as bearings to carry the boring bar; set the bar accurately to height and alignment by testing its centres with the poppet head centre placed first one side and then on the other; rig up a temporary pulley on the boring bar so as to get a very slow motion, and feed bar through by means of the poppet head; a spring should be fitted



FITTING NEW BEARINGS TO LATHE.

at other end of bar to press the centre against poppet centre (see sketch). As travel will be limited, you can bore the bearings one at a time. You could adopt the plan of accurately supporting the mandrel in position and casting the white metal round it whilst it is in place, pouring it through holes in the top brasses. If you do this the bearing brasses and mandrel should be nicely warmed, to prevent chilling of the metal. The mandrel can be accurately centred by the help of the poppet head centre, and be held in place by wood supports clamped to the bed.

The News of the Trade.

Lincoln Industrial Exhibition.

An Art and Industrial Exhibition will be held at Lincoln from August 22nd to 25th inclusive, and prizes, open to competitors residing anywhere in the United Kingdom, to the value of £98 will be awarded for models of machinery, examples of ironwork, woodwork, carving, painting, and photography. The last date for entries is August 1st, and full particulars may be obtained from Mr. R. A. MacBrair, Hon. Sec., Corporation Offices, Lincoln.

The Editor's Page.

OWING to the large number of entries received during the last few days of the month for the "Gauge" Competition, which has just closed, it has not been possible to adjudge them with the despatch we should have liked. We hope, however, to be able to send prizes to all successful competitors within a few days of the issue of this number.

* * *

In connection with the article on page 578 of our last volume, describing a self-acting feed for a hand planer, the Liverpool Castings Company write us that the attachment illustrated is identical with that fitted to their medium size planing machines, as made for them by Messrs. Shaw Bros., and they take exception to its being described by our contributor without any acknowledgment of its origin being made. The writer of the article, in reply to a letter from us, states that he has seen several feeds similar to the one described, and that as he had built a planing machine fitted with this device, the article sent was intended merely to describe a piece of amateur work, and not with the idea of claiming any originality for the design. We think the Liverpool Castings Company are entitled to the acknowledgment which they claim, and we would ask other readers who may at any time send in descriptions of work they have done to make it quite clear as to whether the design described is original or not.

Answers to Correspondents.

F. B. (Bradford).—Yes, all the back numbers for 1904 are in print. They can be supplied post free 3d. each.

J. C. (Hull).—You will probably find a tool-holder more convenient and economical for a small lathe than solid forged tools. There are several good patterns on the market; see the lists issued by those of our advertisers who supply tools.

F. H. T. (Edinburgh).—The address of the Institution of Mechanical Engineers is Storey's Gate, St. James's Park, London, S.W.

H. C. (London, S.W.).—You will find a fine collection of marine engine models at the Victoria and Albert Museum, South Kensington; many of them are shown in motion.

K. L. (Sheffield).—Full particulars of windings for various outputs are given in our sixpenny handbook, "Small Dynamos and Motors."

E. F. C. (Brixton).—The Allan Company's two new boats are the first turbine ocean liners, though several smaller passenger boats have been running for some time on river and short sea passages.

L. N. (Clapham).—We thank you for the recipe, which we will use in an early issue.

C. H. R. (Prescot).—We thank you for your letter and plan for a model railway. You do not include sufficient practical data to warrant publication.

A. H. G. (Ealing).—We would advise you to purchase "The Compound Engine," by W. J. Tennant, A.M.I.Mech.E., price 2s. 6d. net, or 2s. 9d. post free from this office. This will enable you to clear up your difficulties.

L. S. (Wimbledon).—Many of the fine iron castings now obtainable are machine moulded. You will find malleable iron and cast steel very useful materials in the construction of small power engines, and, if you are likely to duplicate your engines, a cheaper method than forging the parts. Patterns for cast steel should not be very intricate.

Notices.

The Editor invites correspondence and original contributions on all amateur mechanical and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected or not, and all MSS. should be accompanied by a stamped addressed envelope for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

This journal will be sent post free to any address for 13s. per annum, payable in advance. Remittances should be made by Postal Order.

Advertisement rates may be had on application to the Advertisement Manager.

How to Address Letters.

All correspondence relating to the literary portion of the paper, and all new apparatus and price lists, &c., for review, to be addressed to The Editor, "The Model Engineer," 26—29, Poppin's Court Fleet Street, London, E.C.

All correspondence relating to advertisements and deposits to be addressed to The Advertisement Manager, "The Model Engineer," 26—29, Poppin's Court, Fleet Street, London, E.C.

All subscriptions and correspondence relating to sales of the paper and books to be addressed to Percival Marshall & Co., 26—29, Poppin's Court, Fleet Street, London, E.C.

Sole Agents for United States, Canada, and Mexico: Spon and Chamberlain, 123, Liberty Street, New York, U.S.A., to whom all subscriptions from these countries should be addressed.

Contents.

[*The asterisk* (*) *denotes that this subject is illustrated.*]

THE

Model Engineer

And Electrician.

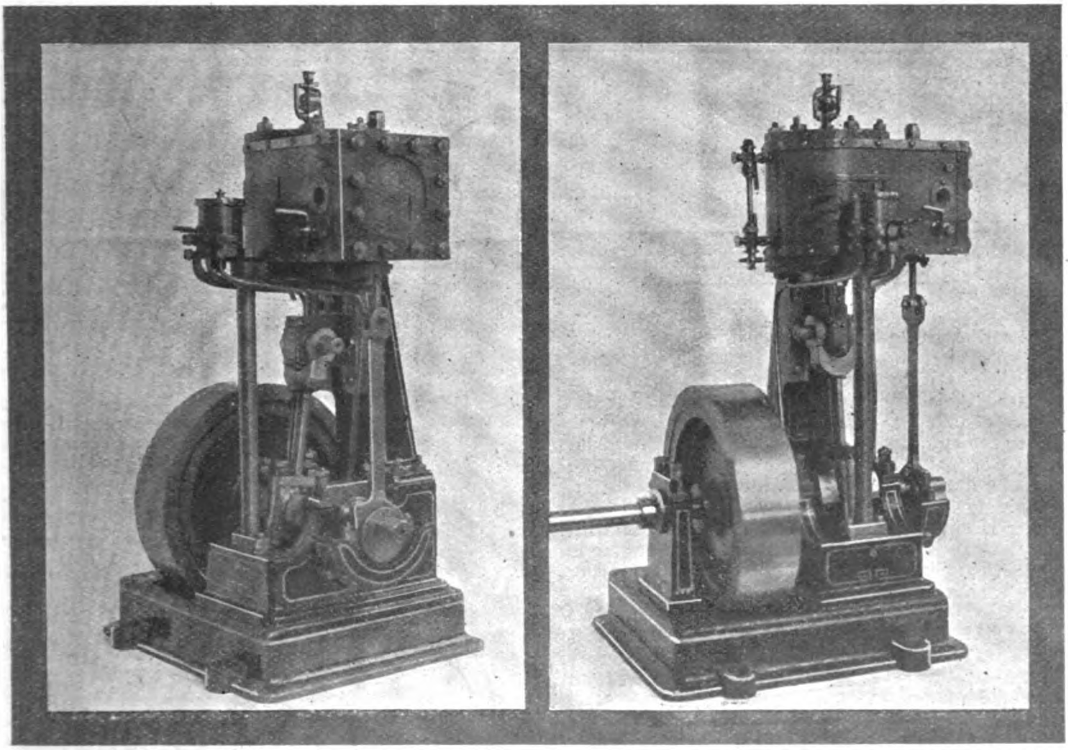
A JOURNAL OF PRACTICAL MECHANICS AND ELECTRICITY.

EDITED BY PERCIVAL MARSHALL, A.I.MECH.E.

VOL. XIII. No. 221. JULY 20, 1905. PUBLISHED WEEKLY.

A Model High-Speed Vertical Engine.

By S. P. LOWE.



MR. S. P. LOWE'S MODEL HIGH-SPEED VERTICAL ENGINE.

THE accompanying photographs illustrate a model high-speed engine which I have made in my spare time from a set of castings which I bought from one of the former advertisers in this journal. The cylinder is 2 ins. bore by $1\frac{1}{2}$ ins. stroke, and is bored out, in accordance with the best practice, so that the working surface of the cylinder is just equal to the stroke of the piston, thus preventing any ridge being formed.

The engine is very massive throughout, and is designed for hard work, running very quietly at high speeds.

The piston-rod and crosshead are machined up from one mild steel forging, the latter being fitted with split brasses to take up wear. The piston is of cast iron, fitted with two cast-iron rings machined throughout. The connecting-rod is a mild steel forging, the big end being fitted with split brasses for wear.

The crank is machined up from a steel casting. The main bearings are of gunmetal, and are fitted into journals previously milled out in the bedplate. The bearing surface is very long, thus ensuring easy running and durability.

All the bolts on the bearings and on the big end of the connecting-rod are fitted with lock nuts.

The flywheel is 5 ins. diameter, of cast iron, keyed to the shaft. The shaft is extended outside the end bearing to permit of a pulley being fitted if necessary.

The cylinder is supported by a turned steel column and the main frame, the latter forming the bottom cover of the cylinder. A splash guard is fitted underneath the eccentric to catch any oil. The oil box seen in the photograph lubricates the main bearings, the slide and the crosshead, and is fitted with drip taps to each pipe. The outside bearing is fitted with an oil cup. The cylinder is lubricated by a two-cock lubricator placed on the top cover. A two-cock blow-off drainer is also fitted to the cylinder, and a blow-off tap to the steam chest. The valve spindle is prolonged through the steam chest to the gunmetal guide above the latter, thus giving good bearing to the spindle. The cylinder is covered with asbestos, and lagged with sheet Russian iron and brass bands. The engine is designed to give ½ h.-p. at 2000 revolutions per minute with a pressure of 60 lbs.

Unfortunately, having only a 7-in. by 14-in. steel boiler, I have never been able to really test the full capabilities of the engine, as the boiler cannot supply sufficient steam. The bedplate is of cast iron, and the whole engine weighs about 35 lbs. The engine is painted a deep chocolate and lined with silver paint, which gives it a very smart appearance.

N.E.R. Electric Trains.—The cost of working trains electrically on the North-Eastern Railway is, according to Mr. Wilson Worsdell of that line, 5·7d. per train mile; the average train, however, is only composed of 2·75 cars.

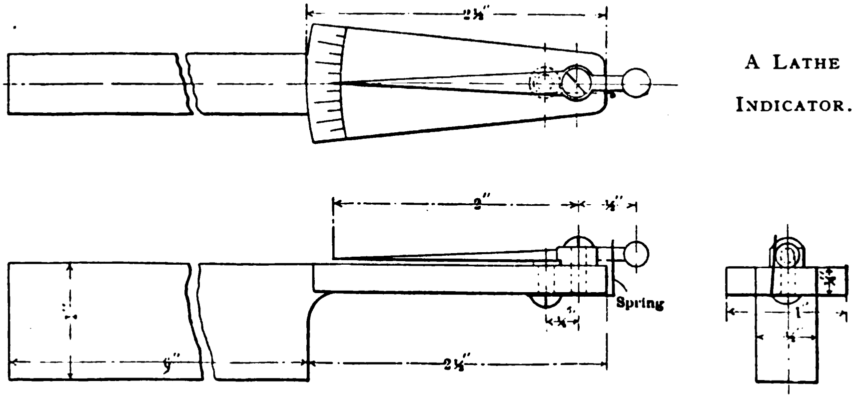
Workshop Notes and Notions.

[Readers are invited to contribute short practical items for this column, based on their own workshop experience. Accepted contributions will be paid for on publication, if desired, according to merit. All matter intended for this column should be marked "Workshop" on the envelope.]

A Lathe Indicator.

By C. S.

In order to make this indicating tool which I send a sketch of, I took a piece of ½ by 1-in. iron and got the blacksmith to forge it the shape I wanted. I then made a small pointer with a ball on the end, of tool steel, then made a spring out of a light piece of brass wire, and fixed it to rest against the pointer. This tool shows about four times the amount that the job is out, and it is very easy to set the job true.—*American Machinist.*

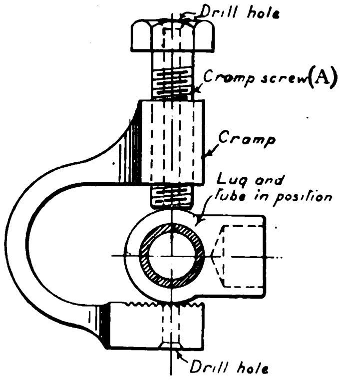


A Lathe Indicator.

A Combined Drill Jig and Cramp.

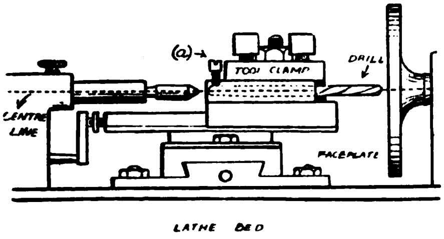
By "Sregor."

The accompanying sketches illustrate a combined drilling jig and cramp, and is particularly useful when drilling tubes, lugs, and stays, or any class of brazing work which requires drilling and pegging together before brazing. As will readily be seen, the parts can be drilled while the cramp is holding them together. It also forms a guide for the drills,



Combined Drilling Jig and Cramp.

which prevents the drill striking off the round surface of the tubing, which generally happens, unless a deep point has been previously formed with a centre punch. The latter is, of course, unnecessary when using the jig. The body of jig can be made from an ordinary malleable casting, as used for a cramp. When the screw A is fitted, a suitable hole for the work to be operated upon should be drilled through screw and bottom jaw of cramp. The



Holding Drill in Lathe.

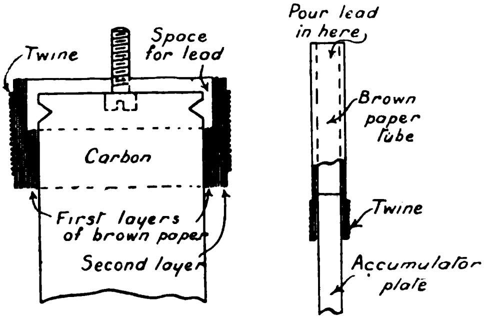
hole should be central with pin, and continued through jaw when screw is down against jaw. This enables the operator to drill a hole in the tube from each end of cramp, instead of having to use a long drill to pass through the tube. As shown in sketch, the jaw of cramp should have some rough teeth filed in to grip the parts to be operated upon and prevent the cramp slipping off the work. The cramp screw should be of fine pitch, and be a fairly tight fit in the cramp; otherwise it is advisable to fit a lock-nut on screw to prevent it slacking off when drilling.

A Useful Drill-Holder.

By A. E. Smith.

It is often required to drill holes up to about ⅜ in. in work revolving in the chuck or face-plate. Owing to the small size of the hole, the use of a boring tool is impossible, and to amateurs who are not prepared to forge their own flat drills, the following note may be of use :—

Obtain several pieces of brass or steel about 2½ ins. long and ½ in. wide, and about ¼ in. higher



Casting Lead Tops on Carbon Plates.

than the lathe centre when tightly clamped on the slide-rest.

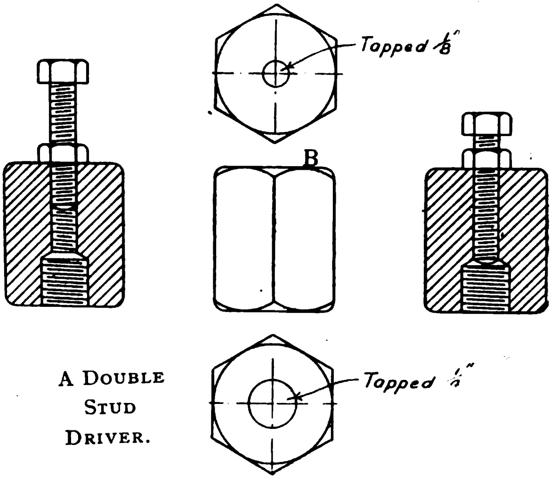
After squaring the ends, mark accurate centres, and fix tightly in the clamp, seeing that the drill is exactly opposite the punch-mark, while the back centre touches the other. This ensures that the metal is parallel with the lathe bed. Drill through with the drill it is required to hold, and fix in a set-screw (*a*).

A set of these will well repay the trouble spent upon them as they hold the drill always dead true without damaging it in any way.

Casting Lead Tops on Carbon Plates without Sand.

By "Round Square."

The following is the method I use for casting lead tops on battery carbons :—First cut a piece out of carbon plate to allow a brass, cheese-headed screw to rest in; this is for the terminal. Cut a few notches around the edges of plate to give the lead a better grip; then proceed to wrap some half-dozen turns of stout brown paper round the carbon, about ⅛ in. below screw-head, and on top of this a further wrapping of paper the depth you need the lead, the whole afterwards being firmly bound with twine. It is then ready for pouring the molten



A Double Stud Driver.

lead in the top opening; when cold, the paper can be removed. The writer has used the same method to cast lugs on accumulator plates by making a tube of brown paper on a lead pencil, and binding same to the plate. The sketch explains how this was accomplished.

A Double Stud Driver.

By J. H. P. Boldero.

Procure a piece of good hexagon steel ⅝ in. across the flats and ¾ in. long; square the ends with a file, then set out top and bottom as shown in sketch for ⅛ in. by ¼-in. tapping holes respectively. After having drilled and tapped these, procure a ¼-in. set-screw ¾ in. long, and having a locknut on it; screw this in from the top side—*i.e.*, as at B. If this fits all right, take out the screw again, and carefully harden the point to prevent it burring up; then set as shown for ⅛-in. studs, or for ¼-in. studs, as the case may be. This will be found a very handy tool.

German Coal Briquets.—The output of coal briquets in Germany in 1904 was 11,413,497 tons, which exceeded the output of 1903 by 937,297 tons, which figures show the growing importance of the briquetting industry.

A Gold-Leaf Electroscope.

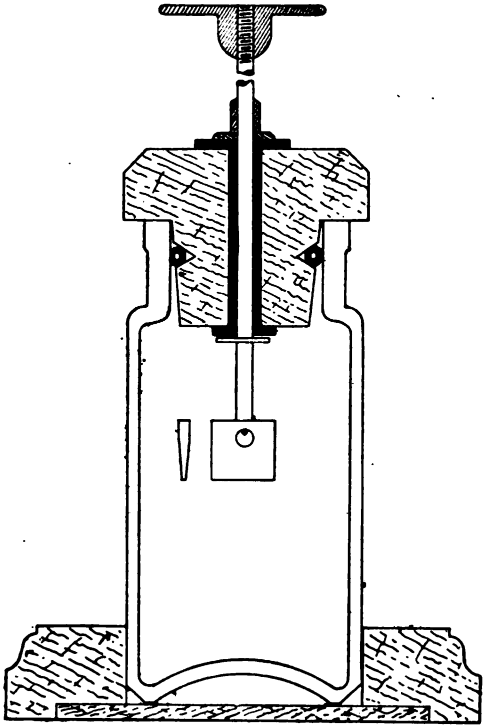
By Nathan Sharpe.

THE instrument, which is described below is one which can be made very cheaply, and it will be found to be as reliable and sensitive as any dealer's article costing a much higher price. The materials used in its construction are as follows:—A wide-mouthed, square, clear glass jam or pickle-jar, measuring about 2½ ins. by 2½ ins. by 5½ ins.; 6 ins. of 3-16ths in. brass rod; a circular disc of brass about 1½ ins. diameter, and between ⅛ in. and ¼ in. in thickness (a cylinder cover casting will do nicely); two pieces of oak—one piece about 5½ ins. square, the other 3 ins. square by 2 ins. thick; two india-rubber washers, and about a foot of black rubber tube, such as chemists sell for use with sucking bottles. Some other small items will will be required during the course of construction, but the scrap heap will supply all these.

Take the piece of oak, 5½ ins. square by about 1 in. thick, and centre it on a faceplate. In one side, cut a recess ¼ in. deep by 4 ins. broad. At the same time, reduce the square block to circular form, about 5 ins. diameter. Now reverse the work, face the other side and the edge, and turn the moulding. Now cut a disc of thin wood (cigar boxwood will do) to fit into the recess tightly. After having found the centre (of the thick piece), describe a circle equal to the largest diameter of the bottle; inside this circle, describe a square the same size as the base of the bottle, and cut out with saw, hammer and chisel. Trim up with a rasp or coarse file until the jar will fit tightly enough to enable the base to be lifted along with the air. Glue in the thin wood disc, and sandpaper and varnish. Now chuck the 3 ins. by 3 ins. by 2 ins. piece, and turn up about a half to two-thirds its thickness until it fits loosely in the neck of the jar. About half way down, turn a **V**-groove. Reverse, and turn up the upper face to about 2¾ ins. diameter, and bevel the edge. Remove it from the chuck, and bore through the centre of it a ¼ in. hole, working from the centre of both sides. Sandpaper up smooth and varnish, using good shellac varnish.

Now take in hand the 3-16ths in. rod. Chuck it in the lathe, and turndown a length of ¼ in. to 3-32nds in. and screw it. Screw the other end for about ⅝ in. the full size. After this has been done, search the scrap heap for some ⅛ in. or 3-16ths in. sheet brass, a very small piece being necessary. From this cut a piece ⅝ in. square, and another piece about ¾ in. diameter, round. Clean up the edges of the square piece, and in the middle of one edge put a centre dot. About ¼ in. directly below it, but on one of the flat sides, put another dot. Drill the latter dot with a 3-16ths in. drill, and very carefully drill a hole from the edge into it 3-32nds in. tapping size. Tap the latter hole, and screw in the reduced end of the brass rod to make sure that it will fit. Unscrew the rod, and, with a countersink bit or larger drill, remove any burr from all three openings. Now file down the brass until it is less than 1-16th in. at the side opposite the tapped hole, tapering the metal gently towards that side. Polish up smooth with emery cloth.

Take up again the piece of 3-16ths inch rod and procure a short piece of brass tubing, which will fit tightly over the rod. Cut off a piece about ½ in. long, and drive it on to the rod until the edge next the reduced end is about 3¼ ins. from the same. Pin, and sweat with soft solder, then put it in the lathe. Turn up the edge next the small end, square, but round off the other edge. Now take the round ¾-in. piece of scrap. Drill a 3-16ths in. hole through the centre, and chuck it in the lathe. Clean it up on both sides, and bevel the edge of one face. Remove it from the lathe, and slip it on to the brass rod, bevelled edge uppermost, until it butts against the square shoulder of the tube. Now slip on a rubber washer, and then the wooden top. Next to that put on the other washer, and then a thin brass washer. Press the whole well together, and mark just where the brass washer rests against the standard. Remove everything now, and drill a hole to take a brass taper pin, about 1-16th in. at its smallest part, and ¾ in. long.



A Gold-Leaf Electroscope.

Now take in hand the cylinder cover casting. This should be of as plain a type as is procurable, the one used by the writer being flat on both sides, except for a ⅜-in. central boss on one face Centre dot and drill as nearly in the centre as possible, a 3-16ths-in. tapping hole, and tap it 3-16ths in. It will be found necessary to clear through the hole with a plug tap, but any piece of steel of a suitable length, and screwed 3-16ths in. diameter, will do quite as well, the object being to make the fit of the pillar into the table such as will require no vice to enable it to be driven home. Now chuck the disc, and turn it up on both sides and edge true with the central hole. The edge must be carefully rounded off.

After the table has been turned up, the pillar should be screwed tightly into it, and secured by carefully and lightly riveting over the end. The whole should now again be chucked, and the riveting cleaned up, and the whole thoroughly polished with a soft rag, a high speed, and some globe polishing paste. Holding the polished parts in a duster, pass the various parts on to the rod in their order thus: Thick brass washer, bevelled face next table; rubber washer; now 2 ins. of rubber tubing; over this slip the varnished top; rubber washer; thin brass washer; then pin up. The brass support for the leaves should now be screwed cutting through both thicknesses. Now take up the stopper, and smear very thinly with very dilute gum arabic the square at the bottom of the stalk. Lift off the upper thickness of paper from the gold strips, and lift them by pressing down the gummed brass upon them, one side to each. Great care should be taken to have the strips square with one another, and with the brass. Trim the leaves until they are about 2 ins. long over all. It will be found advisable to place a few lumps of calcium chloride in the bottom of the jar, for the purpose of absorbing any moisture which may find its way in. Now very carefully close down the stopper tightly. The instrument should be slightly warmed to remove any external moisture before use.

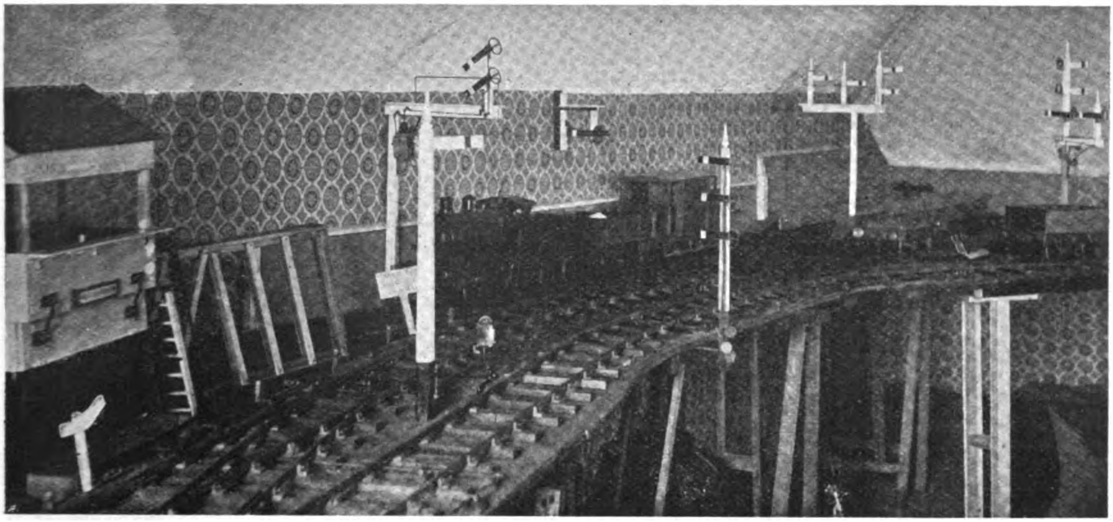


Fig. 1.—A Part of Mr. Sydney L. Solomon's Model Railway.
(*Photograph taken from the Window, see Fig. 2, page 54.*)

on. Before going any further, take the remaining rubber tubing, and lay it round the **V**-groove in the stopper, cut off any surplus, and join the ends of the packing piece with rubber solution. If it is desired to lacquer the bright brass work, it should be done now, all except the top surface of the table. When the joint has set, the tubing ring should be slipped into its groove, and when the stopper is fitted into the neck of the bottle, the rubber should press evenly on the glass all round, forming an airtight joint. We are now practically ready to attach the leaves. Having procured a book of gold-leaf, proceed to transfer a leaf to a previously folded piece of paper. This is best done by opening the book of leaf, carefully laying the paper over the gold, inverting every thing very carefully, then lift away the book, and closing down the fold over the leaf. In working with leaf, be very careful not to breathe upon it, or very likely that particular leaf will be of no more use.

Having folded down the paper, mark lightly on its upper surface three lines, each $\frac{1}{2}$ in. apart from its neighbour, in such a position that they will pass pretty well over the middle of the sheet. Now with a ruler and a very keen penknife, cut down through the paper along the marked lines,

My Model Railway.

By Sydney L. Solomon.

The railway illustrated herewith I started making about seven years ago. My brother having completed the Doris engine (which members of the Society no doubt remember having seen running on the track), we found it absolutely necessary to have a line for running the engine. I found that wooden lines were of no use for a decent model. I might here mention that I had previously made two elaborate permanent ways of wood, and they answered the purpose fairly well for the small locomotives of the tin variety.

The gauge is $3\frac{1}{4}$ ins.; the rails are made from strips of wrought iron, $\frac{3}{8}$ in. deep by $\frac{1}{8}$ in. broad; it is purchased in lengths of 6 ft. and makes a very satisfactory permanent way. The chairs are made from brass castings, cast in lengths of 9 ins., and then cut into pieces $\frac{1}{2}$ in. broad, each one drilled with three holes—one each side and one in the middle; the latter takes a metal screw which goes into the rail, this having been marked out beforehand and then drilled and tapped. The chairs are fastened to sleepers, these being spaced about 3½ ins. from centre to centre, but a little closer at points and crossings. The rail joints are supported with a chair ⅜ in. wide, with a screw in each rail. There is an immense deal of work in laying down a permanent way of this description, but it seldom gets out of order; if I were making a fresh track I should certainly use the new permanent way which is now made, but which was not obtainable when I started. The whole line is laid on a good foundation; this, I find, is an important item.

The railway is 23 ft. long, but reaches 27 ft. on the branch line. This is the limit of length I can have in the present room. There is an up and down main, a siding line which leads to the sheds, and a single branch line which divides into two after leaving the main: the whole running line amounts to about 120 ft.

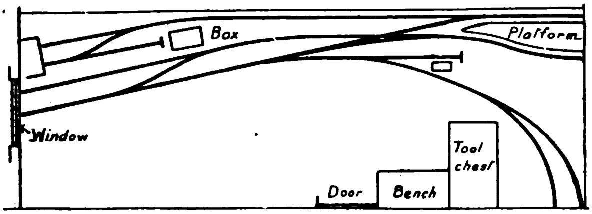


FIG. 2.—A PLAN OF MR. S. L. SOLOMON'S MODEL RAILWAY.

There are sixteen signals, nine points, and two disc signals for cross-over road. The line being divided into two sections, these are controlled from a signal-box and a ground frame; the latter can be seen in the distance. Originally it had only four levers, but these are now increased to nine. The points are connected by brass wire, ⅛ in. diameter, running in guides. There is one facing point bar and lock fitted and point detector; this has worked capitally many hundreds of times, and ensures the point being properly closed and so saves derailment. An adjusting apparatus is fitted to all the point rods as the changes in temperature affect the movement. The distant signals are all slotted; the disc signals are fitted with small oil lamps, which burn very well, but are a lot of trouble, and in the future should like to fit all with electric light. Being particularly interested in signalling, I have devoted a great amount of time to the signals and everyone is in its correct position for controlling the movements of the trains. The arms are cut from sheet brass and riveted to the spectacle plates and are mounted on brass, connections to the counter weights being made with 1-16th in. brass wire.

The rolling-stock consists of three locomotives, a small four-coupled shunting engine, a six-wheeled outside cylinder single driver engine; and the Doris, which has a single driver and a leading bogie. Then, as can be seen in the illustration, there are two wagons, one carriage truck, and a guard's van. These were built by my brother and all provided with axle springs and spring buffers, and run very smoothly.

A platform is fitted at the end of the line close to which is a turntable and a pit. The buffer stops are fitted with spring buffers. The sleepers and foundation are stained a dark brown, and the railway stands about 3 ft. from the floor.

Notes on Locomotive Practice.

By CHAS. S. LAKE.

TANK LOCOMOTIVES ON BRITISH RAILWAYS.

(*Continued from page* 10.)

PERHAPS the best example of the 0—6—2 type of locomotive to be found on a British railway is that illustrated in Fig. 23, which shows one of the most recent additions of its kind to the locomotive stock of the London, Brighton and South Coast Railway. Engines of this class are performing meritorious service on the suburban services of the line, and are not infrequently employed for hauling heavy excursion and other trains on the main line between London and Brighton, etc., at respectable rates of speed. The boiler is high pitched, and has ample heating surface, whilst the proportions of the wheels and cylinders are well calculated to produce a powerful engine, and one which may be relied upon for all round usefulness and adaptability to varying circumstances. Standard "Brighton" details are employed throughout; the cylinders have the steam chests below them, inclined in the opposite direction to themselves, and Stephenson link motion is employed. Steam sanding gear is fitted at both ends of the coupled wheels, and the equipment throughout is of a modern description. The cylinders are 18 ins. diameter by 26 stroke; coupled wheels, 5 ft. 6 ins. diameter; total heating surface, 1211·69 sq. ft.; working steam pressure, 160 lbs.; total weight (loaded), 58 tons.

The Great Eastern Railway possess a large number of small six-coupled locomotives specially designed by Mr. Holden for working the Enfield branch traffic, in which trains of seventeen coaches, equivalent (loaded) in weight to 277 tons, have to be hauled a distance of 10¾ miles in 40 minutes, with fourteen intermediate stations to call at. The first engine of the design illustrated was put to work as long ago as 1890, and the design has been adhered to in all its main features ever since. The latest additions to the class have slightly altered dimensions, and others of the same type are now being altered to bring them into line with the newer examples. The cylinders are 16½ by 22 ins.; six coupled wheels, 4 ft. diam.; total heating surface, 988·17 sq. ft.; grate area, 14·5 sq. ft.; working steam pressure, 180 lbs.; total weight (loaded), 42 tons 9 cwts.

The most powerful class of tank engine employed in suburban passenger service on the railways of this country is that illustrated in the *M.E.* for November 19th, 1903 (soon after their first appearance). They were built to the design of Mr. H. A. Ivatt, Locomotive Engineer of the Great Northern Railway, for working the heaviest suburban passenger traffic between Moorgate Street terminus and outlying stations on the company's main line in the London district. As originally designed, the engines had heavier boilers and longer side tanks, but the total weight proved too much for the track (other than that on the G.N. main line); consequently lighter boilers were fitted to the subsequent engines, and smaller side tanks, whilst the pioneer engine was altered to allow it to conform to the required restrictions of weight. The eight coupled wheels are 4 ft. 7½ ins. diameter, and are spread over a wheelbase of 17 ft. 8 ins.,

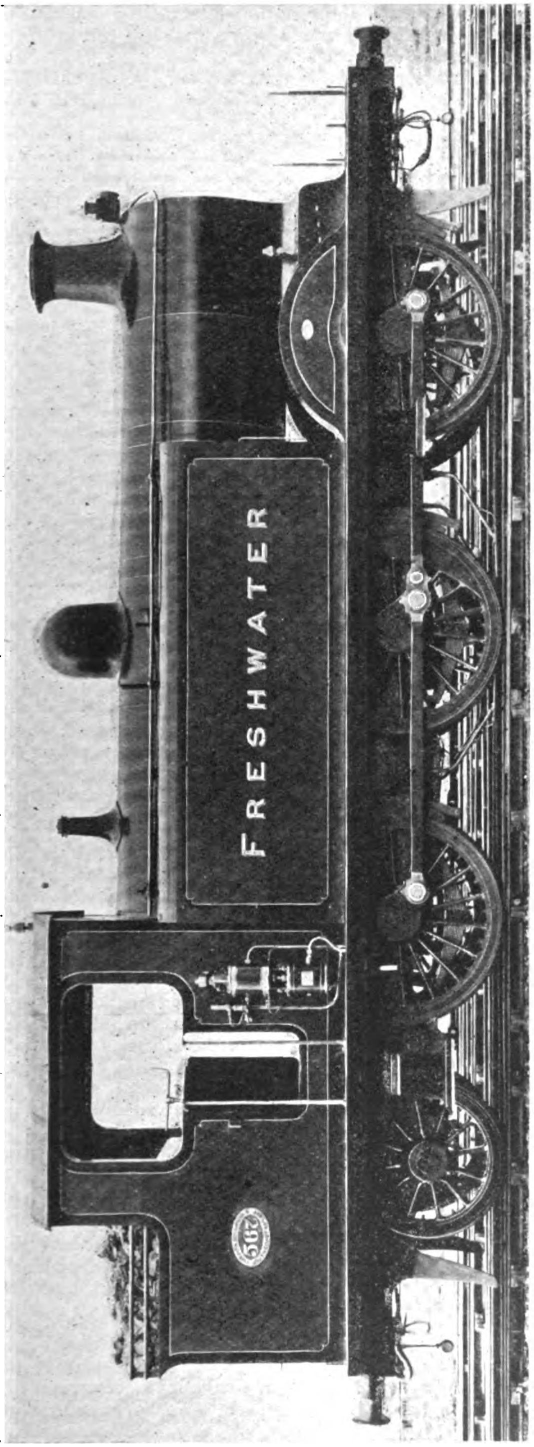


FIG. 23.—L.B. & S.C.R. SIX-COUPLED PASSENGER TANK LOCOMOTIVE.

the total wheelbase being 25 ft. 2 ins. The cylinders are inside, driving the crank axle of the second pair of wheels. The valves work above them through the medium of a rocking-shaft, the gear being of the ordinary Stephenson pattern. The engines are noted for rapid acceleration, for which, of course, they are admirably adapted, and the present total weight of 70 tons 5 cwts. is decidedly moderate under the circumstances. The cylinders are 20 by 26 ins.; coupled wheels, 4 ft. 7½ ins. diameter; total heating surface, 1043·7 sq. ft.; grate area, 17·8 sq. ft.; working pressure, 175 lbs. per sq. in; and tank capacity, 1500 gallons.

With the increasing attention now being devoted to electric traction, and the known advantages of that system of conducting local and suburban traffic, it is more than probable, of course, that tank locomotives will gradually disappear from our railways; but the process will be a slow one, and it will be many years, presumably, before any appreciable difference has been made in the methods of working local traffic. Still, it is certain that the tank engine will be the first to go, for even the most hardened enthusiast and upholder of electric traction would hardly be so foolish as to say that long-distance main line express passenger and goods traffic on railways will be dealt with by means of electric propulsion for a very long time to come. Even in the case of tank engines, the thin edge of the wedge which is to bring about their disappearance from the field of regular operations on railways has hardly yet been properly inserted; but it is, nevertheless, almost certain that we aie to see, within the next few years, a remarkable development in electrical methods in connection with railway traction in local districts.

The Latest in Engineering.

Record Airship Flight.—The celebrated Lebaudy airship recently created a new record flight. It ascended from the ground at 4.25 a.m., and continued in the air without even its guide-rope touching the ground for 3 hours 11 minutes, not coming to ground again before 7.36. It was subjected to manœuvring tests all the time, going to and fro between Moisson and Fieneuse, and repeatedly circling the clock tower at the latter place.

Locomotives and Railway Wagons in Private Grounds.—Our attention has been called to proposed regulations under the Factory and Workshop Act of 1901 for "the use of locomotives, wagons, and other rolling stock on lines of rails or sidings in any factory or workshop." These will, if carried out, render it impossible to work many narrow lines of rail for removing coke, lime, and other commodities in gasworks and factories, and as notice of objection has to be given by the 21st inst., there is no time to be lost in taking the necessary steps. The notice required to be given in the first instance is, we believe, purely formal; and the specific objections can be put into more detailed form later, when possibly a hearing will be granted. Any firm affected by the Act should communicate with Mr. Taylor, the secretary to the London Waterside Manufacturers' Association, at Messrs. Tate & Sons, 21, Mincing Lane, London, E.C.

Thermit

For Alumino-Thermic Welding.

THE two elements of most frequent occurrence on our planet are oxygen and aluminium. By producing in a suitable manner the chemical combination of these two, a temperature is created, which is about equal to that of the electric arc light. On this discovery is based the Alumino - Thermic system of welding. Which is the proper manner of combining aluminium with oxygen? By taking not the atmospheric oxygen, but the solid oxygen contained in the oxides; these are mixed with finely granulated or pulverised aluminium. The resulting mixture is the heat producer. The next aim is to produce this great heat in the simplest and most efficacious manner, and then to discover the fields on which it can be applied to most advantage.

The first important discovery in observing the properties of this mixture was that when ignited in one spot the combustion continued throughout the whole mass without any supply of heat from outside. The mass is placed in crucibles which are not in contact with any external source of heat, and the combustion, once started, embraces the whole mass in a very short time. This is the essence of alumino-thermics.

In the crucible after the reaction there are two layers. The bottom one is pure metal of equal weight to, but occupying only one-third of the space of, the top layer, which is now oxide of aluminium, so-called corundum. These two layers whilst still liquid are poured rapidly over the rim of the crucible. It is not difficult to distinguish between the slag which flows first and the brightly glittering overheated metal.

To demonstrate the heat created by this chemical reaction, a hole may be burned through a 1-in. wrought-iron plate.

It is noticed that in this case the crucible is tapped from the bottom, so as to allow the pure iron, which has a temperature of about 3000° C. (5,400° F.), to run out first. The hole is perfectly smooth-edged; the heat is so concentrated that the plate is still cold after the reaction.

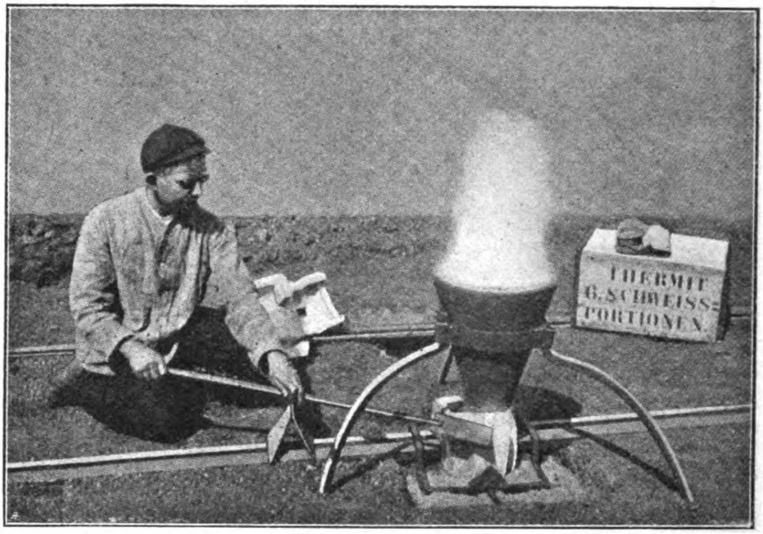


FIG. 2.—THERMIT RAIL WELDING WITHOUT CLAMPS.

FIG. 1.—WELDING A TRAMWAY RAIL WITH THERMIT, USING CLAMPS.

Nearly fifty years ago attempts were made to apply the reducing properties of aluminium. Without exception, the experimenters heated their compounds externally. The reaction was always so violent that they could only operate with very small quantities. It will easily be seen that to arrive at alumino-thermics on a commercial scale from such a starting point required patient study and assiduous work. Each of the mixtures, although made according to simple chemical rules, required studying out by itself. The formulæ for gunpowder or dynamite sound fairly simple, but it requires more than a mere mixture of the ingredients to obtain any effect sufficient for industrial requirements.

Considering the innumerable details connected with the application of so new and practically unknown a force, it is not surprising that only since about a year ago the process has been introduced on a large and commercial scale.

The most important of these welding processes is the one by which a continuous rail—a necessity of modern tramway road construction—is simply, cheaply, and effectively obtained. Engineers in America, in which no less than 25,000 miles of single track are in existence, are watching the good results obtained in Europe with this system. European authorities recognise its advantages over all its competitors, about 20,000 joints having been welded by this process since about a year ago in forty cities of the old world.

A marked advantage enjoyed by this system is the absence of any bulky equipment; all that is required is a crucible, a mould-box, and, in some instances, where a complete butt-weld of the head of the rail is desired, a rail-clamp. All these materials, including the necessary quantity of the welding compound, can easily be moved on a hand truck. Each weld, according to section, requires from 15 to 20 lbs. of the compound.

Even where a rail-clamp is used the time employed is less than that necessary for fixing fishplates and copper bonds. The mould is made according to a model designed specially for each section. Its two parts, one on each side, firmly

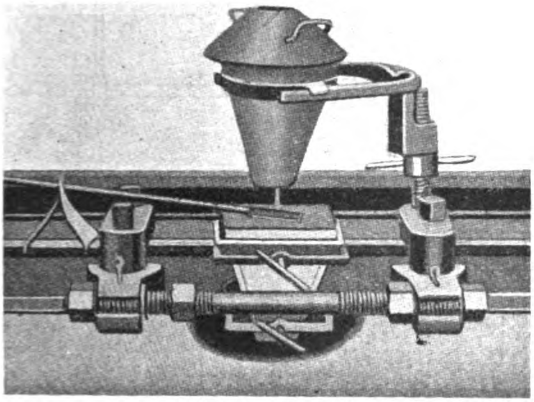


FIG. 3.—COMPLETE OUTFIT FOR RAIL BENDING.

enclose and exactly fit the rail. They are made on a large scale by manufacturers of refractory earthenware, or according to the requirements of the trolley lines, in the repair shops, by tamping an ordinary mixture of china clay and loam into a sheet iron case placed over the model, which has afterwards to be dried during a couple of hours at a temperature of some 100° C. The cost is only a few pence (Fig. 4).

The iron running out of the crucible flows round the web and foot of the rail and, melting them, forms one mass with them. The liquid slag which follows the metal is diverted to the top of the rail and brings the latter to welding heat. The whole section is thus heated equally, and the rail ends will not buckle.

The weld can be made with or without rail-clamps. In the former case the rail ends are butted together by tightening the screw two or three minutes after the run. By using the rail-clamps a perfect butt-weld, without even the smallest slit, is obtained; the slight and very short upset can be easily removed. The rigidity of the joint is particularly great. Under hydraulic pressure the break occurs outside the welded zone, as with the iron shoe welded on to the section the joint is really stronger than the rail.

The use of the rail-clamps is, however, by no means obligatory. Without them the work is still further simplified, as the time necessary for adjusting the heavy clamps and for chiselling off the upset is saved. By practical experience it has been

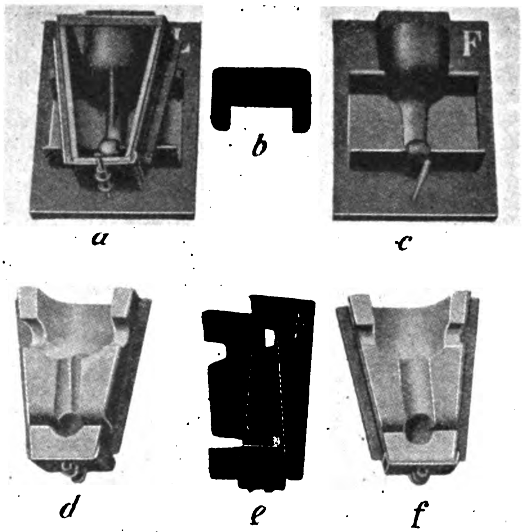


FIG. 4.—FORMS AND MOULDS FOR RAIL WELDING. *a*, Model for the lip side with mould shell; *b*, Appliance used when ramming the sand in; *c*, Model for tread side; *d*, Finished half of mould for lip side; *e*, Half of mould shell for tread side; *f*, Finished half of mould for tread side.

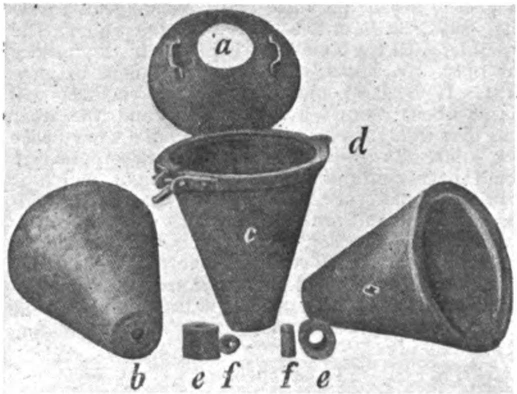


FIG. 5.—CRUCIBLES FOR THERMIT WELDING OF RAILS.

found that the weld without clamps is quite sufficient. Of late the clamps are being used less and less.

The use of clamps is based chiefly on theoretical considerations. Even a butt-weld can be obtained without clamps, particularly with rails already embedded. At Barmen (Germany) such work was done very successfully about a year and a half ago

The old fish-plates were taken off, the ends of the rails were raised slightly by mean of a crowbar, and a shim firmly wedged in between; in this case the shim is welded into the head of the rail.

When welding new rails not yet embedded, the use of rail-clamps can be obviated by firmly wedging up the rail from the next succeeding joint.

Working without clamps, the time consumed per joint equals three-quarters of an hour for one man; trained squads of four men, including foreman, did not use nearly so much time. At 4s. 6d. per day the wages item of cost is about 4d. per joint. The use of the clamps doubles this amount. All other labour connected with welding remains the same, whether clamps are used or not. The mould, which must be dry and porous, is screwed on to the rail and the rims touching the rail are carefully smeared with clay. Before doing so, however, the rail ends are cleaned of dirt and rust with a wire brush, and slightly warmed; a sand blast is superfluous.

In case the tops of the rails are to be butt-welded, the section has to be filed. This is all that is required in the way of preparatory work. A true alignment of the rail is, of course, an indispensable precaution. The rails require no bolt holes, as no provisional fish-plates are necessary. It will be recognised that none of this work demands special training. A certain supervision to see that it is done carefully is a matter of course. The welding is done automatically, and does not require the trained eye of an expert welder.

In case of wet weather, the protection of a few planks is desirable to prevent the mould and compound getting wet.

The next and only remaining appliance necessary for welding by the Alumino-Thermic process is the crucible (Fig. 5). This consists of a sheet iron mantle lined with magnesia. It is of simple construction, the lining being introduced by tamping it round a cone which is suspended in the middle of the mantle. The bottom is formed by a hard magnesia stone provided with exchangeable outlets, which will stand nine to ten runs. The crucible, with the cone in it, is placed in the furnace for only two hours, and finally brought to glow heat. It is then ready for use. Crucibles will stand about twenty-five reactions, and the wear and tear will, therefore, amount to only a few pence per joint. The welding compound is supplied in small bags containing the exact weight which is needed to effect the weld. These are called welding portions, and are sold as such to the tramway contractors. The contractors who make their own crucibles and moulds will, therefore, have to pay freight only on the welding portions, which is considerably less than that on fish-plates and bolts. The Essen Works have a plant to supply over 500 welding portions daily.

(To be continued.)

Long Distance Trains.—The New York City and Pennsylvania Railway Company's first 18-hour trains between New York and Chicago, a distance of 912 miles, both eastbound and westbound, arrived three minutes ahead of time. One stretch of 131 miles was covered in 114½ minutes. The average speed—says Reuter—was a mile a minute, and that was maintained for four long stretches, excluding the Ferry trip.

Some Ingenious Models.

We are pleased to be able to show in the accompanying illustrations some very excellent examples of model making executed by Mr. Louis Nicole, who, for a long time past, has been an enthusiastic reader of our paper. These models possess an especial interest from the fact

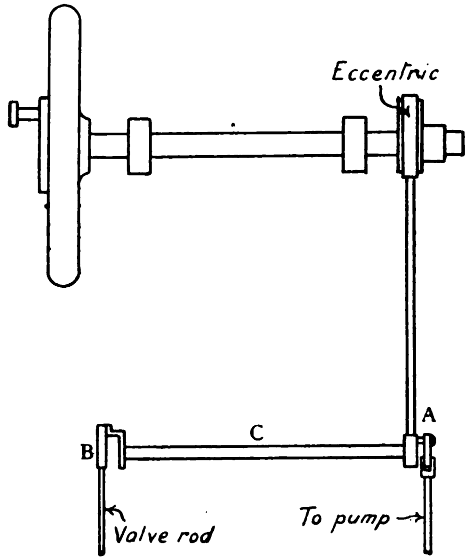


Fig. 1.—Diagram showing how both Pump and Valve are Operated by one Eccentric.

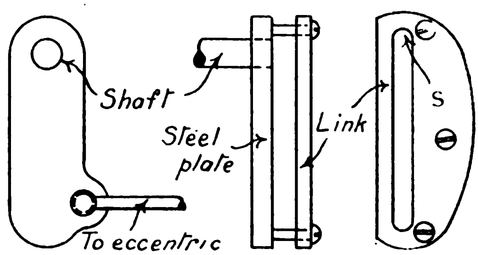


Fig. 2.—Pump Rocker and Slotted Link.

that Mr. Nicole has been working under conditions of considerable disadvantage, having had no training whatever in the use of tools or in engineering science, and having no model-making friends to whom he could turn for advice or assistance when confronted with a difficulty. Indeed, Mr. Nicole tells us that it is only quite recently that he has had the opportunity of seeing any model work other than his own, and when we asked him to show some of his productions at the last Conversazione of the Society of Model Engineers, he hesitated, feeling doubtful whether his models would be worthy of the inspection of such experts as are to be found in the ranks of that Society. Our persuasive powers prevailed however, and many of our readers will doubtless remember with pleasure the admirable models he sent to that gathering. Mr. Nicole is a musician by profession, but in spite of the number and exacting nature of his engagements, he finds time not only for h s hobby as an engineer, but for other forms of useful relaxation, such as bookbinding, medical research, photography, and drawing and painting. Some charming examples of pen and ink work which we saw when at his house revealed the strong artistic the rod being pinned to a plate, as shown in Fig. 2. On the side of this plate is a slotted link in which the end of the pump rod is arranged to slide. This slotted link is not pivoted centrally, but is attached to the shaft at the top end (S), so that the nearer the die of the pump rod is placed to the shaft the smaller the travel becomes. In this way the

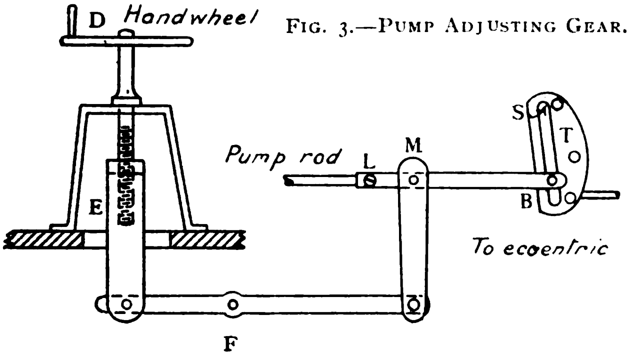


Fig. 3.—Pump Adjusting Gear.

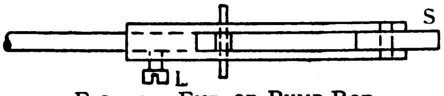


Fig. 3a.—End of Pump Rod.

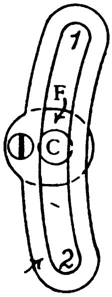


Fig. 4.—Curved Reversing Link.

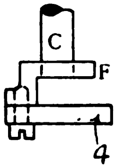


Fig. 4a.—Plan of Reversing Link, showing its Attachment to the Rocking Shaft.

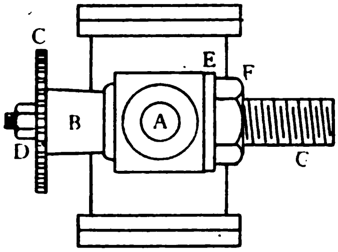


Fig. 7.—Valve and Connections.

A, Steam inlet; B, Valve; C, Cogwheel; D, Nut for cogwheel; E, Washer; F, Back nut; G, Exhaust through hollow valve.

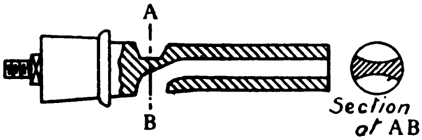


Fig. 6.—Section of Valve.

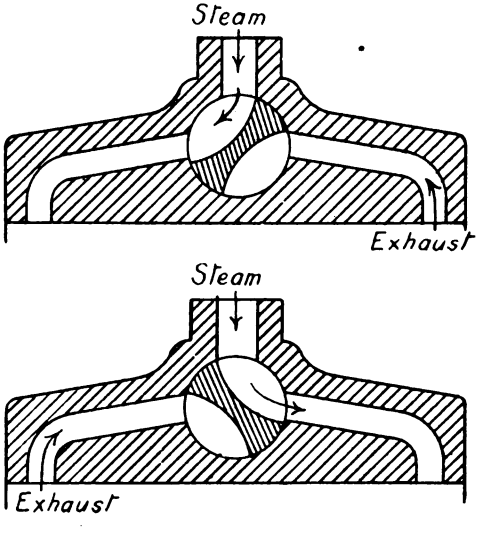


Fig. 5.—Sketches showing Action of Valve.

temperament with which he is imbued, and illustrating as they did the beauty spots of Europe, they encouraged their author to chat of his varied travels abroad.

But to return to the models. Our first photographic illustration shows an ingenious model.

Horizontal Engine.—This model has a cylinder 1¼-ins. bore and 1½-ins. stroke. The engine can be reversed, and has a pump, the stroke of which is variable—all this with one eccentric only, as the accompanying sketches show. The eccentric-rod actuates the rocking-shaft (C, Fig 1), the end of amount of water forced into the boiler by the pump can be altered at will. To accomplish this, the screw gear shown in Fig. 3 is fitted. The hand wheel D, which revolves in a frame, makes it possible by means of the screwed and forked nut E to raise or lower the end of the pump rod (B, Fig. 3) in the slotted link T. The horizontal lever is pivoted to the frame of the engine at F, and actuates the double link M (Fig. 3) (N in photograph, Fig. 11). The joint in the pump rod at L (Fig. 3) is a rigid one, and simply provides a convenient means of attaching the round pump rod to the long forked end. The pump rod is pivoted to the plunger beyond the hand wheel, as shown in the photographic illustration on page 61.

The valve is operated from the other end of the shaft C (Fig. 1). At this end a similar link to that used to vary the stroke of the pump is employed, but it is not pivoted in quite the same manner, and is curved. Instead of attaching the link at one end, it is arranged so that the centre of the slot coincides exactly with the axis of the shaft, as shown in Fig. 4. The bracket F is securely fixed to the shaft, and the curved link and the latter screwed to the bracket in the manner indicated. To reverse the engine a lever is employed, as will be seen by the photograph. This lever is connected to the valve-rod, so that when the die in the curved link stands centrally in the link the valve remains stationary, and the engine is in "mid gear," or neutral. When it is placed in position 1 (Fig. 4) the valve will have full travel, and the engine will move in a reverse way to when it is at the other end (position 2) of the link. The valve is somewhat like a Corliss valve, except that it serves to admit and release the steam from the cylinder, and is double-acting. As shown in Fig. 5, the one valve does duty for the four valves of a proper Corliss engine.

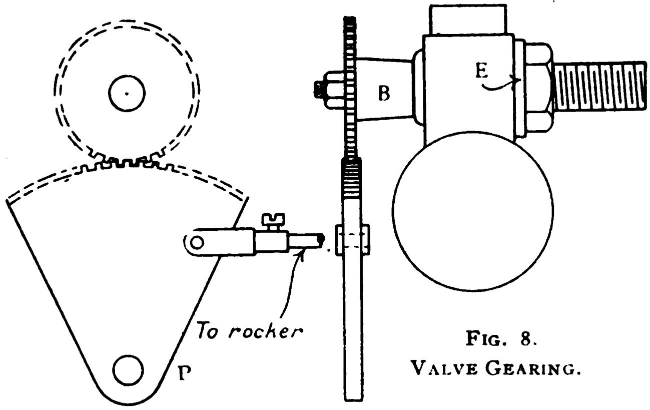


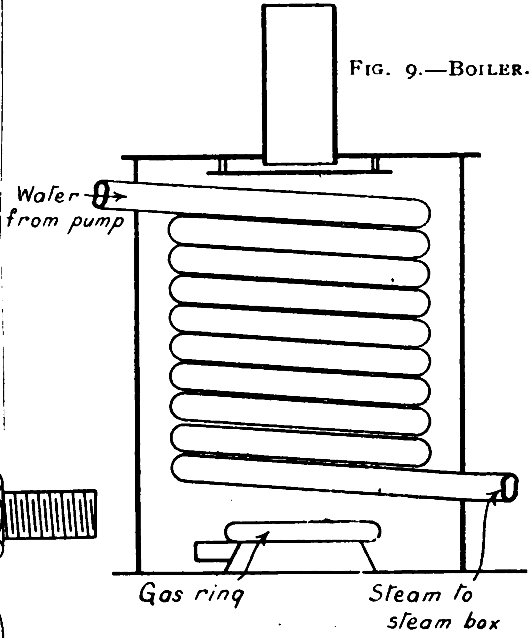
FIG. 8.
VALVE GEARING.

The method by which the valve is actuated is also very novel. This is shown in Fig. 8, the valve rod being attached to a cogged sector plate, the teeth of which engage in a cog-wheel on the valve. The sector plate is pivoted at P, and its motion gives a rotary motion to the valve, the angle through which the latter turns being, of course, greater than that of the sector plate.

The Boiler.—This is of quite a novel type, and the steam generating portion consisting of a coil of solid drawn copper tube, surrounded by sheet asbestos and a casing of brass plate. Against this shell a steam chamber (see Fig. 10) is fixed, the lowest coil of the generator being led to this chamber in the manner indicated. The top of the chamber is fitted with a baffle, and the usual wheel stop-valve and safety valve. The design of these fittings, and also the water gauge, was taken from THE MODEL ENGINEER sixpenny handbook, "Model Boiler Making." The lower tap of the water gauge is used as a blow-off cock or drain for the steam drum, and is operated when any water finds its way into this chamber.

The action of the boiler is obvious from its construction, and the speed of the engine depends entirely on the adjustment of the pump (with a given fire). Within the limits of the heating surface of the boiler, the greater the stroke of the pump the more power is developed; and, unlike most steam plants, a model such as the one under consideration can be run at low pressures without trouble in the matter of excessive cylinder condensation, as the lighter the engine is worked, the hotter will the steam be delivered to the engine. Again, with such a boiler there is no fear of a serious explosion.

FIG. 9.—BOILER.



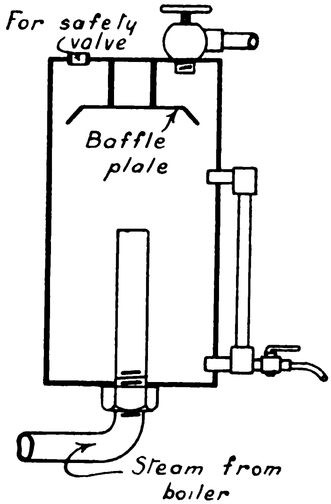


FIG. 10.—STEAM CHAMBER.

(*To be continued.*)

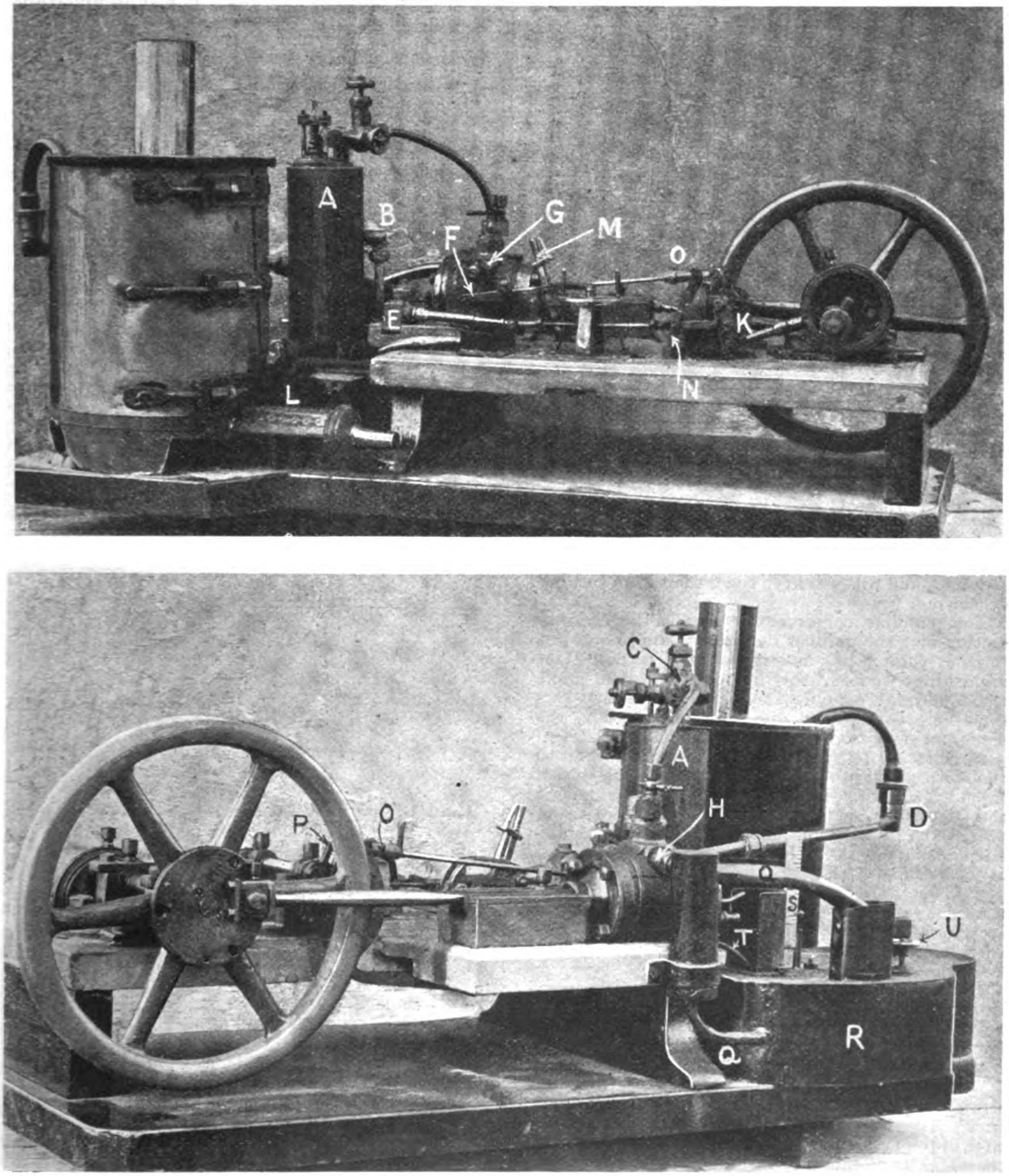


FIG. 11.—TWO VIEWS OF MR. LOUIS NICOLE'S INGENIOUS MODEL HORIZONTAL ENGINE AND BOILER.

A, Steam chamber; B, Water gauge on steam chamber; C, Stop cock; D, Clack valve; E, Pump; F, Valve gear; G, Cogwheel on valve; H, Exhaust of valve; I, Pump regulator; K, Link for pump; L, Gas ring; M, Reversing lever; N, Lifting link of pump gear; O, Valve rod; P, Link for valve; Q, Exhaust pipe to feed tank; R, Feed tank; S, Scale of float actuated water indicator; T, Blow-off pipe from steam chamber; U, Screw-down discharge valve on water tank R.

Practical Notes on Model Boat Building.

By T. LOCHORE.

(Continued from page 34.)

THE bevels of the frames should properly be taken off the water lines and buttocks at different points, and wood on the frames faired in between those points. A good way—which the amateur especially will find advantageous when the fairing batten is on the frames for the planking—is to obtain the bevel of it, so that the batten will be flat on the frames. In that case, when setting up the frames, the midship side edge of his frames will come to the section mark on the keel, thus allowing the wood to be, taken off the fore and aft sides of the frames respectively.

Setting up of the frames is a business that requires accuracy. The place of the sections has to be marked on the keel and on the two battens that go on the deck, these battens having one edge shaped to the sheer of the vessel. In this way it is possible to turn the boat upside down without putting it out of shape, the battens being level with each other.

Now set up the frames one by one, screwing to keel and batten, and fixing the stem and stern in position. One batten at the gunwale is, at least, required, and this will keep the frames from turning or slewing.

The planking comes next. Divide the midship section into the number required, using planks not broader than $\frac{3}{4}$ in., and not narrower than $\frac{1}{2}$ in. amidships; indeed, the broader you can make them without capping the better, and easy sections help this. Then divide, approximately, the stem and stern the same way. Take a thin batten, 3-16ths in. by 1-16th in. (say), and pin it flat on to the stern midship section and stern at each line of intended planking, in this way lining off and paring the edges of intended planking, taking care to let the batten lie easy and flat if possible. After the batten is fair, draw by the faired edge of the batten at each frame with a pencil. This method allows you to see how best to work in your planking at the bilge and the counter. The top strake of planks are made thicker to take the screws of the deck; therefore, they are sunk partly into the frame to keep the planking flush.

Having lined off the boat, planking is the next thing to start. The keel plank, of course, is straight on the lower edge to fit the keel, the upper edge not being necessarily straight, but fair. In any case, you will find, when about to fit the edge of the second plank to this edge, that it is not straight, the shape of the boat causing the difference. To fit the edge of the second plank to the edge of the first, take the piece of wood, from which the plank is intended to be cut, and clip or snib it on to already fixed plank, the edge overlapping the edge of the latter. Take a pencil and scribe off, thus obtaining the shape on to the plank that will fit the edge of the first. Take care to let the wood lie or clip on naturally without vertical bending of the plank. Now carefully pare the wood to the line, and try on until a close joint or butt is obtained. The upper edge should now be trimmed and faired off according to your breadths on the frames. The plank is then fixed and the remainder continued in the same way. It will be found that the plank with the greatest curvature is the one before the bilge plank; therefore, when there is great curvature, it is sometimes advisable to halve or butt the planks, so as not to get too much of the cross grain at the ends, the butts being arranged clear of each other—that is, not directly over each other, and made according to Fig. 8.

The caulking of the boat may be done in either of the following ways: (1) By painted calico on the inside between the frames and lapping the frames; (2) by running a thin wick of cotton with the point of a knife in the close seams on the outside, taking care not to push it right through to the inside, and a little putty to keep the seams flush; (3) by raw oil varnish in the inside. The second method, I think, is the best. All you require to do each season is to put a little putty here and there. It also saves a pound or two of weight in varnish or cloth, and causes little trouble to do it. The fin comes next, and is best held by screws through the keel, taking care that the fin is plumb in the centre when screwing. The double diagonal built boats, though decidedly most difficult to build, are advantageous in this way—that (1) they do away with a great many frames; (2) they remain water-

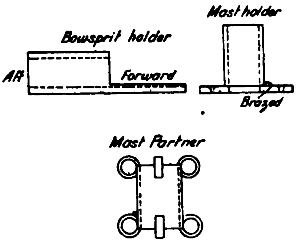


FIG. 12.

FIG. 10.

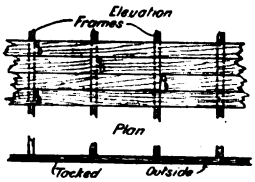


FIG. 11.

tight through several seasons; (3) are stronger in every respect. The keel, stem and stern-post are made as described before, but the frames may be shaped solid, and not built, if it is intended that they come out again. Into the frames are imbedded or sunk ribbands or stringers, as shown in Fig. 9, and these take the place of the frames, for the frames are cut out and these remain, floors being put in at intervals, instead, as in Fig. 9.

The setting up of the frames is the same as before—indeed, everything until you come to planking. The two skins of planking run at right angles to each other, except near the ends, as will be described. Evenly divide the gunwhale into the number of planks advisable, about $\frac{1}{2}$ in. or $\frac{3}{4}$ in. Take the mark of one of the proposed planks near amidships, and with a thin batten at 45° to gunwhale, bend round to the keel; mark the keel and divide in the number of planks on the keel, gradually working the planks near the ends of the boat nearly to the upright, but not quite. This is for the sake of avoiding short planks at the ends, which, as one can see, would give trouble with their short grain.

The planking is now proceeded with, and is started near amidships working towards the ends. The first plank is straight on both edges before fixing, but immediately it is on, it curves, making the next planks respectively round and hollow on the fitting edge, the other edge of the planks being always straightened before being put on. The first skin planks are fixed to the ribbands with as few fastenings as possible, and merely to the gunwhale and keel, if the planks will lie.

When the first skin is on calico or thin close-woven cloth is stretched over it, it being painted to receive it, then the cloth is painted and the next skin started. The next skin may be put on at right angles to the first, or run fore and aft. In the latter case the planks are first lined off to suit the eye, and the shape of the fitting edges taken with the mark of a little paint brushed on the outside of the fixed planks. Of course, the frames in the latter case will have been built to remain, and, therefore, ribbands or stringers will not be required except at gunwhale. But where the second skin is at right angles to the first, the skin is put on the same way as the first, only instead of putting in a few fastenings, you put in the final fastenings, what is called cape and corner fastening (as in Fig. 10), the planks starting amidships at 45° to gunwhale, and at right angles to first skin. The outside is then finished up with sandpaper, the frames taken out by sawing through the middle, and the inside painted or varnished. As one can see, this type of boat is very adaptable for a steam model where you require the inside free of frames or bulkheads.

The metal built model is a very unsatisfactory one to build, the metal working itself into many bumps and holes, that one would require to make a miniature set of rolls for rolling the plates, and no end of time to spare. Furnacing over a metal slab is the method adopted by the Steel Lifeboat Company, and it is the best way, but involves a great expense in moulds—one might as well make a casting. But one way of making the moulds for a metal boat is of wood, what is called a male and a female mould, one sitting inside the other. Then dust the moulds well with whiting powder, heat your metal red-hot, place it on the female mould, and crush the male mould into it with great pressure, the whiting powder preventing the wood moulds from burning. When doing this, it is as well to take care of your eyes.

The reader will probably be wondering now what are the best materials for the different parts of the construction of the boats.

For dug-out models, St. John's yellow pine is certainly the best, being very soft and workable, solid, containing very little resin, and is not grainy like the Quebec yellow pine.

For the keel, stern, and stern-posts of built-up models, oak, Canadian elm, or ash; for the counter-piece and counter yellow pine.

The frames should not be spaced more than 3 ins. apart, for the sake of caulking the planks, and ¼ in. thick and ½ in. to about ¾ in. broad; this is quite broad and thick enough. They should be made of yellow pine for lightness' sake, and clenched with shoemakers' brass sprigs.

The planking, of ⅛ in. thick yellow pine, may be either fastened with No. 1 or 2 ½-in. brass screws, or with thin copper nails.

I made my own copper nails out of electric copper wire, 1-32nd in. diameter, and filed them through on the other side of the frames. They held exceedingly well, and I think they are the best, by their size allowing more than one fastening for each frame per plank.

The deck and fin are made of yellow pine; indeed, yellow pine is used wherever possible, for the sake of lightness. A neat finish to the deck is provided by screwing it down and running a

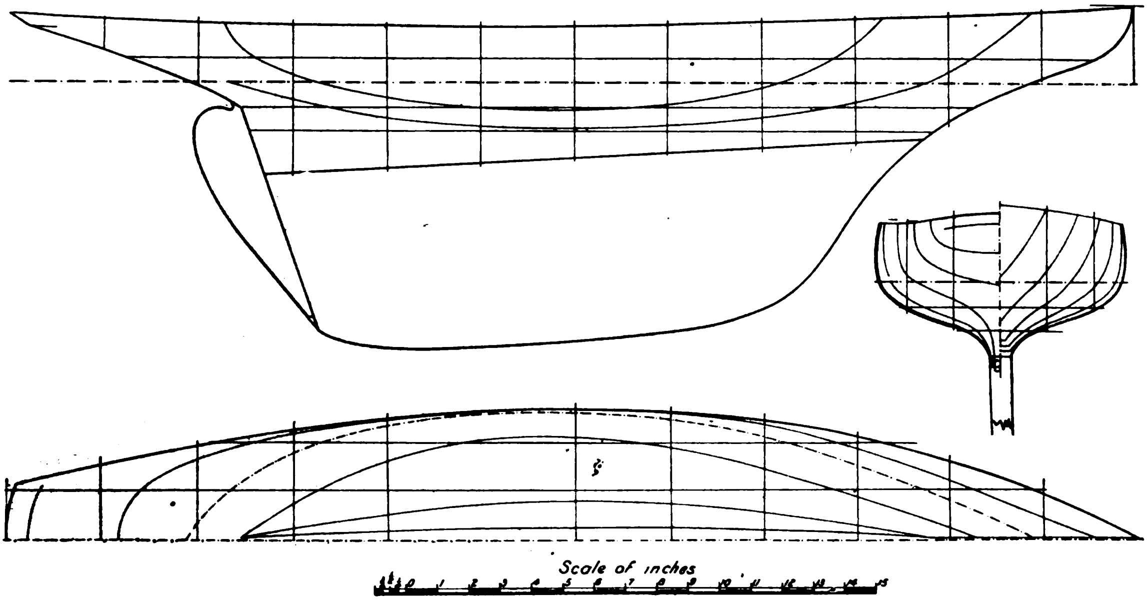


Fig. 13.—A Design for a Model Sailing Yacht.
By T. Lochore

½ in. by ⅛-in. beading, rounded on the outside and chamfered on the inside, on the top of the screws round the outside of the deck. The deck may also be marked with black paint, ink or pencil for planks, and varnished all over.

The fin is best with its grain running fore and aft, for fastening it to the keel and the lead to it; taper the ends for entry, and run and slit each end with the saw, putting in the slit a piece of hardwood chucked or tacked through.

The rudder trunk is generally made of brass tubing, and the rudder has a thin brass tube fastened to it by splitting the lower part of the tube and screwing it into the rudder. This makes an excellent rudder stock.

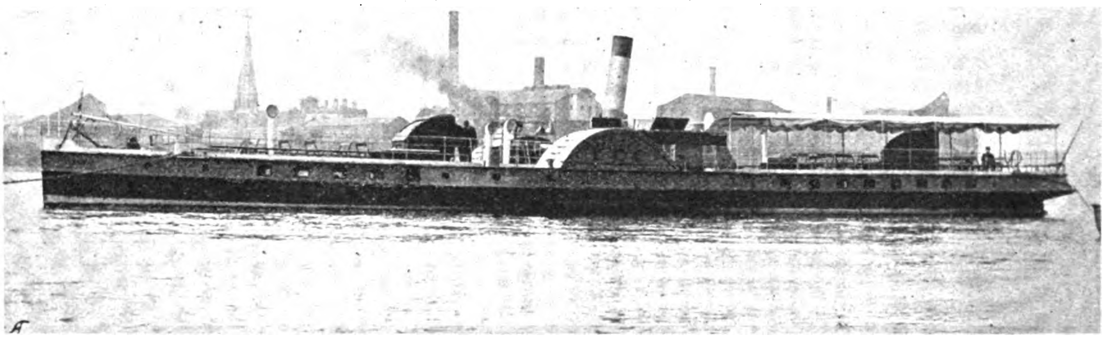
For the tiller and quadrant, thin brass, worked to shape, is the easiest way.

The bowsprit, socket, mast-partner, and mast deck-holder are very easily made of brass tubing cut as shown in Fig. 12.

Canadian Exhibits at Liege.—The large and important collection of minerals sent by Canada to the Liege Exhibition contains a piece of radium found in the province of Quebec, a block of nickel weighing 1½ tons, some enormous sheets of mica, and specimens of asbestos, of which substance Canada contributes 80 per cent. of the world's consumption.

The London County Council New Thames Steamers.

It will be remembered that the construction of the thirty Thames passenger steamers for the London County Council was divided equally between the Thames Ironworks Company, of Blackwall, Messrs. J. I. Thornycroft & Co., of Chiswick, and Messrs. Napier & Co., on the Clyde; each firm to build ten boats. A profile and plan of these vessels, reproduced from the *Engineer*, by kind permission of the editor, is given herewith.



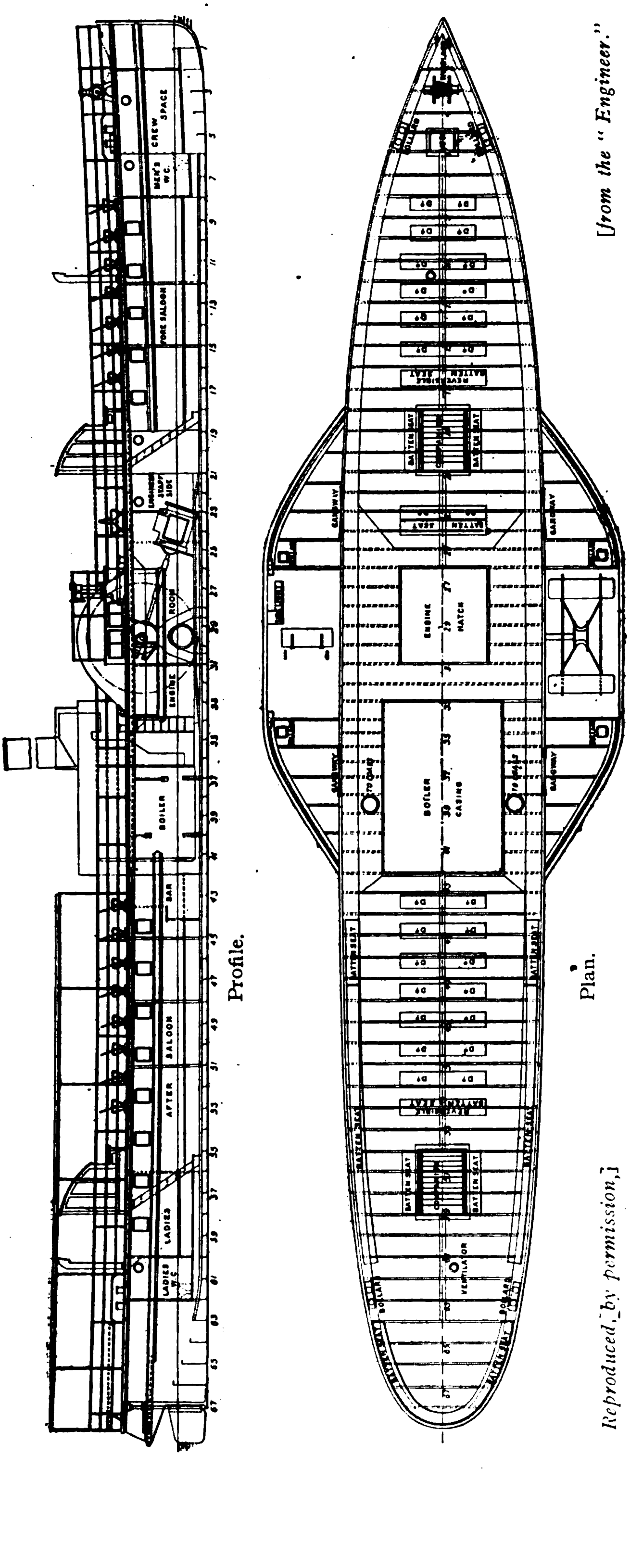
One of the New Paddle Steamers for Passenger Service on the Thames.

In December last the work on the boats building at Blackwall was being rapidly pushed on, and by the end of March of the current year seven had been launched, and the machinery for them was rapidly drawing to a finish at the Company's works at Greenwich and Deptford. Since then work on them has been continuous, and they are now all complete and in regular service on the Thames.

These ten boats have been given the following names:—*Purcell, Vanbrugh, Boydell, Brunel, Morris, King Alfred, Alleyn, Carlyle, Sloane,* and *Gibbon.* The first was launched on February 24th last, and the last one on the 20th May. The first boat completed being the *Boydell*, ran her official trials on the measured mile in Long Reach on the 5th of June, four runs having been made, when an average speed was attained of 13½ miles

Results of Trials of One of the New L.C.C. Thames Steamers.

	Boiler steam.	Steam at engine.	Receiver	Vacuum.	Revs.	M.E.P.		I.H.P.		
						H.P.	L.P.	H.P.	L.P.	Totals.
1st mile	114	109	16½	26⅞	63	76·85	22·17	176·9	191·6	368·5
2nd mile	112	108	17	27	64	77·28	22·35	180·7	196·2	376·9
3rd mile	112	108	17	27	64	76·2	21·88	178·2	192·1	370·3
4th mile	115	110	17	27	62	75·5	21·86	171·0	185·9	356·9
Totals	453	435	67½	107⅞	253	305·83	88·26	706·8	765·8	1472·6
Means	113·25	108·75	16·875	26·91	63·25	76·45	22·06	176·7	191·45	368·1



Profile.

Plan.

[From the "Engineer." Reproduced by permission.]

THE NEW THAMES STEAMERS FOR THE LONDON COUNTY COUNCIL.

an hour, 360 h.-p. being indicated by her engines, making 63 revolutions a minute when that speed was realised. The boat was drawing 2 ft. 9 ins. of water and carrying 25 tons of dead-weight to represent coals and passengers.

The accompanying table gives the results attained at the official trials of the new London County Council river steamer *Boydell*, made on May 5th.

The normal speed of all the boats when on service is ten miles an hour, and the revolutions of engines to give that speed is 48 per minute. The boiler in each boat is one of the marine return-tube type, worked at a pressure of 115 lbs. per sq. in., forced draught on Howden's system being used.

Each boat has accommodation for 500 passengers, there being room for all above deck or below, seating being provided for 162 on deck and 90 below. The cabins are heated by steam radiators, and lit electrically. As a provision against accident by collision or otherwise, each boat is constructed with four water-tight compartments in the hull. All have run satisfactory trials at their full load draught. Of the ten built at the Thames Ironworks, seven have been engined at the Company's works at Greenwich, and three by the ship-building department at Blackwall.

Four other steamers were constructed on the Thames for the Council's fleet at the shipyard of Messrs. G. Rennie and Co., Thames Street, Greenwich. These vessels, the names of which are *Rennie*, *Marlowe*, *Pepys*, and *Christopher Wren*, are all of the same dimensions as those building at Blackwall, and are fitted with the same type and power of engines and boilers, which are, however, being made at the Scott's Engineering Works at Greenock.

At a recent private trial of the *Rennie*, a mean speed of 13·4 miles an hour was attained, with 85 lbs. steam pressure at the boiler; very little vibration being experienced at the full power of the engines, which was about 350 indicated horse.

The passenger accommodation and method of warming and lighting the cabins are identical in all the boats built for the Council on the river.

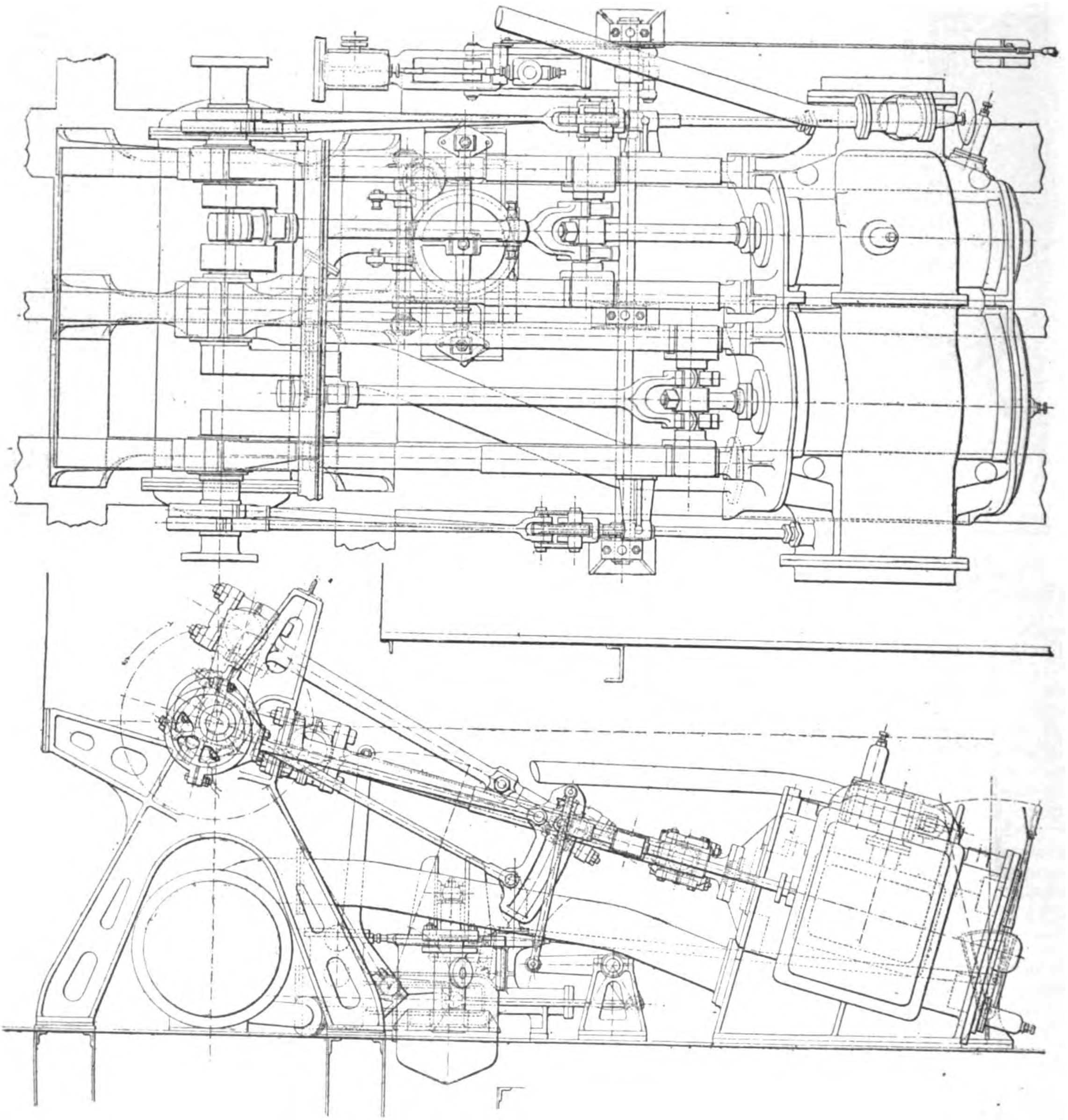
INDIA-RUBBER GLOVES FOR FIREMEN.—The *Electrician* states that, owing to the inc ease in the use of electrical power, india-rubber gloves are provided for London firemen on all occasions, as they often have to deal with electrically-charged wires. An insulating material less affected by heat than is india-rubber would be preferable if such a one could be found.

The Society of Model Engineers.

[*Reports of meetings should be sent to the offices of* THE MODEL ENGINEER *without delay, and will be inserted in any particular issue if received a clear nine days before its usual date of publication.*]

London.

EXCURSION TO CHATHAM.—The annual all-day excursion will take place on Thursday, July 27th, when a visit will be paid in the morning to the Dockyard at Chatham, and in the afternoon to the works of Messrs. Aveling & Porter, Ltd., at Rochester. The Secretary will be glad to receive as early an intimation as possible from those members who wish to join the party, which will be made up of those members who have signified their intention of being present by Saturday, July 22nd. Provided the party numbers at least ten, the railway company will issue special tickets at the rate of 3s. 2d. each (third class) for the return journey. Cash for the tickets must accompany the intimation of any member to be present, or be sent to me



GENERAL ARRANGEMENT OF COMPOUND DIAGONAL PADDLE ENGINES, NEW L.C.C. THAMES STEAMBOATS.
For description] (From the *Engineer*.) [*see page* 65.

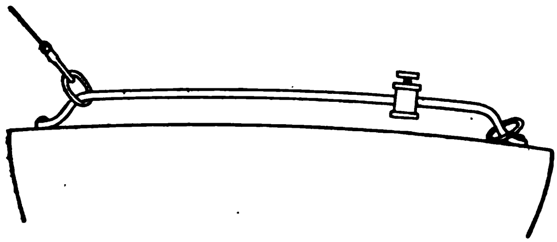
on or before July 22nd. The party will travel by a fast train leaving St. Paul's Station at 9.57 a.m., returning from Chatham at 7.37 p.m.—HERBERT G. RIDDLE, Hon. Sec., 37, Minard Road, Hither Green, S.E.

Model Yachting Correspondence.

[*The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a nom-de-plume if desired, but the full name and address of the sender* MUST *invariably be attached, though not necessarily intended for publication.*]

TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—I am sending a sketch of a sprag for main sheet for a model yacht, which I thought might be of use to model yachtsmen. I have used it with great effect for the last twelve months. The sketch I send is simple and effective. Some use a cork for the purpose, but this is an improvement. The idea is to keep a yacht on her course. When



A SPRAG FOR THE MAIN SHEET.

starting a race, whatever the tack the boat starts on, the terminal screw should be shifted over to the lee side and screwed down on the traveller. If the boat should go on the opposite tack, the sprag will bring her back to her original course.

The sketch shows the sheet on the port side, or, in other words, on the starboard tack, so that the screw would require sliding over that side and screwed down. These terminal screws can be bought at any electrical shop for one penny, but the screw wants to be filed off so as not to come into contact with the deck. I may say that several in our Club have adopted it with success. The traveller must not be too thick for the screw to slide over, and before finishing the traveller put a small ring on either side as shown in sketch. The rings are for each tack. One end of traveller may be plunged first, then the screw may be put on, the rings can be put on—one in each side—before screwing down to deck. I trust I have made it sufficiently clear for anybody to understand. To the end of the sheet I use a watch swivel as shown in sketch.—Yours truly,

G. ANDERSON,
Liverpool. Derby M.Y.C.

FRENCH ENGINE-DRIVERS.—Hitherto the engine-drivers on the French Northern Railway have taken their stand on the right of the footplate; but the chief engineer, M. du Bousquet, has decided that in future, on fast and express trains, they shall stand generally on the left—that is to say, on the side where the signals are placed.

Practical Letters from our Readers.

The "Model Engineer" Electric Locomotive.

TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—A little time ago several letters appeared in THE MODEL ENGINEER complaining that the design of model electric locomotives was not up to the standard of model steam locomotives, and, truly, the design of the motors in the electric locomotive lately described is a good example of what was meant. My objections to these motors are as follows :—

(1) *Field magnets.*—For a locomotive, where space and weight are of the utmost importance, iron of a high permeability should assuredly be used, and where the armature has teeth, as in this case, the pole-pieces ought to be laminated, so that the whole magnet could be advantageously built up of laminations, which has the advantage that they could be cut out with snips. The shape of the magnet is not unsuitable, but the magnetic leakage between the upper pole and the frame will be very large, as the cross-section of the magnet core is large compared with the core of an armature pole.

(2) *Armature.*—I can understand the reasons for using a three-pole armature, however unreal it may seem, but has the designer never heard of eddy currents? In a small dynamo I have which has a toothed drum armature and cast iron pole-pieces, the eddy current losses at a reasonable speed for its size are so large that they absorb nearly all its power, the other losses being small beside them. And this machine has a three-pole armature, which means dragging the whole magnetic flux right across the pole-piece three times in a revolution, and letting it fly back between ; consequently, the eddy currents will be large in the pole-pieces, and, the leakage being large and variable, there will also be large eddy currents in the brass plates which support the bearings.

This is apart from the eddy current and hysteresis losses in the armature, which will be considerable, especially if it is made of cast iron. I am certain that a motor made of the same dimensions at right angles to the shaft and half the size along the shaft, and all laminated, would give the same total power at the same speed, with vastly smaller losses, so that the net power would be much greater, and this would leave plenty of room for wire at the ends of the armature.

I should like to know if anyone has yet made the motor described, and, if so, whether it has been tested as a motor running light, at different speeds, to separate the losses and find out what the eddy current losses really are. I would advise anyone who is making this machine to insulate the brass plates from the magnets, as otherwise there will be eddy currents flowing round the circuit made up of the two-pole faces and the two brasss plates.—I am, etc.,

R. C. SIMPSON, A.M.Inst.E.E.

TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—The design and specification for these motors were not adopted without due consideration. In planning the locomotive I intended that the construction throughout should be such as would attract the largest possible number of readers of

THE MODEL ENGINEER. When dealing with the motors it was decided that castings would be inexpensive and easily put together by the less skilled amateur, and that they would probably be more readily procurable than stampings. The tri-polar motor, made entirely from iron castings as regards the field-magnet and armature, is a proved success; *there are thousands in use and their users do not appear to be much worried about the question of eddy currents or a possible high efficiency so long as they are running well.*

The description of these motors given in THE MODEL ENGINEER states that wrought iron would give greater power than cast iron; but reduction in weight in a locomotive is not wanted; in fact, is undesirable, so that even if wrought iron is used, it would be better to keep to the same dimensions. It is, of course, quite optional for any reader who is making this locomotive to modify not only the motors, but any other part if he prefers to do so.

The various points raised by Mr. Simpson are all familiar to the designer of these motors. A laminated armature and field-magnet would be better than either solid wrought iron or cast iron, but stampings introduce mechanical difficulties which it was preferred to avoid. As regards the suggestion that the bearing plates should be insulated from the magnet frame, this again will introduce extra trouble, and a likely source of error in getting the bearings into line. It is very doubtful if such a precaution will be worth while adopting, or make any appreciable difference. It is only necessary to point to the remarkably successful electric locomotives of Lieut.-Col. Harvey (see issue of August 20th, 1903), to show that the designs of THE MODEL ENGINEER locomotive are based upon a practical acquaintance with the subject, and that there are good reasons for the proportions and arrangements adopted. With regard to the weight question, the addition of some 15 to 20 lbs. of lead to this locomotive increased the actual tractive effort considerably, there being on the Colonel's railway unlimited electrical power available.

It is desirable in motors of this type to have a moderate magnetic density in the field-magnet, owing to the long magnetic circuit; also castings such as the core are liable to contain internal blowholes which are unseen; the dimensions of the armature were limited by the arrangement of the bogie. After all, the whole of Mr. Simpson's objections merely mean that he could possibly save a few watts in the motors when running by adopting a more difficult form of construction, yet a badly arranged track, a tight bearing, or too strong a spring on the brushes, would send up the current consumption to a much greater degree. His letter reminds me of the legendary senior wrangler, who, although he could calculate the entire thermodynamics of the steam engine, forgot to oil the bearings.—Yours faithfully,

THE DESIGNER OF THE LOCO.

CARBONISING WROUGHT IRON.—Wrought iron may be carbonised by long heating in contact with cast iron or steel, the effect thus obtained being analogous to that produced by the charcoal of the cementation furnace.

Queries and Replies.

[Attention is especially directed to the first condition given below and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-hand corner of the envelope "Query Department." No other matters but those relating to the Queries should be enclosed in the same envelope.

Queries on subjects within the scope of this journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied, wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed, and also a "Queries and Replies Coupon" cut out from the advertisement pages of the current issue. (4) Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of Replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor,* THE MODEL ENGINEER, *26–29, Poppin's Court, Fleet Street, London, E.C.]*

The following are selected from the Queries which have been replied to recently:—

[13,701] **The "M.E." Steam Locomotive.** W. C. (Manchester) writes: (1) Can you tell me in what colours the *M.E.* locomotive should be painted, and the kind of paint to use? (2) I have made the boiler as described, but with one of the new style downcomers; but although I can get up 10 lbs. of steam in about five minutes from cold water, I find when the regulator is wide open the pressure runs down from 30 lbs. to about 7 or 8 lbs., and it sticks at about this when loco is running. I have not a track for it so have to run it on the floor, and, of course, this is not satisfactory. What I should like to know is this: the lamp instead of being designed as per your directions, I have made out of two tin tanks about ½ in. wide, 5 ins. long, and 1 in. deep, connected by two pipes to the tank. Should this give as much heat as your design? The burners are packed with cotton wool and seem to give a lot of heat. (3) I have made the cylinders as described, but somehow I made a mistake in the travel of eccentrics, and to remedy this I filed off a little at each end of the slide-valves and now find they only just cover the ports; less than a 1-32nd in. lap, I think, is left. A great deal of steam seems to be going up the funnel without doing any work. Will this account for it? (4) Would forced draught assist to make more steam when locomotive is running by causing the lamp to burn better, or would it waste steam from the boiler? I have a superheater on as designed. My idea was that the blower would only be useful in getting up steam but not in keeping it up, seeing it would take a certain amount of steam to work it. I should be obliged if you would assist me on these points; also say whether it is intended that the boiler should keep up a constant pressure of 30 lbs. of steam when running, as, if so, there must be something very wrong with my boiler.

So long as the boiler does not leak anywhere you have no need to trouble yourself about its apparent non-success. The lamp would be a little better if made as designed, but this point is not so important as the fact that the slide-valves leak to the exhaust. This is the reason the pressure falls so rapidly. Attend to the valves (study the chapter on Valve Gearing in "The Model Locomotive"), face them properly and see that there is no waste of steam. With the regulator full open and the wheel held still, there should be no emission of live steam from the exhaust. Pack the pistons as tightly as possible. Ordinary paint is of no use on this size of engine. Use Aspinall's or Maurice's enamel, and practice on a piece of metal before commencing the engine. Bake the enamel on by putting in a moderately warm kitchen oven, but be careful not to touch the paint before it is dry or to have the oven too hot In one case you will spoil the finish, and in the other melt any soldered parts.

[14,312] **Electric Light Installation.** T. T. (Blairgowrie) writes: I am fitting up an electric light installation, which is to be supplied from a dynamo of about 500 watts capacity (55 volts 9 amps.), and would be greatly obliged if you would answer me the following:—(1) Size of wire for main leads. (2) Size of flexible twin wire from main leads to each lamp. (3) Size of fuse wire on main leads. (4) Size of fuse wire in lampholders. (5) I intend to construct a switchboard similar to that described on page 164 of your issue of April 1st, 1902. What material do you recommend for constructing baseboard of same for above pressure, and where can such a switch be procured ready made?

(1) No. 12 gauge solid wire or 7/19 stranded cable. (2) Standard size flexible is sold by all dealers in electric wiring materials. (3) No. 20 gauge tin wire. (4) No. 30 gauge tin wire. (5) Preferably slate, which can be obtained quite easily from slate merchants; it can be used with surface and edges merely rubbed smooth, or coated with hard enamel. It is important, however,

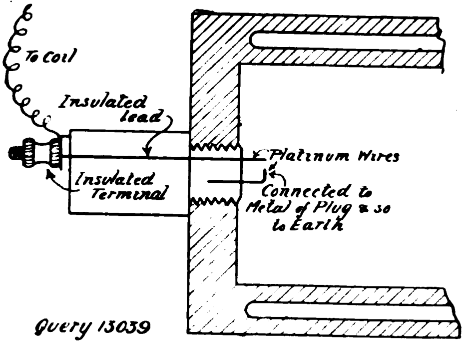
for the slate to be free from metal veins which would cause short circuits. If you do happen to hit upon such a vein, the insulation can be restored by fitting an ebonite bush to the hole, through which the contact stud passes. Failing slate, use teak or any hardwood. Switch can be obtained from one of the electrical firms advertising in THE MODEL ENGINEER; it is a common form of construction, though not perhaps in stock

[14,311] **Condenser for Spark Coil.** W. B. A. S. (Dublin) writes: Kindly inform me on the following through your esteemed columns. I have been told that if the condenser in a sparking coil is suspected to be at fault in the event of coil not giving expected length of spark, this can be tested by making up another condenser *extempore* and then shunting it across the contact-breaker. Is this a good test or is there a better one?

The condenser is a most important accessory to a spark coil; if there is no condenser, or it has broken down, or is disconnected, the spark length will be about one-tenth of the full spark length which the coil should give. The best way to test for a faulty condenser is to remove it and connect a new one. If the old one is at fault, the new one would, if a good one, at once make a great improvement in the spark length, even though of smaller size. The trial can be made as you suggest, and probably the improvement would show at once; but if not, it would be as well to disconnect the old condenser temporarily when trying the new one. An exception to these remarks is when a Wehnelt electrolytic interrupter is used; the condenser then becomes of little or no value owing to the very high rate of interruption. Condensers break down owing to sparks piercing the insulation between the tinfoil sheets.

[13,039] **Small Petrol Engine.** A. E. S. (Peterborough) writes: I have a small gas engine, cylinder 15-16ths bore, and 2 ins. stroke. I wish to know if the petrol carburettor for small gas engines, described by C. N. Turner in the *M.E.* for October 1st, 1902, could be used to work it in place of gas, as I have not gas on the premises? If so, is there any danger attached by

FIG. 1.—CONNECTION FOR ELECTRICAL IGNITION.



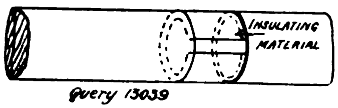


FIG. 2.—CONTACT-BREAKER ON CAM SHAFT.

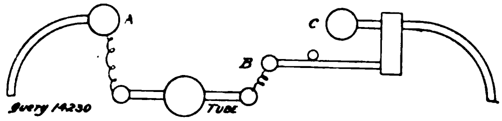
leaving it working for a few hours? I require it to drive a 10-watt dynamo. The ignition is not fitted at the end of cylinder as most are, but near the centre of cylinder is a small hole, with gas burner close to it, and I suppose the flame is drawn into the cylinder and the explosion takes place. About what fraction of horse-power can I expect to get from it? Would it be possible to fit electric ignition to it? If so, would you kindly tell me how? If the engine is no use for driving the dynamo, would you kindly give me dimensions of oil engine suitable for doing so?

Yes, this could be used. Fit several pieces of fine gauze wire in the petrol supply pipe, however, to prevent any danger of "firing back" into the carburettor. If you converted to electric ignition you would have to introduce some mechanism for giving a make-and-break. The side shaft of engine would do, but we suspect from your description that it has not got one. You might try converting it into an Otto or four-cycle engine—*i.e.*, with compression before ignition. At present you explode the charge at something below the atmospheric pressure. The horse-power obtained would be extremely small, and could only be found by trial, unless the makers could tell you what they guarantee it to do. If you fitted electric ignition you would have to plug up the present ignition hole and bore a fresh hole in the end of combustion chamber to take the plug. On the side shaft you must fit an insulating bush, so that the primary of induction coil is only put in circuit once every four revolutions of crankshaft. A small shoe or brush bears against this bush, and so the circuit is made just when required.

[13,856] **Steam Ports, Valves and Valve Gearing.** G. R. (Kilmarnock) writes: I am making working drawings for a model launch engine, boiler pressure, 45 lbs.; cylinder, 2½-in. bore, 3-in. stroke. Would you kindly give me the following dimensions:—(1) Size of steam and exhaust ports. (2) The inside and outside lap of slide-valve, and the lead. (3) The travel of valve. (4) Throw of the eccentric pulley. (5) The size and weight of the flywheel.

(1) Steam ports, 3-16ths in. by 1¼ ins.; exhaust, ⅜ in. by 1¼ ins. (2) Lap of valve (outside), 3-16ths in.; inside, 1-32nd in.; lead, 1-16th in. or 1-20th in. (3) Travel of valve (when new), 1 1-16th in. (4) Throw of eccentric sheave depends upon the design of link motion. See our new book, "The Model Locomotive," price 6s. net, for detailed information (5) Wheel about 8 or 10 ins. diameter; weight about 20 to 25 lbs.

[14,230] **Lighting Vacuum Tubes with High Tension Machine.** M. M. (Caterham) writes: I have bought one of Dollond's improved high tension machines, but I am at a loss to know how to connect it to some vacuum tubes I have. I tried connecting them to the outer coatings of the Leyden jars, but I can't get them to light up at all, except when the spark leaps across the dischargers, and then it is only a flash. I may say the



LIGHTING VACUUM TUBES.

machine has given a 1½-in. spark to-day, although it is so damp. The diameter of the cylinder is 9½ ins. I shall be very much obliged if you will let me know where I am wrong.

The tubes should be worked from the main dischargers of the machine, being connected by means of thin wires to the knobs A B in sketch herewith. The knob B should be adjusted so that there is a gap between knob C and the little knob on the rod of B, so that the discharge sparks across from C to the little knob whilst the tube is at work. The tube must, of course, be held in an insulating stand holder, or hang by means of the wires from the knobs. The knob B should be positive, and as you cannot be sure how it will come, you ought to be able to interchange this knob with its spark-gap bar to either pillar, so as to find out which is positive. If the discharge is too irregular and jerky, try disconnecting the Leyden jars by moving the connections to the interior coatings. The thin connecting wires to the tube should be free from any protruding ends, as the charge will leak away from points; therefore, twist the ends round the main wire, so that they do not project. Turn the handle slowly at first and get up speed by degrees. The sparks should go in a stream of short hissing sparks from knob C to the little knob on the B knob bar. (Also see our handbook No. 19 on *x*-Rays.)

[13,911] **Injector.** W. H. (Brighton) writes: Will you kindly let me know what is wrong with the enclosed injector? I cannot get it to work at all.

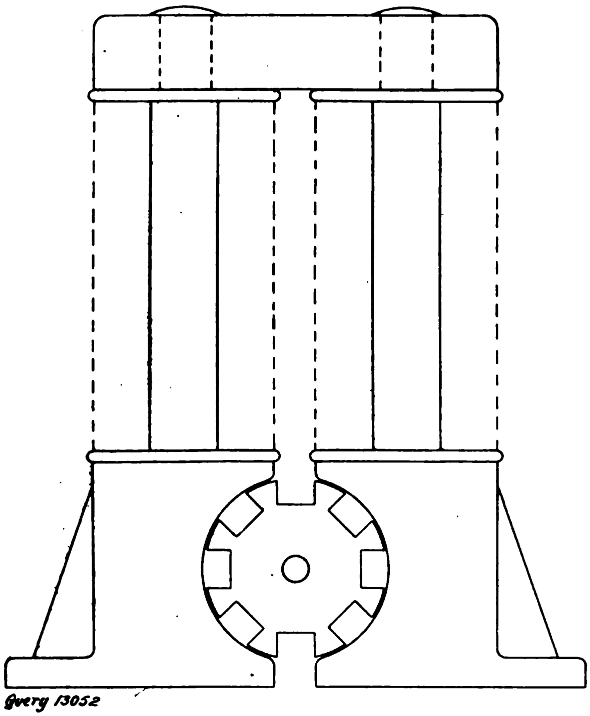
The reason for the injector not working lies in the incorrect proportions of the details. The area of the steam nozzle is actually less than that of the combining cone, instead of being—as it should be—about three times as great. The combining cone is too short and the overflow not large enough. The connections are too small, and the diaphragm in the body had better be dispensed with. Make internal area of connecting pipes twenty to twenty-five times area of combining tube. Separate latter from delivery tube so as to leave annular overflow of fair size. Make length of combining tube ten times its minimum diameter. Area of steam nozzle 2·8 times area of combining cone. *Note.*—Areas and diameters means *minimum* areas, etc.

[12,545] **Model Marine Water Tube Boilers.** P. M. (Leeds) writes: Would you kindly oblige me with a sketch of a boiler of an engine, cylinder 1-in. bore by 1-in. stroke, which is intended to drive a boat 3 ft. 6 ins. long by 4½ ins. wide (inside) amidships. The boiler must be a fairly fast steamer, simple in construction, and must have a good water capacity. Water tubes would be preferred to flue tubes.

There are many types of water-tube boilers which may be used for a model boat, but not one of them is far and away superior to the others. The best from a steam generating point of view would be a modification of the water-tube boiler used for THE MODEL ENGINEER loco; but as you know, its centre of gravity would come rather high in the boat and affect the design of the hull. One of the best designs is that in our handbook, "Model Boiler Making," price 7d. post free from this office, on page 46. We should prefer in place of the coiled tube that a steam drum about 1½ ins. diameter and the whole length of the boiler, each end being connected to one of the water drums. A "blow-in" burner (benzoline, paraffin, or methylated spirit) may be used in conjunction with this boiler, and by this means the centre of gravity may be kept comparatively low down in the boat.

[13,052] **Low Voltage Dynamo.** G. W. M. (Yeovil, Somerset) writes: Enclosed please find tracing of an undertype dynamo that I am making. I want to get 5 volts, *not* more, and *as many amps. as possible.* Please answer the following:—(1) How much, and what size, standard wire gauge wire on the field-magnets, double or single cotton? (2) How much, and what size S.W.G. on the armature (eight-slot, wound in four sections), and whether double or single cotton? (3) What output can I expect at 5 volts, and at what speed to work?

(1) It is not advisable to wind small drum armature dynamos with a thick gauge wire, so as to produce low volts, as they are liable to refuse to excite. It is better to wind for about 8 volts and use some resistance in the main circuit. We advise you to use



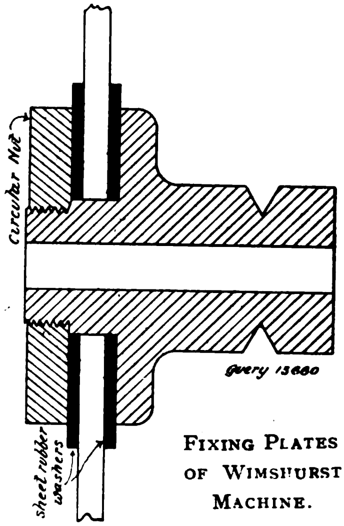
LOW VOLTAGE DYNAMO.

No. 20 S.W.G. s.c.c. copper wire for the field, and to get on about 2½ lbs. in all, or more if the coils will hold it; half of this wire will of course, go on each bobbin, the coils to be joined in series with each other, and in shunt to the armature. We presume the cores are circular and of wrought iron; they are insufficient in size for good proportion. We advise you to make them at least 1 in. diameter, 1¼ ins. would be better still. If you keep to ¾ in. diameter, you will get higher speed or smaller output. (2) Wind armature with No. 23 S.W.G. double silk-covered copper wire, getting on as much as possible; about 6 ozs. will be required. We advise you to wind eight coils instead of four, two being in each slot. (3) Output 6 to 8 volts and about 7 amps. at 3000 revolutions per minute. You may be able to work at 5 volts at a lower speed. Exact output and speed cannot, in small machines, be stated precisely.

[14,334] **Converting Engine from Oil to Petrol.** W. J. E. (Pontardulais) writes: I have recently bought an oil engine and wish to convert same to use petrol (electric ignition). Herewith I enclose rough sketch (not reproduced) and trust you will understand same. (1) Could I fit sparking plug in air-valve marked A, back end of cylinder? (2) Should I remove present ignition plugs and fill holes up? (3) Would Mr. Turner's carburettor (1902, *M.E.*) be suitable for above, or would it be best to fit a "Longuemare"? (4) Would it be best to govern by throttle, or wipe contact—*i.e.*, advance sparking? (5) What should be the bore of inlet pipe? At present ⅜ in.

(1 and 2) If you did, where would you put your air-valve? We doubt whether the oil inlet is large enough to pass a sufficient quantity of air *and* petrol vapour. If you make it large enough, and then passed all the air required in to cylinder with the petrol, then all would be right. Failing this, you must retain an air inlet to mix with and dilute the petrol vapour. (3) Yes. (4) Throttle. (5) Not less than 1 in., if both air and petrol are admitted by same pipe.

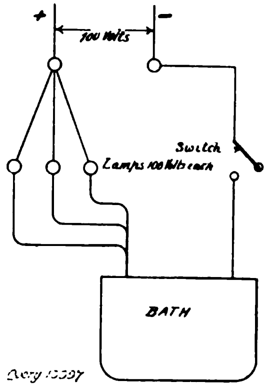
[13,660] **Wimshurst Plates.** A. F. C. (Sunderland) writes: I am constructing a Wimshurst machine, and should be glad of your advice *re* the following. I want to be able to keep the glass plates separate from their respective pulleys, but fail to see how I can fix them to pulleys in a sufficiently secure manner when in use. My idea for having them separate is for ease of portability, as



FIXING PLATES OF WIMSHURST MACHINE.

when the pulleys are fixed permanently it would necessitate a box of 6 ins. deep; when loose one of ½ in. deep would be ample. Hoping that the few particulars and sketch (not reproduced) will be sufficient for you to give me some idea.

You will find a method of fixing the plates so that they could be detached in THE MODEL ENGINEER for January 7th, 1904, page 23; another way would be to hold them with circular nuts; the nuts could be made thin and of some hard material. Try ebonite. A brass sleeve could be threaded on the hub to take the screw on to which the nut would turn. It would be a good plan to use a



CONNECTIONS FOR GILDING AND PLATING,

washer of thin sheet rubber on each side of the glass plate to help to grip the plate and to form a soft bed to take the pressure of the nut. We should recommend the rubber washers if you adopt the plan shown in THE MODEL ENGINEER.

[13,997] **Gilding and Plating.** C. W. R. (London, N.W.) writes: With reference to a former query *re* gilding and plating—(1) If I arrange the lamps as per enclosed sketch, will this be right? (2) How many lamps should I require to reduce the pressure to 2 volts? I have seen in shop windows charging boards for accu-

mulators, with a handle for altering the current. (3) Can I use one of these, and how shall I make my connections? (4) What will the voltage of the lamps be? Will they all be the same, or lower as the pressure weakens?

(1) The lamps should be arranged in parallel as diagram, *not* as in your sketch. (2) You need not trouble about the volts on your bath, but should take heed of the amount of current. This you can ascertain by knowing how much current each lamp takes by its candle-power. A 100-volt 32 c.-p. lamp takes about 1 amp.; a 16 c.-p. lamp about ½ amp.; an 8 c.-p. lamp about ¼ amp., reckoning average efficiency lamps. You have merely to add lamps in parallel until you pass enough current through your bath. As there are 100 volts forcing the current through the lamps, it is bound to go through the bath as well, as the bath offers very little resistance indeed, not worth taking into account, and your bath cannot possibly send current back because of the resistance of the lamps; hence you need not trouble about the volts; all you need look after is the *amount of current*, as it is the current which deposits the metal. (3) Regulate by putting in more or less lamps; you can regulate by means of a contact switch if you care to go to the expense, but it is easy to take lamps out by hand. (4) Lamps should be of 100 volts. A ceiling rose usually is only of a capacity to pass about 2 amps. Stand the bath on a rubber mat or a block of wood which has been well varnished, or a sheet of vulcanite, and do not allow the liquid to splash over, so that you keep your circuit well insulated from earth.

[14,299] **Electrolysis of Calcium Chloride.** R. P. K. (Windsor) writes: In your issue of June 15th I see it stated that calcium metal is now made by the electrolysis of calcium carbide. I have always understood that calcium carbide is infusible even at the temperature of the electric arc furnace, and also that calcium is made by the electrolysis of its chloride. I should be glad of further information on the subject.

You are perfectly correct. Calcium is made by electrolysis of its fused chloride. The metallic calcium fuses at a slightly higher temperature than its chloride, and as electrolysis proceeds the electrode is very gradually withdrawn from the fused chloride, the metal adhering to it in a just solid condition.

[14,255] **Transformers for Charging.** J. W. T. (Upper Tooting) writes: If not trespassing too much on your valuable time would you mind answering the following query:—The voltage on mains here is 205 volts, periodicity 85, and at times I want to charge four large 40-amp. ignition cells, and by using lamps for resistance it will be very wasteful of current; therefore, how can I find out windings of a transformer to give out 20 volts 4 amps. so made as to be insulated in oil?

Some articles on the design of alternating current transformer are given in The Model Engineer for December 10th, 17th, and 24th, 1903. There is no need at all to use an oil insulated transformer. Several designs for small transformers are also given in back numbers.

[14,308] **To Become an Electrical Engineer.** W. J. R. (Ystym-Colwyn) writes: I am writing to ask you for your kind advice on the following points. I am a farmer's son, twenty years of age, and wish to become an electrical engineer, but my parents will not pay for me to go as an apprentice. (1) Do you know anything about the Electrical Engineer Institute of Correspondence Instruction conducted by Messrs. Wetzler & Martin? If so, what is your opinion of it? I have one of their catalogues, and think of taking the complete course (No. 7) in electrical engineering. The price is 13 guineas, and the student is furnished with a Reference Library and books for his study. By what I gather from the testimonials, the student who takes this course gets a sound, practical knowledge of his subject, and they also state that it is as good as a technical college. I also see that something appeared in your 1902 papers on "How to Become an Electrical Engineer." (2) Would these be of any use if I were to get them? I take great interest in any engineering subjects, and am sure I should get on well. (3) Kindly let me know, too, whether or not the statement is true that engineers experience great difficulty in obtaining employment? (4) About what salary per year or week does a good engineer get? I hope you will kindly give me the information I require, and any other points that would be likely to help me.

(1 and 2) We believe that the Institution referred to gives very good courses of instruction, and that you would get good value for the fees paid. The articles in The Model Engineer, Vol. VII, on "How to Become an Electrical Engineer," should prove useful reading for you; they are not a course of instruction in the electrical engineering, but consist of advice on how to proceed. (3) The business of electrical engineering is considered to be in a crowded condition; pay is low, and good positions difficult to obtain; all things are, however, possible to genius, and the field is an increasing one. (4) About £200 per annum, as a rule, for positions of responsibility, but there are plenty of highly trained electrical engineers receiving about 30s. per week. The best pay is given for experience of a practical nature; you should get as much of this as possible in handling electrical machinery and testing work in a technical college. A reply to a similar query was published in The Model Engineer last week; we advise you to study it with due consideration.

The News of the Trade.

** Reviews distinguished by the asterisk have been based on actual Editorial inspection of the goods noticed.*

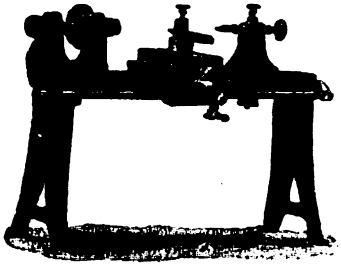
A Disclaimer.

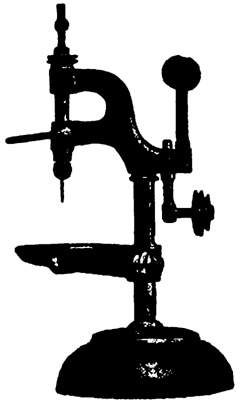
We are asked by Mr. A. A. Maxwell, the managing director of the Twentieth Century Motor, Co., Ltd., of Penge, to state that he is in no way connected with a person of the same surname engaged in the motor trade in Penge, who was recently convicted of robbing a trust fund.

Model Workshop Tools.

We have received from Messrs. W. J. Bassett-Lowke & Co., Northampton, samples of some realistic model workshop tools. These tools are fully described in a new four-page leaflet they are publishing (which will be sent to any reader on receipt of a stamp) and are really excellent models. The lathe, a picture of which we herewith reproduce, is a well-made model of a screw-cutting

Model Screw-Cutting Lathe.





Model Sensitive Drilling Machine.

Model Engineer's Machine Tools, by W. J. Bassett-Lowke and Co.

lathe with hand surfacing slide-rest. It has a planed iron bed 8 ins. long, 1½ ins. centre, headstock with steel mandrel and chuck, change wheels and tool post for a 3-16ths in. tool. Other models include—circular saw and bench, drop hammer, power hammer, power punch, shears, grindstone and a sensitive pillar drilling machine. The latter is one of the best of the set. It has adjustable circular table, and three-jaw chuck. The height over all is 9½ ins.

New Catalogues and Lists.

The "Silver Queen" Cycle Co., Ltd., 56, Edgware Road, London, W.—We have to hand a copy of the new season's list of the well-known high grade cycles supplied by the above Company. This list is well illustarted, and contains much useful information and besides the prices and particulars of machines of various qualities includes those of accessories and component parts. It also comprises an illustration and specification of the 1905 "Royal Ajax" 2¾ h.-p. motor bicycle. Accompanying the list we received a copy of a useful pocket-book, "The Cyclist's Enquire Within."

Consett Iron Co., Ltd., Consett, co. Durham.—This firm send us a booklet giving particulars of the engineering commodities they supply, which include all grades of Siemens-Martin steel plates, coal, coke, and firebricks, pig iron, chequered plates, and sectional steel bars. A trade card should be enclosed with all enquiries.

The Editor's Page.

IN this issue, on page 53, we reproduce a photograph of the indoor model railway built by Mr. S. L. Solomon, one of the oldest members of the London Society of Model Engineers. Owing to the difficulties of the situation—the railway is in a room very poorly lighted—the picture does not convey the best idea of the general excellence of the work; however, it may act as a stimulus to readers who only take a passive interest in the signalling portion of a model railway to devote themselves to similar work. For our own part, we may mention that we have, thanks to Mr. Solomon, spent several interesting hours manipulating the various points and signals, and watching the shunting of the model trains.

* * *

We quote the following letter from a correspondent "Oona," on which some of our readers may like to express their views:—"In comparing some of the back numbers of THE MODEL ENGINEER, more especially those of older date, with those of the present time, I have been struck by the much larger space which you used to devote to the subject of model yachting. Would it be possible for you to give some space, say, once a month to this subject. I do not mean to the building, designing, or rigging of model yachts, as on these subjects you have not only had several excellent articles, but also published a book dealing with the subject. What I do mean is, if you could give some space to reports of races, club doings, etc. There must be a large number of your readers interested in the sport, and I am sure that if you gave more space to it you would have a number of subscribers who, though not interested in model engineering, would subscribe towards a paper giving model yachting some space. I was lately in the workshop of one of the principal model yacht builders, and saw quite a number of models both built and building, so that interest cannot be on the wane. I greatly appreciate the articles which have appeared in the *M.E.* on designing and building models, but I cannot help thinking that if some space were given to reports of races, illustrations of models, and other model yachting news, it would greatly increase the value of your paper to all model yachtsmen. There should be no difficulty in getting the reports, as in most cases club secretaries would be very glad to send in accounts of races for publication. I would also suggest that a register of clubs published from time to time in the *M.E.* would be most useful. If readers interested were asked to send in particulars of any clubs in their neighbourhood, with the address of secretary, it should not be long before the principal clubs were on your list. Such a register as I suggest would make it much easier to get up inter-club races, and would also cause many men to join clubs who are at present prevented from doing so by ignorance of the existence of a club in their neighbourhood. I should be much obliged if you could publish this letter, so as to get the opinions of others of your readers on the subject."

* * *

A correspondent writes saying that he has some thirty cloth-bound volumes of the *Engineer* and *Engineering*, dating from 1882 to 1888, which he must dispose of very shortly. As he would like to give them to the library of some society or other properly-constituted body, where they would be of real service to the members, we shall be glad to hear from any reader who can suggest a suitable "home" for these volumes.

Notices.

The Editor invites correspondence and original contributions on all amateur mechanical and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected or not, and all MSS. should be accompanied by a stamped addressed envelope for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

This journal will be sent post free to any address for 13s. per annum, payable in advance. Remittances should be made by Postal Order.

Advertisement rates may be had on application to the Advertisement Manager.

HOW TO ADDRESS LETTERS.

All correspondence relating to the literary portion of the paper, and all new apparatus and price lists, &c., for review, to be addressed to THE EDITOR, "The Model Engineer," 26—29, Poppin's Court Fleet Street, London, E.C.

All correspondence relating to advertisements and deposits to be addressed to THE ADVERTISEMENT MANAGER, "The Model Engineer," 26—29, Poppin's Court, Fleet Street, London, E.C.

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Contents.

[*The asterisk* (*) *denotes that the subject is illustrated.*]

THE
Model Engineer
And Electrician.
A JOURNAL OF PRACTICAL MECHANICS AND ELECTRICITY.

EDITED BY PERCIVAL MARSHALL, A.I.MECH.E.

VOL. XIII. No. 222. JULY 27, 1905. PUBLISHED WEEKLY.

An Example of Fine Casting.

THE accompanying photograph was taken from an ornamental plate sent for our inspection, recently cast in Messrs. Drummond Bros.' new foundry. It is really a beautiful piece of work, and was cast from a plate bought by Mr. Drummond some time ago as a curio, the only other one he knows of being in the Geological Museum, Jermyn Street, London. It is referred to in the catalogue of this collection as follows :—

". . . Some beautiful specimens of the delicate Berlin castings are in this case. At the time when the final struggle commenced between Prussia and Napoleon, the patriotism of the Prussian ladies was particularly conspicuous. With the noblest generosity they sent their jewels and trinkets to the royal treasury, to assist in furnishing funds for the expenses of the campaign. Rings, crosses, and other ornaments of cast iron given in return to those who made this sacrifice, bore the inscription 'Gold für Eisen' (gold for iron), and such Spartan jewels are, to this day, much treasured by the possessors and their families. This led to the production of ornaments far more delicate than anything which had heretofore been manufactured; and these becoming known and admired in every part of Europe, an extensive trade in them speedily arose. The large circular ornamental casting, with the sand attached as it was taken from the mould, shows the perfection to which the processes have been brought. It has been thought that much of the beauty of these castings depends upon the sand employed in forming the moulds. . . ."

We think that the plate we show speaks well for the general equipment and materials used in the new foundry. It was cast in quite the ordinary manner, with the usual moulding box, and with the same sand and iron as used for all castings of their well-known lathe, and without the very specially constructed pattern used by the Berlin founders. Of course, the principal credit is due to Messrs. Drummond's foundry foreman, Mr. S. Simpson, who made the mould. The photograph shows the plate just as it left the sand, without any trimming or touching up. The small projections at the head are really casts of the foreman's thumb nail, made as he lifted the pattern from the sand.

Oil or fat exerts a most destructive influence on Portland cement. The result shows in coarse cracks, weakening and even disintegrating the mass in the course of a few months.

Piston Rings for Small Power Steam Engines.

By Samuel Keighley.

I SHOULD like to bring before your notice the piston ring I have designed. I have tried them both in large and small engines, and several are working at the present time.

The ring is cut into four quarters, as you will see by the photographs and drawings. The ring itself

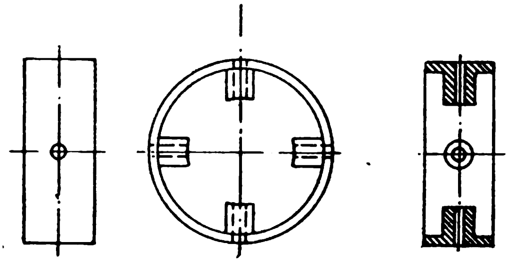


Fig. 1.—Guide Ring.

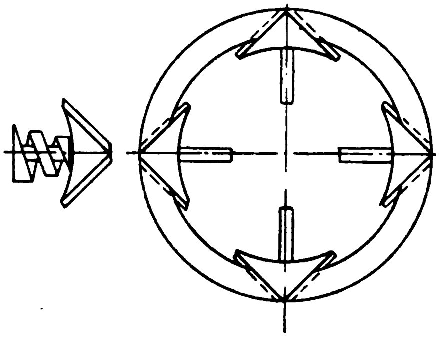


Fig. 2.—Ring and Vee Pieces.

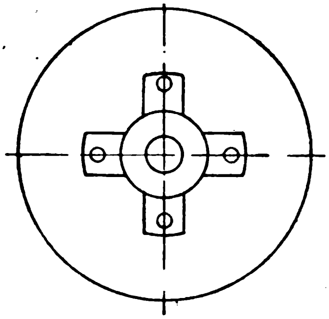


Fig. 3.—Piston Body without Guide Ring.

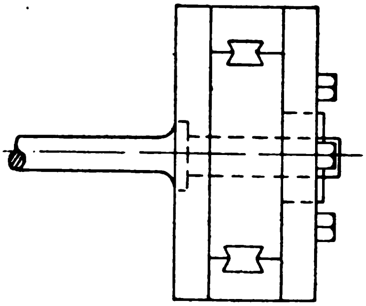


Fig. 4.—Piston Complete.

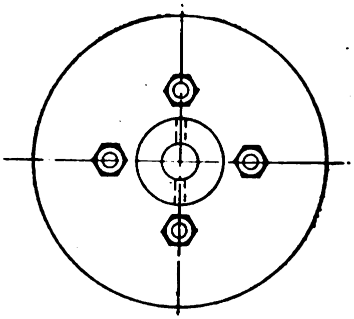


Fig. 5.—Piston Body with Lid on.

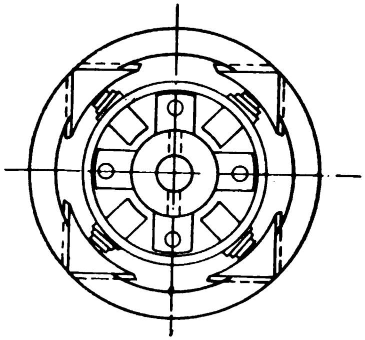


Fig. 6.—View of Rings Complete.

I prefer to make of cast iron; into these are fitted four vee-pieces, for the purpose of adjusting the wear that takes place. These vees are thrust out by spring coil, as shown, or by spiral springs bedded into boss of piston body. The novelty of this ring lies in the fact that each vee-piece is dovetailed into each portion of the ring, thus maintaining a more equal expansion of the ring. If one portion tended to expand more than another, the fact of their being dovetailed in the manner shown would lock

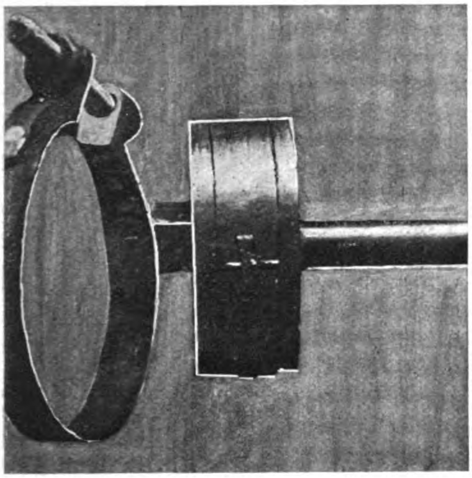


FIG. 7.—A COMPLETE 4-IN. PISTON AND CLAMP.

that portion and retain it till the opposite side expanded. This also allows uniform wear on all parts of the ring.

Another advantage is that there is no passage for steam—as the ring wears the vee-blocks follow up the gap, thus keeping the ring practically as tight as a solid ring, with the advantage of being as elastic as possible. I may mention that this ring can be employed for pumping, instead of bucket leathers. The photographs were taken from a piston 4 ins. in diameter.

The "Racing Engine."

A FEATURE of the exhibition of the Royal Agricultural Society used to be the "racing engine." A racing engine had to be built six or twelve months before the time of trial, placed in a special shed and worked by a special staff, and every possible effort was made to get the highest possible result out of it. When the trial at the show grounds came on, the competitor declared what power his engine was going to work at, and 14 lbs. of coal were allowed per declared brake horse-power. The engine that ran the longest on the coal allowance won the prize. Nearly all the engines were fitted with jackets, so that steam could be turned into them when necessary. Mr. Vaughan Pendred, in discussing the recent report of the steam engine research committee, called attention to the fact that an examination of the reports of the Royal Agricultural Society would show that not one single engine which admitted steam to the jacket had taken a prize.

AT the Borough Polytechnic Institute recently marble busts of Joseph Lancaster and Michael Faraday (the work of Mr. H. C. Fehr), presented to the Institute by Mr. Passmore Edwards, were formally unveiled by Prof. S. P. Thompson, F.R.S.

Electrical Resistance of Steel.

THE May *Bulletin* of the Société d'Encouragement pour l'Industrie Nationale contains a short but interesting article upon the "Electrical Resistance of Steel." Following up some experiments made some time ago by Monsieur H. Le Chatelier, the author of this article—Monsieur P. Mahler—has carried out a series of tests on specimens of steel containing varying amounts of carbon, manganese, sulphur, phosphorus, and silicon. Generally speaking, he has established the fact—which, in truth, is what might have been expected—that the more impure the steel, the higher is its electrical resistance.

For example, in one of his sets of experiments he took five test-pieces, varying from soft steel with a breaking stress of 40 kilos. per square millimetre of cross-section, to hard steel with a breaking stress of 70 kilos. The percentage of carbon varied from 0·16 per cent. to 0·62 per cent., and of manganese from 0·70 per cent. to 0·80 per cent. The observed resistance was 14·6 michrom-centimetres for the soft steel, and 18·0 michrom-centimetres for the hard steel. M. Mahler found that the total resistance varied in accordance with the formula $R = 10 + 7\,C + 5\,Mn$; where C is the carbon, Mn the manganese, and 10 the resistance due to the iron and to the other impurities, such as sulphur, phosphorus, &c. The 7 and the 5 for carbon and manganese were the figures which M. Le Chatelier had found in his experiments. The coefficient 10 has been found by M. Mahler, and within the limits

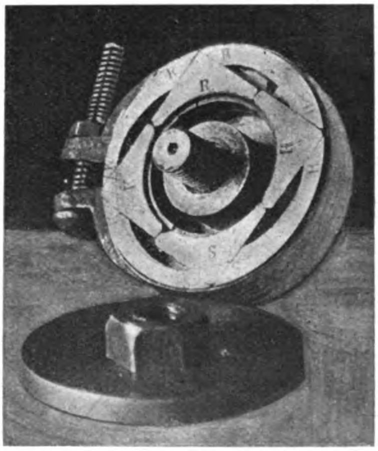


FIG. 8.—VIEW SHOWING INNER CONSTRUCTION OF PISTON RING.

of his investigations the formula appears to give the resistance of any steel of known composition very fairly nearly.

There are discrepancies, which are sometimes on one side and sometimes on the other; but in a number of cases the calculated resistance was found to be the same as that which was obtained by measurement. Perhaps the balance lies rather in the direction of the coefficient, 10 being somewhat high, but this error is certainly on the right side. The ability to estimate the electrical resistance of steels of known composition within a reasonable degree of accuracy is highly important, having regard to the increasing use of steel rails for conducting electricity, and it would appear that in samples of metal known to be more or less oxidised or more or less gaseous, the actual resistance is less than what might be looked for if the above formula is taken as a basis. This means that, at any rate, the probabilities are that a calculation of the resistance is more likely to err on the high than on the low side.—*The Engineer.*

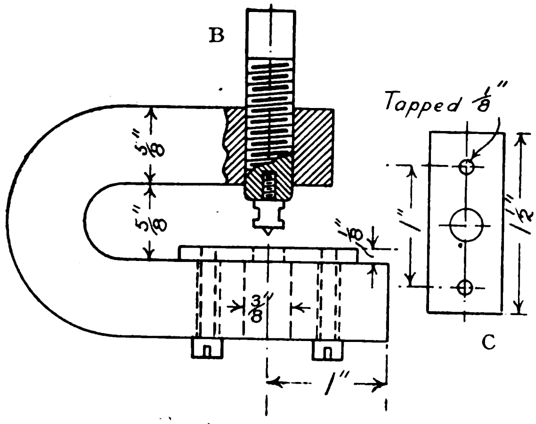
Workshop Notes and Notions.

[Readers are invited to contribute short practical items for this column, based on their own workshop experience. Accepted contributions will be paid for on publication, if desired, according to merit. All matter intended for this column should be marked "Workshop" on the envelope.]

A Small Punching Machine.

By "Round Square."

The tool here described is known as a "Fly press." I have used it for punching round holes



A Home-made Punching Machine.

in armature laminations, and thin sheet metal up to 5-16ths diameter. (For larger sizes I have a bigger machine). It is intended to be held in the vice. A is a piece of tool steel, ⅝ in. square, about 7 ins. long, bent to the form shown. B is a steel spindle, screwed ⅜ in. Whitworth, and tapped 2 B.A. to take die, with square on top to fit tap wrench. It will be seen that the punch has a narrow slot each side to fit spanner for changing. The points on these are handy when using the press on marked-off work, such as rivet holes in a model boiler; but when using a jig it is not necessary. C is the die in my case; they are made from old smooth files. When hardening these, I find it best to use warm water, as it is not so liable to produce cracks. Plenty of clearance must be allowed for the holding down screws of dies for the purpose of adjusting.

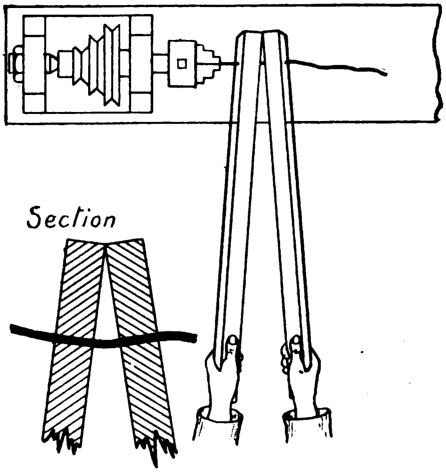
Polish for Brass and Copper.

Take ¾ lb. of rotten-stone, 1½ ozs. of oxalic acid, and ¾ oz. of gum arabic. Finely powder these ingredients. Then make a paste by stirring into the dry ingredients 1½ ozs. of sweet oil and as much water as necessary.

How to Straighten Wire.

By W. P.

The process of straightening short lengths of thick wire which have been cut from a hank is usually very laborious if done with a mallet. It can be done in the lathe quickly and easily by a method shown in sketch. Grip the wire in the chuck, and roughly straighten it with the hand, so that it clears the bed. Now get two pieces of hardwood about 1 ft. by 2 ins. by ½ in., and bore a



How to Straighten Wire.

hole in each about 2 ins. from one end to fit the wire. Slip them on the wire close up to chuck, and start the lathe. The pieces of wood are now gripped in the position shown in the sketch, keeping the end farthest away pressed close together, and twisting the pieces of wood in opposite directions. Now move slowly along the wire, keeping in same position. If the wire is not now straight, repeat the process. When the holes get too big, new holes can be bored at a little distance from them. The way this method works is this, the wire gets slightly bent while revolving in going through the holes in the wood, and so takes up a neutral position as soon as it is free from the holes.

Another "tip" for when you have several pieces of sheet brass or copper to be filed or bored similarly, is to cut them out roughly, flatten, and then grip them together in the vice between two pieces of wood, and solder the edges together just enough to hold them. They can now be shaped or bored, and, if care is taken to file square, on melting apart, they will be exactly the same shape and size.

A Lacquer for Brass.

By J. H. P. B.

Take 2 qrts. of rectified spirits of wine and 3 lbs. of seed lac, picked particularly clean, and clear of all black specks; upon the cleanness depends the brightness of the lacquer. Add the two together, put in a bottle, keep warm, and shake often till dissolved. Apply to brass with a camel's hair brush, taking care that the brass is perfectly clean and free from grease.

The Latest in Engineering.

A Portable Electric Power Station.—Many very useful motor-dynamo plants have been introduced by the De Dion-Bouton Company for lighting country houses, and for other purposes where a supply of electricity is required in out-of-the-way parts. That which the *Automotor Journal* recently illustrated is a portable installation mounted upon a tubular frame, and designed for horse haulage. It has a standard four-cylinder 15 h.-p. petrol engine coupled direct to an unusually light 10-kilowatt dynamo, and is rendered completely self-contained, with the necessary tanks, radiator, fan, and switchboard. The makers also build self-propelled plants of a similar kind, the power being transmitted electrically to the road wheels.

Dust-Laying on Roads.—The dust-laying experiments which have been conducted on the main road between Hythe and Folkestone are reported to have proved a success. The area treated with the tar solution was 5,288 sq. yds. The cost of this is reported by the surveyor to be a little over £30, equal to 1·38d. per sq. yd.

New Locomotives for America.—An order for twenty-two large compound passenger locomotive engines and tenders for the Buenos Ayres and Rosario Railway Company has been received by Messrs. Robert Stephenson & Co., Darlington. The engines are to be of the six-wheel type, coupled, with leading bogie and double bogie tenders. The firm have also booked an order for the Argentine Transandine Railway Company for three tank locomotives. Messrs. Hudswell, Clarke & Co., of Railway Foundry, Leeds, have lately signed a contract for supplying some powerful bogie tender locomotives for the Central American Railway.

Can Iron Grow?—That iron can be made to grow is shown by a new process for which the Franklin Institute has awarded the Elliot Cresson Gold Medal. The process consists in heating and cooling the bar of iron which it is intended to magnify to a "critical" temperature a number of times. The results are extraordinary. To the Mechanical Science Section of the American Association two bars of iron cast in one mould were presented for critical inspection. One bar remained exactly as cast. The companion bar had been caused to grow gradually in cubical dimensions till it is now 46 per cent. larger than the other, the weight remaining the same as before expansion. Both bars were machined on one side to show the texture and metallic appearance; and it was difficult to detect any change except the very apparent difference in size. It is said that important practical applications have already been found for this remarkable discovery.

Improvements in Locomotives.—Mr. Hugh Reid, managing director of the North British Locomotive Company, Ltd., Hyde Park, Glasgow, and Mr. David M. Ramsay have devised a new form of locomotive. Upon a frame mounted upon two bogies is carried a modified locomotive boiler, which supplies steam to a turbine of the Parsons type. The turbine is directly coupled to an electric generator of the multi-phase type, to an exciter for the generator, and to a centrifugal air pump. The generator supplies current to a series of motors geared by gearing enclosed in gear cases to the axles of the bogie wheels. A controller, rheostat, etc., are provided for regulating the current and the speed of the locomotive. A condenser is employed for the exhaust steam of the turbine, the condensing surfaces of which are cooled by air drawn over them by the rapidity of motion of the locomotive when running, and by means of a centrifugal air pump when the locomotive is stationary.

Compound Gas Engine.—According to the *Iron Age*, a compound gas engine has been built with two high-pressure cylinders and a single low-pressure cylinder between them. The high-pressure cylinders work on the Otto cycle, the engine receiving one impulse from them each revolution. The exhaust from the two explosions is expanded in the low-pressure cylinder, the crank of which is 180° behind the high-pressure cranks. Thus at every forward stroke the low-pressure cylinder takes the exhaust gases from one of the high-pressure cylinders. The total effect is thus to produce an impulse every half revolution. With a 12 h.-p. engine 13 b.h.-p. were obtained with the low-pressure cylinder in use, and only 8·9 h.-p. without it, 46·2 per cent. being thus added to the power by the use of the low-pressure cylinder and without the expenditure of any additional fuel.

A Speed Indicator for Motor Cars.—Davis's speedometer is an extremely simple appliance for showing at a glance the speed at which a vehicle is moving. There is only one working part, and that is a small eccentric. The eccentric carries a short piston-rod, which actuates a rubber disc forming one end of an air chamber, and oscillates air over the end of a small air tube, creating a vacuum. This vacuum varies with the speed of the car. The indicator is connected by a tube with the pulsator, and is fixed on the splashboard, and a coloured liquid in a glass tube shows at a glance the speed travelling in miles per hour. The indicator requires no timing. The apparatus is supplied by the Wolseley Tool and Motor Car Company, Ltd., Birmingham.

The United States Navy.—The dynamite cruiser *Vesuvius* is about to be put in commission at the Charlestown navy yard. She is practically a new ship, 200,000 dols. having been expended to convert her into a torpedo training ship, and little but the hull, engines, and boilers being left of the original vessel. Built as an experiment to mount dynamite guns, the *Vesuvius* was a failure. To-day she is a modern ship of probably greater speed than her original 21½ knots per hour, owing to improvements in her engines and boilers, upon which 50,000 dols. have been expended. She carries three above-water and two submerged torpedo tubes, and also a few light guns.

New Locomotives for the Miniature Railways of Great Britain, Ltd.

(Concluded from page 30.)

THE Blackpool Railway is situated on the beach at the south end of the town, quite near to the Maxim flying machine. The one for children), and proceeds up to the gate at the platform, where the ticket is punched in the orthodox manner by the ticket examiner. Tickets are collected after the passengers have had their ride, as they leave the station. The booking office also contains a bookstall. Here the visitor can obtain the current issue of THE MODEL ENGINEER and any of the sixpenny handbooks, together with post-cards and pamphlets illustrating and describing the railway. On the fences and walls of the

FIG. 13.—"GIPSYVILLE" STATION, MINIATURE RAILWAY, BLACKPOOL, AND SOME OF THE STAFF.

railway is a continuous one, about 455 yds. long, and is laid on the flattest portion of the sands in such a way as to miss the sandhills and other permanent buildings in the vicinity, and to reduce the amount of excavating to a minimum. It was not, however, possible to obtain a really level line; and to open the line for the Whitsun holidays—which was the chief object in view—only a small amount of cutting was attempted, embankments being raised to reduce the steepness of the gradients. Since, however, a cutting has been made at the highest portion of the site, as shown in the accompanying gradient profile drawing.

The rails are of steel, rolled to the Vignolles or flat-bottomed section. They weigh 12 lbs. per yard and rest on pressed steel sleepers. The rails are fixed to the latter by riveted clips on the outside, and dogs on the inside. On the softest portion of the site the sleepers are supported by timbers and stakes. A siding capable of holding four carriages is also provided at the station as indicated on the plan herewith.

The station is, of course, the chief feature of the railway. From end to end it measures about 100 ft., the platform itself being 55 ft. long without the ramps (or slopes) at the ends. The booking office is placed at one end, and entering the barrier the passenger passes the ticket window, purchases his ticket (there are two fares—one for adults and

booking offices are the advertisement plates of well known commodities. At the other end of the station is the engine house and water tank. The

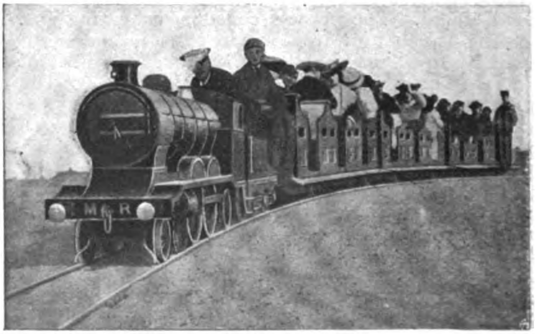


FIG. 14.—A TRAIN OF THREE COACHES.

former embraces part of the siding, and when the day's work is done, the engine can shunt the train through the engine house up to the buffer stops whilst it remains under cover for the night. The station buildings are of quite an attractive character, and were built by Mr. H. Jarvis—who is perhaps known to many of our readers as a contributor to *The Woodworker*—to the drawings of the engineer. Mr. Jarvis was also responsible for the carriage bodies. These are bogie vehicles, which are now provided with a roof to shade the passengers from

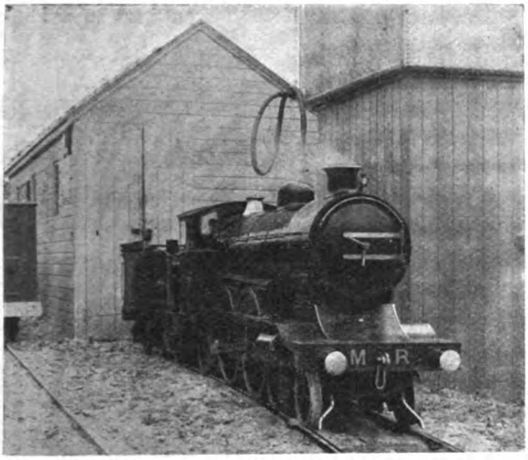
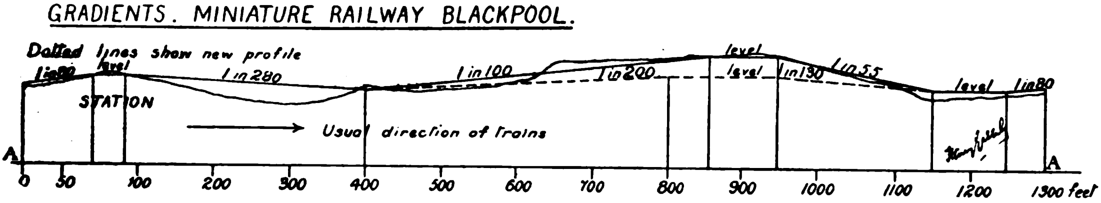


FIG. 15.—THE WATER TANK AND ENGINE SHED.



the sun, and to protect them from any smuts from the engine chimney, and carry twelve adult passengers in each. They measure 13 ft. long by 2 ft. 6½ ins. wide over the bodies. The bogies are cast in one piece, and are provided with solid wheels 8 ins. diameter and dust-proof padded axle-boxes.

The whole railway and staff are under the superintendence of the station master, Mr. Geo. Mead. The staff number a booking clerk, two drivers, ticket examiner, guard, and two platelayers—all of whom wear a uniform or uniform cap. The station is named "Gipsyville," owing to the proximity of the renowned gipsy encampment. The only drawback to the site is the sand, which has considerably increased working expenses and wear and tear of the engine and rolling-stock.

ELECTRIC TRACTION is to replace steam power on the Chicago and Evanston line of the Chicago, Milwaukee, and St. Paul Railway, and the line will be operated by the North-Western Elevated Railway, which will connect with the surface line by an extension from its present terminus at Wilson Ave. All passengers and freight traffic will be handled by electricity north of this point, and within a few years the railway will be elevated from Wilson Ave. to the city limits. The cost of electric wiring and equipment will be about £200,000.

Boiler Incrustation.

M. E. ASSELIN, of Paris, recommends the use of glycerine as a preventative of boiler incrustation. It increases the solubility of combinations of lime, and especially of the sulphate. It forms with these combinations soluble compounds. When the quantity of lime becomes so great that it can no longer be dissolved, nor form soluble combinations, it is deposited in a gelatinous substance, which never adheres to the surface of the iron plates. The gelatinous substances thus formed are not carried with the steam into the cylinder of the engine. M. Asselin advises the employment of 1 lb. of glycerine for every 300 lbs. or 400 lbs. of coal burnt. Other preparations are:—

(1) For a 5 h.-p. boiler, fed with water, which contains calcic sulphate, take: Catechu, 2 lbs.; dextrine, 1 lb.; crystallised soda, 2 lbs.; potash, ½ lb.; cane sugar, ½ lb.; alum, ½ lb.; gum arabic, ½ lb.

(2) For a boiler of the same size, fed with water which contains lime: Turmeric, 2 lbs.; dextrine, 1 lb.; sodium bicarbonate, 2 lbs.; potash, ½ lb.; alum, ½ lb.; molasses, ½ lb.

(3) For a boiler of the same size, fed with water which contains iron: Gamboge, 2 lbs.; soda, 2 lbs.; dextrine, 1 lb.; potash, ½ lb.; sugar, ½ lb.; alum, ½ lb.; gum arabic, ½ lb.

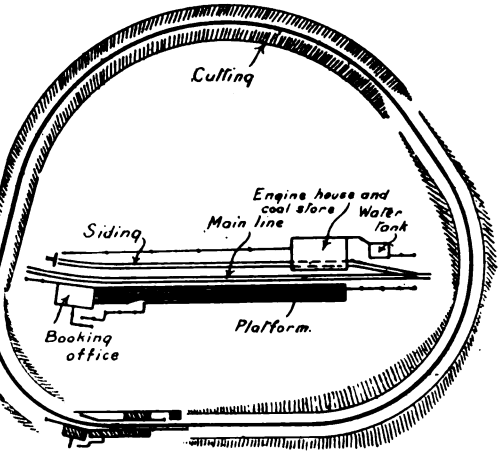


FIG. 16.—PLAN OF LINE AND GRADIENTS.

(4) For a boiler of the same size, fed with sea water: Catechu, 2 lbs.; Glauber's salt, 2 lbs.; dextrine, 2 lbs.; alum, ½ lb.; gum arabic, ½ lb.

When these preparations are used add 1 qrt. of water, and in ordinary cases charge the boiler every month; but if the incrustation is very bad, charge every two weeks.—*Chemical Engineer.*

Thermit

For Alumino-Thermic Welding.

(*Continued from page* 58.)

THE strength of the weld is about 80 per cent. of the strength of the original material. The shoe welded on to the foot of the rail not only makes up for the remaining 20 per cent., but materially strengthens the rail at the joint (Fig. 6). The head does not get softer, although it is brought to welding heat, the reason being that the operation takes place without the air having access to it. Test rods cut out of rails brought to welding heat by this process prove that tensile strength and elasticity have not suffered—a fact which is confirmed by three years' practical experience on tram-roads.

The third rail of an electric railway is also welded by this means. The skin resistance of copper bonds increases with time, and frequent repairs are necessitated thereby. Welding obviates these repairs. It can be done in two ways. The first is identical

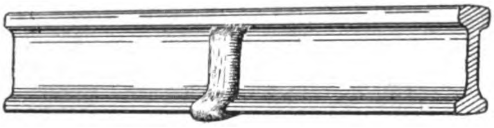


FIG. 6.—A THERMIT WELDED RAIL.

with the one described before (but without the use of clamps), and is now in operation on twenty miles of road at Paris, France, where a short track gave satisfaction after a year's trial. The second consists in welding a small bridge of "Thermit" iron between the feet on one side of the rail. Both are in use on a large scale. The other side of the joint, where there is no "Thermit" welded "bridge," is mechanically strengthened by an ordinary light fish plate.

In this case the crucible is superfluous. The welding portion of about 3 lbs. only is placed directly into the upper part of the mould, which is prolonged by a piece of gas pipe (Fig. 7).

Steel girders for construction work can of course be welded in just the same way as rails. For really solid jointing equal to the strength of the girder itself, welding is necessarily cheaper than riveting.

The next field of application is the repair of solid iron and steel objects. The compound, as already noted, gives 50 per cent. of mild, very overheated steel, with 0·1 carbon, which can be hardened if desired, for instance by an addition of manganese. Whoever has a supply of the compound "Thermit" has a supply of liquid steel. Accordingly, foundries can correct faulty castings, machinery shops can mend broken or worn-out parts, and last, but not least, marine engineering works can repair large steel castings, such as crankshafts (Fig. 9), and particularly broken stern-posts.

Wherever the distance from construction shops is a matter of consideration, and in all outlying districts, this is of particular value.

The most startling and, at the same time, most effective work done in the way of repairs by the Alumino-Thermic process is in connection with marine engineering. To weld broken stern-posts of big transatlantic liners, or crankshafts or similar pieces, crucibles of 6 ft. in height, with a capacity of 7 cwts., have been constructed. The reaction in these takes hardly longer than in a small crucible. The enormous advantage offered to

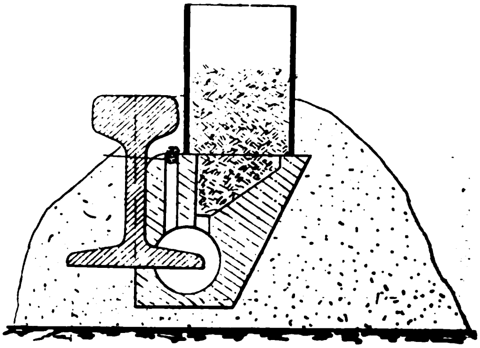


FIG. 7.—WELDING A CONDUCTOR RAIL.

steamship owners by such repairs will be apparent when it is remembered that a broken stern-post would otherwise have to be replaced by a new one. Besides this expense, the one incurred through loss of time, the steamer being laid up in dry dock for weeks and weeks in order to have the new part fitted in, is very heavy indeed.

To butt-weld the pipes, the ends must be made

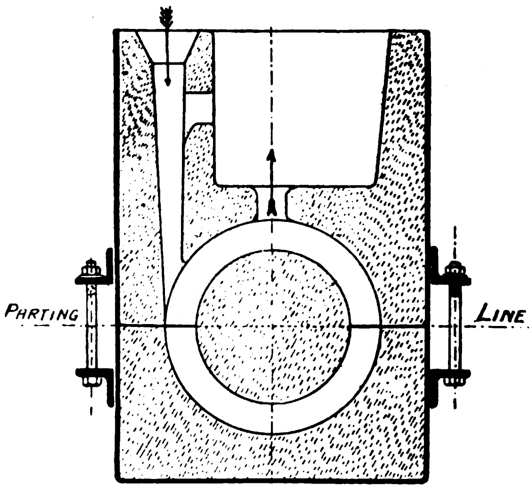


FIG. 8.—WELDING A BROKEN SHAFT.

to fit accurately on to each other, and must be made bright with a file or emery paper. The two pipes are then firmly pressed together by the clamping apparatus, and the sheet iron mould, well surrounded with moist sand, is attached. After pouring the liquid contents off the crucible, welding temperature will take place within a minute or two. The clamps then want tightening one turn of the screw, and the weld is complete. The mould-box is removed almost at once, and can be used several times. The surrounding mass, containing the iron between the layers of slag, like the yoke in the white of an egg, is easily removed with a hammer. Such welds will stand pressure of hundreds of atmospheres; as a matter of fact, as much as the pipe itself. About 40,000–50,000 pipe joints have been welded by this method, the advantages of which are, shortly, that the operation can take place anywhere *in situ*, and that it is cheaper than a solid flange joint. The dimensions of the moulds have

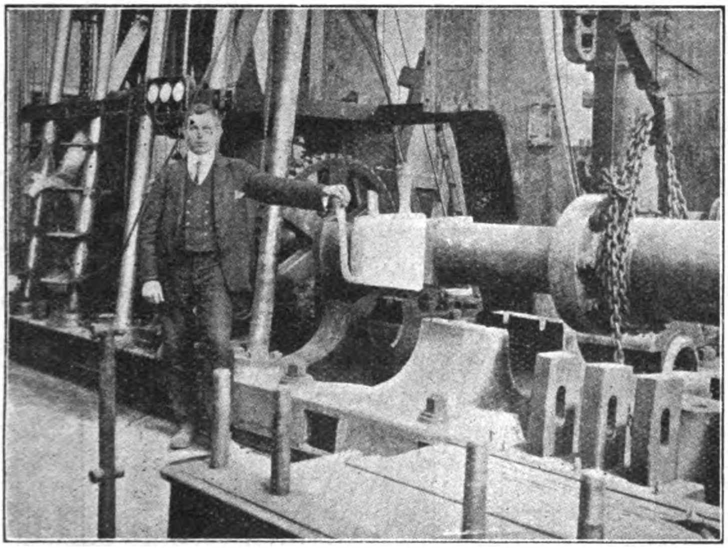


FIG. 9.—WELDING A BROKEN SHAFT IN THE TRANSVAAL.

been carefully worked out and tabulated for every size of wrought iron pipe up to 6 ins. diameter. Any workman will be able to make such welds after very short practice by carefully observing the few rules and directions printed in the pamphlets published by Messrs. Thermit, Ltd.

PRIMARY BATTERIES. — Two cheap primary batteries suitable for bells or telephones can be made as follows:—(1) Mix equal parts of manganese peroxide, in pieces the size of a pea, with coke or retort coal, also in small pieces. Put the whole in a wire-cloth bag, and in the middle a piece of retort coal. Tie the upper part of the bag, and immerse in a kettle or jar containing a solution of chlorhydrate of ammonia and a piece of zinc. (2) Take a porous vessel about 6 ins. in diameter, and pile up round a piece of charcoal and small pieces of coke mixed with a little chloride of lime. Add a little melted pitch in order to avoid the odour of chlorine. Put in an outer vessel water containing 5 ozs. of table salt to the pint and a piece of zinc. A little salt water four times a year is sufficient to keep the battery in condition.

Model "Dunalastair" Locomotive Tender.

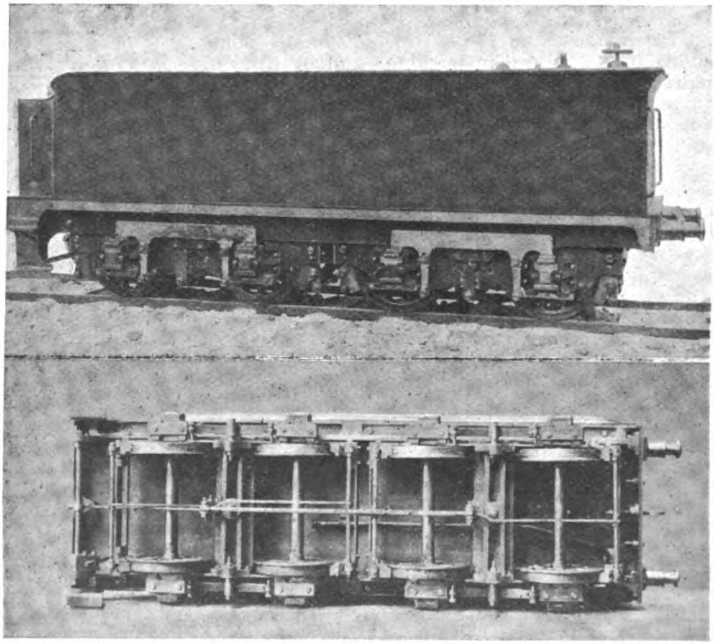
By H. A. STEVENS.

IT appears to be the rule among model engineers who build locomotives to construct the engine before the tender. I departed from this order of work, and completed the tender first, partly that it might be ready when the engine was far enough advanced for testing, but more particularly for the sake of the experience to be gained, as this was my first serious attempt at model making, and I was thus more competent, after building the tender, to undertake the more difficult work in connection with the engine.

I followed the drawings published in the *M.E.* in 1901, and made very few departures therefrom. The chief differences are:—

(1) The brake rods, which in the drawings cross the bogie pivots centrally, have been set out to clear the pivot nuts, enabling the latter to be removed without dismantling the brake gear.

(2) The rear buffer beam, instead of being in one piece ⅛ in. thick, is in two pieces each 1-16th in. thick. This allows the buffer stocks to be screwed on from the back in one piece, while the other piece is screwed to the angles affixed to the frames.



MR. H. A. STEVENS' MODEL ¾-IN. SCALE LOCOMOTIVE TENDER.

The interference of the two sets of screws is thus avoided. The two pieces are fastened together by bolts placed where the side chains are usually fixed.

(3) The outer ornamental angle-brass along the sides of the footplating, and the angle brass connecting the footplating to the frames were made in one piece, of ┌─┐ section. This somewhat simplified matters.

As the photograph shows, the model is unpainted. The mottled appearance, which is less marked in the reproduction than in the photo, is caused, not as might be thought, by irregularities in the surface,

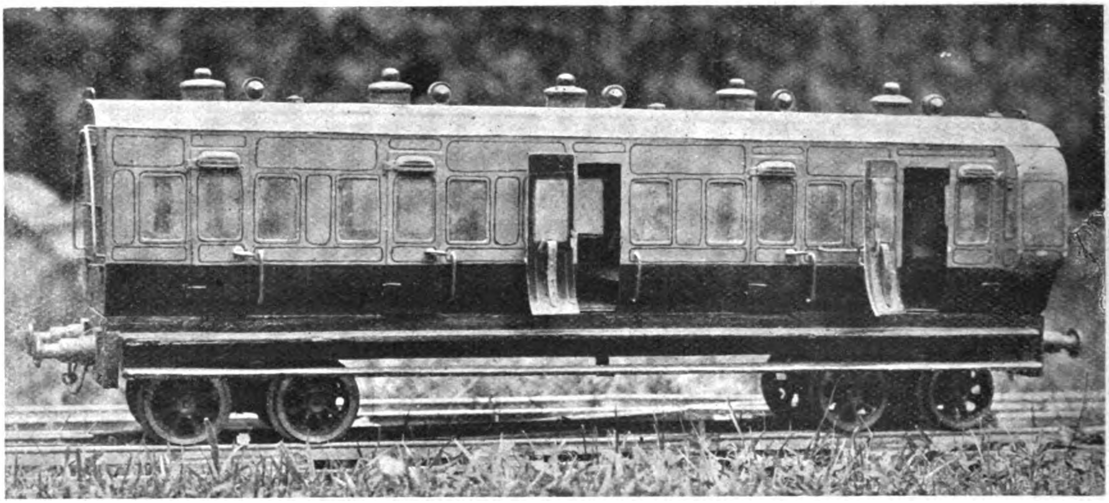


FIG. 11A.—ONE OF MR. L. NICOLE'S MODEL RAILWAY CARRIAGES. (*Body made of Zinc.*)

but by differences in the coating of oxide—some having been removed in working—and by films of solder where screws, &c., are placed.

I must add my tribute to the excellence of the drawings given in the *M.E.* I had only to make one reference to the Query Department, which was answered with the usual courtesy and thoroughness. The total time taken in construction was 345 hours, including pattern making. The cost was about £2. This is, I think, not excessive, chiefly because a local firm of brass founders supply all my castings and material, both brass and gunmetal, at 8d. per lb. They take all possible trouble over these little castings. I have received nothing but help and encouragement from "professionals" in every way. A well-known firm of locomotive builders in this neighbourhood placed their experience and resources entirely at my disposal, and though, like most amateurs, I preferred to conquer my difficulties by my own efforts, the kindness of the offer remains.

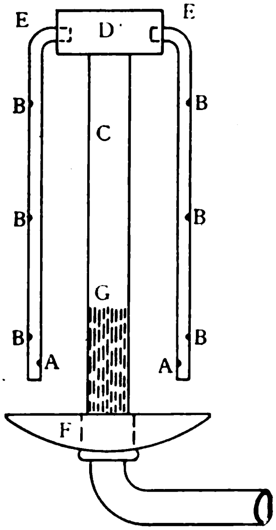
MOTOR CYCLE DEMAND.—A Coventry firm is said to have sold 6000 motor cycles, and that the demand, instead of diminishing, is now greater by threefold than it was a year ago. The firm says that at the present time it has on hand a larger number of orders than at any previous period, and on all sides customers are clamouring for delivery.

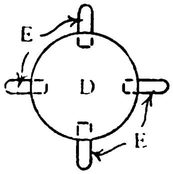
Some Ingenious Models.

(*Continued from page 60.*)

THE exhaust steam from the engine is carried by a pipe into water tank, where it warms the feed water.

Fig. 12 is a view of the spirit lamp, which is sometimes used instead of the gas ring for the purpose of raising steam. The spirit passes from the supply tank through the bunch of iron wire at G to the pipe C; cup F having been previously





Plan of Burner,

FIG. 12.—VAPORISING SPIRIT BURNER FOR COIL BOILER.

filled with spirit and lighted vaporises the spirit in the tube C, and the vapour issues by way of cap D through the small holes B in the hanging tubes E. The holes A provide small flames, which impinge on the tube C, and maintain it at a vaporising heat

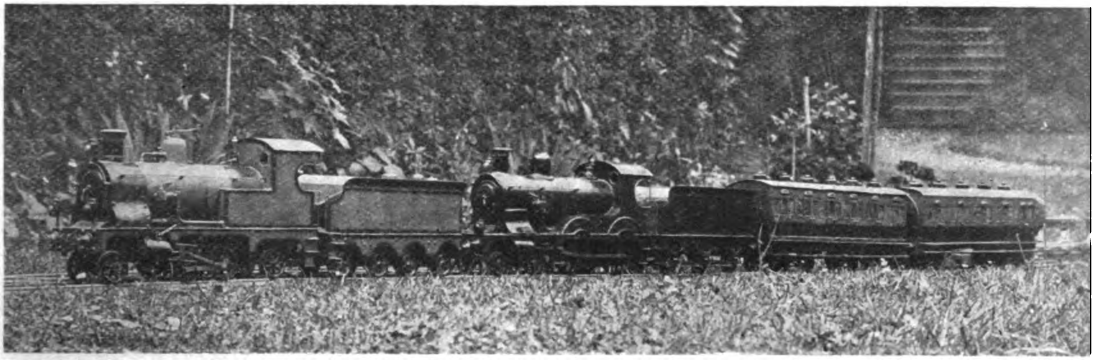


FIG. 13.—COMPLETE TRAIN DRAWN BY TWO ENGINES.

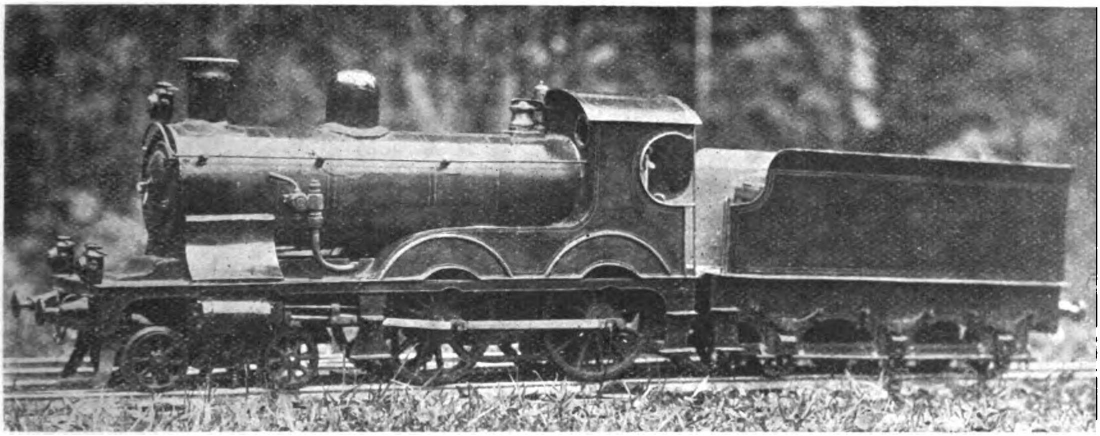


FIG. 14.—MODEL FOUR-COUPLED BOGIE EXPRESS ENGINE.

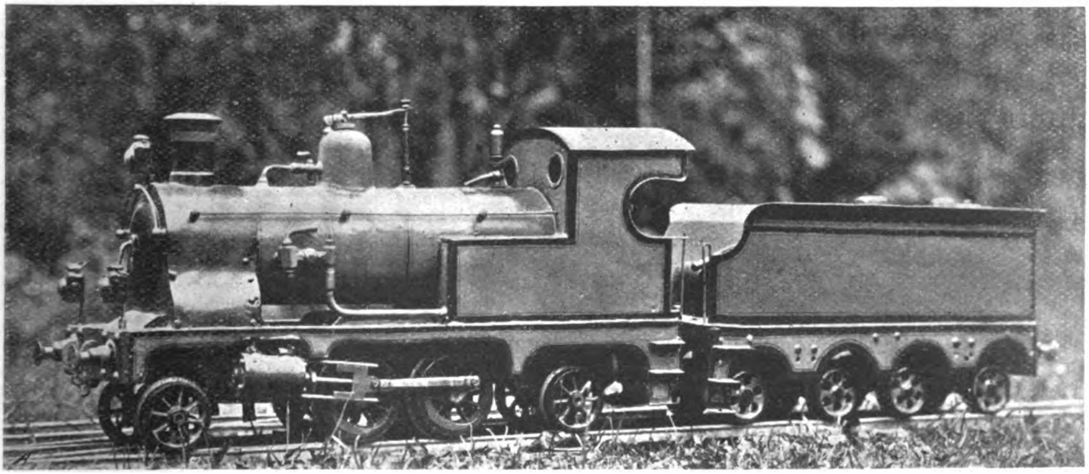


FIG. 15.—MODEL 2—4—2 TYPE LOCOMOTIVE.

MR. LOUIS NICOLE'S MODEL LOCOMOTIVES AND RAILWAY CARRIAGES.

after the cup F is empty. Three or four burner pipes E may be employed.

Railway Coaches.—These carriages are very interesting, in that they are constructed of sheet metal. The passenger coach has four compartments, and measures 18½ ins. long. The guard's van is of similar proportions and construction. The material used is zinc, and the windows and doors were cut out with a fretsaw. The accompanying sketches of the sides, doors, and ends are two thirds full size, the former being curved as indicated.

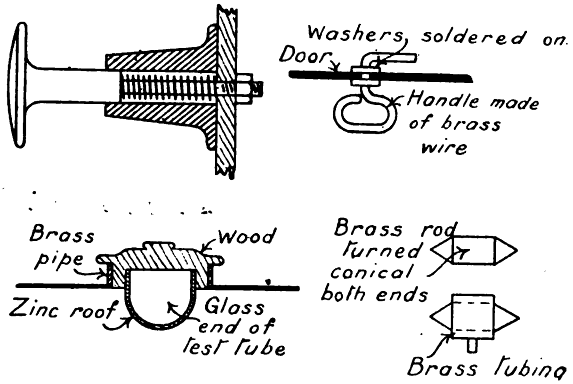
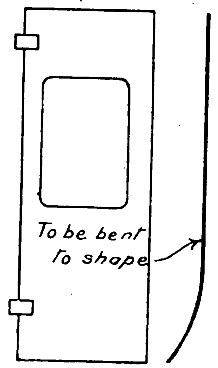


FIG. 16.—MODEL RAILWAY CARRIAGE FITTINGS.

FIG. 17.—DOORS FOR MODEL RAILWAY CARRIAGES.



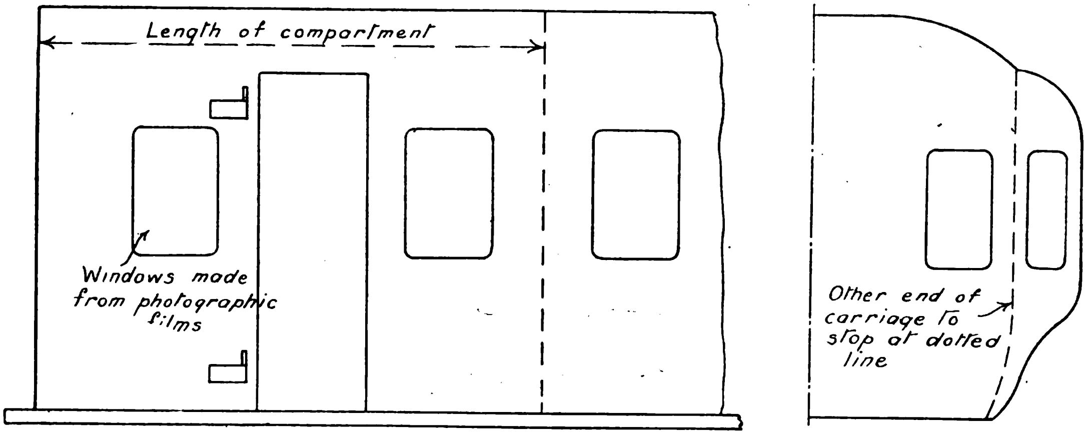


FIG. 18.—SIDES AND ENDS OF CARRIAGES.

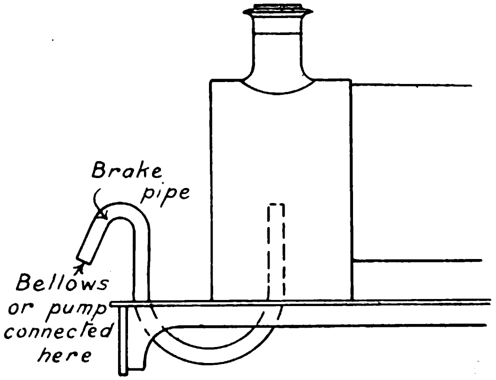


FIG. 19.—MR. NICOLE'S PROPOSED AUXILIARY BLOWER FOR MODEL LOCOMOTIVES.

Each compartment of the carriage contains the proper seats, racks, straps for windows, and carpet. The lamps are made as shown in the detail drawing (Fig. 16). The torpedo ventilatoıs are made in two pieces, as shown in Fig. 16.

The Locomotives.—With regard to the locomotives, Mr. Nicole seemed diffident about describing these. He modestly said that far nicer ones had been illustrated in THE MODEL ENGINEER in the past; however, he suggested one improvement. For producing a draught during steam raising, and before the blower can be applied, he advises that the vacuum brake pipe should be used as an auxiliary blower pipe in the manner indicated in the sketch herewith (see Fig. 19). Both of the locomotives are interesting types, the one in Fig. 15 more especially.

Model Man o' War.—Mr. Nicole's model battle ship is 3 ft. 6 ins. in length, and has twin screws. The motive power is electricity. The hull is made of brown paper moulded on a plaster model. When dry, the hull was coated with a couple of coats of gold size, and then painted. After this was completed, the whole boat was varnished with carriage

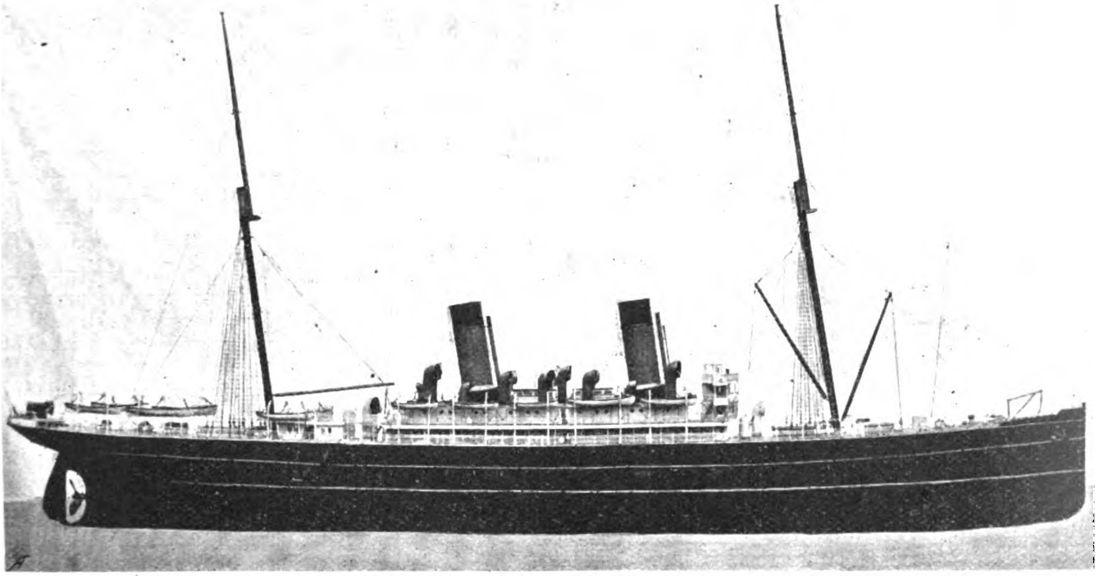


FIG. 20.—MODEL ATLANTIC LINER.

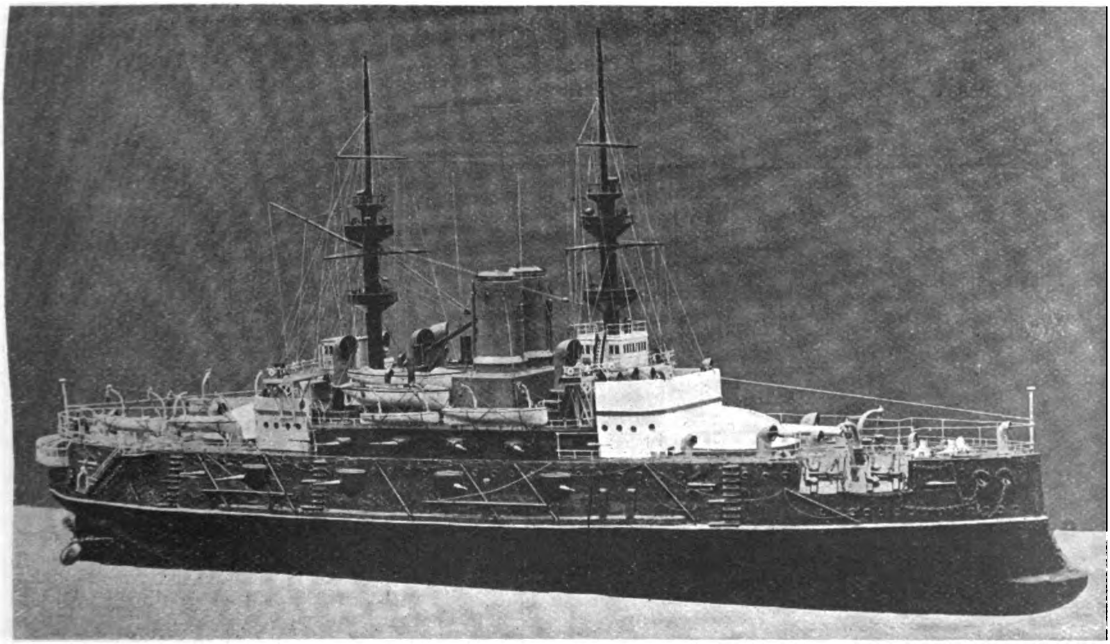


FIG. 21.—MODEL FIRST-CLASS BATTLESHIP.

TWO OF MR. LOUIS NICOLE'S SHIP MODELS.

For description] [*see pages* 84 *and* 86.

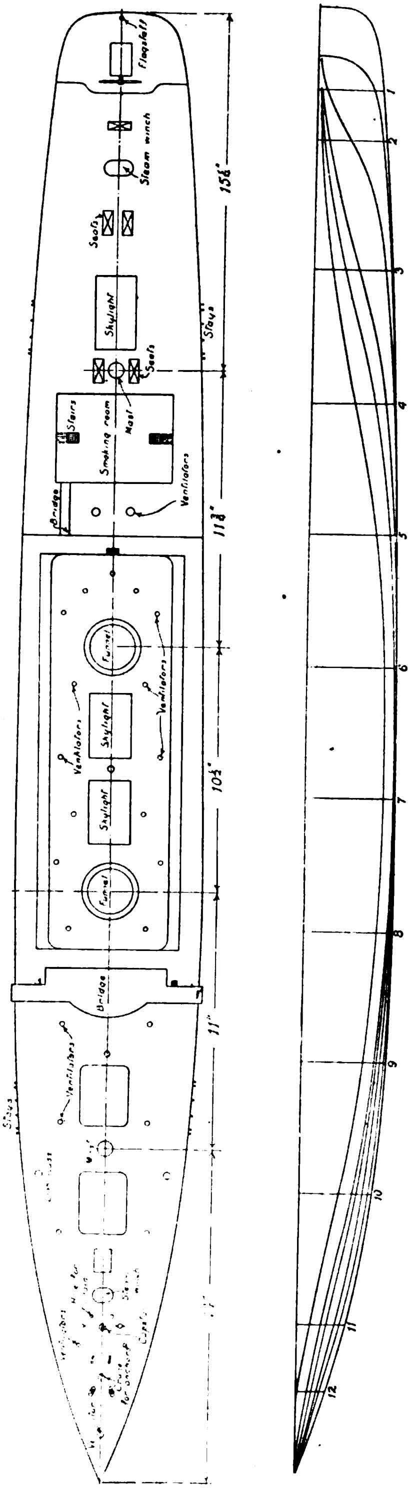


FIG. 22.—DECK PLAN AND HALF BREADTH PLAN OF MR. LOUIS NICOLE'S MODEL ATLANTIC LINER.

varnish. The tubes for the propeller shaft are fixed with shellac varnish, and with bichromatised glue (which gets insoluble when exposed to light), and, finally varnished. This makes a good water-tight job. The fittings of the vessel are much the same as those published from time to time in THE MODEL ENGINEER, more particularly following those described in the issue of July 1st, 1902 (Vol. VII). The ventilators are cast, cored out to make

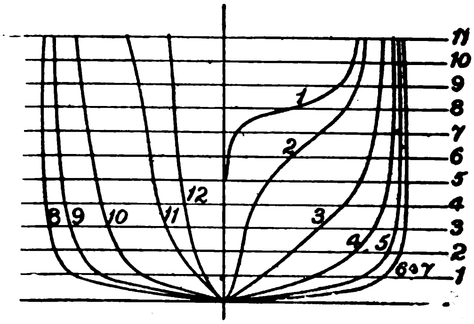


FIG. 23.—BODY PLAN OF ATLANTIC LINER.

them as light as possible. Aluminium is suggested as the best material for these fittings.

The Liner.—The hull of this model was made of zinc strips, and has fore and aft water-tight compartments, which can be filled with water ballast, through a valve which opens underneath, to get the boat in proper trim. All the heavy ropes, mast stays, &c., are made of florist's wire twisted together and painted dark grey. The coils of rope on deck are made in the same way.

With regard to the painting of the models, to get the paint to adhere to the zinc he "primes" the latter with a special preparation. To make this—

Dissolve in water	.. ..	64 parts.
Chloride of copper	.. ..	1 part.
Nitrate of copper	.. ..	1 ,,
Sal ammoniac	.. ..	1 ,,

then add one part of commercial hydrochloric acid.

To use, clean the hull and brush the preparation over it, when it turns the zinc a deep black. Allow the model to dry for twenty-four hours, and any oil colour will be found to firmly adhere to the metal.

In a letter received just as we go to press, Mr. Nicole says it may interest readers of the *M.E.* to know that he has successfully tried making ventilators and small boats from a lead mould by electro-typing copper on to the mould. The fittings made in this way are very light and strong.

LIQUID CHALK.—A very handy thing to have on the bench where there is much work to lay out on castings or sheet iron, is a solution made of chalk, glue, and water. Take a pint can and powder enough chalk to fill it two-thirds full; then fill it almost full of clean hot water and add about two tablespoonfuls of liquid glue, and mix thoroughly while it is hot. This is much more handy than chalk, as you can put it on with a brush the same as paint. It will not rub off in handling, and gives a nice surface to work on. The chalk must be powdered very fine, or it will be rough when dry.

Lessons in Workshop Practice.

(*Continued from page* 8.)

XX.—Notes on Design of Small Dynamos and Motors.

By A. W. M.

WHEN designing or testing a small dynamo or motor, the amateur is very likely to have in mind some statement which he has seen as to the efficiency of dynamos being 90 per cent. or 95 per cent., and expect his own to have this efficiency also, being at a loss to understand why he cannot get it to approach this high figure. Such a high efficiency is only reached with machines of large size. Taking a ½ h.-p. motor or 500-watt dynamo as the largest size the amateur is likely to construct, a commercial efficiency, as it is termed, of 65 per cent. at full load would be very good: that is, the proportion of watts given

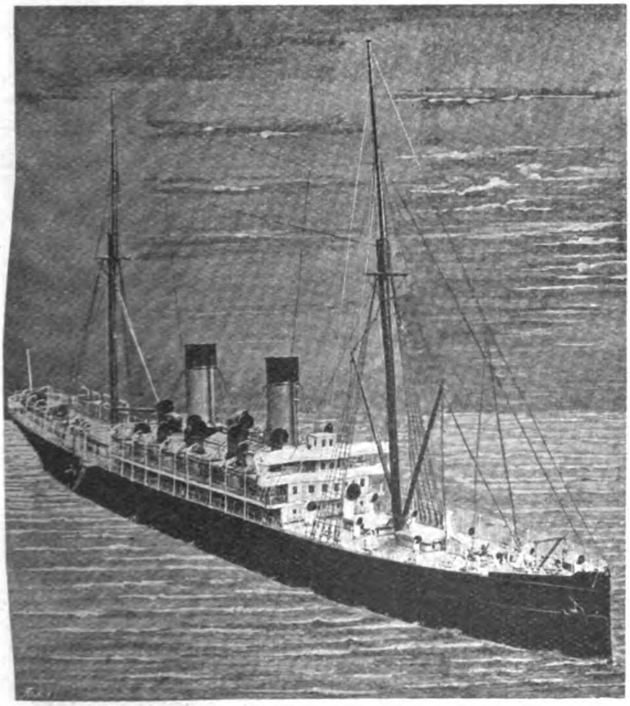


Fig. 24.—Another View of Mr. L. Nicole's Model Atlantic Liner.

out by the machine would bear that ratio to the power in watts put into it. This efficiency would decrease with smaller sizes; 60 per cent. would be near the mark for a ¼ h.-p. or 250-watt size, and so on downwards at an increasing rate. As regards choice of design, the amateur should select that which takes his fancy, and not worry too much in trying to decide upon some design which shall be superior to all others in every respect. As a rule, any of the regular patterns can be safely selected; each one has its own good points. If you consider from your particular requirements that a Kapp type or a Manchester pattern is superior, then adopt that one, and do not be troubled because you might have secured 2 or 3 per cent. more efficiency if you had selected some other type. There is, however, one thing generally desirable, and that is, to keep the speed down. There are special uses for high and extra high speeds, but as a rule the lower the speed at which the machine runs, the better. You must remember, though, that for any given machine the lower the speed at which it runs the less will be

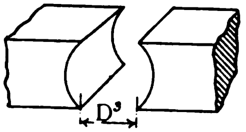
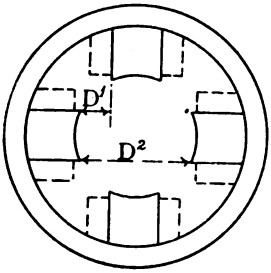


Fig. 1. Field-magnet Design.



its output—that is, supposing a dynamo was designed to give 500 watts at 2,500 revolutions per minute, you could not get the same output if it was only driven at, say, 1,250 revolutions per minute—you could only get 250 watts. You could get the same voltage by rewinding with suitable wire, but you would only be able to get half the amount of current. To take a few practical illustrations of the pros and cons of different patterns of machine, we can start with those relating to the field coils. If you select an ordinary Manchester pattern dynamo, the field coils are easy to make, as the cores are circular, the bobbins can be quickly wound, and are readily taken off and replaced by lifting off the top yoke. If you select an ironclad machine, with internal poles, the coil space is limited if the machine is to be compact and of reasonable dimensions, whilst if the poles are cast in one with the yoke, you are further limited by the distance between the pole horns (see Fig. 1), the distance D1 limiting the depth, and the distance D2 the over-all size of the coil. In the case of a two-pole machine, the distance D3 limits the breadth of the coil, as, if these dimensions are exceeded, the coils cannot be slipped over the cores. Little limitations of this kind give a great deal of bother to the designer who has not previously considered them. The following will be found useful hints :—

Field Coils.—Whenever possible make them circular; they are then easiest to wind, and take less weight of wire. Make them as long as convenient, as they become then less deep, and, therefore, are economical in wire, and do not become so hot in working; make them removable, if you can. If you cannot adopt circular coils, make them square with rounded corners, as being the next best thing to do.

Magnet cores should be made circular when practicable. The next best section is the square with rounded corners. Wrought iron is preferable to cast iron, as the area of the core need then be only one-half of that required for cast iron; but magnets made of cast iron entirely give very good results, and there is no need to make any great effort to

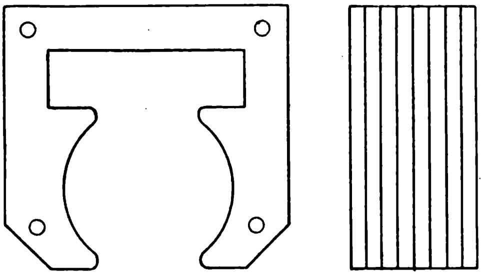


FIG. 2.

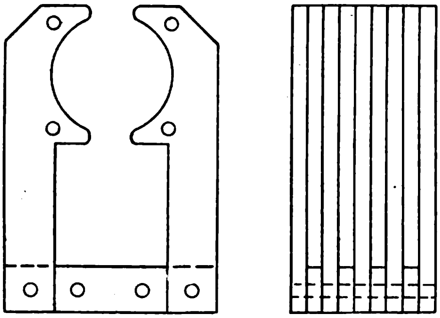


FIG. 4.

use wrought iron. As a matter of fact, with very small dynamos, the one having its field-magnet made of cast iron entirely has a better chance of working successfully than one having a field-magnet made of wrought iron. It is no disadvantage to build up a field-magnet or its core by using strips or thin bars of iron. It may be very convenient for the amateur to do so if he cannot easily procure large iron, or wishes to use up some which he has at hand. Fig. 2 shows a round core made up of iron strip and riveted together. Fig. 3 is a field-magnet of single coil pattern made up with pieces of thick sheet iron. Fig. 4 is a Kapp or overtype magnet made in a similar manner, but the two limbs of the magnet are made separate to the yoke, which, in order to obtain a good magnetic joint, is inserted into the limbs, the joint being squeezed

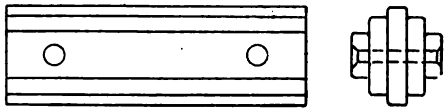


FIG. 3.

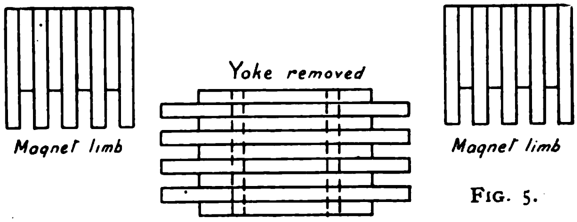


FIG. 5.

up tightly by the rivets. The drawing (Fig. 5) clearly shows how the joint is made.

(To be continued.)

Recent Electric Locomotives.

By CHAS. S. LAKE.

THE electrification of the Metropolitan Railway is a scheme which has long been looked upon with favour by the directors, and even longer looked forward to by the travelling public, especially that portion whose lot it is to make daily use of the underground section of the line. As readers are doubtless aware, the scheme is now practically complete so far as equipment is concerned, but in the matter of traffic operation there still remains something to be done before all is in order and the last of the old steam-propelled trains has disappeared from view.

FIG. 1.—THE NEW METROPOLITAN RAILWAY ELECTRIC LOCOMOTIVE AND TRAIN.

Even when things have been placed upon a permanent basis, with electricity as the sole means of traction, there will, of course, always be a certain number of trains running on sections of the line which will require a detachable form of motor for hauling them over the electrified tracks, such, for

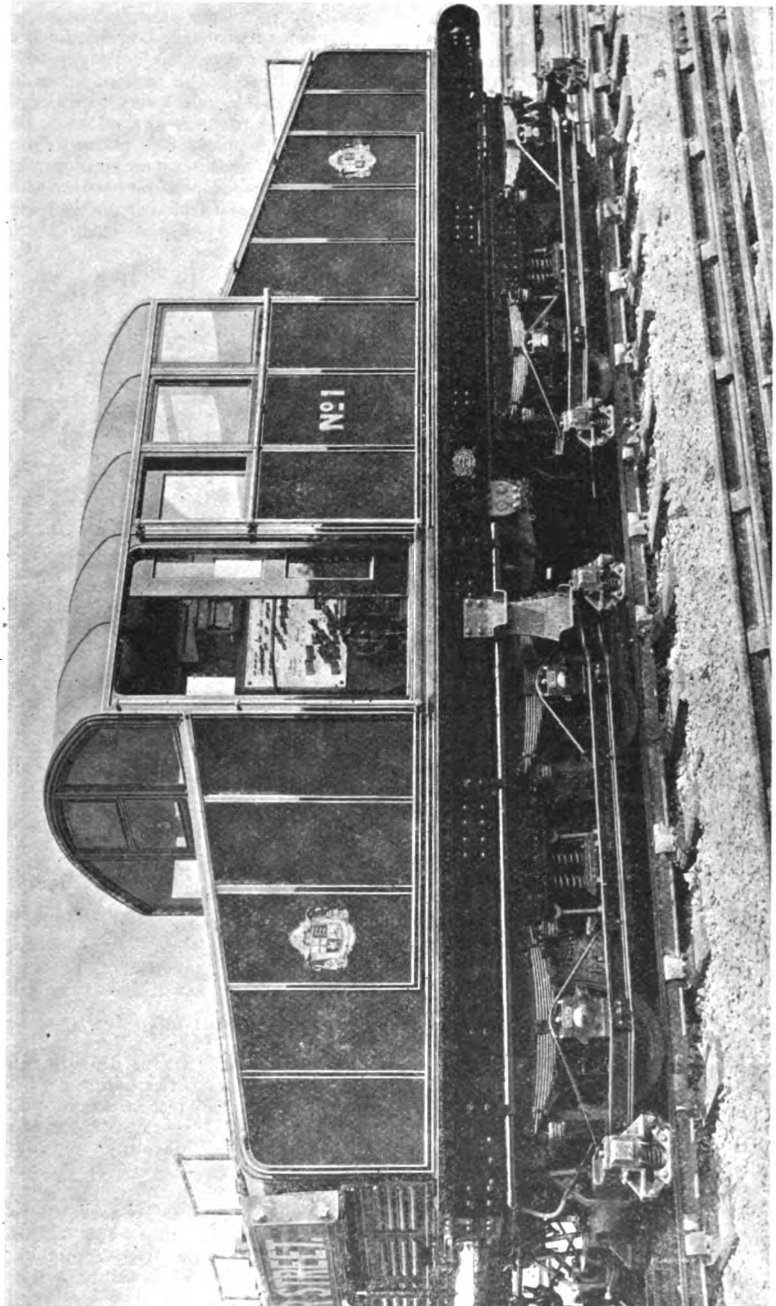


Fig. 2.—50-ton Electric Locomotive No. 1, Metropolitan Railway.
Supplied by the British Westinghouse Company.

For description] [see pages 88, 90 and 91.

instance, as the Great Western Company's trains connecting Aldgate, as an eastern extremity, with Southall, Uxbridge, Windsor, &c., on the main line or branches in outlving districts; also the L. and N.W.R. trains running over the District Railway between Mansion House and Earl's Court for Willesden. These trains will continue to be worked as at present by steam locomotives up to the points—viz., Bishop's Road for the Great Western, and Earl's Court for the London & North-Western trains, where the new methods come into operation, and from thence onward separate electric locomotives will be attached for hauling the trains to their destinations. The Metropolitan and District Companies' trains on the same sections will, of course, be worked on the multiple unit system, with motor cars at each end of the train.

In addition to this, there will also be necessary an adjustment of methods with regard to propulsion in respect of the Metropolitan Company's steam trains coming up from Aylesbury and beyond to Baker Street. In this case the steam locomotives will be detached at Harrow, which at present marks the extremity of the electrified portion of the main line*, and electric locomotives will be substituted for the run to the terminus, a similar change, only in reverse order, being made on the return journey at Harrow.

The accompanying illustrations show the appearance of one of the new electric locomotives both separately and when attached to a standard 120-ton passenger train of six bogie coaches and van, as used on the Baker Street to Verney Junction services. This locomotive is the first of an order of ten, weighing 50 tons each, now being supplied through the British Westinghouse Company, and they have been designed to propel the above trains at a maximum speed of 36 miles per hour on the level. The same class of engine will be used on the Metropolitan half of the Inner Circle for goods traffic, and for hauling the passenger trains already referred to, belonging to other companies using the lines.

The locomotives are equipped with four motors of 300 h.-p. each, and a feature of interest is that owing to the terminus facilities being somewhat restricted, it has been necessary to use motors of a smaller size than usual, equipped with forced ventilation, so as to keep the over-all length down to convenient limits for handling at the termini. The writer hopes to give further particulars of these locomotives and possibly a detailed drawing in a future issue.

The British Westinghouse Company have also recently supplied the Swedish State Railways with a single-phase electric locomotive weighing 25 tons, all of which is carried upon four wheels of 3 ft. 5 ins. diameter. Particulars of this design were briefly given in The Model Engineer so recently as the issue for July 6th, but in view of the fact that the locomotive is now illustrated, it may be desirable

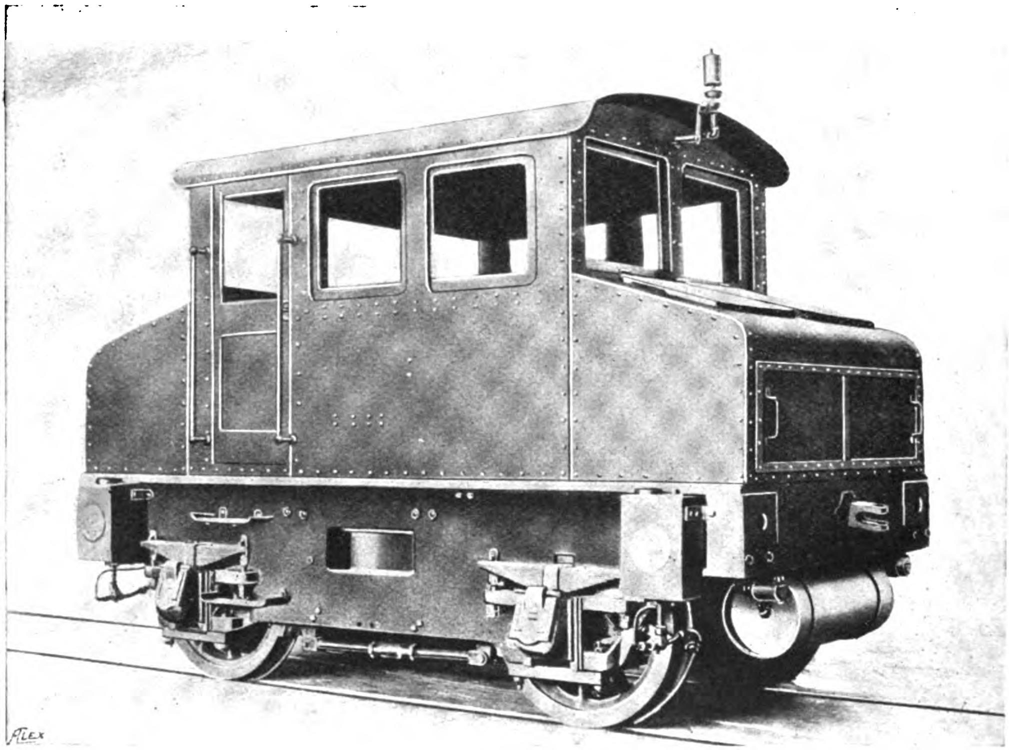


Fig. 3.—25-ton Electric Locomotive, Swedish State Railways.

* The Uxbridge branch is worked by three-car electric trains, and in any case is not "main" line.

to restate the leading characteristics. One of the interesting features is the high trolley voltage for which the equipment is designed—viz., 18,000 volts, though connections are supplied for operating at several voltages lower than this, the minimum being 3000 volts.

This high voltage necessitates the use of an oil-cooled main auto-transformer and an oil break circuit breaker, oil having insulating properties which have been amply demonstrated by service in high tension transmission. The intention is to experiment at various line pressures, with a view to ascertaining the highest working pressure suitable for the conditions prevailing upon the Swedish State Railways.

The control system is electro-pneumatic, and consists of an air compressor driven by a single-phase alternating current motor, an air motor on the induction regulator, air cylinders on the circuit breaker, and reverser and the necessary magnet valves. The air brakes and air sanding gear are also supplied by the above compressor. There are two connectors at each end of the locomotive, so that two locomotives can be coupled together and operated by one motor switch. The master switch is in the middle of the cab, and is so situated that the operator has a clear view in all directions without leaving his seat. Two 150 h.-p. twenty-five period single-phase motors are geared, one to each axle, with a gear reduction of 18 to 70, and the locomotive so equipped has shown its ability to handle a 70-ton train at 40 miles per hour without exceeding the rise of temperature for which the motors were designed.

Ready access to all the parts has been arranged for; only the small operating devices have been placed in the cab, and the lay-out is such as to allow of the greatest convenience in operation with a maximum of safety to the operator. The illustration shows the locomotive as sent out from the builder's works; the buffers, collecting devices, etc., are being fitted at the railway works, Stockholm. The design is that of Mr. Robert Dahlander, director of the Electrical Department of the Swedish State Railways. The writer is indebted to Messrs. The British Westinghouse Company for photographs and particulars of the locomotives, and also to Mr. A. C. Ellis, general manager of the Metropolitan Railway, for the photograph of the complete train. Thanks are also due to Mr. C. Jones, chief electrical engineer, Metropolitan Railway, for facilities to inspect the Metropolitan locomotive.

Practical Letters from our Readers.

[The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a nom-de-plume *if desired, but the full name and address of the sender* MUST *invariably be attached, though not necessarily intended for publication.]*

A Model Steamer.

To the Editor of *The Model Engineer*.

Dear Sir,—I send you herewith some photos of a model torpedo cruiser which I made last year during my spare time after school. As may be seen from the photos, the boat is not an exact model in any way. Her only deck fittings are the guns

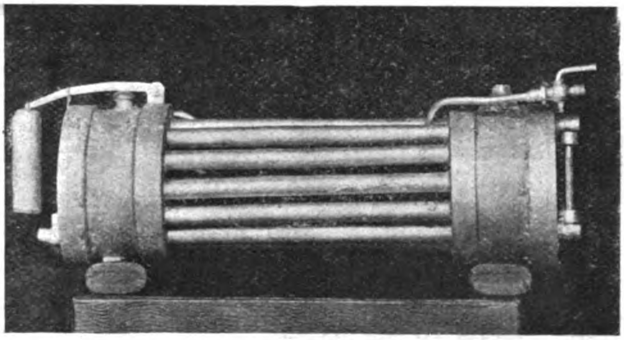


Fig. 2.—Water-tube Boiler for Model Steamer.

(dummies) and one boat, this making a much handier boat to work on the water. The hull was made of small strips of sheet tin, which were bent over a framework of wood and soldered together, the wood being afterwards taken out, thus forming a very thin and light shell of tin of the desired shape. This shell having no stiffness, I cut out a deck of ¼ in. mahogany and let it in round the top, tacking it every inch or so, thus making a very stiff and strong boat.

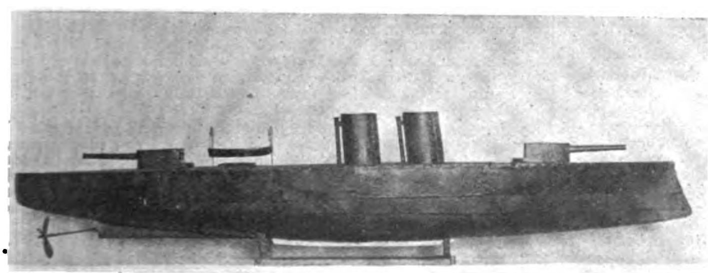


Fig. 1.—Mr. George C. Bergius' Model Steamer.

Fig. 2 represents the boiler. It consists of two brass drums set 5½ ins. apart, and with nineteen ⅜ in. s.d. copper tubes between them. The ends of the drums are cast, and the tubes are widened out on the inside of the drums and soft soldered. The space round the tubes and between the drums is covered half-round with a piece of tin which carries the inner funnel. The forward funnel is used as a downward ventilator to the spirit lamp, which is an ordinary one with eight asbestos wicks. The fittings of the boiler are—safety valve (blowing off at 35 lbs.), water gauge, and inlet tap. The boiler steams splendidly, getting up full pressure from cold water in five minutes. The engine is a double-acting oscillating one, with two flywheels and cylinder.

The principal dimensions of the model are as follows:—Boat: Length, 42 ins.; beam, 6 ins.; depth, 5½ ins.; weight, 4½ lbs.; weight of boat in sailing trim, 14½ lbs. Boiler: Length, 20 ins.; diameter, 3 ins.; heating surface, 130 sq. ins. Engine: Stroke, 1 in.; bore, 1 in.; propeller, 3 ins. diameter.

The boat took about two months to build, the engine and boiler taking most of the time (the hull only took four days). I made all my own drawings and patterns, and did all my own machining on an old 7-in. lathe centre, which was far too big for the job, besides being rather shaky with age. I may say in conclusion that she steams splendidly, making a speed of about 2½ miles per hour, which I think is not bad for a boat of her length. I have been a reader of THE MODEL ENGINEER for about two

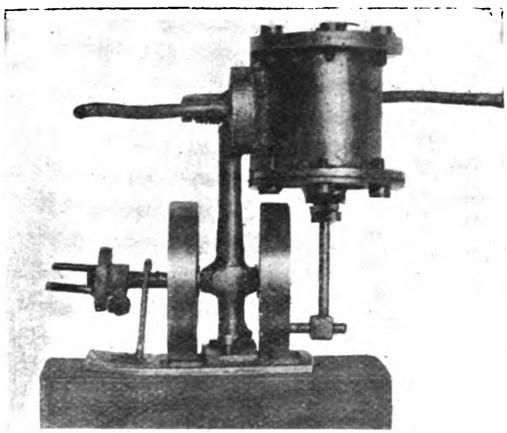


FIG. 3.—ENGINE FOR MODEL STEAMER.

years now, and found it to contain a great many hints which have been very useful to me in my model making. With thanks to your very useful and instructive journal, I am, yours truly.

GEORGE C. BERGIUS.

WATERPROOFING FOR LEATHER BOOTS, ETC.—Boil an ox-foot in 2 qrts. of linseed oil for two hours, then add 6 ozs. of india-rubber, and let it boil until thoroughly dissolved. Apply this to the leather with a soft brush a little at a time. Or, mix 1 pint of linseed oil and 2 ozs. of yellow wax 2 ozs. of turpentine, ½ oz. of Burgundy pitch, and melt it over a slow fire. Or, melt together 6 parts of beeswax, 20 parts of mutton fat, 6 parts of turpentine, 6 parts of olive oil, 12 parts lard, 5 parts of lampblack. Stir the mixture up until it is all melted. The mass may then be poured into boxes and allowed to cool. Apply with the fingers before a warm fire. It will soften hard boots as well as make them perfectly watertight if they are sound.

Queries and Replies.

[Attention is especially directed to the first condition given below and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-hand corner of the envelope "Query Department." No other matters but those relating to the Queries should be enclosed in the same envelope.

Queries on subjects within the scope of this journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied, wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed. (4) Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of Replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor,* THE MODEL ENGINEER, *26—29, Poppin's Court, Fleet Street, London, E.C.]*

The following are selected from the Queries which have been replied to recently:—

[13,687] **Motor for Phonograph.** J. J. (Moseley) writes: I wish to make an electric motor for phonograph (style like Fig. 5, page 16, of "Small Dynamos and Motors"). I should be glad if you would answer the following questions:—(1) Would 4 volts be sufficient for driving Edison home phonograph? (2) Please give sizes of fields and armature, also winding for same. (3) Would it be best connected in series? (4) Would a brake of any sort be detrimental to motor for keeping speed down? If so, say how I could do the same, so as to obviate noise. I propose casting in soft grey iron.

(1, 2 and 3) We advise you to take the 20-watt size and to run at slow speed, so as to obviate noise. The dimensions are given on page 23, the second scale from the top of the page. Wind the armature—which should preferably be a cogged drum, having eight slots and eight coils wound two in each slot—and a commutator with eight sections, so as to get steady running, with No. 24 gauge D.S.C. copper wire; about 3 ozs. will be required; wind field-magnet with 1 lb. No. 18 D.C.C. copper wire, and connect field coil in series with the armature. (4) We do not advise a brake to regulate speed, but recommend you to make an adjustable wire resistance of 2 ozs. No. 20 gauge bare German silver wire, arranged with a switch, and, say, six stops: a battery to give 4 volts and 2 to 3 amps. should do very well. Adjust matters by trying several sizes of pulley on the motor.

[14,282] **Morse Recorder.** J. W. D. (Farnborough) writes: I have made a Morse writer, but I cannot get the motion of the armature shown on the paper tape. The armature has a little wheel on its end; this dips into the ink trough. When the current passes through the electro-magnet coils the armature brings the wheel up against a flat piece of brass over which the paper is drawn by suitable clockwork. I should be very much obliged if you could inform me on the following points:—(1) Is any special kind of paper tape used, and where can I obtain it? (2) Is any special kind of ink used, and where could I obtain it? (3) How is the paper marked with the dots and dashes? (4) In the wheel I used the ink does not seem to stick to the wheel. Ought the wheel to be notched or grooved in any way?

(1 and 2) You can probably obtain ink and paper (which is supplied in rolls) from Messrs. J. J. Griffin & Sons, Ltd. scientific instrument makers, of 26, Sardinia Street, Lincoln's Inn Fields, London, W.C., as this firm makes educational Morse telegraph apparatus. If not, try Messrs. Elliott Bros., Century Works, Lewisham, London, S.E. (3) The dots and dashes are formed according to the length of time during which current is on; for a dot the current is sent in a momentary impulse; for a dash the current has a duration of a second or so. The wheel would then be pressing against the moving tape and thus draw a line which represents the dash. The impulses of current are, when sent by hand, created by pressing down a tapper; the operator, by practice, is able to regulate the duration with great nicety. There are also repeaters in which the impulses are formed by a perforated master tape at great speed. (4) The wheel is not grooved or notched.

[14,292] **Windings for Small Motors.** H. R. B. (Tonbridge) writes: *Re* the wire for armature and F.M.'s given in the tables in your book on "Small Electric Motors." Would you favour me by saying what kind of insulation has been allowed for on the wires—D.C.C. or silk—and whether it is intended that each separate layer should be shellac varnished, or if it would be sufficient to soak the wound armature in melted paraffin? As I am making one of these motors (1-10th h.-p.) I should be glad of the above information. Also, do you think that the separate

laminations of the armature ring require any more insulation than that already provided by the oxidation and scale on the laminations themseves?

For field-magnet, single cotton-covered will do very well for the armature, double silk-covered by preference for so small a size, but double cotton-covered can be used; silk covered wire packs more closely and you can thus get more turns on, and, therefore, slower speed. There is no need to varnish each layer, but it makes a better job to do so for the armature. The field cores will do with two or three good coats on the top layer. If you do not varnish each layer of the armature winding, you should coat the outside of the coils well; do not use paraffin wax; it melts and flies out; shellac varnish is much better, but the spirit should be well dried out before the motor is tested with current. The oxide on armature laminations is sufficient, but it is better to varnish one side of each with shellac varnish or thin Japan paint to make quite sure; if, however, you care to trust to the oxide alone, the machine will probably keep sufficiently cool.

[13,876] **Four-pole Motor Construction.** A. R. (Sunderland) writes: I am building the four-pole electric motor, size D (current required 3 amps. 20 volts), as illustrated in your handbook of Small Motors, but one thing I don't understand is the commutator which you describe. I understand all the other parts thoroughly, and I hope you will answer the following questions through THE MODEL ENGINEER:—The commutator consists of a brass ring bevelled at the outer edges in a lathe, and fitted over a bush of vulcanised fibre. Where has the vulcanised fibre to be placed, and will this mean you have to turn a brass ring for each end of the commutator, and put a piece of copper on top of the rings? Would a piece of copper tube do for this purpose? Where is the vulcanised fibre bush? This is undercut to take the tube as shown in Fig. 13, and is cut right across by a thin saw. What do you mean by undercut, and for what purpose is it cut across the centre? What is this tube to be made of, and where is it to be placed? What has to be put in the cut that is across the commutator? Where have the fibre bushes to be placed? What position are the four pieces of fibre to be placed? Have these to touch the armature shaft as shown? Where shall I connect the wires from the armature—to the brass rings or to the copper? What thickness has the fibre to be that runs across the commutator? Would mica do for this fibre? Has the wire for the armature and the field-magnets to be silk or cotton covered or the bare wire? Where can I get the armature stampings for a four-pole motor? How many dry batteries would it take to drive a 6 ft. model at a good speed? What dry batteries do you recommend? Kindly draw me a sketch of this commutator, as in your handbook,

FIG. 1.

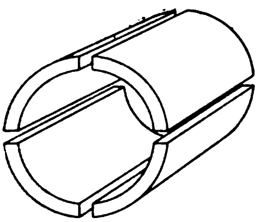
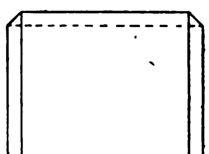


FIG. 2.



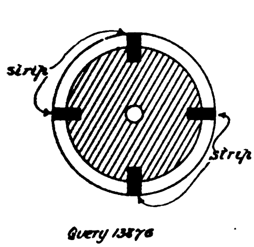


FIG. 3.

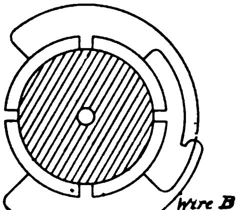


FIG. 4.

for a four-pole motor; sketch it as clearly as possible. Would the brush holders do if cast in brass instead of aluminium?

The commutator ring can be made of brass or copper; it is simply a piece of tube cut into four pieces or segments, and these pieces are clamped between two fibre or ebonite bushes. The segments are kept from touching each other by thin strips of mica, or fibre if you have no mica. The edges of the tube are bevelled, so as to fit into the grooved flanges of the fibre bushes. Fig. 1 shows ring cut into four pieces, and Fig. 5 shows one fibre bush cut in half to show the bevelled flange. Fig. 2 shows ring edges bevelled before sawing into four pieces, and Fig. 6 the two fibre bushes cut in half to show how they fit on to the ring. The two fibre bushes slip on the shaft, and are pressed together by the nut shown in Fig. 13, so that they squeeze up the four pieces of the commutator and keep them tight. Each piece of the ring must be separated from the others by mica or fibre, so that they are not in metallic contact. The strips of mica or fibre, between the pieces of the ring do not necessarily cut into the bushes, but you can cut in for ⅛ in. or so if you cannot get them to stick. Strips to be not more than 1-16th in. thick or less than 1-32nd in. thick. The wires from the armature are to be soldered to the pieces of the ring, as shown in Fig. 17, and opposite pieces are to be connected

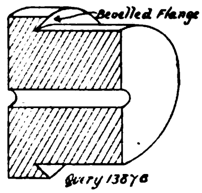


FIG. 5.

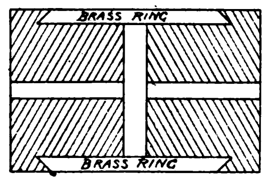


FIG. 6.

together by short pieces of copper wire (see Fig. 4). Armature stampings can be obtained from Mr. A. H. Avery, Fulmen Works, Park Street, Tunbridge Wells. Wire for armature and field-magnet can be silk or cotton covered; we should use double cotton-covered for the field and double silk-covered wire for the armature: bare wire is useless. We do not recommend dry batteries at all for driving this motor, as they would soon run out; accumulators or bichromate pattern cells should be used; either give about 2 volts per cell. You can start with, say, four cells in series, and add more if you want higher speed; the cells should be as large as you can get in the boats. Brush holders can be made of brass. See our handbooks on accumulators and primary batteries.

[14,303] **Cells for Spark Coil.** J. C. F. (Wimbledon) writes: I have a 3-in. spark coil, and I wish to know if the following accumulators are suitable for working it, and the best way of connecting them up. The coil works very well with two accumulators in series, but does not run long enough. Is it possible to join the four accumulators, say, two in parallel, so as to increase the capacity, or would that send too much current through the coil? The cells I have are: Three 4-volt accumulators, each cell with three 3½ ins. by 4 ins. plates, and one 4-volt one, each cell with five 4 ins. by 4 ins. plates.

The larger accumulator may be able to stand the rate of discharge required by your coil, but the smaller ones have not sufficient plate area; they may be used in parallel provided you do not discharge the smaller size to such an extent that its voltage falls below that of the larger one, but we doubt if you will get enough voltage to work the coil to full spark length at 4 volts only. If worked two in series and two sets in parallel, you may then get improved results. The large cell will, of course, not be in such a discharged condition as the smaller ones, so that its voltage will not fall so quickly; therefore, you should see that the voltage of the branch containing the two smaller cells in series does not fall below that of the other.

[14,304] **Patents.** F. B. F. (Ottershaw) writes: I should be glad if you would give me an answer to the following question *re* patents. A friend of mine has an idea for a patent, but he now finds that practically the same idea is now in use for quite a different purpose to what he would put it to. Would it be possible for him to take out a patent for it, to be used for the purpose he intends it for? If the patent has run out for the article which is now in use, would this make any difference?

You raise a question which admits of considerable difference of opinion, and the correct answer will depend upon the general circumstances of the case. A method of accomplishing a novel result by known appliances is certainly good subject-matter for a patent, or a result which is a distinct improvement upon the result produced by the usual or previous method of accomplishing. The fact that a previous patent has existed and has lapsed need not prevent the new patent from being obtained. The question is one for an expert to decide, and he would require to be informed of all the facts of the case. If you will apply to our Expert Service Department you can obtain expert advice at a reasonable fee, or you could apply for a "Provisional Protection" on the chance of your application being accepted. See our handbook No. 20 on "Patents."

[14,323] **Electric Light Decorations.** H. L. H. (Manchester) writes: I should like to know how to set up some simple and effective electric (or other) illumination upon the face of the house, whose photograph is enclosed. It must be simple and comparatively cheap. I thought of electricity, as there are easy means of getting a supply from the nine lights in the various front rooms of the house. All the lamps are 16 c.-p.; voltage, 200·

amps., 3. The two lamps at the front door are 32 c.-p. each. Please note that the whole thing must be as cheap as possible. (2) I have a lantern of the usual size (for lantern slides, of course), in which was originally an oil burner. This was smelly and not particularly successful. I use it mostly in Eccles, where the installation is an alternating one. I have tried a Nernst lamp, with little success. Is there no way by which an arc light can be used in this case, without transforming, &c., the current, and would it be expensive to use an arc light in this manner?

(1) The General Electric Co., Ltd., of Victoria Bridge, Manchester, would probably be able to show you some cheap fittings for making up into devices, or the letters themselves in an inexpensive form. If you use 8 c.-p. lamps you should be able to make a fair show, as your available current would light about twenty lamps of this candle-power. Lamps coated with coloured varnish are inexpensive and could be obtained from the firm referred to above. You should run a pair of main cables from the main fuse board of your installation to the device, such cables to be of 3/20 stranded wire. (2) Do you mean that you have tried an ordinary Nernst lamp, or a Projector Nernst lamp, such as sold by the Electrical Co., Ltd., of 125, Charing Cross Road, London, and devised on purpose for optical lantern use? If not, you may find it worth your while to try one of these. We believe that Mr. R. W. Paul, of High Holborn, London, scientific instrument maker, has a speciality of this kind also. Whilst alternating current is not so good as continuous current for lantern work, it will give very fair results. An arc lamp of the hand-feed type, with carbons both projecting forward, is, perhaps, the best form to use, the voltage of supply being transformed down by a small alternating current transformer to that required by the lamp. We shall be pleased to advise you further through our Expert Service Department; a fee would be charged according to the amount of information required.

[14,335] **Charging Cells from a 50-watt Dynamo.** H. J. G. (Rye) writes: I want to know about charging accumulators. I am going to charge about two at the time, 10 to 20 amp.-hour and 4 volts each. My dynamo is 10 volts 5 amps. I have your small book, but can hardly gather how to go on. Could you tell me in any way?

The dynamo must give 2½ volts for every cell to be charged in series; thus a six-cell accumulator would require 15 volts to charge it. The current must not exceed the charging rate allowed per surface area of positive plate. An ampere meter inserted in the circuit will indicate the amount of current flowing, and it should preferably be fitted with a current indicator to show that the flow is from dynamo to cells and not from cells to dynamo. If the rate of current is too high, it should be reduced either by means of a resistance or by reducing the voltage of the dynamo. The charging rate for cells of the size you mention should not exceed 4 amps. per sq. ft. of positive surface; that is, reckoning the total active area of each side of the positive plates added together. Two plates, each 4 ins. by 4 ins., would have an area of 64 sq. ins., and so on. The positive pole of dynamo must be joined to the positive pole of accumulator; continue the charging until the acid in the cells bubbles and turns milky. The dynamo voltage can be reduced by running at lower speed, but it is better with so small a dynamo to insert resistance wire between the dynamo and cells, because the dynamo is more likely to excite, and the resistance partially acts as a safeguard to prevent the current from flowing out of the cells if the dynamo should stop or the speed fall below normal. About 3 yds. of No. 20 gauge bare German silver wire would make a suitable resistance; it should be used in stretched out coils or any convenient way so that adjacent coils do not touch. Dynamo should be run up to full speed before cells are connected. Though not absolutely necessary, an automatic return current cut-out such as made by Mr. Avery, of Fulmen Works, Tunbridge Wells, is very useful to prevent the cells from discharging back to the dynamo.

[14,325] **Zincs for Primary Battery.** R. M. F. (Stratford-on-Avon) writes: I send you two zincs for batteries described in your book "Electric Lighting for Amateurs," for setting up an accumulator installation. Will you please let me know if these would work all right? If not, please tell me the names of one or two firms who would supply them.

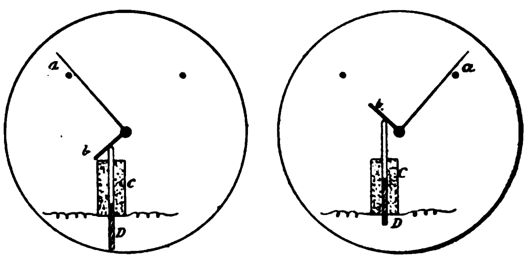
We expect you will find these zincs satisfactory, but we advise you to paint the copper connecting wires with insulating rubber varnish, or enamel, or pitch, to keep the copper from contact with the solution. Brush the varnish well down into the holes where the wires enter the zinc; also arrange the solution so that the top surface of the zinc is just out of the liquid. If you find much local action at the surface of the zincs, it will be well to amalgamate the surface with mercury.

[14,313] **Coil Winding and Testing for Leakage.** H. H. (Waterloo Road) writes: I am about to construct a 1-in. spark coil, and in looking through my back numbers of THE MODEL ENGINEER I find in No. 35, Vol. III (October 15th, 1900), on page 243, "An Improved Method in Making Induction Coils," in which it says—First method: Two insulated wires of the same length and kind are wound as one strand on the bobbin through their entire length, &c. Now, in your book on "Induction Coils" it gives this length of primary wire as 12 yds. of No. 16. I am, therefore, puzzled to know if the two insulated wires of the same length and kind are to be two lengths of 12 yds. or two lengths of 6 yds. only. Could you kindly help me in this? I should also like your opinion as to whether you think this method as good as condenser. Another matter I should like to be put right in. After having wound primary wire on core, in testing for leaks. Should I get a deflection on galvanometer by touching *core* with one end of wire, the other end being connected to battery and galvanometer?

We advise you to keep to recognised methods and use a condenser. If you wish to experiment, it is another matter. We should take the author's meaning to require two lengths of 12 yds. of wire for the primary. The fact remains that all professional coil makers (as far as we are aware) use a condenser, and as the induction spark coil has arrived at its present stage by numberless trials and experiments, you would be on safe lines in keeping to this practice. *Re* testing for leaks, see Chapter VII of our sixpenny handbook No. 24.

[14,237] **Small Low-reading Voltmeter.** S. B. (Plumstead) writes: I thank you very much for your prompt answer to my last query, and should be glad of your kind consideration of the following. The sketches below represent my idea of a voltmeter for reading volts up to about 8 or 10. I have been unsuccessful in my efforts to adapt the one that is shown in your handbook No. 24. *a* is the pointer pivoted at the centre, *b* is a flat piece of brass, say, ¼ in. square, or thereabouts, *c* is a solenoid, and *D* is a soft iron core to which is attached at the top a brass or other rod of the same diameter as *D*, and *b* rests lightly upon it. The sketch almost explains the action, viz.: the solenoid draws *D* up into it and the extension rod pushes *b* upwards, and *b* being soldered on to the spindle pushes the pointer over. When the current is off, the weight of *b* pulls the pointer over again to zero, and *D* falls just far enough for *b* to rest on it. Do you think the idea is any good, and what number wire, and how much shall I require? If I am unable to get enough wire on the bobbin, can the overplus be wound on a separate reel and stowed away in the case? Would you kindly say what gauge wire the enclosed is, and whether it will be suitable for winding this instrument?

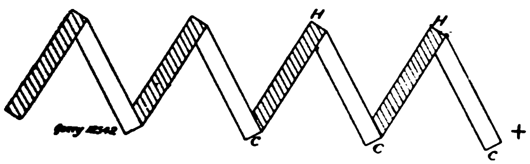
Voltmeters made on a similar plan are already in use, and have been for some years, the difference being that the soft iron core is sucked downwards in the upper end of the coil instead of being pulled upwards as you suggest, thus saving the weight of the long attachment piece connecting the core to the arm *b*. We think you will do well to adopt this plan in preference to your own arrangement. It is of the greatest importance to reduce the weight of the moving parts as much as possible. The power available in such an instrument is so very small that unless friction is almost eliminated at the spindle pivots, the magnetic force of the coil is insufficient to move the needle. The pointer should be made of aluminium or some exceedingly light substance; the bar *b* must also be extremely light; brass ¼ in. square is entirely out of the question, and the iron core *D* should consist of a bundle of annealed iron wire in preference to being solid; its diameter should not exceed ⅛ in. (the weight of iron core in an actual instrument is about 1-25th of a gramme), and it must be much smaller than the tube in which it moves, to prevent friction with the sides. You will notice that as the arm *b* moves in a circle the core *D* will not move up and down in a straight line, but will move side-ways as well. A suitable gauge of wire to use would be No. 34, the bobbin being made large enough to hold about 2 ozs.; but it may be necessary for you to try several arrangements of bobbin and wire before you get just the right effect. You cannot calculate exactly beforehand the proportions of these instruments. If necessary, wire can be added to make up resistance by winding it upon a frame and fixing it in any convenient position. You may find it necessary to attach an adjustable counterbalance similar to that shown in Fig. 18 of our handbook, because, as you will notice, the weight of the needle opposes the coil until it reaches the centre of the scale, and then aids the coil, and further the force is not constant throughout the movement. Your sample of wire is No. 40 gauge.



SMALL LOW-READING VOLTMETER.

[12,542] **Thermopiles.** T. W. A. (St. Leonards-on-Sea) writes: For about a year I have been using a thermo generator to charge motor-cycle accumulators. It has acted splendidly, till now it suddenly refuses to give more than 1 volt. It was a water-cooled affair with three terminals, either two outside ones giving out current if Bunsen burner inside was alight. Have sent it to electrician who supplied it (second-hand), but he fears he can do nothing, as he does not properly understand it, and says maker's firm is not now in existence. Can you help me by giving name of any firm who would be likely to understand and repair for me?

The apparatus appears from your description to be a Cox thermopile; if so, it is very doubtful if the firm is now in existence. The action of a thermopile depends upon the fact that if you join together two different metals and apply heat to the junction an electric current is set up. The voltage is, however, very low, and it is necessary to use a large number of such couples in series to obtain even 3 or 4 volts. The drawback to thermopiles is that the continual heating and cooling causes the joints to loosen and introduce resistance into the circuit, resulting in loss of volts. This



THERMOPILES.

seems to have happened with your thermopile. Possibly if all the segments were taken out, the joints separated, cleaned, and then fastened up together again, the apparatus would be all right. It would be a lengthy job, but if done by yourself in spare time might be worth the trouble, but it is doubtful if you will get any firm to do it at a quoted price. You might try Messrs. J. J. Griffin & Sons, Ltd., 26, Sardinia Street, Lincoln's Inn Fields, London; they manufacture scientific apparatus and probably the ordinary lecture pattern of thermopile, so should understand the work. The metals generally used are antimony and bismuth. The water jacket probably is arranged to cool each alternate joint, as by this means the voltage is increased. If you decide to try and repair it yourself, before taking out all the couples, examine carefully to see if you can find a bad joint somewhere. It may be merely that the terminals are making bad contact with their respective ends; a single faulty joint or crack may be causing the drop. The principle is shown by sketch herewith. Dark lines bismuth; light lines antimony.

[14,328] **Starting Resistance for Motor.** A. T. (Stoke-on-Trent) writes: I should esteem it a favour if you will give me particulars of the wire I enclose. What kind is it? I have a large quantity of it, and thought of making a starting resistance for a 14 b.h.-p. motor. I suggest winding the wire spiral fashion, about 1 in. diameter. Do you think this would answer my purpose? What length of wire should I want before I commenced to spiral it? Can you suggest a better way of making a resistance of this wire? If so, I should be pleased. I might say that we use 500 volts, and there is very little load on the motor when first switched on. You will know that it is just a matter of starting the motor steady. The current or next to none passes through the resistance when fully switched on. Could you give me particulars of a starting switch?

We cannot say exactly what is the composition of the wire you send; it appears to be resistance wire of some kind. You may take its resistance as approximating to that of German silver; this would be near enough for such a purpose as a motor starter or speed regulator; its size is No. 11 S.W.G. For advice as to the construction of a starting resistance for a 14 b.h.-p. motor, we must refer you to our Expert Service Department. A fee will be charged according to the information required. Full particulars should be given as to what is wanted. Some information on starting switches for motors is given in our handbook No. 14.

[14,302] **Correspondence Instruction.** C. S. (Ilkeston) writes: I should be much obliged if you will answer me the following queries with regard to an electrician's course from the Electrical Engineer Institute of Correspondence Instruction:—(1) Would it be any good taking this course, if I did not get the practical part at the same time? At present I am unable to learn any of the practical part, so I should be much obliged if you would let me know if I should have to go somewhere else to get practice after I had gone through the course before I could get work as an electrician.

(1) No. It is absolutely essential that you have practical experience and are fairly conversant with practical workshop methods, instruments, tools, &c., &c. In fact, without this you would never get a job as a working electrician. It is preferable to take both theory and practice at the same time, but you could take the practical afterwards—better have it even then than not at all.

The News of the Trade.

[*The Editor will be pleased to receive for review under this heading samples and particulars of new tools, apparatus, and material for amateur use. It must be understood that these reviews are free expressions of Editorial opinion, no payment of any kind being required or accepted. The Editor reserves the right to criticise or commend according to the merits of the goods submitted, or to abstain from inserting a review in any case where the goods are not of sufficient interest to his readers.*]

* *Reviews distinguished by the asterisk have been based on actual Editorial inspection of the goods noticed.*

A Removal Clearance Sale.

In view of the forthcoming removal of Messrs. A. J. Wright, Ltd., 318, Upper Street, Islington, N., to new premises—the new address and exact date of the change will be advised later—to save cost of moving, a large portion of their stock is being offered at greatly reduced prices; and to enable readers of the paper not resident in London to avail themselves of the bargains to be obtained, an illustrated sale list has just been issued. This leaflet comprises prices and particulars of electric bells, indicators, indicator movements, magic lanterns and telescopes, batteries, switches, pushes, dynamos and motors, Robertson lamps, and other electric lighting accessories. No MODEL ENGINEER reader who is in want of electrical supplies of any kind should fail to send for this list.

New Catalogues and Lists.

George Adams, 144, High Holborn, W.C.—This is a new illustrated catalogue of lathes, milling, drilling, and shaping machines giving particulars and prices of some excellent tools. It comprises plain and back-gear lathes for driving by foot gear or power; three types of "A & B" screw-cutting lathes. The latest of these is a new and improved tool specially designed for light, accurate and speedy work. The lathe will cut all Whitworth and cycle threads, and with the addition of a 127-toothed wheel will cut most metric pitches. The headstock has a three-speed cone pulley for flat belt, is fitted with back-gear with the usual eccentric shaft, giving a range of six speeds. The spindle has an unusually large bore with a good strong nose to take large faceplate or chuck; it is of cast steel, and the bearings are adjustable. End thrust is taken up by a ball-bearing. The centres are fitted in a bush, and are to Morse taper. The tailstock is of the latest overhanging pattern, is quickly and firmly locked to the bed by an eccentric lever, and is provided with set screws for setting it over for taper work. The bed is exceptionally broad, and is provided with V-slides for carrying the saddle and tailstock. It has a gap provided with a bridge-piece. The saddle has broad and long slides, and can be locked on the bed whenever required for facing. The compound r st has very long heavy slides, and is adjustable for turning cones, it has a triangular steel clamping plate, and the leadscrews are covered in to protect them from dirt, &c. The leadscrew nut is in two halves, and can be held apart so that the saddle can be moved along the bed by the rack and pinion. The leadscrew in size "B" is square threaded and cut 6 to 1 in. Whitworth, the change wheels supplied giving a range of from 3 to 78 threads per inch. The "A" lathe has the ordinary V thread in the leadscrew, cut 12 to 1 in., and the set of change wheels for this size gives a range of from 3 to 64 threads per inch. (Size A lathe is 5¼ centres, and size B 6¼ ins.). The "B" lathe has automatic cross feed, which can be fitted to the "A" size at an extra cost. The sliding, surfacing, and screw-cutting feeds are all operated from the headstock, and can be thrown in or out or reversed without altering the running of the lathe. The treadle motion runs in long bearings, swivelling in all directions; it has a heavy crank shaft, and is very light running. When required for power, a right and left countershaft is supplied at the same price. All change wheels are milled from the solid metal, and all screws and bolts are Whitworth pitches. The rack and pinion are not driven direct, but by intermediate gearing, so giving a much smoother feed. Other appliances listed include boring table, capstan head for the A and B lathes, large screw-cutting and surfacing lathes, small hand and power shapers, and several designs of milling machines. The list, which is excellently printed and illustrated, will be sent to all readers on receipt of 6d. in stamps.

A. G. Thornton, King Street, Manchester.—We have received two leaflets describing instruments lately introduced by this well-known firm. The first is a new soffit or suspension level, useful to surveyors and builders, and the other a draughtsman's protractor. This instrument can be used in the same way as a set-square, it being possible to set the arm to any angle. It is made in electrum and engine divided.

The Editor's Page.

READERS who have been following Mr. Chas. S. Lake's contributions to our pages will be interested to learn that we have arranged with him to deal with a somewhat wider range of subjects than he has hitherto touched upon. Among other things, he will contribute notes upon the latest developments in marine engineering and in traction work, on both of which topics his experience enables him to bring expert knowledge to bear. We may here say that should any reader wish for information on any particular innovation in the directions indicated above, or in locomotive matters, we shall be happy to receive suggestions of subjects suitable for special articles.

* * *

Mr. Lake has recently been engaged on another important contribution to the literature of the locomotive. This is a book entitled "The World's Locomotives," which will give a complete survey of the latest practice in locomotive building in all the principal railway countries of the world. The book will run to about 370 pages, and will contain over three hundred photographs and working drawings of locomotives of all types. It will be published from this office towards the end of the present month, the price being 10s. 6d. net, postage extra. We shall give some further particulars of this volume in an early issue.

* * *

We would call the attention of our inventive readers to the fact that the £150 prize competition, to be held in connection with the Grocery, Oil, and Italian Warehouse Trades' Exhibition, at Agricultural Hall, Islington, London, from September 16th to 23rd next, for the best constructed safety mineral oil lamp, is still open to the public, the previous competitions not having produced a lamp which fully complied with the two essential conditions of safety and simplicity. We may add that the lamp must be designed so that it can be sold at a wholesale price of 2s. Further particulars may be obtained from Mr. Arthur J. Giles, Hon. Secretary to the Competition Committee, 49, Eastcheap, London, E.C. The competition closes on September 11th, next.

Answers to Correspondents.

J. C. T. (Croydon).—Many thanks for your contribution.

J. C. (Ballylongford).—Any of the electrical supply firms advertising in our journal would quote you. It is sold by the pound.

A. C. (Enfield).—Your letter received. It will appear in due course.

B. J. T. (Nuneaton).—We cannot deal with this matter as an ordinary query, and suggest that you avail yourself of the Expert Service Department, particulars of which appear on another page.

A. B. (Battersea).—The subject you mention has been dealt with considerably in our recent "Queries and Replies" columns.

W. D. G. (Shaw).—Your query is not intelligible, but it has already been acknowledged. If you can explain your difficulty a little more clearly, we shall, if possible, be glad to assist you.

E. L. P. (Dulwich).—Contribution received. It will be dealt with in due course.

Notices.

The Editor invites correspondence and original contributions on all amateur mechanical and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected or not, and all MSS. should be accompanied by a stamped addressed envelope for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

This journal will be sent post free to any address for 13s. per annum, payable in advance. Remittances should be made by Postal Order.

Advertisement rates may be had on application to the Advertisement Manager.

HOW TO ADDRESS LETTERS.

All correspondence relating to the literary portion of the paper, and all new apparatus and price lists, &c., for review, to be addressed to THE EDITOR, "The Model Engineer," 26—29, Poppin's Court Fleet Street, London, E.C.

All correspondence relating to advertisements and deposits to be addressed to THE ADVERTISEMENT MANAGER, "The Model Engineer," 26—29, Poppin's Court, Fleet Street, London, E.C.

All subscriptions and correspondence relating to sales of the paper and books to be addressed to Percival Marshall & Co., 26—29, Poppin's Court, Fleet Street, London, E.C.

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Contents.

[*The asterisk* (*) *denotes that the subject is illustrated.*]

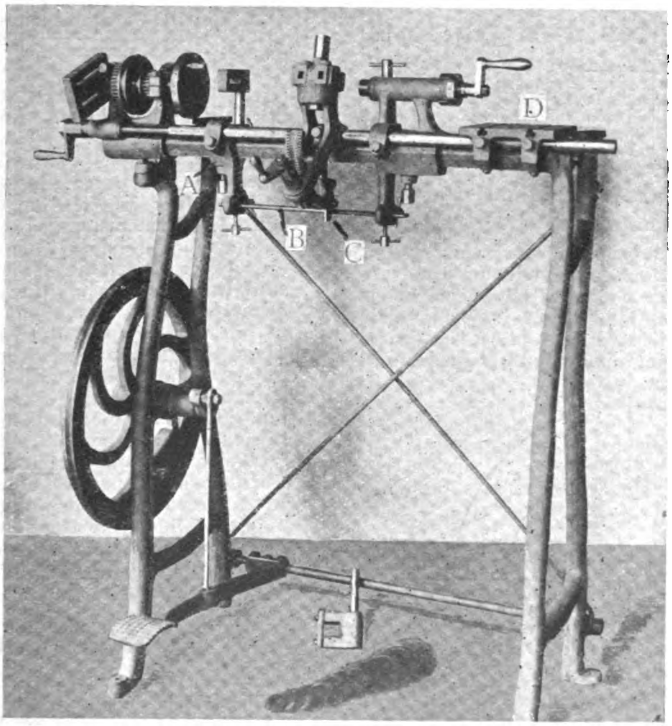
THE
Model Engineer
And Electrician.
A JOURNAL OF PRACTICAL MECHANICS AND ELECTRICITY.

EDITED BY PERCIVAL MARSHALL, A.I.MECH.E.

VOL. XIII. No. 223. AUGUST 3, 1905. PUBLISHED WEEKLY.

A Reader's Home-Made Lathe.

By A. AUSTIN.



MR. A. AUSTIN'S HOME-MADE LATHE.

HEREWITH is briefly described a small lathe, 3½-in. centres, 30-in. bed, that took about fifteen months of my spare time to construct, but now that it is finished I feel in every way repaid for the labour spent upon it. Most of the work I did in a similar lathe which a friend of mine owns, which in itself is proof of its practical design and construction. The headstock has a two-speed cone for gut belting, is back-geared, and arrangement is made for adjustment for wear of bushes, and taking up of end thrust. The bed is of planed hexagon steel, which is at once quite rigid and true; upon this fastens the stay-holder A; the said stay-holder having provision for taking the stays as shown, and also underneath for taking one end of the pattern-bar B, the other end being held in a similar arm under the tailstock. The pattern bars consist of pieces of cast steel, 15 ins. by 1 in. by 1/4 in., in which may be cut inversely any pattern that it is desired to copy. A knife edge on the toolholder at C following the pattern in bar causes the toolholder to swivel on the leadscrew and thus reproduce the pattern upon the material revolving between the centres. Cross traverse is given by the screw which engages the circular rack and tilts the turret head in or out as required.

The boring table seen at D has two bolt slots, enabling any work of small size to be bolted down upon it and machined by a boring bar between the centres. A long nut turning in a sleeve in the headstock engages the screwed end of the leadscrew and gives a traverse of about 8 ins. in either direction; for screw-cutting the handle is removed from the nut and the necessary wheels affixed in its place. The whole is mounted upon a light stand and driven by foot power, the weight of the flywheel being about 40 lbs., with a diameter of 20 ins.

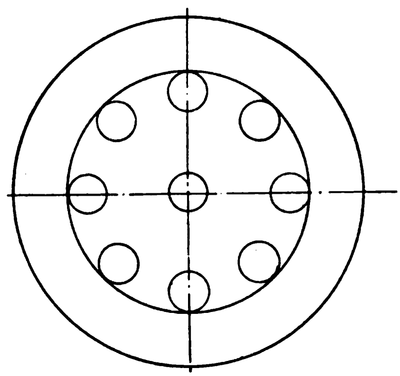
Workshop Notes and Notions.

[*Readers are invited to contribute short practical items for this column, based on their own workshop experience. Accepted contributions will be paid for on publication, if desired, according to merit. All matter intended for this column should be marked* "WORKSHOP" *on the envelope.*]

A Jig for Armature Laminations.

By "ROUND SQUARE."

The following is a description of a handy jig for using when punching round holes in drum armature laminations:—Procure a piece of 1/8-in. sheet brass, larger than diameter of laminations by 1/2 in., recess it in the lathe a good fit to discs, and get the centre before removing it from machine; afterwards mark



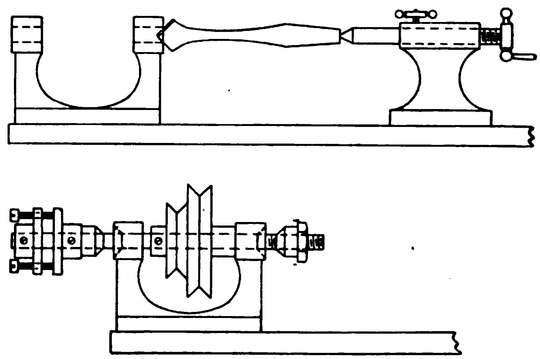
A JIG FOR ARMATURE LAMINATIONS.

off accurately the number of holes you need in your armature, bringing holes to edge of recess; then drill holes the required size, and the jig is complete. Place a blank disc in recess in jig, and punch the centre holes first; this is to allow a bolt to be inserted through centre for holding disc firmly in jig when punching outer circle of holes.

Taking up Slack in a Cheap Lathe.

By A. L. HALL.

Unlike many model engineers, I am not the possessor of a good lathe, the one I possess being a 2½-in. centre "Companion" lathe and fretsaw, the spindle of which passes through the headstock. After five years it began to get very shaky in the bearings; so to take up the slack I proceeded in the following manner:—I first drew spindle out, which is 3/8 in. thick, and is provided with two cast-iron washers or discs for holding emery wheel at left-hand end of spindle. I then procured a 5/8 in.



METHOD OF TAKING UP SLACK IN A CHEAP LATHE.

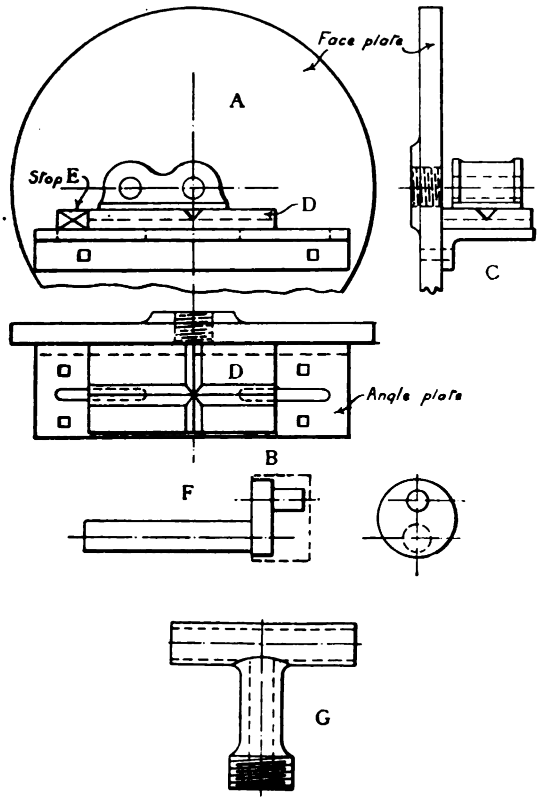
drill, and slid back centre up, and held drill between this and bearing in headstock, working drill with spanner, and feeding with tailstock (this because I have no other means of drilling) until I had made a countersunk hole about 1/4 in. deep. I afterwards turned headstock round, and countersunk the other bearing the same. I next procured a piece of brass tube about 1/8 in. thick and a tight fit on spindle, and cut two pieces 3/8 in. long off same, placing one piece over the screwed end, and forcing it into place with a thin nut, and turned inner end of brass tube down to same angle as bearing. The other piece was forced on other end, and turned down as before. After putting one of the washers on the one on left-hand side on the flange, I drilled and tapped two holes for 3-16ths-in. screws. After screwing on to spindle with setscrew, I was able to tighten the front washer and brass cone, which has made the spindle as rigid as ever. I can also take up future slack. The sketches will help to convey my meaning.

Face and Angle Plates.

By "SREGOR."

The object of this article is to describe a method of producing accurate results in intricate casting, etc., on the ordinary face and angle plate of the lathe without wasting a lot of time in setting true to lines, and which is much more reliable to produce accurate results.

Referring to accompanying sketches, A shows elevation of lathe face and angle plates, B plan, and C side elevation. The plate D is intended to be used in conjunction with face and angle plates and on which the casting, &c., to be machined is fixed (as shown). This plate should be of convenient size and thickness, to suit the size of work to be machined upon it, and should be planed up flat and square and the edges parallel. A slot at each end should be cut in to hold plate secure to angle-plate (as shown in sketch). To use the plate, the castings, &c., to be machined are fixed on it as shown in Fig. (A), which represents a twin cylinder in one casting for model engine, and, as will be observed, the bores and faces can all be finished with one setting of the casting to the plate, and instead of moving the position of casting alone for each operation, the plate is simply moved farther from the lathe centre, to get the position of the next hole, etc., and keeping the edge of plate tight against



Details of Face and Angle Plates.

faceplate, which ensures the two holes being quite parallel.

To commence machining this cylinder casting, fix the body of casting on movable plate, and square with the faceplate, as shown, with one bore opposite the lathe centre; then bore and face flange; then move the plate along faceplate the correct distance of centres between the two cylinders; this is accurately accomplished by fixing a stop (E) on angle-plate, and against edge of movable plate D; then when the first hole is machined, slide the plate along angle-plate until the gap equals the distance required. This distance is readily obtained to an accuracy of a few thousandths of an inch, which is impossible to obtain with certainty by setting to lines in the usual way. When this distance is obtained, and the second hole bored and faced, the plate D can be turned round, keeping the edge of plate D against faceplate. The other end of cylinder can now be faced or recessed, as may be required in the design, and will guarantee the faces being parallel with each other.

Another very useful addition to the plate is a V-groove, or two grooves; this is exceedingly handy as a chuck for round work. The groove must be planed square with the edges of plates, as shown in B. To illustrate the usefulness of this vee, suppose we wish to turn the small crank and spindles F. Having turned the plain spindle between the centre in the usual way with a rough lump left on the end to form the crank pin, as shown in sketch, fix the spindle in vee, with plate on angle-plate and edge against faceplate, which at once locates the spindle square with faceplate, and the angle plate must be moved farther or nearer to lathe centre until the spindle runs true. This is accomplished in much less time, and with far greater accuracy than could be obtained by setting true in any form of chuck jaws, and, when once set, could be used for any number without again setting the plate.

The other groove, which should be planed at right-angles to the other, and to run parallel with the faceplate; this will be found useful for many pieces of work. An example is shown at G, which represents a brass tee-piece which is to be bored in the three branches, and screw-cut at one end to receive a connecting union, such as is used on lubricating pipes, &c. It will be readily seen that the vees form a substantial bed to hold the slender brass tee-piece in, besides ensuring the three branches being true with each other.

Referring to the crank, of course the angle plate must be set the required distance from centre of lathe when about to turn the crank pin. This is accurately obtained in a similar way to boring the holes in cylinders the correct distance apart, only that the stop E must be fixed against the faceplate and tight against angle-plate, and then angle-plate dropped away from these stops the required distances. If it is a ½-in. throw, use a ½-in. gauge to go in between the stops and angle-plate; and, as before, when this is done, it suffices for any number of components to be produced similar to each other.

A New Turbine T.B.D.—The contract for the "experimental" 36-knot destroyer has been secured by Messrs. Thornycroft. She will have turbine engines. The five 33-knot destroyers will be built by Messrs. Beardmore, and, according to report, will be of over 1,200 tons displacement. These are the "ocean-going" destroyers. The horse-power will be from 15,000 to 18,000.

Submarine Signalling.—The official trial of the submarine signalling apparatus by the German Admiralty took place recently in Kiel Harbour. A bell weighing 140 lbs. was suspended at a depth of 20 ft. from the Gabelflasch Lightship. The sound of the bell was heard with such distinctness at a distance of 3½ miles that its position could be readily located with precision. At a distance of 5½ miles the sound was heard in sufficient volume, but was disturbed by other sounds in the harbour. The result of the trial was considered thoroughly satisfactory, and an order for the adoption of the apparatus was given there and then.

A Kapp Electro-Motor.

By S. Barnard.

THE photograph herewith reproduced is of a small electro-motor which I have lately constructed. The field-magnet casting was bought in the rough, and had to be filed into shape, armature tunnel as well. The armature is an 8-cogged laminated drum, and was built up as follows:—All the stampings (Avery) were varnished on one side and whilst drying a small block of ½-in. wood was drilled with a ⅛-in. hole. At equal distances, and diametrically opposite from this hole, two pieces of 3-16ths in. wide brass were screwed and so arranged that any two slots in a stamping could fit on them.

The next step was to drill a hard piece of wood, as long as the finished armature, with an ⅛-in. hole along its length, and then it was cut with a penknife until exactly the same diameter as the central holes of the stampings, the ⅛-in. hole lying perfectly in the centre of the cylinder. After the requisite number of stampings were slipped over the brass strips, this wood core was driven right through the central hole in iron armature, and through its ⅛-in. hole was passed the brass shaft. The armature was finished off by having a layer of 1-16th in. celluloid, cut to the shape of a stamping, strung on at each end, and the whole lot, after being clamped together, secured by brass pieces soldered to the shaft. The commutator was made from a

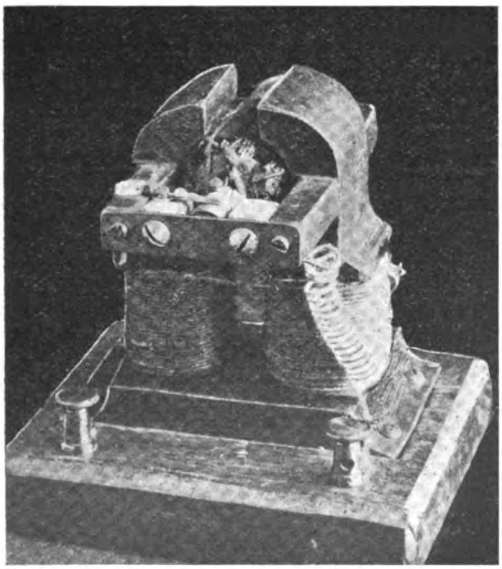


Fig. 1.—Mr. S. Barnard's Kapp Motor.

Bray's gas burner, mounted on a wooden cylinder, which was cut in the same way as that for the armature. It is slit into four parts and secured by screws, four of which, nearest the armature, are used for connections. As a dynamo, it is supposed to give 10 watts, and therefore as a motor it should take about 25 watts; but I had it working from the mains with about 8 watts, although, of course, delicate adjustment was necessary. The windings are taken from the *M.E. & E.* sixpenny handbook on Motors, whilst shellac, silk, and

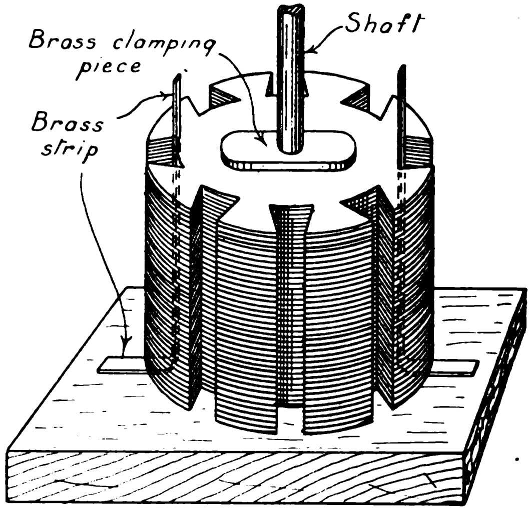


Fig. 2.—The Armature.

celluloid photography film are used as insulators. No lathe was used in its construction, and the only part which I put out to be done was the drilling and tapping of the bearing holes in field-magnets.

A Gasoline Motor Car.

THE use of gas or gasoline engines in railway work has been accompanied with more or less complication for obvious reasons. The Marinette Gas Engine Company has, however, recently completed a car which has been in successful operation on the line of the St. Joseph Valley Traction Company between La Grange and Middleboro, Ind., and which comprises the essential apparatus of such a car. The car, which is 34 ft. long, is equipped with a four-cylinder Walrath engine direct connected to a Sprague generator. The engine has a capacity of 70 horse-power at 325 revolutions per minute, and the current generated is fed to four 35 horse-power motors on the trucks and to an auxiliary storage battery of 120 cells. The latter are so arranged that excess current is fed to them automatically when the motors are not taking it all, and current from the battery is used for the abnormal requirements when starting the car and getting it up to speed. The engine also drives a small air-compressor, which is used for the air brakes and for starting the engine. The generators may also be run as a motor from the storage battery for this purpose. The cooling of the jacket water of the engine is accomplished by circulating it through 800 ft. of ¾-in automobile radiator pipe, and thence through a supply tank of 190 gallons capacity. The jacket water is positively circulated by means of a pump, and two 42-in. fans revolving in a horizontal plane furnish a draught through the radiator coils to assist in cooling the water. The mechanical and electric equipment of this car occupies 33 per cent. of the floor space, and the weight aggregates about 25 tons.—*Power.*

Notes on Current Traction Matters.

By CHAS. S. LAKE.

G.W.R. RAIL MOTOR SERVICES.

THE rail car service on the Southall to Brentford branch of the Great Western Railway is at present being partially worked by means of a small four wheels coupled tank locomotive hauling one of the new trailing cars recently built at Swindon Works. The locomotive is one of an old class built a number of years ago at Wolverhampton Works. It runs upon six wheels, with the front two pairs coupled together, and a small pair of carrying wheels below the bunker. A smart appearance has been imparted to the engine by painting it after the style of the G.W. carriage stock—viz., cream colour and brown, the cab and front wheel splashers being of the former; and the tanks, boiler, and wheels of the latter colour, with lining out to resemble the trailing car. For some time after it commenced running in this way, the engine had to run round the car at each end of the journey; but arrangements have now been made whereby the engine can be controlled from the end compartment of the car, as in the steam motor coaches, thus avoiding the necessity of uncoupling the locomotive at the end of each run. A similar method of working is being introduced on other G.W.R. branch lines.

NEW STEEL CARS, BOSTON ELEVATED RAILWAY.

Some new cars have recently been built at the Bartlett Street shops of the Boston (U.S.A.) Elevated Railway Company for use in the East Boston Tunnel service and the streets connecting therewith. Each car is of a semi-convertible type, allowing of its advantageous use either in summer or winter. They are specially designed for a maximum carrying capacity, with ample provision for quick ingress and egress of passengers, whilst at the same time the ends are closed by doors whilst the car is in motion so as to avoid accidents.

The floor of the car is continuous at the same level to its extreme ends, and there are sliding doors at the sides where passengers enter or leave, but these doors give direct access to the body of the car, there being no "bulkhead" separating the ordinary end platform or vestibule portion from the seating accommodation. The construction is mainly of steel for the heavier portions, and the interior of the car is lined with sheet aluminium. There are fourteeen reversible transverse, four fixed transverse, and four longitudinal seats, so that fifty-two persons in all are accommodated. The cars are lighted by six 5-light circuits, and motion is derived from four G.E. 74 motors having a rated capacity of 65 h.-p. with Sprague-General Electric control. The motors are mounted upon Brill 27 E 1 trucks, having four 2 ft. 9 ins. wheels, with steel tyres and axles. These cars are intended to be used as motors for trains consisting of two cars of equal size, the train to drive from either end and the second car being of the trailer type without motors. The East Boston Tunnel contains long grades of 5 per cent. and less and at present there are no facilities for "running round" operations at the terminal.

THE "BRUSH" ONE-MAN MOTOR OMNIBUS.

The writer is indebted to Messrs. The Brush Electrical Engineering Co., Ltd., of London, and Loughborough, for the accompanying photographs and particulars of their "one-man" motor omnibus.

A new department has been organised at the Brush Works, Loughborough, for the manufacture of motor omnibuses, and the one illustrated was built there for the Potteries Traction Company and exhibited at the Olympia Motor Car Show held in February of the present year. The vehicle is arranged so that it can be entirely controlled by one man, and the entrance doorway for passengers is placed at the front end, giving access to the inside seats from the driver's platform.

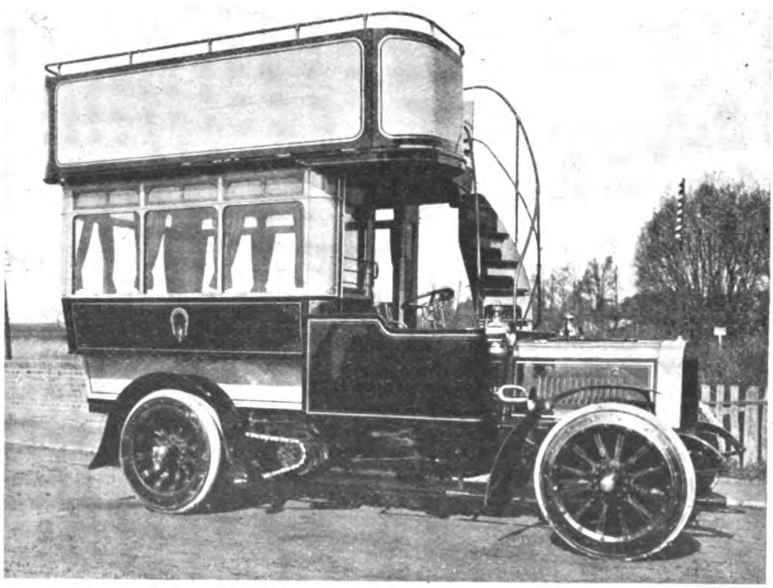


FIG. 1.—THE BRUSH ELECTRICAL ENGINEERING CO.'S "ONE-MAN" MOTOR OMNIBUS.

The outside seats are reached in the usual way by means of a staircase, also leading from the front platform. Seating accommodation for thirty-two passengers is provided, and an automatically operated box is used for collecting the fares.

The trailer used in the construction of the omnibus is rendered non-inflammable by chemical treatment by the Brush Company's plant installed for the purpose—a wise precaution where motor propelled vehicles are concerned.

The one-man omnibus has been specially designed for service in sparsely populated districts, wherein only light traffic exists; but which may be linked with tramways and railways by means of motor omnibuses. The construction of the body is principally in seasoned English ash for the framing, mahogany and aluminium for the panels, and red deal for the flooring. The inside is framed and panelled in wainscot oak, and the seats are of perforated veneer. Grooved rubber is used for preventing rattling of the windows, and hinged sashes over the side and end windows provide an adequate means of ventilation. The engine is of the four-cylinder type, governed on the throttle with mechanically operated inlet and exhaust valves (each driven by separate half time shafts), running at a maximum speed of 900 revolutions per minute, giving 30 h.-p. on the brake. An efficient silencer and water circulating pump are provided, and either the usual high tension ignition apparatus or that of the Simms-Bosch magneto type is fitted. King's patent friction clutch drive is employed, giving three speeds at 14, 9½ and 4½ miles per hour and reverse at three miles per hour. The gear wheels are of best steel, accurately machined for noiseless running, and are always in mesh, consequently obviating all the disastrous effect of the wear and tear caused by forcing one gear wheel into the other when changing speeds. The illustration (Fig. 3) shows the gear-box with three sets of wheels always in mesh. At one end of the gear-box the usual coupling is fixed to the foot clutch connected to the engine; the other end has three external drums, each running at different speeds in proportion to the gear wheels mounted on their respective shafts, the two outer shafts being hollow to admit of their being driven separately. The inner shaft is solid, and has the smallest or inner drum connected to it so that when the small clutch is expanded, to grip the small outer clutch the drive is straight through from the engine to the cardan shaft; but as the medium or larger clutches are expanded into their respective outer clutches, the drive is effected through the small wheel on the high speed shaft and through the counter shaft back again to the respective outer clutches, in proportion to the ratio of the wheels.

FIG. 2.—ANOTHER VIEW OF THE "ONE-MAN" MOTOR OMNIBUS.

From this it will at once be seen that in case of changing speeds, nothing but the simple movement of the lever is necessary; and as friction clutches are the means of transmission, there is no need to work the foot clutch when so changing. Sudden shocks, such as are experienced with other types of gears, are entirely avoided, thus effecting a great saving in wear and tear and a great reduction of vibration throughout the whole frame. The life of the tyres is also considerably extended, owing to the increase of speed being gradual, thus preventing the ripping action due to wheels suddenly brought into mesh as in the ordinary gear.

The engine develops 30 b.h.-p. at about 900 revolutions. The bore of the cylinders is 110 millimetres and the stroke 130 millimetres. The transmission is of the ordinary type for chain-driven vehicles through differential and bevel gears.

THE timber exports of Norway decreased 15 to 16 per cent. during 1904, as compared with 1903.

RADIOPHOR.—Dr. Hans Axmann, of Erfurt, has lately made a fresh discovery of great importance in the matter of radium activity. We are told he succeeded in producing a radium substance (*praeparat*) which has all the properties of radium in full measure and which can be made active by artificial means. This substance, which the discoverer calls Radiophor, keeps its activity just as long as pure radium, and is of equal value with the latter for technical and especially for medical purposes. It can be placed on and in every part of the body, under the skin, and even in cancer boils, and Berlin authorities have had very good results with radiophor. It is manufactured at a very low price by P. Beiersdorf & Co., of Hamburg.

The Latest in Engineering.

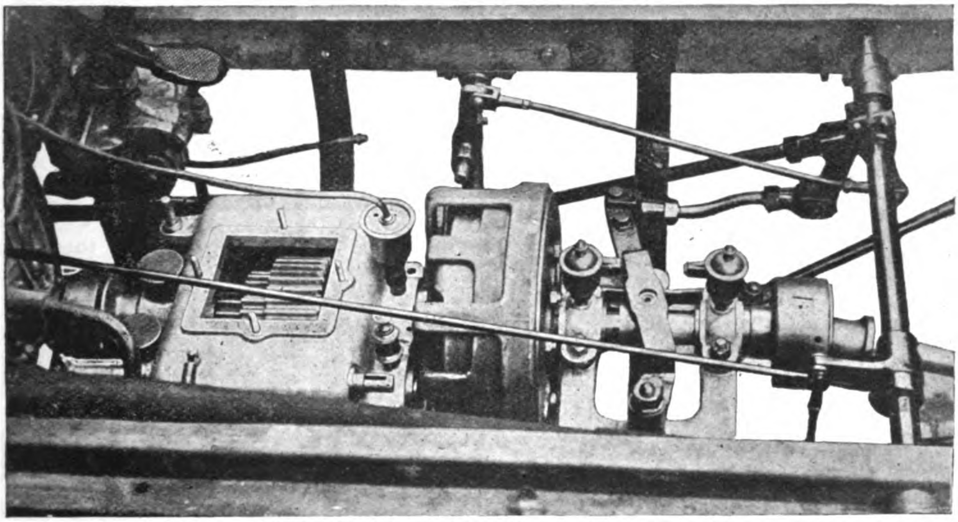
A New Type of Locomotive.—The Rhymney Railway Company has recently introduced the first of a new type of locomotive. These locomotives have six coupled wheels and a pair of radially-fitted trailing wheels. The inside cylinders are 18½ ins. in diameter, with a stroke of 26 ins. The coupled wheels are 4 ft. 6 ins., and the trailing wheels 3 ft. 6 ins. in diameter. The coupled wheelbase is 15 ft. 3 ins., the total wheelbase being 21 ft. 9 ins. The boiler pressure is 165 lbs. per sq. in., and it has a heating surface of 1,374 sq. ft., of which 122 sq. ft. is contributed by the firebox. The grate area is 21·5 sq. ft. The firebox is of the Belpaire pattern. The engine in running order weighs 61 tons 6 cwt., of which 48 tons 14 cwt. is carried on the coupled wheels.

Corliss Engines.—The advantages of tail-rods have seen a practical demonstration in the power plant of the Camden and Suburban Railway Company, says *Power*, at which station there are two cross-compound ondensing Corliss engines direct connected to 800-kilowatt generators. One of these engines is equipped with tail rods, and the other is not. The former engine has, in the three years' service, worn out two sets of bull rings, and the low-pressure cylinder has worn down 1-16th in. The latter engine, in two years of service, has cost nothing for repairs, the bull-rings have not been changed, and the tool marks are still visible on the bottom of the cylinder. The engine with the tail rods has also shown greater steam economy, and can be run at about 10 per cent. greater capacity.

Steel Sleepers.—Mr. J. T. Richards, chief permanent way engineer of the Pennsylvania Railroad, has made the following objections to steel cross-ties :—They increase expansion and contraction in all parts of the track ; they weigh about one-half as much as wooden ties, and do not make a heavy enough track ; the connection of metal and metal between the rail and the tie is very detrimental ; they are noisy ; they have not the elasticity or cushion that wooden ties have ; they cost more ; they could not be used where the automatic signals are used, because they would connect the current between the rails ; lastly, there is no difficulty in getting all the wooden ties required, and the greatest standard road in England (the London and North-Western) is now getting twenty-one years of life out of cross-ties by creosoting them, at a cost of 7½d. a tie.

A Large Cantilever Bridge.—A cantilever bridge crossing the St. Lawrence at Quebec, which is now under construction, is credited with the longest span ever built. The structure consists of two approach spans of a length of 210 ft. each, two shore arms each 500 ft. long, and a great central span of 1,800 ft. This bridge compares with the 1,710 ft. of the great Forth cantilever bridge, and the 1,596 ft. and 1,600 ft. respectively of the Brooklyn and Williamsburgh suspension bridges. The total length of the bridge is 4,220 ft., which is less than that of any of the other three mentioned by 1000 ft. or more. The total floor width is 80 ft., provision being made for two railway tracks, two roadways, and two sidewalks. The main posts of the great cantilever have a height of 325 ft., and each weighs 750 tons.

A New Magnetic Alloy.—This alloy contains more than 60 per cent. of copper, 20 per cent. of manganese, 10 per cent. of aluminium, and a trace of lead. It is said to be easily worked, and to have the coercive force of prime cast steel. Its maximum permeability equals that of cast iron, and increases considerably with age. Unfortunately, it will not stand heating, and a temperature of 165° C. permanently strips it of its magnetic properties.



For description] Fig. 3.—The Gear Box of the "Brush" Motor Omnibus. [*see page* 102.

Design for a Model Electric Travelling Crane.*

By C. W. Sherwin.

In designing a model electric travelling crane, with its three distinct motions, and, of course, a reverse movement to each, it is rather a difficult matter to decide which would be the best arrangement to adopt—*i.e.*, one, two, or three motors for the three movements. To have one motor for the three movements would require from fourteen to sixteen gear wheels, with the necessary spindles for them to work upon, the main shaft or spindle requiring a long feather or key fitted, and keyways in some of the gear wheels, whilst levers would have to be arranged to slide them in and out of gear. To have two motors for the three movements would certainly lessen the complication, but personally I think that one motor for each movement works out to be the least complicated arrangement. As to the matter of expense, I very much doubt if the difference in total cost of the three motors and gearing would work out much more than one motor and the extra gearing and fittings.

The crane as described herewith cannot claim to be a special copy of any large one, but has been designed to meet the present requirements, and I think its general appearance is fairly realistic. I have very little doubt that it will prove a very interesting model, amply repaying anyone making it.

Starting with the bottom half or carriage, this will require a piece of mahogany, or other hardwood, 12½ ins. by 6 ins. by ½ in. thick, with a hole ½ in. diameter through the centre, and a recess 1½ ins. diameter by ⅛ in. deep, cut out to take a disc of brass for the centre pillar, which will be described later. Two pieces of similar wood, 12½ ins. by 1½ ins. by ½ in., thick are fastened, by means of countersunk wood screws let in from the top, underneath at ⅝ in. from either side. A strip of brass ½ in. wide by ⅛ in. thick screwed to the underside of each of these pieces, will form a better seat for the bearings of the loco wheels, which are screwed on to these brass strips in the positions shown. Two end plates of ⅛-in. brass or iron, shaped as shown in the end elevation, will be necessary to keep the two pieces of wood rigid, and can be utilised to fasten the buffers and hooks to. The buffers and hooks of the usual pattern, whilst nót being indispensable, are often fitted if there is other rolling-stock, and in this case rather improve the appearance of the crane.

The bearings are of the solid type, with a ¼-in. hole for the ends of the wheel spindles to fit into; spring bearings, as used on locomotives, are not generally used on cranes of this description, as they cannot travel very fast to cause much vibration, and the distance is usually somewhat limited. The loco wheels are 1¾ ins. diameter on the tread, and look better if made more massive than the ordinary type. The spindles for these may be turned from pieces of silver steel ⅜ in. diameter, reduced to 5-16ths in. diameter for the wheels, and ¼ in. for the bearings, the wheels being fastened to them either by screwing or by means of a grub-screw in each.

The top part or revolving platform next claims our attention. This may be made from a piece of mahogany 9 ins. by 6 ins. by ½ in. thick, with a hole ½ in. diameter drilled through the centre at 2¾ ins. from the front end, and a 1½-in. diameter countersink or recess ⅛ in. deep cut out to take the top discs of central pillar. The front end of this wood is cut out as shown, leaving two lugs, through which a bolt ¼ in. diameter passes to hold the jib in position. A hole ½ in. diameter will also have to be drilled where the switch-box is situated, to allow the wire connections to pass through to the underside, and another hole ½ in. diameter for the vertical spindle, which actuates the slewing motion, to pass through, so that the pinion on the end may engage with the large cog-wheel, shown fixed to the top of the undercarriage. This large cog-wheel is bored ½ in. diameter to fit the central tube, is 3¾ ins. diameter by 3-16ths in. thick, and was, in my case, found amongst a lot of scrap brass, together with the pinion; and I have no doubt similar ones may be obtained from an old clock, or perhaps from a vendor of scrap articles.

The centre pillar or pivot, shown in section separately, is made from a piece of ½ in. external diameter brass tube and three brass discs, each 1½ ins. diameter by ⅛ in. thick, with ½ in. diameter hole through centres; one disc is sweated to the top end of tube, the second disc is fastened to the bottom of the countersink or recess in the top platform, whilst the bottom end of tube is threaded,

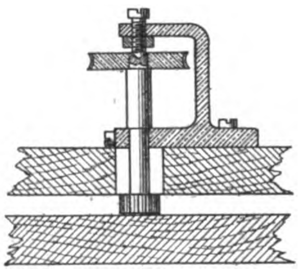


Fig. 3.
Section of Slewing Gear.

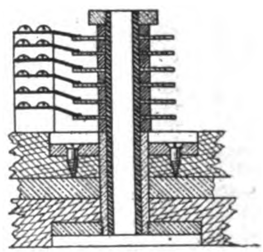


Fig. 4.
Pivot and Current Collector.

and the hole in the third disc is tapped and screwed on, so holding the top platform in position. I have found that this arrangement does not require any ball or roller bearings, as the platform will revolve quite freely without. In the sectional view of the above will be seen a current collector, which enables the top platform to revolve in either direction continuously, without fear of injuring the connecting wires from the travelling motor and battery, which pass up the centre tube, by their being twisted up.

It consists of a piece of vulcanised fibre tube ⅜ in. external diameter, driven into the brass tube a tight fit, and six thin discs of brass, each 1 in. diameter, drilled to fit over the fibre tube; small washers are cut from another piece of fibre tube 9-16ths in. external diameter, and placed alternately washer and disc as shown. A thread is cut in the top end of fibre tube, and a brass nut screwed on will hold all in position; in the edge of each washer and through tube is drilled a small hole, through which the connecting wires are pushed and their ends soldered, each to one of the discs. Of

* The prize of two guineas was awarded for this design in our Competition No. 41.

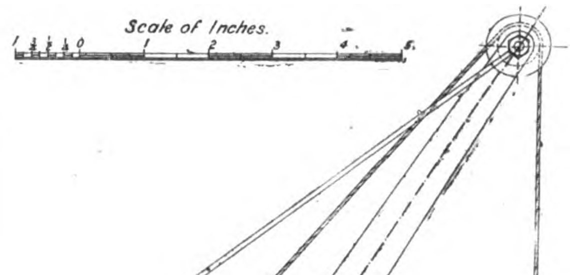
course, the bottom disc must be soldered first, then another disc and washer put on, and another wire pushed through and soldered until complete. Four of these wires are connected to the travelling motor, the fifth to the collector on the track, and the sixth to one of the wheel bearings. A small piece of hardwood, made as shown in perspective in Fig. 8, will stand alongside of collector discs; six small thin springs are screwed to this, so that each one bears on a disc, making good contact. It should be noted that this spring holder is shown straight in the sectional view, to make it clearer, but should be curved as shown in the plan of crane.

Six similar copper wires are connected to these springs by placing the ends under a screw in each spring. These wires are taken to the switch-box and connected to the switches.

The slewing gear consists of a vertical spindle

being adjusted to work freely. Two screws will fix this bracket to the top platform.

The motor that actuates this gear is one as sold by Messrs. Thompson & Co., of Greenwich; it has a cogged drum armature 1¼ ins. diameter, wound in eight sections, and connected to an 8-part com-



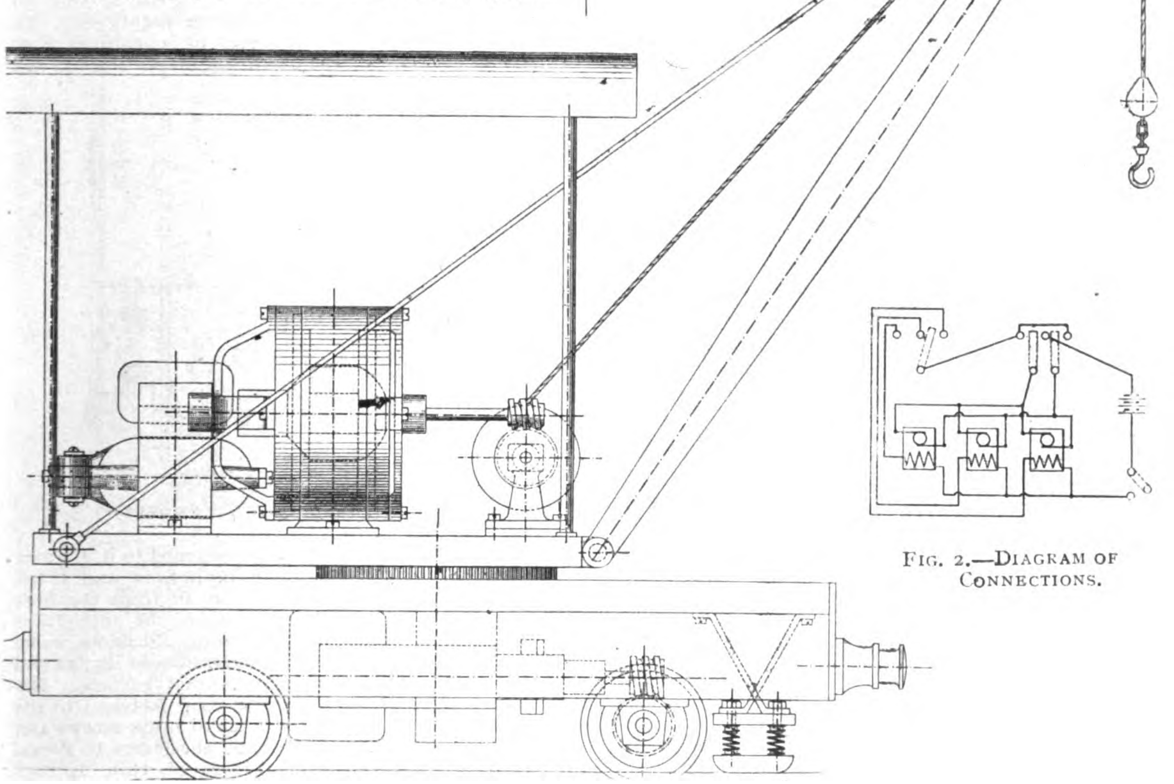


Fig. 2.—Diagram of Connections.

Fig. 1.—A Design for a Model Electric Travelling Crane.

mounted as is shown in sketch (Fig. 3), with a worm wheel on the top end and a small pinion on the bottom end. The bearing bracket is rather a peculiar one, but is well suited for this purpose; it should be preferably a casting, but may be built up from sheet brass. The bottom bearing will have to be split to allow the spindle to be placed in position; a small screw on either side of centre hole will hold the loose half in its place. The top hole is threaded to take a pointed steel screw ¼ in. diameter and lock-nut, which engages with a small countersunk hole in the end of spindle; this allows of the spindle

mutator and one field-magnet coil. The castings and parts may be purchased very cheaply, and are not difficult to fit up. A worm is fastened to the end of motor spindle, which works the worm wheel; this, in turn, drives the pinion that is in gear with the large cog-wheel, and so causes the top platform to revolve.

The lifting and lowering gear consists of a winding drum made from a piece of mahogany, turned down to 1 in. diameter by 1¾ ins. long, and two brass end discs, each 1¾ ins. diameter by ⅛ in. thick. These are fastened to the wood centre by small wood screws, let into countersunk holes on the outside of the discs. A ¼-in. diameter hole is drilled right through the centre of drum, and a steel spindle ¼ in. diameter is fixed in same. The spindle is reduced at each end to 3-16ths in. diameter, and fits in similar holes in the two bearing brackets; these brackets are small castings screwed to a brass baseplate 3 ins. by 1½ ins. by ¼ in., this, in turn, being fastened to the top platform. A worm-wheel is fastened to one end of the spindle, and is driven by a worm on the end of the armature spindle of a four-pole motor, as described by "F. E. P." in THE MODEL ENGINEER for June 15th, 1902. This motor, shown in the drawings, is the smallest size, the only difference from the published design being the position of the holding-down feet and the armature. This is an eight-cogged drum connected to an eight-part commutator, instead of a quadripolar armature, thus having the advantage of being self-starting.

The armature should be wound with 1½ ozs. of No. 21, and the field-magnet coils with 4 ozs. No. 20 D.C.C. copper wire. No brake will be

on the pulley spindle before putting the nuts on. The opposite ends of stays are cut to the correct length, threaded and screwed into small pieces of brass, shaped as shown in elevation, these in turn being fastened to the top platform.

The travelling gear is worked by one of Mr. A. H. Avery's tramcar motors, with a worm on the armature spindle, which drives a worm-wheel in the centre of spindle of the front wheels, as shown A complete set of parts, or the finished motor, can be obtained, and will not present any great difficulty in fitting up. The armature is wound with No. 24, and the field-magnets with No. 20 D.C.C. wire.

We next come to the controlling gear. This has been designed to represent the levers on the ordinary crane, but is, in reality, two switches; one is arranged as a three-way switch, to complete the circuit of each motor in turn; the other is a reversing switch, and reverses the motor which is in circuit with the three-way switch.

The switch gear is shown in detail (Fig. 7), and is made from two pieces of vulcanised fibre 3-16ths in. thick; these are shaped as shown, and

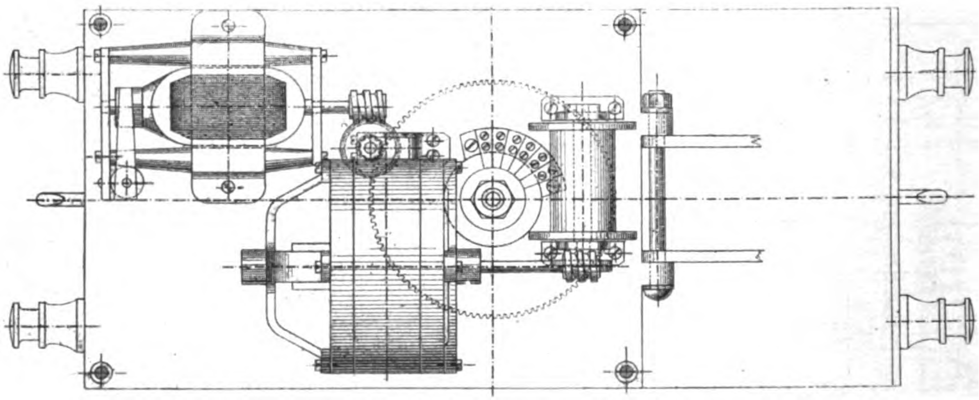


FIG. 5.—PLAN OF MODEL ELECTRIC TRAVELLING CRANE: JIB AND COVER REMOVED.

necessary on the winding drum, because the worm will not allow the worm wheel to revolve, unless the worm is driving it. Thus it acts as an automatic brake, holding the load in any position.

The wire rope, as used on large cranes, may be replaced by small round cord; this is wound on the drum and carried over the pulley wheel on the top of the jib, and should be passed through the centre of a small weight to keep it taut, and the end fastened to a small piece of chain, and a small hook made from stiff brass wire. The jib is composed of two pieces of wood ⅞ in. wide by 3-16ths in. thick and 15½ ins. long, shaped as shown. Strips of tin or brass may be fastened in crosses on the top and bottom edges, with small round-headed escutcheon pins to represent rivets; it should gradually taper from 2 ins. wide at the base to ¾ in. at the top The pulley wheel is 1 in. diameter by ⅜ in. wide, with a 3-16ths-in. central hole, and revolves on a small steel spindle with threaded ends to receive small nuts. A small washer should be placed on either side, between pulley and the sides of the jib, to allow the wheel to clear. The two stays which hold the jib in position may be made from 3-32nds in. diameter brass wire, the top ends being bent to form small eyes or rings, and placed

each has a piece of brass plate fastened to it, tapping holes being drilled through both fibre and brass, and 3-32nds-in. brass screws let in from the fibre side. The brass plates are then cut into three segments to form contact pieces, the slots being filled in, and the face of segments should be flat and smooth to present a good contact surface. The levers are pieces of thin brass strip fastened to the lower ends of the fibre, with small brass screws and nuts at the back, just allowing the levers to swivel nicely on same. Small pieces of thin springy brass are riveted to the underside of levers, so that they make good contact with the brass segments. The three-way switch has one lever, but the reversing switch will require two, with a separate central handle. These are fitted as described, and will be connected together by a small piece of vulcanised fibre, which is drilled for four screws, the outer two being screwed into the brass levers, thus causing the two to swivel together. The central handle is placed between the levers and fastened tightly to the fibre by two screws. The two outer segments in this switch are electrically connected to one another. The two switches are enclosed in a case made of thin brass sheet in one piece, cut to shape, the joint being soldered. The switches are then inserted and fastened to the case with small screws let into the edges of the fibre. The top is made from a similar piece of brass sheet, and fastened in the same manner.

It would be well to point out that the fibre should project beyond the top and sides of the brass segments, to prevent the brass case from short-circuiting any of them. Two lugs should be allowed for when cutting out the case; these being drilled for screws, and screwed to the top platform, will hold it in position. Connections to the motors may be made with No. 20 D.C.C. copper wire passed under the head of a screw in each segment, although I think in this case soldered connections would be preferable. A diagram of connections is given (Fig. 2), and it will be seen how the different movements are

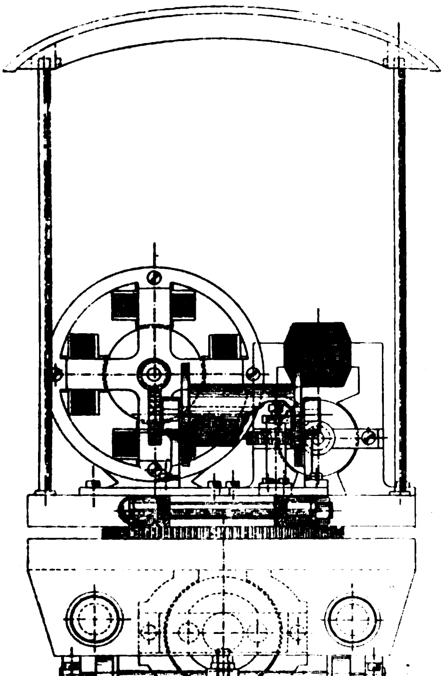


FIG. 6.—END ELEVATION.

carried out. A one-way switch is shown in the circuit, and is intended to be fixed somewhere near the track, and not on the crane itself. This is fitted for starting any movement after having set the three-way switch to the required position, and stopping same without having to touch the crane, and will be found to be a very useful addition.

The collector for the centre of track is made from a piece of brass 1½ ins. by ½ in. by 3-16ths in. thick, with two ⅛ in. holes drilled in it, and another piece 1¼ ins. by ⅜ in. by ⅛ in. thick, with the ends rounded off; this has two ⅛-in. screws in it, which hold two small spiral springs, and the top of springs are fastened to the other piece of brass by two ⅛ in. diameter bolts and nuts. Two stiff wire stays hold this to the underneath of crane, as shown in the elevation.

The roof is mounted on four pieces of 3-16ths in. diameter silver steel, each 7 ins. long. The bottom ends are drilled and tapped for ⅛-in. screws, which are let into countersunk holes in the underside of top platform, and screwed into these pieces of steel; a small washer or disc sweated on the end of each will improve the appearance and form a better seat for them. The top ends are fitted into corresponding 3-16ths-in. holes in the framework of the roof, and held in position by small screws, as shown in end elevation. The back and front ends of

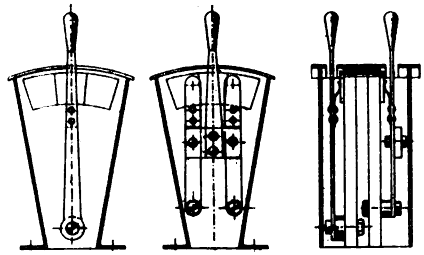


FIG. 7.—SWITCHES.

framework are made from two pieces of wood ⅜-in. thick, shaped as shown, the sides being made from two pieces ⅜ in. by ⅜ in. by 9 ins. long, the outside top edges being rounded off to allow the roof to fit nicely.

The roof may be made from a sheet of tin, but a piece of corrugated cardboard, as used for packing purposes, looks more like the corrugated iron roofs generally used on large cranes; this can be fastened to the framework by small tacks, and, when painted, looks very realistic.

The crane may be made to perform the various movements, without in any way touching it, by having six central conductors instead of only one. As the reason for making a crane in preference to a locomotive is generally lack of sufficient space to have a long track, it will not be very difficult to fit six central conductors, because the crane can work very comfortably on a track only 6 ft. long, which is perhaps quite as extensive, in proportion, to the length of track that some large cranes

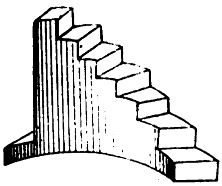


FIG. 8.

have to work on—such, for instance, as the frontage of a wharf. Of course, in this case six collectors will be necessary, and they may be of similar design to the one shown, but must be narrower to accommodate them inside the track rails. They may all be fastened to a piece of 3-16ths in. vulcanised fibre sheet, to insulate them from one another, and perhaps it would be better to place them in two rows of three, alternately, rather than in one straight line; this will allow more room and less chance of their touching one another.

Another interesting addition would be to have a small compound magnet hanging on the end of the jib "rope." The "rope" in this case would have to be two insulated wires twisted together, and connected to the magnet. The opposite ends would be soldered—one to the disc on the drum, and the other to the drum spindle; this disc must not make contact with the spindle. I have found that the very flexible twin electric light cord, if the outer braiding is removed, leaving the black rubber covering, makes a very good flexible "rope." A light spring brush may be made to make contact with the disc, and the other connection made to one of the drum bearings.

With this apparatus the crane could be made to pick up small iron or steel objects, carry them along, and deposit in another position without having to touch it. The switches may be placed somewhere near the track, and the connections made by short lengths of insulated wire from conductors and battery. An extra switch would be necessary to control the lifting magnet. A battery of four one-quart bichromate cells, or, preferably, a 6-volt accumulator, will be required to work the crane. These need no special description.

The finishing touches, such as painting, &c., are left to the individual maker's taste; two coats of good enamel would perhaps give the most desirable finish.

Two Model Sailing Yachts.

By A. Begbie.

THE model sailing yachts illustrated herewith, are the result of my spare time work during last winter. No. 1, shown in Fig. 1, and separately in Fig. 2, was made from the design of Mr. A. Noble, which was published in The Model Engineer for August 1st, 1902. No. 2 yacht, also shown in Fig. 1, and separately in Fig. 3, was made from a model kindly lent to me by the same gentleman, to whom I am indebted for much practical advice, particularly concerning the rigging, etc. The hull of No. 1 model measures 30 ins. long; her beam is 8 ins., and she is 3½ ins. deep, with 5½-in. fin keel, including lead. No. 2 model also has a length of 30 ins., but a 10-in. beam, and is 4 ins. deep, the fin keel, including lead, is 6 ins. deep. The hulls are made from blocks of yellow pine, hollowed out to 3-16ths in. thick, and the exterior enamelled white. The decks are of pine, lined to represent planking, and varnished; the spars and bulwarks are of ash, and the keels are bronzed. Sailcloth and other fittings were purchased from an advertiser in The Model Engineer.

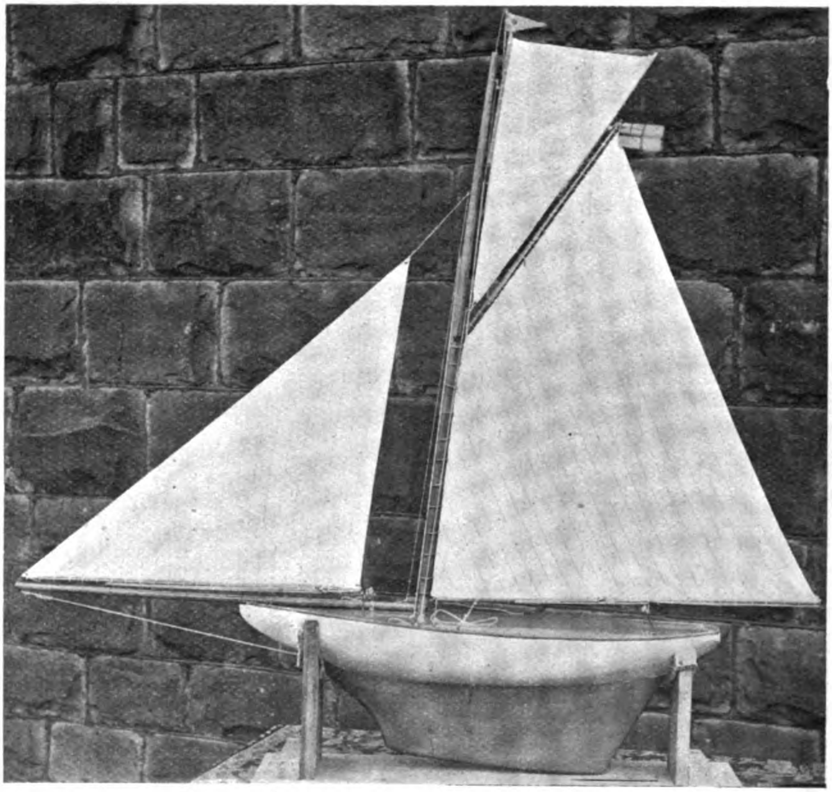


Fig. 3.—Side View of No. 2 Model Yacht.

For the Bookshelf.

[Any book reviewed under this heading may be obtained from THE MODEL ENGINEER *Book Department, 26–29, Poppin's Court, Fleet Street, London, E.C., by remitting the published price and the cost of postage.]*

THE ELEMENTS OF YACHT DESIGN. By Norman L. Skene, S.B. New York: The Rudder Publishing Company. Price, 8s. 4d. post free.

The process of designing a modern yacht is gone into in a thoroughly practical fashion by the author. Being interesting reading throughout, it will appeal particularly to many men who are better acquainted with practical methods than theoretical reasoning. That is to say, the pages are not overrun with abstruse mathematical calculations; the subject is simplified to the last degree compatible with accuracy. The first chapter deals with the various types of craft, their peculiarities, differences, and a general comparison of their advantages under certain conditions, and the following chapters deal respectively with methods of calculations; displacement; the lateral plane; design; stability; ballast; the sail plan, and construction. The appendix contains many useful tables, and a number of plates giving plotted curves for determining the proportions of sailing yachts of various sizes—which have been prepared by the author from data on many existing yachts—will be found, as Mr. Skene says, most useful in roughing out designs. The various methods of designing recommended or exemplified in the book are illustrated by work on a 30 ft. water line sloop, whose plans are given in Plates I to IV, together with complete data on the design of this craft. We can recommend all practical yacht and boat builders who have not yet done any original designing to read this little volume.

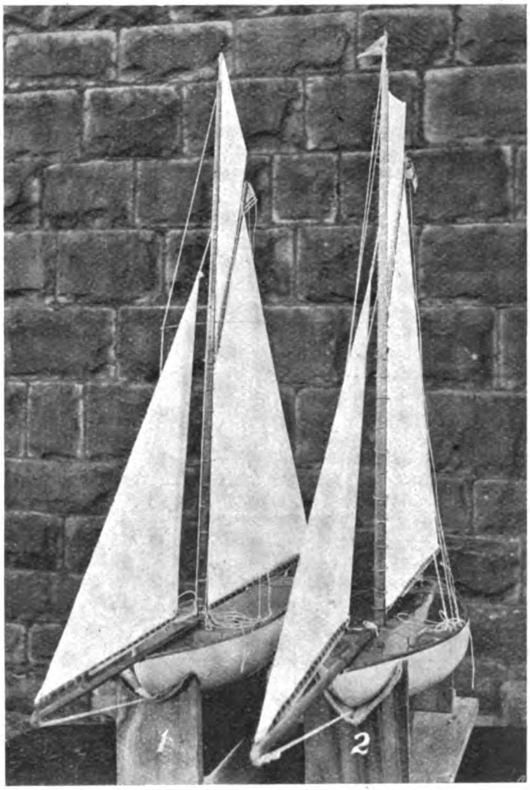


FIG. 1.—MR. A. BEGBIE'S TWO MODEL SAILING YACHTS.

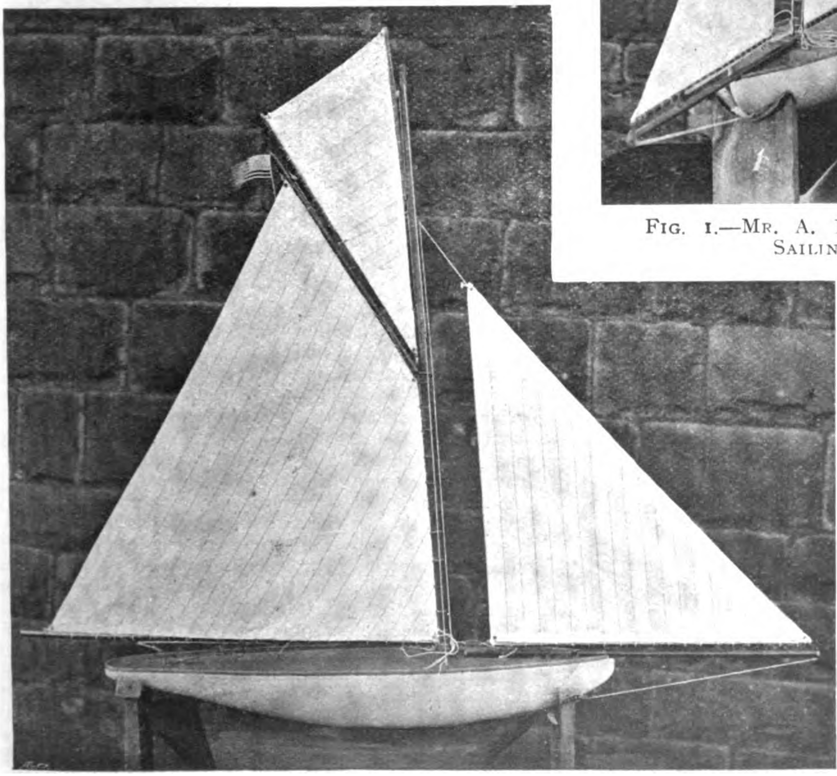


FIG. 2.—SIDE VIEW OF NO. 1 MODEL YACHT.

SCREW-CUTTING. By Geo. F. Harrison, 45, Rupert Street, Nottingham. Price 6d. net; postage 1d.

This is a handy little pocket book of twenty pages, giving rules to find the train of change wheels (simple and compound) required for cutting any particular thread, a list of wheels, tables of Whitworth threads, rules to ascertain speeds of shafts and sizes of pulleys to give a definite speed, table of twist drill speeds, and other notes useful in the workshop.

High-Speed Engines.

By H. Muncaster.

(*Continued from page 42.*)

AN excellent form of vertical high-speed engine; is shown by Fig. 16, which is a front view, and Fig. 17, which is a side view, having the valve gearing removed to show the bearings more clearly.

The bed or standard is of the bored guide type, and the engine is entirely self-contained. On account of the simplicity of the design, and the ease with which the parts can be machined, this class of engine is particularly suited to economical production, and with ordinary care in machining the bed, the chances of perfect alignment are greater than in any other class, for, as will be readily seen, the boring of the guides, the facing of the flange on which the cylinder rests, and the machining of the base are all operations that can be carried out with the same setting of the casting. The base must then be normal to the centre line of the piston. The crankshaft bearings can be set off and bored parallel to the base; this will bring the shaft into a line at right angles to the centre line of the guides, the most important condition to smooth running, the cylindrical form of the guides allowing for any slight deflection in a horizontal plane.

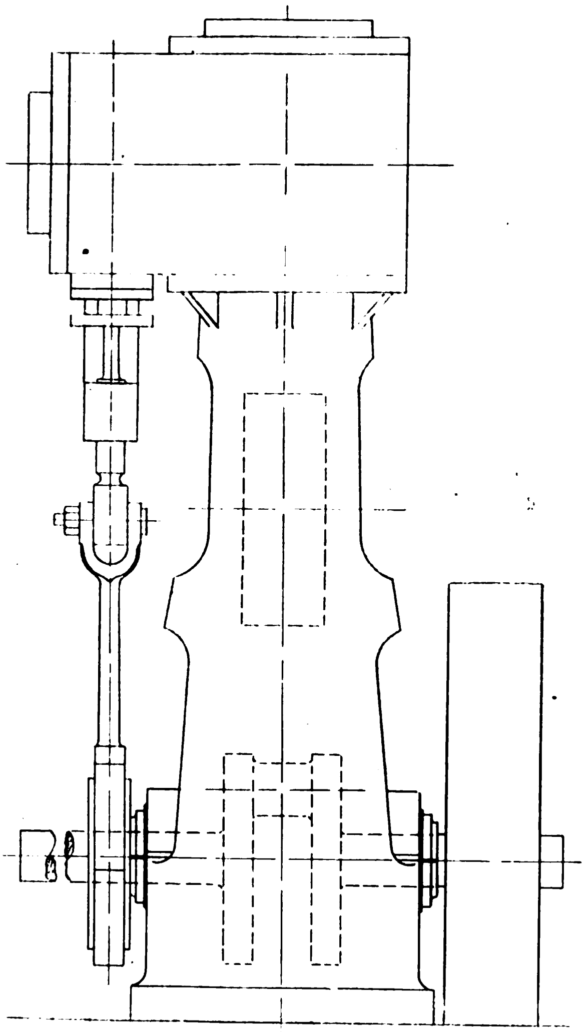


Fig. 16.—Front Elevation.
(*Scale: ½ full size.*)

There is no reason for stinting the amount of surface given to the guides, and as the crosshead can be turned to fit the guides, the piston-rod at the same time being turned in the lathe, there will be no difficulty about getting the centres true.

The design is, however, not so well suited to engines having a comparatively long stroke; where the stroke exceeds 1½ times the diameter, the standard begins to look gawky.

This design of standard is often used with a crankshaft bent out of a round bar instead of the shaped crankshaft shown in the illustration. With the bent crank the bearings must be much further apart, and this introduces a difficulty in getting the eccentric placed so as to be in line with the valve spindle, as the centre line comes approximately over the centre of the bearing. In some cases the eccentric is placed inside the bearing, and the eccentric rod made with the jaw on one side to accommodate its being out of line. In another case the eccentric is placed outside the bearings, and to bring the spindle more nearly the line of the eccentric rod, the steam ports are lengthened by making the valve face farther away from the centre line of the cylinder. As, however, a bent crank, although it may considerably reduce the cost of manufacture, is not suited to the high speed engine, principally on account of the difficulty of balancing, we do not intend at present to give it any further consideration.

A noticeable feature in this class of engine is the large proportion of lathe work in the machining, the rod, spindles, bearings, &c., all being round.

Referring to Fig. 16, the solidity of the valve gearing may be noticeable. In an engine running at the rate we are assuming as the most suitable speed for this engine—say, 1000 revolutions per minute—the inertia of the valve group will be equal to a considerable amount; there is also the friction of the valve to consider. In the case of the piston group the steam will relieve the strain due to inertia; in the case of the valve group, this does not happen, and the effects of the inertia and momentum come directly on the eccentric. The momentum is, however, to some extent absorbed by the friction of the valve against the face of the steam ports, but the same cause aggravates the effects of inertia. By the employment of a piston valve in the place of the slide-valve, some of the friction due to the latter may be avoided, but as a piston valve will contain more metal, the greater mass will give an increased amount of inertia, so that there is in that and many other respects no advantage to be gained by using a piston valve.

A means of adjustment should be provided where the valve spindle couples to the eccentric rod. The ordinary knuckle joint is not good enough if much work is to be done, although if the parts be carefully case-hardened and make a very good fit, they may last some considerable time before any rattle takes place.

Harmony of design in the various parts is necessary if the engine is to look well. How frequently we find that all attempts at a uniform character in the details are quite overlooked, and the work looks like a heterogeneous collection of parts from

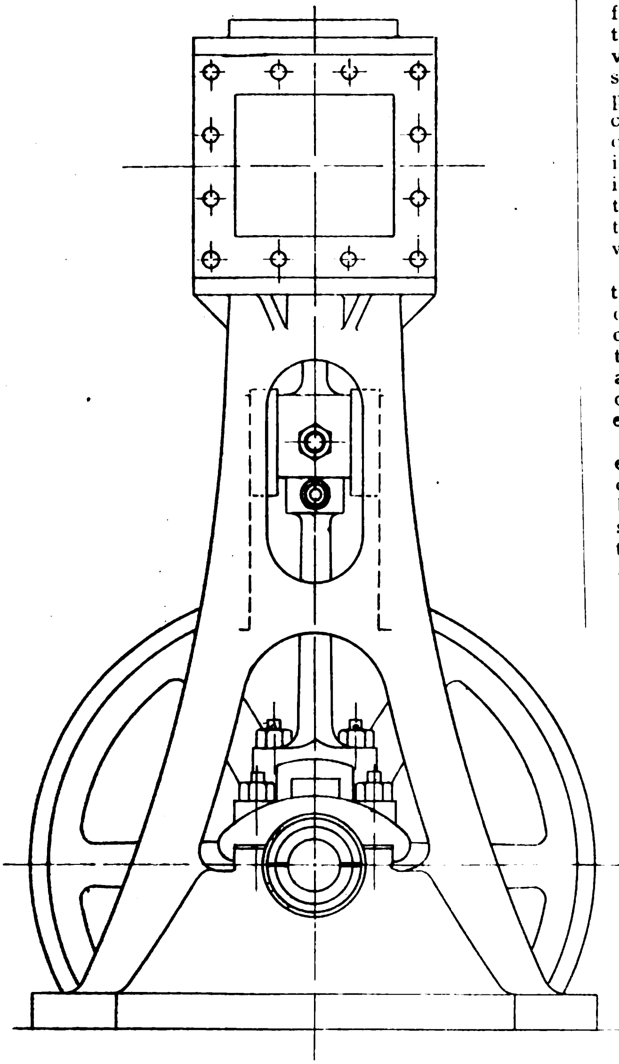


FIG. 17.—SIDE ELEVATION.
(*Scale : ½ full size.*)

various sources, instead of a carefully thought-out scheme. We see, for instance, a flat connecting-rod in close proximity to a turned eccentric-rod. Sometimes a turned connecting-rod entirely finished in the lathe, with a round jaw, the bosses nicely shaped and larger in diameter than the width of the jaw. Alongside of this we have a flat eccentric spindle with a square jaw of the same width as the boss. Sometimes the cylinder has a round gland for the piston-rod and an oval gland for the valve spindle; or, if both be the same shape, one will have the bolts arranged vertically and the other horizontally. True, it is not always possible to make everything uniform in character, and ways and means have to be considered; but the subject is worth a deal more attention than it receives, not only by amateurs, but also by engineers generally.

Lack of harmony in design is often due to the fact that the engine has not been carefully set out to scale. Before commencing the work on the various parts the object of making a drawing is to see how the design looks, not merely how any one part looks, but how the whole as a complete machine appeals to our sense of proportion. If any one part is conspicuous, or advertises some feature, it evidently requires some modification to bring it into line with the rest, which seems to emphasise the fact that it is not only desirable but necessary to make a drawing first, and having done this, to work carefully to the drawing.

There are not, as in architecture, such well defined types as set forth in the various orders, nor is it desirable there should be; but still, especially in the case of models and small engines made for exhibition, a sincere attempt at producing a pleasing and attractive design, while avoiding all superfluous ornamentation, ought to be the aim of every one who essays to produce original work of any description.

Returning to our subject. The dimensions of the engine are the same as previously given: the cylinder (already shown in detail) is 3 ins. diameter by 3 ins. stroke. Suitable governor gear will be shown in detail in a later paper, and fuller particulars of the bed or standard, as this design may appeal to some of our readers who purpose making an engine suited for useful work.

(*To be continued.*)

RUSSIAN RAILWAY TRAFFIC.—Beginning with next year, the passengers and goods traffic on the Nicolas Railway between St. Petersburg and Moscow will be almost doubled, for more than 120 trains are expected to travel daily on that line. In fact, as the Russian press says, some trains will follow one another so closely that the driver of one train will be well in sight of the tail car of the train ahead. There will be lively times next year on the Nicolas Railway. At any rate, the authorities recognise that the increased traffic will require a better permanent way, so the present rails will be replaced by heavier rails of 35 ft. in length, and the new rails are to be laid down on metal sleepers and fastened with four pins or bolts instead of with three, as is the case now. The Nicolas Railway is absolutely the shortest distance between the capital and Moscow, thus the risks of accidents are less than if the line contained frequent curves.

A NEW AIRSHIP.—Count Zeppelin's new airship, which has cost £50,000, has made its first successful ascent, and has crossed Lake Constance. Three expert aeronauts steered the airship from Monzell to Romanshorn within three hours, while the Count gave his orders from a motor boat, which was connected by telephone with the balloon. The experiments were completely successful, the airship answering to its helm in the air as if it were an automobile. The balloon is driven by an 80 h.-p. motor, and the material is chiefly aluminium.

The Bursting Strength of Boilers.

THERE are two ways that a shell, such as is shown in the sketches herewith, might break under internal pressure. The sheets might tear lengthwise, letting the shell separate, as in Fig. 1, or they might tear across, letting it separate endwise, as in Fig. 2.

Which is it the more likely to do ?

To push it apart endwise, as in Fig. 2, we have the force acting on the heads. This force is the pressure per sq. in. multiplied by the number of sq. ins. in the head. The area of a circle is the diameter multiplied by itself and by 3·1416, and divided by 4 ; or since 3·1416 divided by 4 is ·7854, the area is the square of the diameter multiplied by ·7854.

Suppose the internal diameter of the shell to be 48 ins., and the pressure 100 lbs. per sq. in., the pressure on each head would be—

$$48 \times 48 \times {\cdot}7854 \times 100 = 180956{\cdot}16 \text{ lbs.}$$

or over 90 tons. This pressure would act on each head, and the effect would be the same as though two weights of 180956·16 lbs. each were pulling against each other through the boiler, as in Fig. 6.

If the shell were not heavy enough to stand the strain, it would tear apart along the line where the metal happened to be the weakest, as at A. At first sight it looks as though the metal had to sustain both these forces or weights, and that the stress upon the shell would be twice 180956·16 lbs. But a little consideration will show that it is not so. One simply furnishes the equal and opposite action with which every force must be resisted. A man pulling against a boy on a rope (Fig. 3) can pull no harder than the boy pulls against him. If he does, he will pull the boy off his feet, and the strain on the rope will be only what one of them pulls, not the sum of both pulls. In order that the man may pull with a force of 50 lbs., the boy must hold against him with a force of 50 lbs. Both are pulling with a force of 50 lbs., but the tension on the rope is 50 lbs., not 100. The boy might be replaced with a post (see Fig. 4). Now, when the man pulls with a force of 50 lbs., against the post, you would not say that there was 100 lbs. tension on the rope ; yet the post is pulling or holding against him with a force of 50 lbs., just as the boy did. In Fig. 5 it is easily seen that the tension on the cord is 50 lbs. You would not say that it was 100 if the pull of the weight were resisted by another weight of 50 lbs., as in Fig. 7, instead of by the floor.

The shell is therefore, in the case which we have imagined, subjected to a force of 180956·16 lbs., which tends to pull it apart endwise, as in Fig .6.

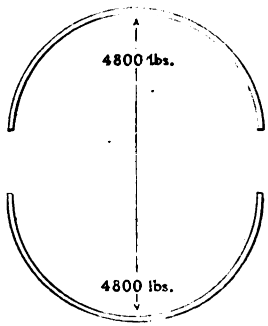


FIG. 1.

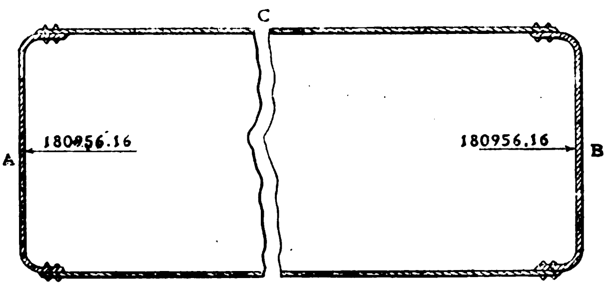


FIG. 2.

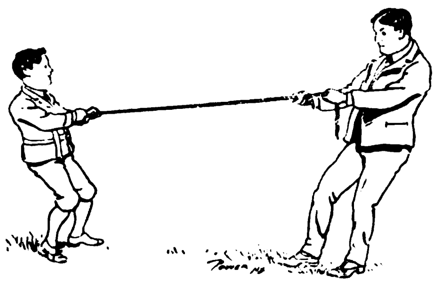


FIG. 3.

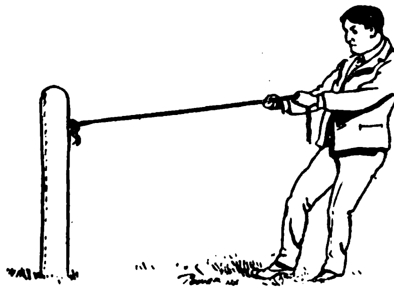


FIG. 4.

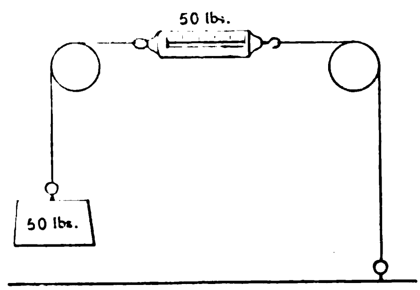


FIG. 5.

To resist this there are as many running inches of shell as there are inches in the circumference.

The circumference is 3·1416 times the diameter, so that to pull the boiler in two

$$48 \times 3{\cdot}1416 = 150{\cdot}7968 \text{ ins.}$$

of sheet would have to be pulled apart.

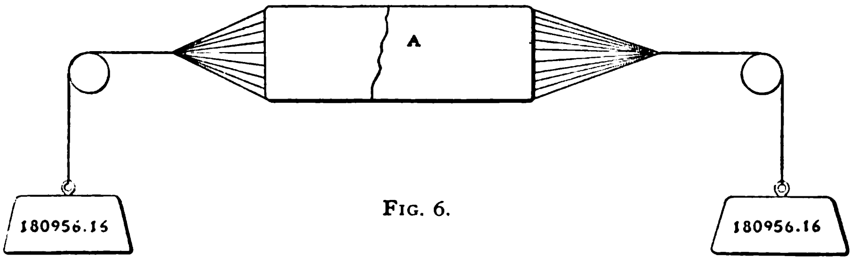


FIG. 6.

The force exerted upon each running inch of sheet would be the pressure acting endwise divided by the circumference, or

$$180956{\cdot}16 \div 150{\cdot}7968 = 1200 \text{ lbs.}$$

The area is

$$\frac{\text{diam.} \times \text{diam.} \times 3{\cdot}1416}{4}$$

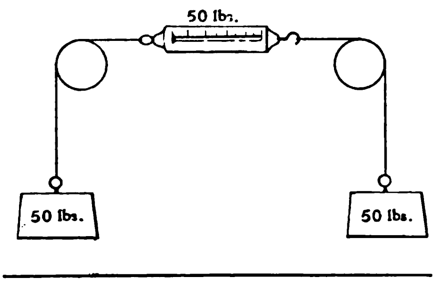


FIG. 7.

The circumference is

$$\text{Diam.} \times 3{\cdot}1416.$$

Dividing the area by the circumference, we have

$$\frac{\text{diam.} \times \text{diam.} \times 3{\cdot}1416}{4 \times \text{diam.} \times 3{\cdot}1416} = \frac{\text{diam.}}{4}$$

or the strain on each running inch of sheet per pound of pressure is one-fourth the diameter.

Now let us see what it would be in the other direction.

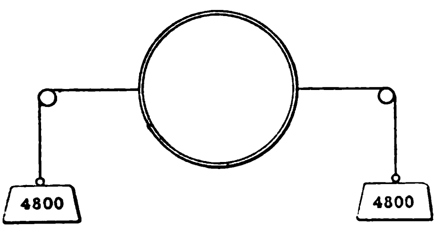


FIG. 8.

If we consider the pressure acting in all directions as in the upper half of Fig. 9, we should, to get the total pressure on the area, have to multiply the pressure per sq. in. by the whole area, which would be the circumference for a strip 1 in. wide; but if we are considering the effect of pressure in one direction only, we must consider only the area in that direction. If we are studying the effect of the pressure in forcing the shell in the direction of the arrows in the lower half of Fig. 9, we must consider only the area which comes crosswise to that direction, the "projected area," as it is called; the area which the piece would present if we were to hold it up and look at it in the direction of the arrows, or of the shadow which it would cast in rays of light running in the direction of the pressure. This, it will be easily recognised, is the diameter of the boiler wide and 1 in. high, as shown in Fig. 9, so that the number of sq. ins. upon which the pressure is effective in one direction is equal to the diameter for a strip 1 in. wide. There is, therefore, a force tending to pull each 1-in. ring of the shell apart, as in Fig. 8, of

$$48 \times 100 = 4800 \text{ lbs.}$$

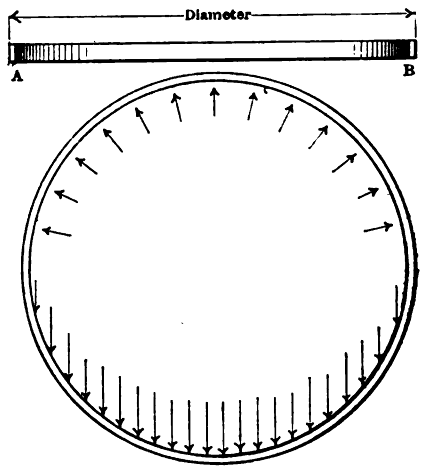


FIG. 9.

and as this force is resisted by two running inches of metal, one at A and one at B (Fig. 9), the stress per inch will be

$$4800 \div 2 = 2400 \text{ lbs.}$$

This is just twice what we found it to be in the other direction; and it is plain that this should be so, for the stress per pound of pressure tending to burst the boiler as in Fig. 1, is, as we have just seen,

$$\frac{\text{diam.}}{2}, \text{ which is just twice the } \frac{\text{diam.}}{4}$$

which we found it to be in the other direction.

It is for this reason that boilers are double riveted along the side or longitudinal seams, while single riveting is good enough for the girth seams.—*Power.*

The Society of Model Engineers.

[Reports of meetings should be sent to the offices of THE MODEL ENGINEER *without delay, and will be inserted in any particular issue if received a clear nine days before its usual date of publication.]*

London.

THE annual river excursion of the Society took place on Saturday, July 15th, when 120 members and friends spent a very enjoyable afternoon and evening in a launch trip from Windsor to Cookham and back. Special arrangements had been made with the Great Western Railway Company for the conveyance of the party to and from Windsor, and the change in the starting-point this year from Richmond to Windsor enabled the party to enjoy some of the loveliest spots on the river, and probably accounted in a very large measure for the great increase in the number present. The catering arrangements on board were excellent, and, combined with the perfect weather, greatly conduced to the success of the trip. After the head of the good ship *Duchess of Kent* had been set in the direction of home, an impromptu concert was arranged, in which Mrs. Simmonds and Miss Denton were heard to advantage in several songs, the latter also rendering some banjo solos excellently. Miss Bashford played, Mr. Hildersley contributed two humorous recitations, and the Secretary played the accompaniments.—HERBERT G. RIDDLE, Hon. Sec., 37, Minard Road, Hither Green, S.E.

Practical Letters from our Readers.

[The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a nom-de-plume *if desired, but the full name and address of the sender* MUST *invariably be attached, though not necessarily intended for publication.]*

Simple Experiments in Wireless Telegraphy.

TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—I trust Mr. Blake will not be offended at a little friendly criticism of his article on wireless telegraphy in the issue of THE MODEL ENGINEER for June 22nd, 1905, for it is only by these means that perfection is attained—one of the notable features of THE MODEL ENGINEER, I believe.

Mr. Blake has not chosen a very happy way of explaining the causes of the results of his experiments; in fact, I am of an opinion that it would have been better if he had omitted the explanation he gave, failing a more extensive one, as it is apt to "fog" the beginner (I presume that the article was intended for such) rather than help him in his understanding of the causes of the results arrived at.

I fail to see how the electric spark or oscillations occur between A and B in Fig. 3 (page 586), for until the air-gaps H between G and A and G and B (and not between A and B, as Mr. Blake explains, contradictory to his diagram) break down, the rods A and B are at a negative potential.

Perhaps Mr. Blake will kindly give a fuller explanation of the causes of these experimental results, for the benefit of those interested.

Why does Mr. Blake recommend a spark coil giving at least a ⅜-in. spark? This will deter many amateurs with smaller coils from attempting his experiments.

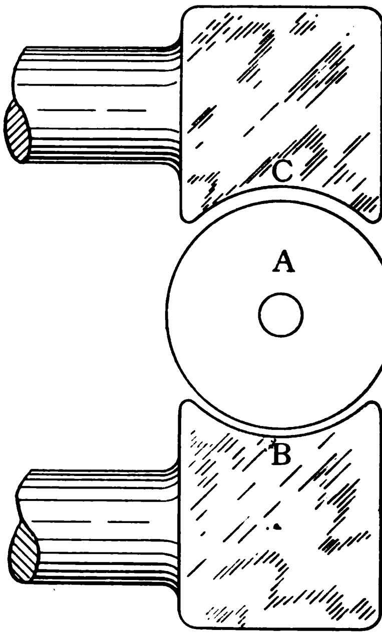
Practice has shown that up to 50 or 60 yds., or even more, with a sensitive relay quite within the amateur's power to construct, a coil giving an ¼-in. spark is sufficient, and all the experiments he details could be performed with a coil giving an ⅛-in. spark, although, of course, they would have to be confined to very short distances.—I am, yours faithfully,
"ERG."

Hereford.

Dynamo Bearings.

TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—One often takes excessive care over the construction of dynamo bearings, only to find them, when fitted, an unmistakable failure. On inspection, one finds the cause is obviously not due to faulty design or building, nor is it due to bad lubrication; the armature does not catch on the pole faces, neither do the brushes press too heavily on the commutator; yet the shaft runs anything



THE FAILURE OF DYNAMO BEARINGS.

but sweetly in its bearings, and the latter soon become undesirably hot and develop signs of excessive wear and tear.

The reason is made clear by means of the accompanying sketch. A is the armature, and B and C the pole faces. The air gap between A and C has purposely been shown greater than that between A and B, though the armature does not catch on either side. This inequality of air gaps causes the lower pole B to exert an attractive force on the armature much greater than that exerted by C; hence the pressure on the bearings of the machine will be the weight of the armature plus the difference between the two attractive forces, this last force being often of considerable value.

It is easy to see that for other positions of the armature this force may act, as well as downwards, sideways or upwards, thus producing increased wear on the sides or tops of the bearings. In the latter case the pressure on the lower part of the bearings will be the weight of the armature *minus* the difference between the attractive forces. Of course, this may very possibly be a negative quantity—*i.e.*, the resultant pressure may be on the tops of the bearings.

From the preceding, one may get the following useful hints as to the setting of dynamo bearings :—If the armature is supported so that the upper air-gap is slightly smaller than the lower one, the whole weight of the armature, &c., may be taken completely off the bearings, thus occasioning practically no wear on them whatever. In any case, care must be taken not to support the armature, so that the upper air gap is the greater, since this will only aggravate the ordinary wear due to the weight of the revolving parts.—Yours truly,

London, N.W. R. MILWARD ELLIS.

[This cause of the heating of bearings and method of relieving the weight of the armature is well known to designers of dynamos. It is not so important a consideration in small machines as in larger generators.—ED. *M.E. & E.*]

Tangent Galvanometers.

To the Editor of THE MODEL ENGINEER.

DEAR SIR,—In THE MODEL ENGINEER, dated July 13th, 1905, an article entitled "A Tangent Galvanometer," by G. H. Wood, was published. In this article Mr. Wood describes two methods of altering the sensitiveness of his galvanometer.

(1) By moving the needle along the axis of coil.

(2) By connecting layers in series.

The first method is correct, though inconvenient, and involving a fair amount of calculation. In the second Mr. Wood states that in order to measure a large current the coils must be connected in series. This is entirely incorrect. It is obvious that the magnetic field produced by current passing through only one layer is smaller than that produced by the same current through three layers, Therefore only one layer should be used for large currents, or, preferably, the three in parallel. This error has been carried on to the calculation of the various values of K.

Mr. Wood also gives certain values for K ; these, according to the data given, are incorrect.

The formula to be used is :

$$C = \frac{5 H a}{\pi n} \tan. a$$

Where C = current in amperes.

H = horizontal intensity of earth's field = ·185 dyne.

a = radius of coil = $2\frac{1}{2}$ ins. = 6·35 cms.

n = number of turns = 5 (for one layer).

$$\therefore K = \frac{5 \times \cdot 185 \times 6\cdot 35}{3\cdot 1416 \times 5} = \cdot 374 \text{ for one layer.}$$

K for one layer = ·374.

K for two layers = ·187 (where C = K tan. a).

K for three layers = ·125.

Again, Mr. Wood gives the length of the small needle as 2·5 cms. This length of needle should not be used with a coil of less than 20 cms. radius. The formula C = K tan. a is only true if the field is uniform, but in the given galvanometer this is by no means the case, and should only be used for the roughest measurements. This difficulty is accurately eliminated in the two-coil pattern and also in the sine galvanometer.—Yours truly,

Abbey Wood. A. G. WARREN.

Bicycle Driven Dynamos.

TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—Recently there appeared in THE MODEL ENGINEER an article on hand driven dynamos. Why should not a bicycle be used ? My idea is to mount the cycle on a stand, so that the driving wheel runs free, the dynamo to be fitted with a concave pulley in contact with wheel, or, as this might not give sufficient speed, with intermediate gearing. I have never seen this suggested before, but the idea must have occurred to many cyclists—and everyone cycles now. Anyway, it would be a novelty for THE MODEL ENGINEER.

I shall have no opportunity this year of experimenting for myself. I can only offer the idea, and think that many of your readers would be glad to experiment in this direction, if you could give a few hints to guide them, or, say, a prize competition—it would be a prize for originality, which model making does not seem to me to encourage much. I should define the latter as a slavish adherence to recognised forms.

Anyone trying to devise a method for driving by bicycle would have to consider :—

1. The support to hold driving wheel free, and to hold dynamo in gear.

2. Governing the speed. It is not at all easy to work a bicycle at uniform speed when fixed like a home trainer.

3. Cutting out dynamo if the speed rises or falls too much.

4. The size and type of dynamo most suitable.

Yours truly,

AUPHSYDE CRANK.

Mr. Finninghan's Working Model Loom.

TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—This model (described in July 13th issue) is made to a scale of 3 ins. to the foot, and not $\frac{1}{4}$ in., as stated. From floor to the top of an ordinary calico loom, is 50 ins. ; from floor to the top of front rest is 34 ins. The photograph appears to be quarter full size of model, as it shows a reed space of $1\frac{7}{8}$ ins. by 4 = $7\frac{1}{2}$ ins. × 4 = 30 ins. reed space, from floor to top of front rest $2\frac{1}{8}$ ins. × 4 = $8\frac{1}{2}$ ins. × 4 = 34 ins. height of rest.

Assuming model to be $\frac{1}{4}$-in. scale, the prototype would have $7\frac{1}{2}$ × 48 ins. = 30 ft. reed space ; height of rest, $8\frac{1}{2}$ × 48 ins. = 34 ft. Such a loom has never been built. The model is evidently a replica of a 30-in. fast reed calico loom to a scale of 3 ins. to the foot. It would be an impossibility to weave cloth on a loom built to $\frac{1}{4}$-in. scale.—Yours truly,

Rishton. RD. BRADSHAW.

MARTENSITE.—The ingredient "martensite" of steel, though detected and identified by the microscope, has never been isolated. It seems to be a specialised interlacing of ferrite and cementite.

Queries and Replies.

[Attention is especially directed to the first condition given below and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-hand corner of the envelope "Query Department." No other matters but those relating to the Queries should be enclosed in the same envelope.

Queries on subjects within the scope of this journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied, wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed, and also a "Queries and Replies Coupon" cut out from the advertisement pages of the current issue. (4) Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of Replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor,* THE MODEL ENGINEER, *26-29, Poppin's Court, Fleet Street, London, E.C.]*

The following are selected from the Queries which have been replied to recently:—

[14,316] **Coils for Medical Purposes.** G. M. (Bradford) writes: Kindly answer the following questions:—(1) I have a telephone magneto, and should like to use same for administering a current of electricity to the human body for the relief of neuralgia and toothache. (2) Can I use same? If so, what alterations will have to be made (if any)? Kindly mark the apparatus which has to be used in this treatment on the enclosed page; a few instructions how to use same will oblige. (3) If this cannot be used, state what amount of wire, and size, will have to be used for primary and secondary coils of a shocking coil, and size of core, bobbins, etc., for same purpose as magneto. (4) I have two pieces of glass cut round to 18 ins. diameter, given a certain number of sectors, and small Leyden jars; perhaps this would be better for medical purposes. Is this so?

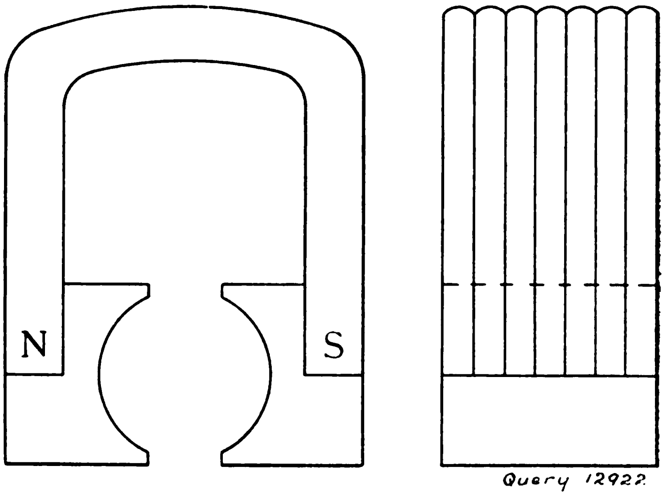
(1) We cannot take the responsibility of giving actual directions upon the application of electricity for medical treatment; our advice is for you to consult a properly qualified medical man and act according to his instructions. (2) In all probability you can use this machine; if not powerful enough, the armature could be rewound with wire of a finer gauge, and perhaps a make-and-break contact fitted, so that the current is interrupted twice in every revolution of the spindle. (3) You will find instructions for making a very good type of medical coil in our handbook No. 11, Chapter iii. (4) The Wimshurst machine is used for medical treatment, but we expect either your magneto or a coil will suit better for your case. The Wimshurst machine requires great care in handling when used for medical work.

[14,314] **Repairing and Charging Accumulators.** C. J. H. (Salford) writes: I would be much obliged if you would kindly give me some information concerning a set of six accumulators that I have just received as being out of order, and I have examined them and found two or three plates broken in the first cell, but all the others seem to be in good order. Each cell contains seven positive plates and seven negatives, 4 ins. by 4 ins. by 3-16ths thick, so will you kindly tell me what current and pressure I should expect from them when fully charged, and what size dynamo and engine I should require to charge them with? I would like to charge them myself if it would be cheaper. Will a gas engine or steam engine be the cheapest?

Cells should have a capacity of about 20 amps.-hours; a shunt-wound dynamo giving about 15 volts 4 amps. would be required to charge them; that is, assuming you mean six cells in series of the size you give making one 12-volt accumulator. Such a dynamo would require an engine giving at least ¼ b.h.-p. to drive it; a gas engine would probably be the more convenient to use, and should be inexpensive to work. We recommend you to read our sixpenny handbook (No. 1) on "Small Accumulators."

[12,922] **Permanent Magnet Dynamo.** P. S. T. (Sharrow) writes: I am desirous of building a dynamo with permanent steel magnets. I want it for driving a motor taking 4 volts 2 amps. at full load, that is, a machine capable of being driven for about 8 watts, and I should be very much obliged if you would not mind answering the following queries:—(1) What size steel magnets and armature will be required? (2) Which is the best armature to use? (3) What amount and what gauge wire would be required for armature? (4) What is the best way to magnetise field-magnets? (5) What power will be required to drive dynamo easily? (6) Will field-magnets last good time without remagnetising? (7) If armature 1¼ ins. diameter would do (it does not matter how long) it would be easy for me to procure. (8) Would a forged magnet made from ¼-in. thick spring steel be correct as I can get one forged to any shape from this material? (9) Would enclosed rough sketch be a good shape to go from? (10) Would winding of armature be carried out as if it was an ordinary dynamo with regard to insulation, &c. (11) Need the air-gap be as small as in ordinary dynamo? (12) How would the different wire ends of armature winding be connected to spindle, if, for instance, a drum was used? Perhaps an H armature is the only one suited to this sort of machine. (13) I do not mind making a bigger machine and using a Siemens H armature instead of any other if it is best for this machine, as I have had no experience in winding armatures.

(1) Armature, 1¼ ins. diameter by 2 ins. long; the magnet should be fairly large, say, about 5 ins. to 6 ins. high, as permanent steel magnets vary very much; you can only approximate as to the dimensions and adjust the voltage by running the armature at higher or lower speed. The best way to make such a machine is to place several magnets side by side to bolt them to soft wrought-iron pole-pieces (see sketch). Magnets about 1 in. by ¼ in. thick would be suitable; bore as few holes in them as possible. (2 and 3) The best armature would be a drum having say, eight sections, and wound with No. 25 gauge D.S.C. copper wire; but you can use a Siemens H armature with laminated core and wound with No. 23 gauge D.S.C. copper wire; the drum armature should also have a laminated core; about 3 ozs. of wire will be required. (4) Place them upon the poles of a large dynamo when it is at work or wind them with several layers of insulated wire and pass a current through the wire; in each case they should be knocked gently with a hammer to help them to take up the magnetism. (5) About 1-20th h.-p. (6) Yes, if well hardened and of suitable steel; tungsten steel is the best kind. (7) Armature should be about 2 ins. long. (8) Spring steel is scarcely good enough, but if you make a big magnet and get it as hard as possible it may be worth a trial. (9) The shape sketched by you is good enough to try. (10) Yes, (11) Yes; it is even more important to make the air-gap small, as a permanent magnet is not so powerful as an electro-magnet for a given size. (12) See our sixpenny handbook on "Small Dynamos and Motors." (13) The drum would be the best pattern, but the H type can be used; length and diameter the same in each case.



PERMANENT MAGNET DYNAMO.

[14,236] **Gas Engine Derangement.** C. C. (Oxford) writes: Will you kindly answer these questions? I have a ¼ h.-p. Crossley gas engine which I bought second-hand. When I first had it it worked very well, opening the gas valve once and then missing four or five times; now it opens the valve two or three times with the same work. I have had the valves faced, the exhaust is tight, and everything is about the same as at first. Will you please let me know of anything that I can do to make it as it was at first.

As you give very few particulars of the engine, it is not possible to say precisely what may be wrong. It is evident that some of the conditions of working are altered. But the cause of trouble may not lie in the engine itself. The shafting for some of machines being driven may be taking more power, either due to some derangement, friction, &c., or to belts slipping. Run the engine light, with all belts off, without even a loose pulley running, and see what she does, and how many times she cuts out. We advise you to read our new handbook by W. C. Runciman, "Gas and Oil Engines," 7d. post free, for further information and hints on this matter.

[14,364] **Induction Coil Failure; Accumulators.** G. D. (Sedburgh) writes: I have an induction coil which ought to give 3-in. sparks, but it does not give much more than 1-in. sparks. I have tested it, and am almost sure that it is the fault of the contact-breaker, so I wish to make a new one. I thought of making a "tuning-fork" contact-breaker. Do you think that they would be too hard for an amateur to make successfully? If not, I suppose the arrangement would be as sketch (not reproduced). What ought the needle that dips into the mercury to be made of? About what pitch ought the tuning-fork to be? If the "tuning-fork" contact-breaker would be too hard to make, what sort of contact-breaker would you recommend? I should greatly prefer not to have one driven by a motor. One of the chief uses of the coil is for *x*-rays. I have made up some accumulators. Each cell has three negative plates and two positive plates. The positive plates are formed according to the instructions in your handbook, but the negatives are plain lead. After one cell had had one full charge it was left for two days, and was then found to be entirely discharged. It had not been short circuited in the least. Is this due to the accumulator being new? If so, how long will it be before the cell is ready for use? How many times must it be charged? Could it possibly have discharged through the battery, which was three bichromate cells? Could you please give me a good recipe for a good sympathetic ink?

We advise you to try the mercury break described in Chapter 6 of our handbook No. 11. It is desirable to be able to regulate the speed of the break, and to so adjust it that the duration of "make" is greater than that of interruption, so that the core of the coil has time to magnetise. The dipper should be made of copper. It takes some days to properly form a plain lead plate. Those in your cells are not in a sufficently porous condition, and we advise you to replace them by pasted plates, or to form them in separate cells, as the forming process consists of repeated charging, discharging, and then re-charging in the reverse direction, all the plates used being plain lead. Pasted plates also do not hold a charge well at first, but require several chargings. The first one should be a prolonged one: they improve with each successive charge. Try a solution of cobalt chloride; the writing appears blue on application of heat ($CoCl_2$).

[14,377] **Electrical Engineering.** O. G. T. (Morriston) writes: I will thank you to inform me the best course to adopt for being qualified as an electrical engineer. I am 17 years of age, and have been through the Board School and Intermediate School, and I am now being apprenticed in a general engineering fitting shop for three years. Would be thankful if informed what subject required to study; whether attending a technical college or correspondence tuition is the better; also what degrees are necessary or advisable?

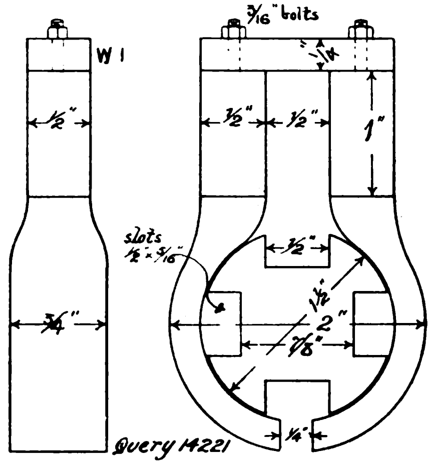
As you are an engineer's apprentice, you could very well acquire some knowledge of electrical engineering by correspondence tuition, because electrical engineering is largely mechanical engineering combined with electrical theory. Some practical experience is, however, necessary. You could acquire this, to an extent, in the laboratories of a technical college. The determining factor in success is experience. Become as good a mechanic as you can during your apprenticeship, and acquire as much theoretical knowledge as you can by evening study at the same time; then if you can, either spend a year or two at a good technical college, or obtain an improver's or similar position in an electrical engineering works. If you can then make up your mind as to which branch of electrical engineering you will stick to, get plenty of experience in various places, being content with subordinate positions until you become qualified to take a better post, and lucky enough to get it. Degrees are only incidentally desirable; if you take to teaching, almost essential, however.

[14,290] **Making Amalgam.** H. S. writes: I should esteem it a great favour if you would advise me how to form the amalgam of tin and mercury mentioned in Query 14,155 in June 15th issue of *M.E. & E.*

Mercury absorbs such metals as tin; mix the two together with a rubbing movement in a small cup.

[14,221] **Windings for Small Undertype Dynamo.** A. B. C. (Sharrow) writes: Would you kindly let me have some particulars, through your paper, of the enclosed sketches of a dynamo I am making? (1) The size and quantity of wire for the field-magnets and armature, and method of winding? (2) The output of this dynamo? (3) The speed necessary to run the machine at? (4) The size of enclosed sample of wire?

(1) Wind armature with No. 28 gauge s.s.c. copper wire; get on as much as you can—about 2 ozs. should be sufficient. Wind field-magnet with 1 oz. of No. 28 s.s.c. copper wire on each core, both coils joined in series with each other, and in shunt to the brushes. (2 and 3) If the machine will excite itself, you may get about 2 or 3 volts and about ½ amp. or so at 4000 to 5000 r.p.m. Armature should be wound as a four-coil drum, with two coils in each slot, and four-section commutator. For method of winding, see our handbook No. 10. (4) Sample of wire sent is No. 23 S.W.G. This machine will run very well as a motor,



SMALL UNDERTYPE DYNAMO FIELD-MAGNETS.

though it may not be successful as a dynamo. To test it as a dynamo, try a 3-volt 1 c.-p. lamp of good make.

[14,372] **Manchester Dynamo Trouble.** G. S. B. (Cressington) writes: I have been making a dynamo of Manchester type, as per enclosed print (not reproduced), and cannot get it to generate. I have on each bobbin of field-magnets about 33 yds. of s.s.c. No. 26 copper wire. Cores are fixed to field-magnets by iron screws (as shown). Also armature connections are as shown in THE MODEL ENGINEER handbook, "Dynamos and Motors." Will contact be good enough between core and field-magnet castings? I cannot get C.I. to magnetise from 4-volt battery with these bobbins—how is it that this is so? Drawing is full size, so how much current should I expect from it, and what voltage running at 3,500 r.p.m.? What power of steam engine should I require to drive it?

Your field-magnet winding should be connected in shunt to the brushes—not in series. Connect both coils in series with each other, and be sure that they are correctly arranged to produce N and S poles (see page 12, Fig. 2, of our handbook No. 10). Perhaps they are at present so connected that they produce two N or two S poles; or perhaps your battery is not very strong. You do not say what gauge wire the armature is wound with. It should be No. 25 or No. 26 gauge s.s.c. The clearance between armature and poles should be less than 1-16th in.—say 1-32nd in. approximately. Run at about 4000 r.p.m., and test with an 8-volt 1 c.p. lamp of good make; output, about 8 volts ½ to 1 amp. Magnet cores should make quite good enough contact with the cast iron. If machine still fails, it is due to insufficient wire on the magnet cores. There should be about 4 ozs. on each core; that is more than double the amount on at present; and No. 24 gauge by preference. It is very difficult to state power required to drive this machine; probably 1-20 h.-p. would suffice.

[14,385] **Accumulator Charging.** C. F. W. (Altrincham) writes: Will you please tell me how to charge four 30 amp.-hour, 4-volt motor accumulators from a 110-volt D.C. circuit? I have used several lamps in parallel before, but these we find too glaring, and would like to use instead several arc lamp resistances (Crompton). They are wound with 16 S.W.G. "Eureka" resistance wire. Sometimes I should only require to charge one or two at a time. Could I use these resistances in series with a regulating resistance? If so, how must I proceed?

We doubt if the resistance of these arc lamp resistances will be high enough; but it depends upon the rate of current at which your cells may be charged. You do not state what this is. A 2-cell accumulator requires quite 5 volts to charge it; so that four such cells in series would require about 20 volts; this means that you must absorb 90 volts in your resistances. The amount of resistance in ohms to absorb this voltage can be calculated by dividing 90 volts by the current in amps. allowed to flow through the cells—that is,

$$\text{Resistance} = \frac{\text{Volts to be absorbed.}}{\text{Current to flow.}}$$

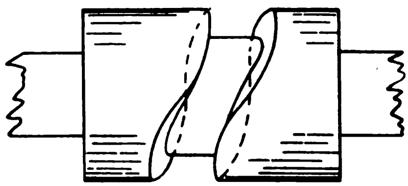
In order to keep the charging current at constant value, a regulating resistance should be inserted as well, to absorb a few volts. Perhaps you can decide the problem by the aid of these remarks.

[14,373] **Direct Reading Measuring Instruments.** M. H. L. (Winchester) writes: Please can you give me the following information? I am making a voltmeter, of the Weston moving coil type, to register, on separate scales, 5 volts and 30 volts. Could you give me particulars of the shunts, gauge of wire, &c., for this; and where could I get a magnet suitable for the above instrument? I have made several other delicate instruments, but have never taken one of these voltmeters in hand before, and any information will be gratefully received.

We can only tell you to make experiments. These instruments are made in quantity to a pattern evolved through a number of trials by makers. Some useful information is given in a paper which was read before the Institution of Electrical Engineers (London) by Messrs. Edgcumbe and Punga, entitled "Direct Reading Measuring Instruments for Switchboard Use." It can be obtained in No. 167, Vol. 33, Part IV of the Transactions of this Institution, price 5s. The authors give the resistance of the moving coil as 10 to 20 ohms, and the consumption of power to be ·01 amp.; but this, of course, will largely depend upon the perfection of construction of the instrument. Moving coil voltmeters are not used with shunts when reading as voltmeters, but with a high resistance in series with the moving coil; they are used with shunts when reading as ammeters. This resistance can be calculated approximately by Ohm's law·R equals $\frac{E}{C}$; that is, volts divided by the current allowed to pass through the instrument. You can probably obtain a Weston magnet from Messrs. Eliott Bros., Century Works, Lewisham, Kent; this firm is giving up the manufacture of the Weston instruments. We believe they have a stock of parts to dispose of.

[13,328] **Turning up Cams.** J. B. W. (Melbourne, Australia) writes: In making the model of a small oil engine, I am confronted with a problem, how to turn a cam, as described by the diagram below. Perhaps you could help me out of the difficulty. If so, I would feel greatly obliged. We amateurs out here are handicapped in not being able to get castings and catalogues such as we see advertised in your journal. I have often wished that someone would start selling them in Melbourne.

You have set yourself a job if you want to turn this cam in the lathe, but nevertheless it is possible to do it by proceeding as follows:—Make a ring out of hardwood of the same shape as face of cam, and fix it true on the lathe faceplate; next place the cam-shaft or piece between the centres, then fix an end cutter in drilling spindle fixed on slide-rest and driven from the overhead, then a piece of metal to engage with the cam ring on faceplate is next fixed to saddle of lathe (say, the end of a bolt projecting through an angle plate), and a cord on the end of which a weight is suspended is then fastened to saddle and runs over a pulley fixed at end of headstock. The cutter is then started, and the lathe faceplate slowly rotated, the cam on plate pushing the saddle forward and the weight bringing it back, the cutter at the same time being fed into the work. However, a simple and better way, particularly if only one is required, is to bore and turn a piece of metal and part it off into two lengths, and then file the desired shape on the end of each piece, making the two pieces fit each other, or nearly so. When finished, that is to say, when the two ends are brought together, a line, as shown by the sketch, should run round the shaft. The pieces are then placed on the cam-shaft the required distance apart, and either sweated, brazed, or pinned in position. Another way is to mould some hard wax, out of which a pattern is made of the shape of cam and a casting obtained.



TURNING UP CAMS.

[14,361] **1-10th h.-p. Series Wound Motor.** H. R. B. (Tonbridge) writes: Will you favour me with a reply to the following:—Given a motor, 220 volts, series wound, 1-10th h.-p., would the following winding be suitable? For the field-magnet No. 26 S.W.G. single cotton-covered, and for the armature No. 29 S.W.G. double silk-covered? Supposing the work on a motor of this description to be good, what would be a fair estimate of the efficiency to be expected?

This winding can be used, but No. 24 gauge would be better for the field coils; No. 26 will probably get rather hot at full load. We should prefer to use No. 30 gauge for a ring and No. 34 for a drum armature, but the motor will accommodate itself to some extent to the winding by running at a higher speed. The thicker the gauge of wire on both armature and field the higher will be the efficiency, but for a given size of machine it means higher speed, which is not generally so convenient, and is more conducive to sparking and wear than a lower speed. Commercial efficiency—that is, ratio of work obtained at the pulley to electrical energy supplied to the motor—of 55 per cent. would be good for a machine of this size. You may expect about 50 per cent. if a good design.

[14,362] **Ignition Accumulator Trouble.** A. O. G. (Caergwrle) writes: I shall be greatly obliged if you can send me a reply to the following query:—I have a 2 h.-p. F.N. motor bicycle, the accumulator of which behaves very peculiarly sometimes. It may go all right for days, but on occasions, as soon as I give the engine a few revolutions, the voltage drops instantly from 4·5 to 1·5. If disconnected from bicycle and tested again in, say, half-an-hour, the needle will jump to about 3·5, then run down in a second or two to 1·5. Yet, if left for some hours, the accumulator *entirely recovers* and shows 4·5 steady. I suspected a leak from positive to frame, but have tested with galvanometer and find none. Fault must be in coil or wiring, as two other accumulators have done exactly the same on my machine. Any assistance would be gratefully received.

There appears to be a short circuit of a temporary and occasional character which occurs in your firing circuit; perhaps you sometimes stop the engine in such a position that the accumulator circuit is closed for a minute or so. This would discharge the accumulator and produce the effects you describe, which are those of a cell recovering from a sudden excessive discharge. Small cells, such as are used for motor firing, are not intended to be discharged at a heavy rate, and will run out almost instantly on short circuit. Examine your engine contact-breaker and the circuits to see if this is what happens.

[14,371] **Sparking at Commutator.** H. S. (London, W.C.) writes: Your reply to the following query will greatly oblige:—What is the cause of, and remedy for, sparking at commutator on small electric motor of about 1-30th h.-p., 110 volts? Commutator was inadvertently oiled, but it, together with the carbon brushes, has been thoroughly cleaned, but sparking continues. As motor is used in photographic dark-room, the sparking is a most serious matter. Motor has run well for twelve months without this trouble. Carbons are 1¼ ins. long, and are kept well up to their work by the springs. Have bought your handbook on "Small Motors," but although the trouble is mentioned, cannot find that you give any remedy for same. I am not an electrician, but think I can follow any directions you may give me.

A broken wire in one of the armature coils or a broken connection from one of the coils to the commutator will produce sparking. If this is the cause, you will find a fused place between two segments to which the faulty coil is connected. If the machine has a brush rocker, perhaps the brushes are set in the wrong position; shifting the rocker would remedy matters. The oiling of the commutator may have caused a short circuit between two or more commutator bars; the result would be a burned out coil or coils, which would be detected by their insulation becoming charred, and brittle. They would have to be removed, and the fault removed from the commutator. The surface of the commutator may be rough in places, or not true. The remedy would be to true up and smooth it in a lathe. You could make a trial by smoothing it with a piece of fine glasspaper in position, wiping off all dust afterwards. Beware of metal dust between the segments!

[14,374] **Dynamo for House Lighting.** C. S. (Lidget Green) writes: As a reader of the *M.E. & E.* I should like some advice about the following. I am thinking of making a dynamo to light about twenty-five 32 c.-p. lamps. (1) What voltage would you suggest as being satisfactory for private house lighting? I thought about 200. (2) I am making a 60-watt dynamo, 4 amps. 15 volts, which I want to light one or two lamps. About what candle-power would this machine give? (3) How can I get at the horse-power of a water motor, the diameter of wheel is 4½ ins.; number of buckets twelve; pressure of water, 60 lbs. per sq. in. diameter of nozzle, 5-32nds ins.

(1) There is no cause to adopt such a high voltage as 200; we, should advise 50 volts as being easier to insulate, requiring less cells, if you should ever instal a battery, as being suitable to work an arc lamp, and more generally useful for any general work, such as charging cells, &c. (2) You can take about 3 watts per candle for low voltage lamps, and reckon your dynamo as approximately 20 c.-p. (3) Only by a brake test. If you drive a dynamo you could roughly reckon that the motor gives double the horse-power output of the dynamo; reckoning 746 watts = 1 b.h.-p. If the dynamo was giving about 90 watts, the water motor would be giving rather more than ¼ b.h.-p., assuming an efficient dynamo. Also see article in THE MODEL ENGINEER for September 2nd, 1903, page 222, on "Data on the Design of Pelton Wheels." This article gives directions on testing a water motor for b.h.-p.

[14,378] **Batteries.** W. H. H. (Chandlers Ford) writes: Please explain the action of the Bennett cell. Can you also give me the internal resistance of this, also of the constant bichromate, Daniell and dry cell? In the article on "Simple Experiments in Wireless Telegraphy," Experiment 3, Fig. 4, it says at the bottom of page 586 that the other terminal of G is connected to the positive terminal of the dry battery L. I have been asked if this

means carbon or zinc, but as I am in doubt, I should be glad if you will inform me which it represents. I find in your handbooks diagrams as sketch. This appears opposed to Fig. 4. Positive and negative signs would have removed all doubt.

A very full description of a modified Bennett cell is given in THE MODEL ENGINEER for April 9th and 16th, 1903. The internal resistance of this cell is given as about ½ ohm. The internal resistance of any battery, however, cannot be stated beforehand, as it will vary with the size and arrangement of the cell and the distance between the plates. A bichromate cell of single fluid type may have an internal resistance of ·01 to 1-10th ohm; constant bichromate with porous pot about ½ to ¼ ohm. Daniell may be from 1 to 5, or as much as 10 ohms; dry cells about 1-10th to ½ ohm. The positive terminal of a battery is always taken to be the one attached to the carbon plate, as it is assumed that the current flows from zinc to carbon inside the battery and from carbon to zinc in the outside circuit.

[14,346] **Iron Turnings for Battery.** R. C. (Oxford) writes: I herewith enclose a few iron turnings for your inspection. Would you kindly inform me if these are suitable for use in the battery described by "F. E. P." in the *M.E.* of April 9th and 16th, 1903? If these are suitable, do you think they will require washing before being used in battery?

The turnings appear to be sufficiently clean to use without washing. We think they are somewhat fine, and that larger chips would be better, but should certainly try them.

[14,348] **Enclosed Arc Lamp.** J. W. (Dunstable) writes: I shall be extremely obliged if you will give me drawing of a thoroughly reliable enclosed arc lamp to work on 110-volt circuit, and take about 5 amps. work in single parallel. I should like it to be of decent appearance when finished. We have at present 110 c.-p. incandescent, and the governor insists on running the machine 20 to 25 per cent. above the normal, which, as you know, causes destructive sparking, so I have induced him to try an arc lamp or two and run machine at speed wound for. I have the sketch of one given in *M.E.* some time ago, but I don't think it would suit the purpose.

We cannot undertake to furnish you with such a design. It would practically amount to inventing an enclosed arc lamp for you. There are good arc lamps on the market of enclosed pattern. Your query is beyond the scope of these columns. We shall be pleased to give you further advice through our Expert Service Department, when a fee will be charged according to the information required.

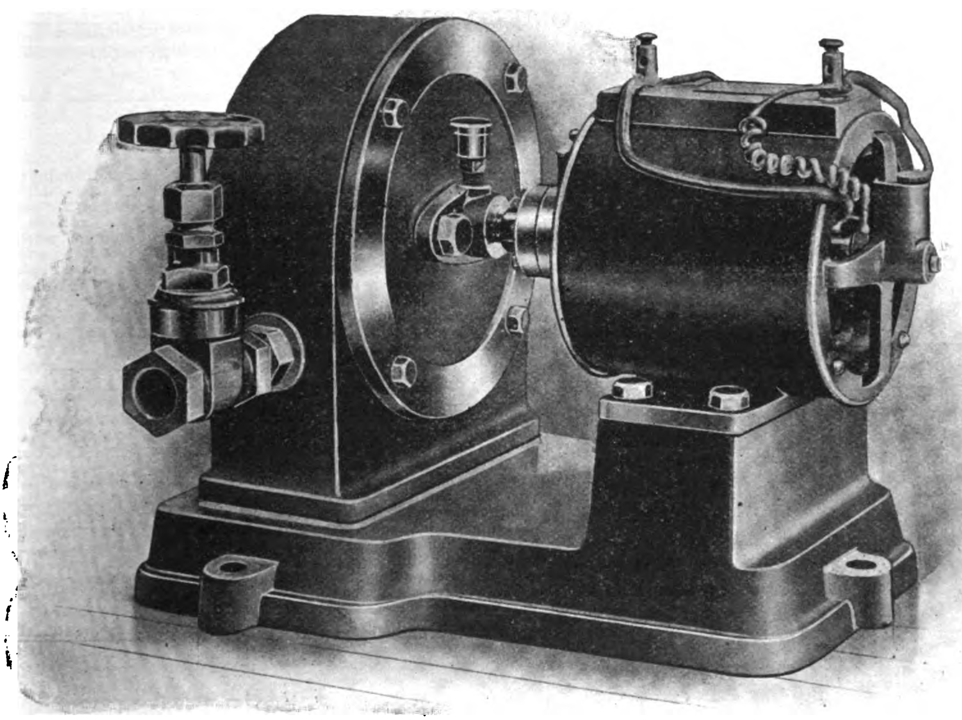
The News of the Trade.

[*The Editor will be pleased to receive for review under this heading samples and particulars of new tools, apparatus, and materials for amateur use. It must be understood that these reviews are free expressions of Editorial opinion, no payment of any kind being required or accepted. The Editor reserves the right to criticise or commend according to the merits of the goods submitted, or to abstain from inserting a review in any case where the goods are not of sufficient interest to his readers.*]

* *Reviews distinguished by the asterisk have been based on actual Editorial inspection of the goods noticed.*

* Combined Water Motor and Dynamo.

We illustrate herewith a very neat combined, small-power water motor and dynamo, suitable, where the water is available, for charging ignition accumulators for motor-cars and cycles. It is made to work with ordinary house supply, and consists of one of the well-known "Hector" water motors coupled to an enclosed field dynamo. The pressure of water should be 40 lbs. per sq. in., and the supply pipe ½ in. in diameter. Further particulars and prices may be obtained from the manufacturer, Mr. Percy Pitman, Bosbury, Ledbury, Herefordshire.



MR. PERCY PITMAN'S COMBINED WATER MOTOR AND DYNAMO.

Small Spring Motors.

Many readers will be interested to know of the spring motors which are now being supplied by George Adams, of 144, High Holborn, London, W.C. These motors, which are for small power—such as driving models, advertising novelties, mechanical toys, gramophones, &c.—are elegantly finished, and carefully put together. The mechanism consists of a strong spring and train of wheels, with a regulating fan. An illustrated list, giving prices and further particulars, will be sent to all readers for one halfpenny stamp.

New Catalogues and Lists.

W. Barratt & Co., Sterling Shoe Works, Northampton.—We have received an attractive list from the above firm, who, as our readers well know, make a speciality of a mechanic's working boot at 9s. 9d. The list comprises quite a variety of styles of ladies' and gentlemen's footwear at very reasonable prices.

The Editor's Page.

IN view of the popularity of the crane as a prototype for model-making, we would call our electrical readers' attention to the prize design for a model travelling crane described on pages 104 to 108 herewith. This design is especially interesting, owing to the fact that the use of toothed gearing is reduced to the minimum, the various movements being made by separate electro-motors.

* * *

We quote below from a Brighton correspondent's letter, which contains an appreciation of our method of helping readers in difficult es by providing a series of cheap handbooks. He rightly points out that many of our querists would find all they want in these handbooks and save themselves much time by a reference to one or the other of the now long list of books published from this office.

* * *

Our correspondent writes :—"Allow me to thank you for the excellent little sixpenny work on 'Gas and Oil Engines,' which I received a few days ago. I have carefully read it, and shall always be willing to heartily recommend the same to others desiring a simple and handy book on the subject. I was very much interested in the 'Little Giant's' trip in THE MODEL ENGINEER of the 13th ult. The only fault—there was not enough of it. I could go on for hours reading such matter. I trust that you will give us another treat, or, rather, a glimpse of another 'Little Giant' at some convenient date. Perhaps, not many readers notice the humorous side of THE MODEL ENGINEER. The advertisement columns speak for themselves. From time to time I notice the advertisement of the amateur who is 'giving up,' which enumerates many valuable things—half finished — going for a few shillings; or, as advertiser sometimes finishes, 'Will exchange for revolver or bath-chair; in good condition.' Hopeless despair and reckless expenditure are written in between the lines. But why is it ? Can the Editor of THE MODEL ENGINEER offer a suggestion ? Judging by some of the queries, some must evidently take you for a mythological god and magician—one that can answer any question under the sun. In spite of your handbooks it is very certain that those who write such brain-racking questions as appear in THE MODEL ENGINEER are evidently not acquainted with the first principles of mechanics. They seem to go on without first becoming thoroughly acquainted with what they are constructing ; then, when half-way through the job, they fly to the unfortunate Editor, who is expected to understand all the conditions and find a way out of all difficulties. I, for one, would like to see, instead of the Query Column, a list of the sixpenny handbooks, and opposite the various titles a few of the points with which each book deals."

Answers to Correspondents.

F. W. (Wortley).—We regret that we cannot accept your kind offer of a contribution.

H. A. (Peterboro').—See the article in January 1st, 1903 issue, page 7. Also recent Queries and Replies.

J. A. (Govan).—We think you will do better to buy a complete set of castings from one of our advertisers. It would, we are sure, mean less expense than the preparation of a design. We do not know any book describing how to make a small lathe.

T. M. E. (Warrington).—We regret that we cannot obtain such information until the drawings are published. Watch the electrical engineering journals.

W. B. (Accrington).—We have already asked the contributor for drawings and further particulars of his model, which, if we receive, we will publish without delay.

Notices.

The Editor invites correspondence and original contributions on all amateur mechanical and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected or not, and all MSS. should be accompanied by a stamped addressed envelope for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

This journal will be sent post free to any address for 13s. per annum, payable in advance. Remittances should be made by Postal Order.

Advertisement rates may be had on application to the Advertisement Manager.

HOW TO ADDRESS LETTERS.

All correspondence relating to the literary portion of the paper, and all new apparatus and price lists, &c., for review, to be addressed to THE EDITOR, "The Model Engineer," 26—29, Poppin's Court, Fleet Street, London, E.C.

All correspondence relating to advertisements and deposits to be addressed to THE ADVERTISEMENT MANAGER, "The Model Engineer, 26—29, Poppin's Court, Fleet Street, London, E.C.

All subscriptions and correspondence relating to sales of the paper and books to be addressed to Percival Marshall & Co., 26—29, Poppin's Court, Fleet Street, London, E.C.

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Contents.

[*The asterisk (*) denotes that the subject is illustrated.*]

THE

Model Engineer

And Electrician.

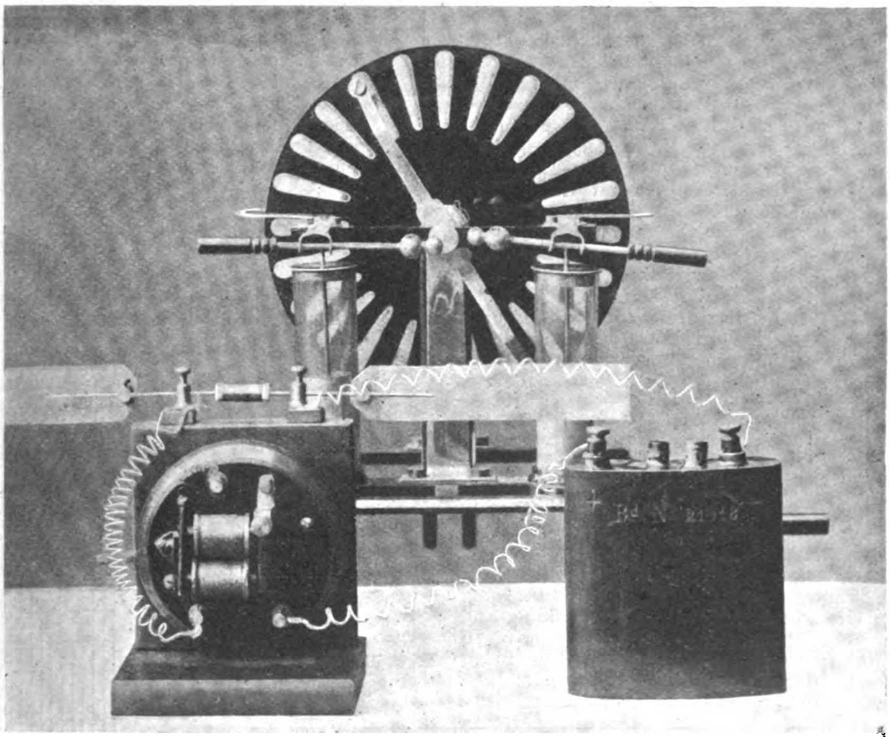
A JOURNAL OF PRACTICAL MECHANICS AND ELECTRICITY.

EDITED BY PERCIVAL MARSHALL, A.I.MECH.E.

VOL. XIII. NO. 224. AUGUST 10, 1905. PUBLISHED WEEKLY.

An Electrical Experimental Set.

By H. L. SWAN.



MR. H. L. SWAN'S ELECTRICAL EXPERIMENTAL SET.

VERY many amateurs who are possessors of a Wimshurst machine soon find the list of experiments that can be performed with it running out, and they are at a loss to find new ones. The experiments I am about to describe, while embodying most of the principles of wireless telegraphy, only require such apparatus as can be easily made by the amateur.

This apparatus consists of a relay, two batteries, a simple coherer, and a Wimshurst machine, or small coil capable of giving ¼-in. spark or more. The object of the relay is to make the very feeble current passing through the coherer (which has been acted on by the Hertzian wave, and its resistance partly broken down) actuate a strong local current which is sufficient to light a lamp, etc.

The following is a description of the way in which I made my relay and coherer :—

The base of the relay was made from a piece of ebonite ¼ in. thick, cut into a 3-in. circle. Not being the happy possessor of a lathe, this was done by holding down a piece of wood, 1½ ins. long, with a point fixed at one end and a knife at the other, on the ebonite, and revolving it round. A hole was then drilled in the centre of the disc, and the ebonite was screwed by a couple of ½-in. brass screws to a turned walnut base, obtained from an old telephone transmitter. The magnet for the relay was made by riveting two pieces of round bar iron, ¼ in. by 1¼ ins. long, to a piece of ½ in. by ⅛ in. by 1⅝ ins. strip iron. On to these cores were slipped two bobbins, 1 in. long by ⅝ in. diameter, wound with ½ oz. each of No. 36 s.s.c. wire ; the free ends of this wire were taken to two terminals screwed in at the bottom of the relay. The bracket supporting the armature is made of a piece of 3-32nds in. by ¼ in. by 1 in. sheet brass, with a ¼ in. at each end bent upwards and downwards, and fixed to a piece of brass 3-32nds in. by ¼ in. by ¾ in. long. The armature is suspended between two screws, with sharp coned points, these being cleaned up and kept bright, as a contact is made between them and the armature. One of these screws is fixed, while the other is adjustable by means of a milled head, seen on the right of the photograph. The armature is a piece of ⅛-in. strip iron ¼ in. wide and 1¼ ins. long. This was cleaned up, and fitted at its lower end with a platinum contact made by riveting ⅜ in. of platinum wire into two holes in the armature, making a little horizontal contact. The lower pole of the magnet is treated in the same way, only this contact is vertical, not horizontal. Two holes were then drilled, 1-16th in. deep and 1-16th in. diameter, in the upper end of the armature at each side, to take the points of the suspending screws. A small piece of brass bent at right angles holds the magnet down to the base.

The yoke of the magnet is connected with one terminal on the top of the base, and the bracket with the other. The relay is screwed to a base, made of two pieces of mahogany ⅜ in. thick, by a screw passing through a hole in the centre, and acting as a pivot for adjusting the relay by the small pin seen on the left of the photograph.

The coherer was made of a piece of ⅛-in. thin brass tube, known as "triblet" tubing, ⅞ in. long, fitted with two wooden plugs 3-16ths in. long, and a tight fit into the tube. Two pieces of No. 16 B.W.G. platinoid wire, 3½ ins. long, are fitted through the centre holes of the plugs. The tube was next three-quarters filled with perfectly clean nickel filings, made over a clean piece of paper with a new file and clean hands ; the plugs were then put in place, the ends of the platinoid wires being ⅛ in. apart, and painted over with shellac varnish to make them air-tight. The coherer is supported by two terminals screwed into oak blocks, ¼ in. thick by ½ in. square, fixed to the top of the base by a couple of screws.

The wings were made of very thin sheet brass, 5 ins. long by 1 in. wide, fitted with a terminal and setscrew to clamp on the coherer wires. This, with two dry batteries, or, better still, a dry battery and 4-volt accumulator, completes the apparatus required at the receiving station.

Now for an example of the experiments that can be performed with it :—First set the sparking balls of the Wimshurst machine about 1½ ins. apart ; next set up the receiving station as follows : Adjust the relay armature so that the contacts are about ⅛ in. apart, connect one of the batteries through the relay windings and the coherer, as shown in the photograph ; although an accumulator is in this, a battery will do almost as well. The other terminals of the relay must be connected in circuit with a bell and battery. If the Wimshurst machine is now set in action discharging sparks, the bell will ring, and continue doing so until the coherer is tapped, when it will stop until more sparks pass. The reason for this is that when a spark is made it sets up Hertzian waves or vibrations in the ether, which act on the filings and cause them to cohere, thus allowing a feeble current to pass through the relay windings, which draws up the armature, and completes the circuit between the bell and battery. The tapping causes the filings to decohere, and the circuit is broken. This example will suggest many other experiments to the amateur, such as lighting a lamp, firing a fuse buried in gunpowder, &c. The experimenter will soon find out the best distance between the transmitting and receiving stations for himself, as it depends on the delicacy of the instruments, length of spark, etc.

In conclusion, I may say that this little piece of apparatus should amply repay the time and trouble taken to construct it.

Lessons in Workshop Practice.

XX.—Notes on Design of Small Dynamos and Motors.

(*Continued from page* 88.)

By A. W. M.

THE attachment of laminated pole-pieces or cores to a solid yoke presents some difficulty, because it is impracticable to drill and tap the laminated metal owing

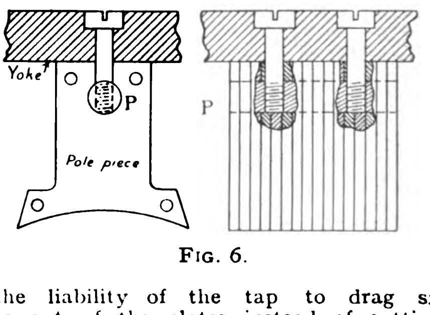


FIG. 6.

to the liability of the tap to drag small pieces out of the plates instead of cutting a clean screw thread. A method of obviating this is shown in Fig. 6, where a hole is drilled through the pole-piece and a plug of solid iron (P) driven into it. It now becomes comparatively easy to drill and tap the holes for the screws into this solid plug, which pulls the pole-piece up against the yoke when the screws are tightened.

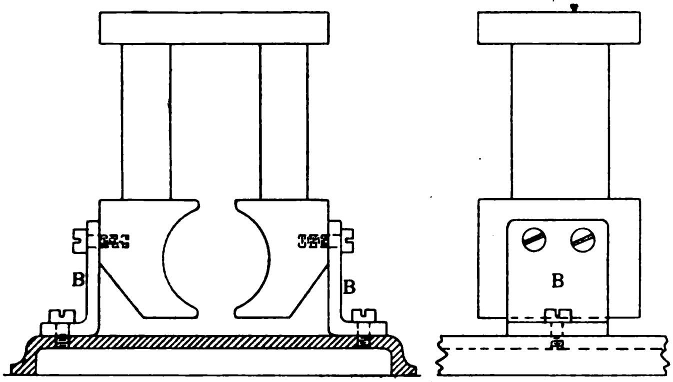


FIG. 7.

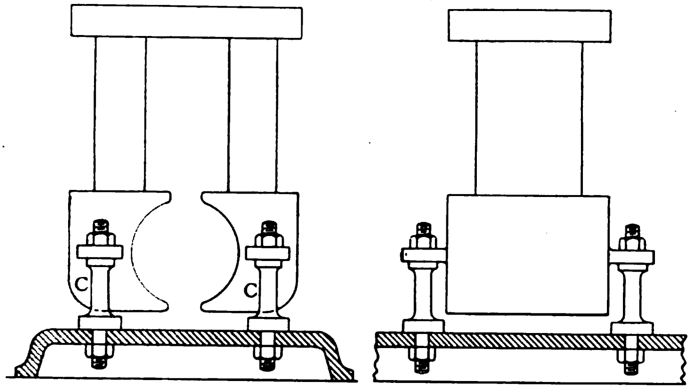


FIG. 8.

Of the various types of field-magnets, each has its own good qualities and drawbacks. The Manchester pattern is very well adapted for ring armatures, so is the simplex or single coil type. The overtype or Kapp pattern is well adapted for drum armatures, and the brush gear is easy to get at. The undertype is also suitable for drum armatures, and is a good type, though the brushes are awkward to get at in small machines. Ironclad machines—that is, those having internal poles, such as the Lahmeyer and multipolar patterns, are suitable for armatures having a large diameter in proportion to length. They are not so well suited for long drum or shuttle armatures, having a comparatively small diameter in proportion to length. The Kapp or undertype pattern is more convenient in this case. One may say generally that with small machines, any of the recognised types of dynamos or motors will give good results if well proportioned and properly made. To guard against unnecessary magnetic leakage, all patterns have a certain amount. It is unavoidable. But it may be much increased by faulty design. The undertype single horseshoe magnet is particularly subject to magnetic leakage when mounted on an iron baseplate. In such a case, it is necessary to separate the poles from the iron base by means of distance pieces made of brass, or to support the magnet upon brass brackets, so that the poles are clear of the base. There is an exact distance at which the poles should be set away from the base. It should increase with the size of machine, but the greater it is the less will be the leakage. It should not be less than, say, four times the distance between the armature and pole faces, so that the magnetic lines of force will prefer the shorter path to the armature core.

Fig. 12 shows an ordinary undertype magnet bolted to an iron base. A, A are brass distance pieces; the screws are also preferably of brass. Fig. 7 shows a similar magnet supported by means of brass brackets B, B. In Fig. 8 is shown another method of supporting the magnet by means of four brass studs C, C; lugs are cast on to the magnet poles on purpose to receive the studs. A neat type of iron base is shown in Fig. 9. The magnet is supported by brass brackets (D, D), so that it is well clear of the base. In Fig. 10 this pattern of base is applied to a Manchester type of dynamo which could be bolted directly to the yoke, no brass distance pieces being necessary. This construction reduces the magnetic leakage which exists to a large extent, through the base, when, as in

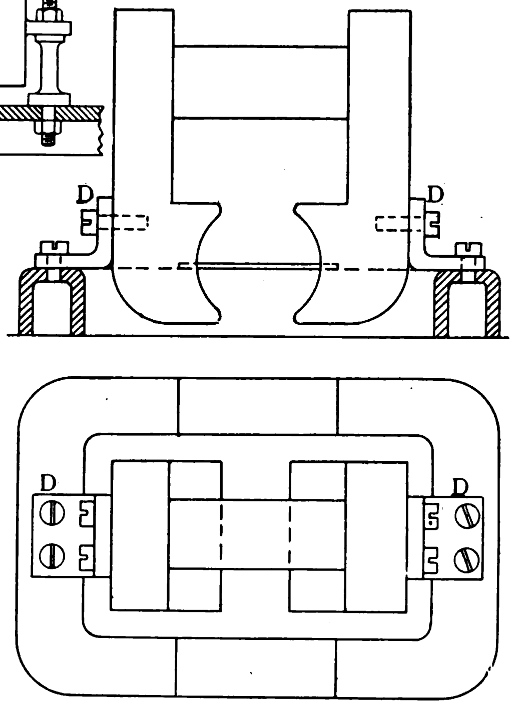


FIG. 9.

the usual Manchester pattern, it is cast on to the lower yoke.

Bearing brackets must be made entirely of brass, when they are attached to a pair of N. and S. poles so as to form a bridge (see Fig. 11). The magnet yoke should be at least equal in area to the core, when both are made of similar material. When the core is of wrought iron and the yoke of cast iron, it

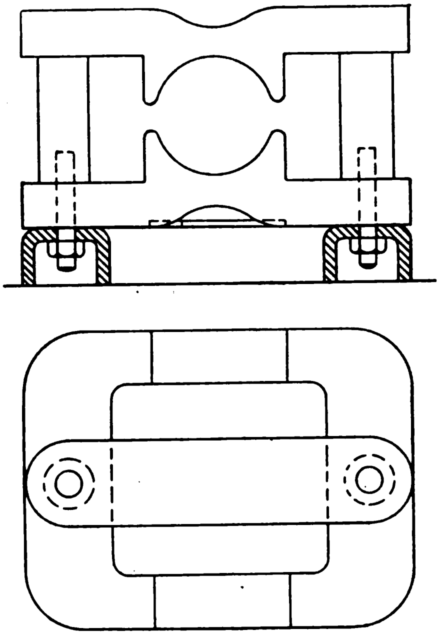


FIG. 10.

should be double the area of the core. Overtype machines of the Kapp pattern reckon in the base as part of the yoke, when the magnet makes good contact with it or forms a part of the base.

As regards choice of armature, there is no such great difference in efficiency between drum and ring patterns as to make it worth while spending time to get in one form when the circumstances under which a machine is to be made favour the other. If the diameter is to be small, a drum armature is generally preferable; if the diameter is

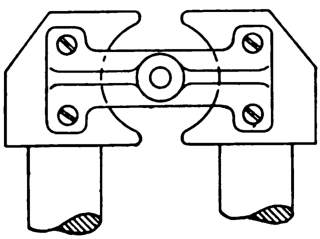


FIG. 11.

large, a ring armature is more convenient. Small ring armatures are difficult to wind, but the system is easily understood, and does not require so much space for the end windings as a drum armature. When designing a ring armature, make the inside diameter as large as practicable and free from unnecessary obstruction, as the wire heaps up inside the ring, especially in small sizes. If a smooth core ring is used the depth of winding on the outside should not be more than three or four layers deep. A ring armature should have about twice the number of coils, and its commutator about twice the number of sections as a drum armature of equal output.

When deciding the proportions of the brush gear, it is better, especially with dynamos, to err on the side of making the brushes too large than too small. Even if the brush is much larger than actually required to carry the current, it will wear better, and require less pressure than a smaller brush.

(To be continued.)

The Latest in Engineering.

A Time Recording Camera.—Primarily intended for the use of the police—to enable them to obtain *accurate* evidence when operating their "traps"—a new time-recording camera is now being introduced by Messrs. Gibbs & Dumbell.

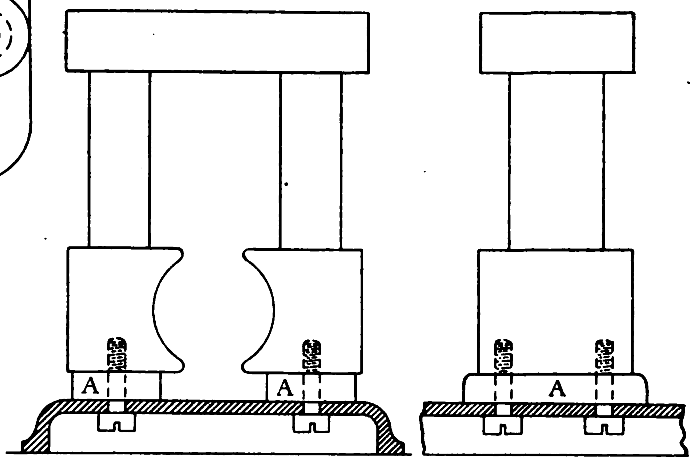


FIG. 12.

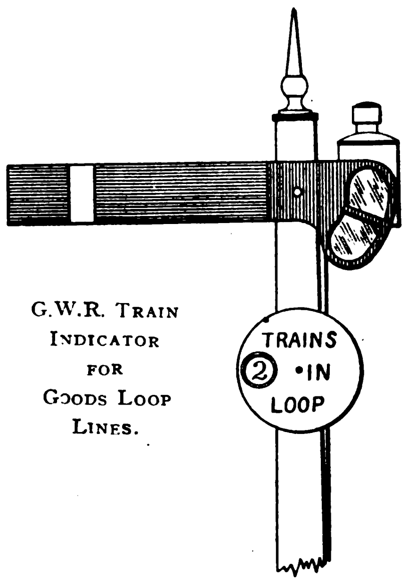
It not only affords a picture showing the car and its precise position at the moment, but it also shows the exact time by the synchronised stop-watch, with a registered number on the case, and this is sealed within the camera in such a way that it cannot be tampered with. Above the watch is an opening for the date-card, and beneath it is a numbering apparatus that enables each negative to be identified, and the order of sequence to be established.

Train Lighting on the L.B. & S.C.R.—The incandescent oil-gas lights fitted to one of the suburban trains of the London, Brighton, and South Coast Railway have proved so satisfactory that the Pintsch's Patent Lighting Company were soon required to equip one of the Pullman expresses running between London and Brighton. A preliminary trip of the first of these trains thus equipped was made on Thursday, July 6th. Each

Pullman car is fitted with six lamps, which originally had four ordinary gas-jets, giving a lighting of thirty candles per lamp, and taking 3½ cubic feet of oil-gas per hour. These lamps have now been fitted with incandescent burners suitable for inverted mantles, and yield 80 c.-p. each at an expenditure of 1·3 cubic feet of oil-gas per hour. The mantle is mounted on a steatite tripod, which fits into a circular groove in the reflector. The latter is hinged, and the mantle is inserted from the back, It can, therefore, be replaced from the interior of the car. In spite of the vibration to which the mantles are unavoidably subject, they have an average of life of fully five weeks. The cost of replacing is only a fraction of the saving effected by the reduction in the amount of gas consumed. This saving cuts both ways; since, in addition to the large decrease in the amount of gas used, there is also a reduction in the labour account, as the same reservoirs which would formerly hold enough gas for thirty-six hours' continuous burning, will now suffice for seventy-two hours. The pressure at which the gas is supplied is 8 ins. of water, that in the reservoirs being 105 lbs. per sq. in. when freshly charged. The average cost of the gas is about 10s. per 100 cubic feet, taken at ordinary pressure and temperature. We note that the first train fitted, which is used in the suburban service between London Bridge and Victoria, is about to be fitted with by-passes, and the slight extra consumption of gas due to the use of them will, we understand, be more than compensated for in the longer life of the mantles and the reduction of labour in lighting up.

A New Galvanising Process.—On Thursday, June 29th, Mr. Sherrard Cowper-Coles exhibited at his offices, 82, Victoria Street, S.W., some very interesting specimens of iron, copper, aluminium, and other metals coated with zinc by his new galvanising process. The articles to be treated are simply heated to a temperature of 500° F. in a "bath" of zinc fume. On removal, after a time, which varies with the thickness of deposit required, but is always small, they are found to be completely coated with a layer of zinc, which has, moreover, alloyed itself with the surface of the metal, into which it penetrates a perceptible distance. In the case of copper, a rod of the metal heated as described can be converted almost wholly into brass, although the highest temperature attained is far below the melting-point of either metal. The coating is remarkably uniform, so that bolts treated by the process will still fit their nuts, whilst hot galvanised bolts have always to be run through the dies again before being used, as "blobs" of zinc are invariably deposited between the threads. A great advantage of the process is that the metals to be treated require no special cleaning beforehand. Hence bolts and nuts can be Sherrardised direct as they come from the machine, the oily layer with which they are covered having, if anything, rather a beneficial action. Works, in which the process is being operated on a commercial scale, have been erected at Willesden. The retorts in which the articles are heated are of iron, and are externally fired. A most peculiar feature of the process lies in the fact that the deposit does not take place on the walls of these retorts, which have remained quite clean after some months' work. The explanation, according to Mr. Cowper-Coles, lies in the fact that the walls are the hottest part of the retort, and that consequently the zinc vapour cannot condense on them. Attempts are being made to deposit other metals in a similar way, and a certain success has been attained with copper and with antimony, but the commercial stage has not yet been reached with these metals.

Train Indicator for Goods Loop Lines, G.W.R.—Our illustration shows an indicator upon the post of a signal controlling the admission of trains to refuge loops, which has been brought into use at Maindee East Junction, Newport. The case upon the signal post contains a circular "window," in which a number appears, corresponding with the number of trains admitted into the loop; so giving information to drivers as to any trains that may already be occupying the line. The disc carrying the numbers is revolved by means of a lever in the



G.W.R. Train Indicator for Goods Loop Lines.

signal-box. There are notches in the curved guide of the lever corresponding with the number of trains the loop will hold; and the numbers upon the disc in the case upon the signal post correspond with these notches. When the loop is empty the lever is in its normal position and "0" appears in the window. A train having been sent into the loop, the signalman pulls the lever to the first notch, which causes the disc to partially revolve, when "1" appears in the window, and so on till the maximum number of trains the loop will hold is reached. A lamp inside the case illuminates the window by night.—*G.W.R. Magazine.*

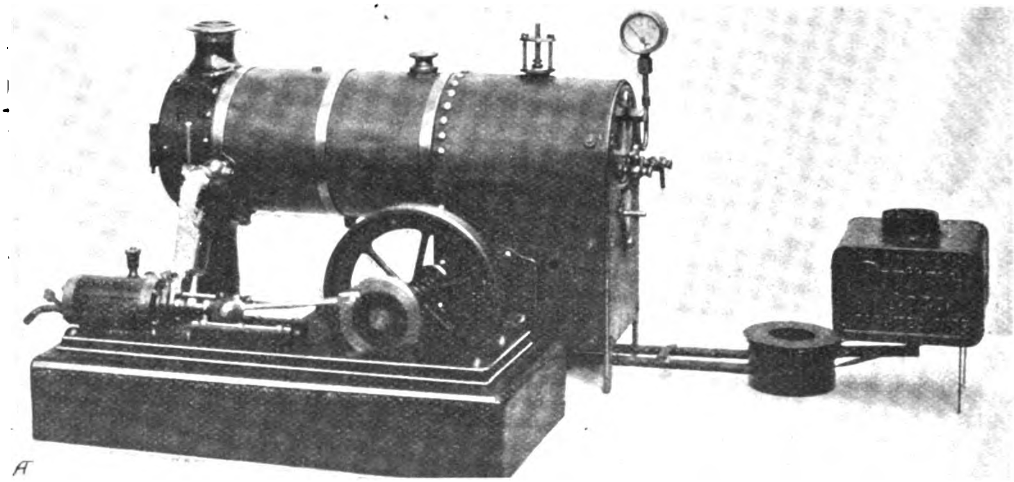
Boilers for Battleships.—The battleship *King Edward VII* was recently subjected to a series of exhaustive steam trials, and competitive tests of the relative value of the two types of boilers fitted in her, viz., the Scotch cylindrical and the Babcock and Wilcox water-tube boilers. So far as coal consumption and development of horse-power are concerned, the water-tube boilers proved their superiority.

A Beginner's Working Model.

By C. Hutson.

THE engine and boiler illustrated herewith were made in spare time. The engine is built up from part of a set of castings having a cylinder ¾-in. bore by 1¼-in. stroke; with the exception of this, the bearings and flywheel were made from scrap material. The crosshead and guide are of cast iron with steel plates overlapping the feet of crosshead to hold it down; the guide and plates are held down to bedplate with six screws made from wire nails. The connecting-rod is of steel with phosphor-bronze bushes each end, but no adjustment. The disc was cast from my own pattern and turned all over, and is driven tight on to crankshaft, and a 1-16th in. hole drilled half in disc and half in shaft, with a pin driven in to prevent it slipping. The eccentric I made from a piece of cast-iron, turning the groove for strap and leaving enough for a boss to take setscrew. It was cut off, then mounted on faceplate, and the hole for shaft drilled and the boss finished off on a mandrel. The valve travel is ⅛ in. full. The flywheel weighed only 3½ ozs. when received, but I have made it up to 10 ozs. by riveting a brass ring each side and a cast-iron ring driven on outside, which is 4 ins. diameter by ½-in. face. The assembled parts are fixed to a ¼-in. steel plate, which in turn is screwed to a mahogany base. The cylinder is lagged with plaster of Paris and stained with wood stain, and has given no trouble as yet.

The boiler is of the Smithies' type, having an outer barrel 3½ ins. diameter, and inner one 2½ ins. diameter by 9 ins. long solid drawn copper. The boiler ends and downcomer are gunmetal castings; there are five copper water tubes, ¼ in. diameter, and a superheater ¼ in. copper tube. Steam is taken from a perforated pipe down one side of boiler and up the other, which dries the steam well. The engine exhausts into a box, which has a small hole for draining the pipe of any water condensed therein. The chimney was turned to the sizes of *M.E.* loco chimney as given in The Model Engineer. The steam and water taps I made, also unions and steam gauge syphon. The lamp, which burns methylated spirit, has six 7-16ths in. wicks; the main tank, as will be seen, is part of a cocoa tin, and has a needle valve in to regulate flow of spirit. The boiler will raise steam from cold water in four minutes, and I have had 50 lbs. in it before the safety valve was finished, which now blows at 25 lbs. The engine works well under steam and drives a model roundabout which I have made, the platform being 16½ ins. diameter, and is complete with horses, figures, and organ. All turning for these models was done on a 5-in. centre wood-turning lathe without a slide-rest, and all work that had to be "chucked" was driven in tight into pieces of wood held on faceplate. I have also made an adjusting chuck for square shank drills, which was described in the *M.E.* for February 11th, 1904, and find it very useful. In conclusion, I may say I have been helped considerably in my work by reading The Model Engineer, this being my first attempt at building a working model.



Mr. C. Hutson's Model Horizontal Engine and Boiler.

Water Hardness.—It is stated that the hardness of certain waters can be partially, or even largely, removed by simple heating under pressure. This applies especially to the carbonates of lime and magnesia, but not to the calcium sulphate present.

According to the *Scientific American*, the power generated in a modern steamship in a single voyage across the Atlantic is enough to raise from the Nile and set in place every stone of one of the great Pyramids.

Wireless Telegraphy Apparatus.

By W. Schneider.

Thinking that some readers of The Model Engineer may be interested in wireless telegraphy, I herewith give a description of some apparatus recently constructed by myself.

The Coil.—The chief dimensions for this were taken from The Model Engineer handbook No. 11, "Small Induction Coils for Amateurs," and are as follows:—

Core, 8½ ins. long by ¾ in. diameter.
Primary, 1 lb. No. 16 S.W.G., s.c.c. copper wire.
Secondary, 3½ lbs. No. 36 S.W.G., s.c.c. copper wire.
Diameter over primary, 1⅜ ins.
" " secondary, 4¼ ins.
Length of secondary, 5¾ ins.
Number of sections in secondary, 24.
Condenser, fifty pieces of tinfoil, 9 ins. by 5 ins.

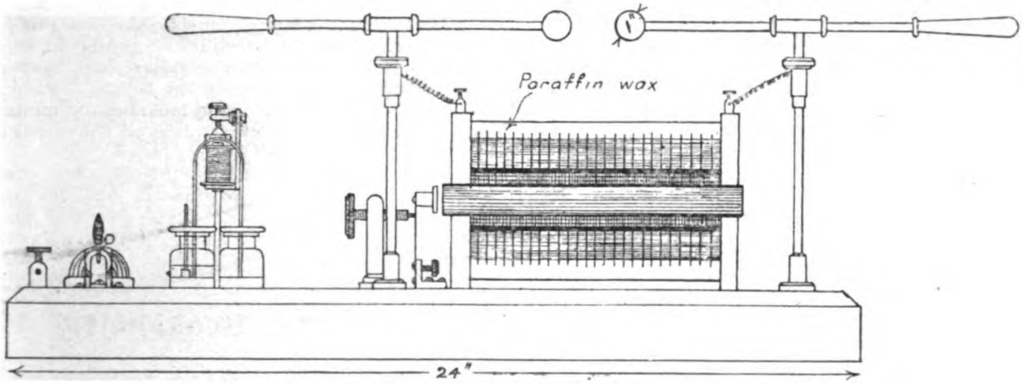


Fig. 1.—General Arrangement of Coil and Transmitter.

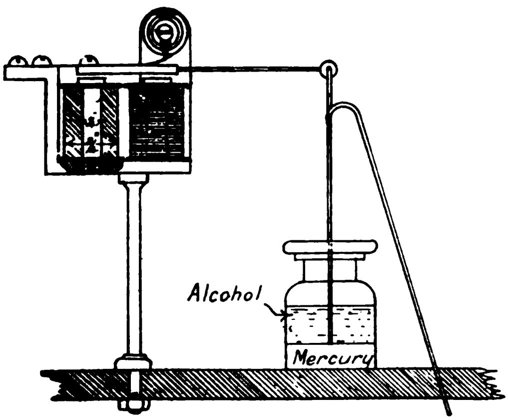


Fig. 2.—Mercury Break.

An ebonite tube, ⅛ in. thick, insulates primary from secondary. Four pieces of filter paper, soaked in paraffin wax were put between each section, the joints which were soldered being brought up between the paper. The coil ends are 5 ins. diameter, and ¾ in. thick, and were turned from well-seasoned walnut. The whole secondary winding was soaked in paraffin wax, and a layer about ⅛ in. thick left all round the outside to keep out dampness. When finished, the coil was tested but would not work at all satisfactory, a 1-in. spark being the maximum obtained. On close examination the secondary was found to leak, owing to some turns of wire being drawn down into the lower layers. The secondary was then rewound with more care. This was rather a tedious job requiring considerable patience; but the final result was quite worth the extra trouble taken. On testing a second time, a full 3-in. spark was obtained with a little adjustment of the condenser.

The coil has two breaks, an ordinary hammer make-and-break, and a mercury interrupter, and is arranged so that either may be switched in. The

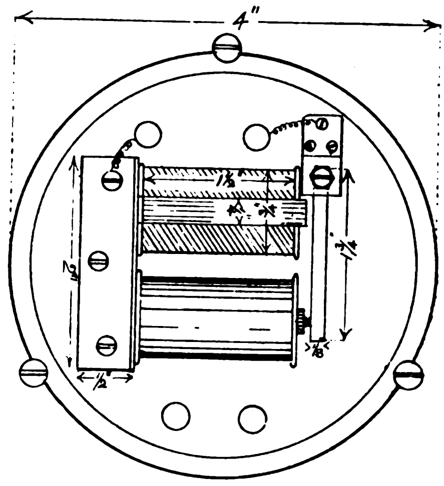


Fig. 3.—Relay.

pillars for the hammer break are gunmetal castings turned up and polished. The hammer was turned up from ¾-in. mild steel rod, and the spring which supports it is an old broken hacksaw blade. The mercury break is fixed on the same base as the coil, and is shown in Fig. 2. It was very easily made and when working the coil with it excellent results are obtained. The magnet is an ordinary bell magnet. Each bobbin is wound with about 1 oz. No. 28 single silk-covered wire. The break works at a very high speed with 2 volts, and fat flaming sparks are obtained with it.

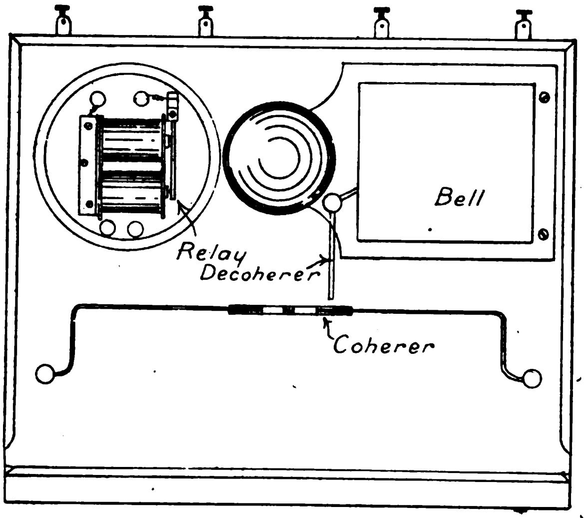


FIG. 4.—GENERAL ARRANGEMENT OF RECEIVER.

The commutator (Fig. 5) has an ebonite roller, the rest being made from scrap brass.

The coil, which is on a French polished walnut base, is finished off with paper ebonite, which gives it a very good appearance. All bright parts are polished and lacquered. The coil is worked off four 2-volt accumulators and takes about 4 amps.

The Transmitter.—This is fixed on the same base as the coil. The sparking pillars are turned up from gunmetal castings. The brass balls are 1 in. diameter, and are screwed on to $\frac{1}{4}$-in. brass rods which slide into supports on the pillars, and can be regulated to any desired sparking distance. The sparking rods are fitted with ebonite handles, which enables one to adjust the spark gap whilst the coil is working.

The Receiver.—A sketch of this is given in Fig. 4.

The Coherer (Fig. 6).—This consists of a piece of glass tubing, $2\frac{1}{4}$ ins. long and 3-16ths in. diameter, and has a bore of about $\frac{1}{8}$-in. Into this are fitted two small brass plugs which are held in their places by two small ebonite corks. The plugs almost meet within the tube, and the space is half filled with fine silver filings. This coherer has so far given very satisfactory results.

The Relay (Fig. 3).—This is similar to the one described by Mr. S. R. Bottone in his book, "Wireless Telegraphy and Hertzian Waves." The bobbins are ordinary bell bobbins, $1\frac{1}{2}$ ins. by $\frac{3}{4}$ in., with a $\frac{1}{4}$-in. pole for the iron core, which is made up of No. 22 soft iron wire. These cores are soldered on to a piece of right-angled brass, which fixes them down to the base. Each bobbin is wound with about 1 oz. No. 36 s.s.c. wire, and is finished off with black paper. The armature is a piece of annealed cast iron, $1\frac{3}{4}$ ins. by $\frac{1}{2}$ in. by $\frac{1}{8}$ in. It is supported by two screws fixed in a piece of brass sheet. The base is a piece of walnut turned up and polished. It is fixed on the base of the receiver by three round-headed brass screws, so that the whole relay may be rotated to get the swinging armature in its correct position. This relay works very well and is fairly sensitive.

The Bell.—This hardly needs any description, being of the usual type and having a $2\frac{1}{2}$-in. gong. A piece of steel wire is screwed into the hammer to act as a decoherer. When the bell is rung the steel wire hits the coherer and so decoheres the filings.

The Batteries.—These consist of two one-pint Leclanchés, and a 2-volt accumulator. The Leclanchés are used between coherer and relay and the accumulator for working the bell.

The coherer, relay, bell, and batteries are mounted on a polished walnut stand and all brass work is polished and lacquered.

So far I have not been able to test these instruments over very long distances, but for short distances they work very well. The two photographs give a very good idea of the two instruments.

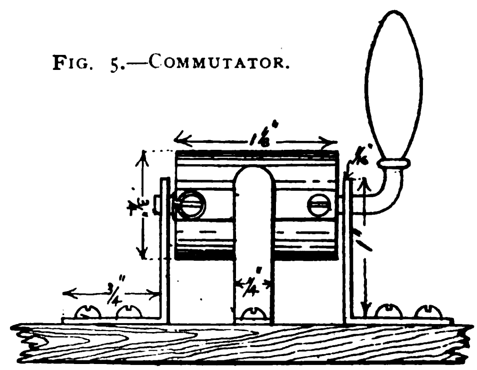
For the Bookshelf.

[*Any book reviewed under this heading may be obtained from* THE MODEL ENGINEER *Book Department*, 26–29, *Poppin's Court, Fleet Street, London*, E.C., *by remitting the published price and the cost of postage.*]

THE DESIGN OF BEAMS, GIRDERS AND COLUMNS. By W. H. Atherton, M.Sc. London: Chas. Griffin & Co., Ltd. Price 6s. net; postage 4d.

In all machines and structures, beams appear in one form or another, and a proper understanding of the fundamental facts and principles underlying their construction is essential to scientific designing

FIG. 5.—COMMUTATOR.



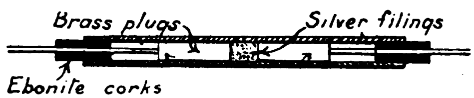


FIG. 6.—COHERER.

For this reason, and also because the author has specially considered the requirements of the draughtsman, the book under notice is one which should commend itself to young engineers and architects. The various problems are presented in a lucid and accurate fashion, without recourse to intricate mathematics, and a strong feature is made of illustrative diagrams. A number of numerical examples in which the principles set forth are applied to regular engineering practice are given, and these will be found most helpful to the student who is confronted with problems of this nature in his daily work.

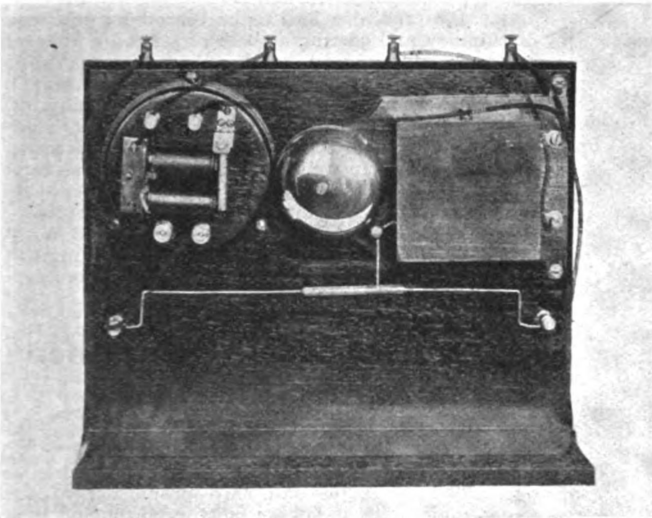


FIG. 7.—MR. W. SCHNEIDER'S WIRELESS TELEGRAPHY APPARATUS: THE RECEIVER.

MODERN IRON FOUNDRY PRACTICE. Part II. By Geo. R. Bale, Assoc.M.Inst.C.E. Manchester: The Technical Publishing Co., Ltd. Price 3s. 6d. net; postage 4d.

In the second part of his useful treatise on foundry practice, Mr. Bale deals with machine moulding and moulding machines, physical tests of cast iron, methods of cleaning castings, foundry accounting, &c. Foundry practice has made such important strides in recent years that it behoves everyone concerned in the production of castings to be fully up-to-date in his knowledge of the subject. We can cordially commend this volume as a useful and well-written guide.

HOW TO INSTALL ELECTRIC BELLS, ANNUNCIATORS AND ALARMS. By Norman H. Schneider. London: E. and F. N. Spon, Ltd. New York: Spon & Chamberlain. Price 1s. 6d. net; postage 1½d.

Like Mr. Schneider's other books, this is an essentially practical little manual. It deals with the installation of electric bells, and also circuits for burglar, fire, and water level alarms. The diagrams are very clearly drawn.

MODERN PRIMARY BATTERIES. By Norman H. Schneider. London: E. & F. N. Spon, Ltd. New York: Spon & Chamberlain. Price 1s. 6d; postage 1½d.

This is a useful guide to the better known forms of primary batteries. The various chapters deal with cells for intermittent use, acid cells, copper sulphate cells, miscellaneous cells, selection and care of batteries, and practical notes on cells. The information throughout is reliable and to the point.

THE PLEASANT ART OF PHOTOGRAPHY MADE EASY. By "Camera." London: Guilbert Pitman. Price 1s. 6d.

This is a handbook for the beginner in which the various processes involved in producing a satisfactory photograph are carefully explained. The author adopts a light and chatty style, and aims at showing that as a hobby photography is not necessarily expensive or difficult. The result is a very readable and instructive book which will give the novice all the information he requires.

THE GUM BICHROMATE PROCESS. By J. Cruwys Richards. London: Iliffe and Sons, Ltd. Price 2s. 6d. net; postage 3d.

This process is *par excellence* the printing process for exhibition photographs, and its leading exponent in this country for some years has been Mr. Cruwys Richards, who in this book puts his knowledge and skill at the disposal of all who would follow in his footsteps. The process is treated completely and practically, and the book is fully illustrated with examples both of finished prints and of the same prints at various earlier stages. Every amateur photographer who is interested in the artistic side of his hobby, should read what can be done with "bi-gum."

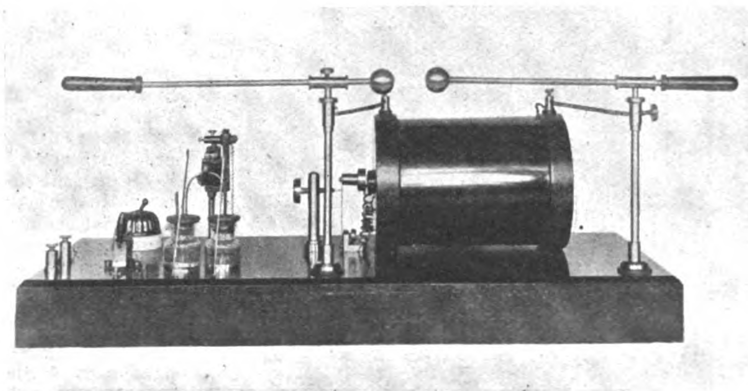


FIG. 8.—THE TRANSMITTER.

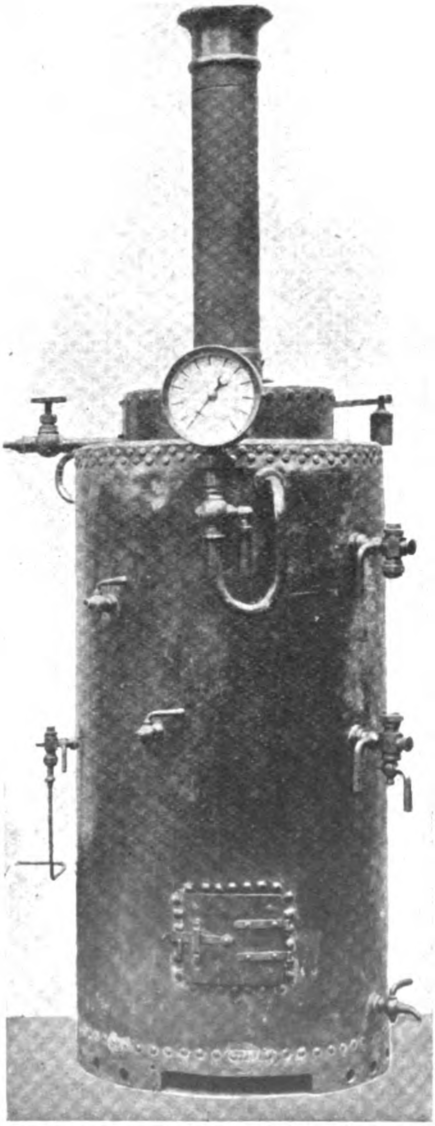
PALM OIL.—Liberia exports about 50,000,000 gallons of palm oil a year. It is made from the outer part of the palm nut, not from the kernel.

A Model Vertical Boiler.

By S. D. French.

THE accompanying photograph is of a model boiler I constructed during the evenings of last winter.

It is entirely built of copper, the outside shell



Mr. S. D. French's Model Vertical Boiler.

and tube plates being 1-16th in. thick, and the firebox shell 3-32nds in. thick. The chief measurements are 18 ins. to top tube plate, 9 ins. diameter, and 8½ ins. to crown of firebox. The tubes, of which there are nine, are 1¼ ins. diameter. The boiler and firebox shell have butt joints with cover plates single riveted, both of which are run in with solder to make steam-tight. The tube plates were flanged after considerable difficulty and constant annealing; these were then riveted to outer and firebox shell, and made tight in the same manner as vertical joints. A pattern had to be made for fire door ring, and a casting taken from the same, which was fitted and riveted in the ordinary way. Patterns also had to be turned for the bell of chimney and casting at base of same. I formed a superheater out of solid drawn copper tube, ⅜ in. by 4 ft. in length, and fitted inside smoke-box. This I find greatly adds to the efficiency of boiler, and is worth the time spent in making and fixing. With regard to firing, I use coal and coke, which raises steam well and maintains the pressure with starting valve open full to engine. At the suggestion of a friend, I fitted a steam blower, which is most successful, steam being raised with great rapidity. As will be seen from the photograph, the usual mountings are fitted to the boiler.

The Isle of Man Turbine Steamer "Viking."

By Chas. S. Lake.

THE introduction of turbine-driven machinery for the purposes of ship propulsion ranks among, if it is not *the* most important of any developments connected with marine engineering which have taken place during recent years. Although we are, as yet, a long way from the time which shall mark the disappearance of the reciprocating type of engine for marine purposes, it is to be noted that the turbine principle is steadily, even if slowly, advancing in favour, not only where coasting and similar vessels are concerned, but also for the largest and swiftest ocean steamships, among them being some of the best known "floating palaces" of the day.

The steamer *Viking*, the subject of this article, is one of the latest and most interesting examples of the turbine driven steamer to be constructed. She has been built by Messrs. Sir W. G. Armstrong, Whitworth & Co., Ltd., at their Low Walker Yard, Newcastle, for the Isle of Man service, and is the first turbine vessel to trade from Liverpool, as well as being the first of the steamers built on the North-east coast for this particular service.

Special attention has been given in designing the ship to the subject of water-tight compartments. Matters have been carried in this respect to what may be described as a point of finality, and as a result the vessel may be confidently relied upon to float with any two compartments full of water. The *Viking* has been built to carry close upon 2000 passengers, whilst at the same time affording ample promenade space for all, and every necessary facility for the comfort and convenience of travellers has been provided. The shelter deck extends the whole length of the ship, viz., 361 ft., and above this is the promenade deck, about one-third shorter and 42 ft. wide at its broadest point. Spacious dining saloons are provided, and, in addition, there are refreshment bars, smoke rooms, and private cabins.

The first-class accommodation is situated aft, whilst that for second-class passengers is forward, the boilers and engine room occupying a position amidships.

The main saloon is the full width of the vessel. It is lighted by means of a skylight, and also by large rectangular windows at the sides. Dark oak woodwork is employed for this saloon, and the decorations include a number of black and white reproductions of pictures by famous artists. The entrance hall is also panelled in oak of the same tone as that used in the main saloon, and here blue and white Dutch tiles are introduced as a relief decoration.

The first-class dining saloon is entered by means of a stairway alongside the main entrance to the saloon, it has accommodation for 100 persons, and oak panelling is employed, as in the other parts of the ship referred to. The pantry arrangements have been made very complete, and everything possible has been done to allow of meals being expeditiously served. The second-class accommodation forward consists of two large general saloons, one being arranged for dining, and a ladies' saloon.

The propelling machinery consists of three sets of turbines, manufactured by the Parsons Marine Steam Turbine Company, of Newcastle. The high-pressure turbine is in the centre, with a low-pressure turbine on each side of it. The surface condensers are in the wings at the after end of the engine room, with the centrifugal circulating pumps close alongside them. Two large "Weir" air pumps are fitted near the condenser, and these discharge into a large feed tank, from whence the water is led to the automatic float control tank, and so to the feed pumps (two in number, and of Messrs. Weir's make).

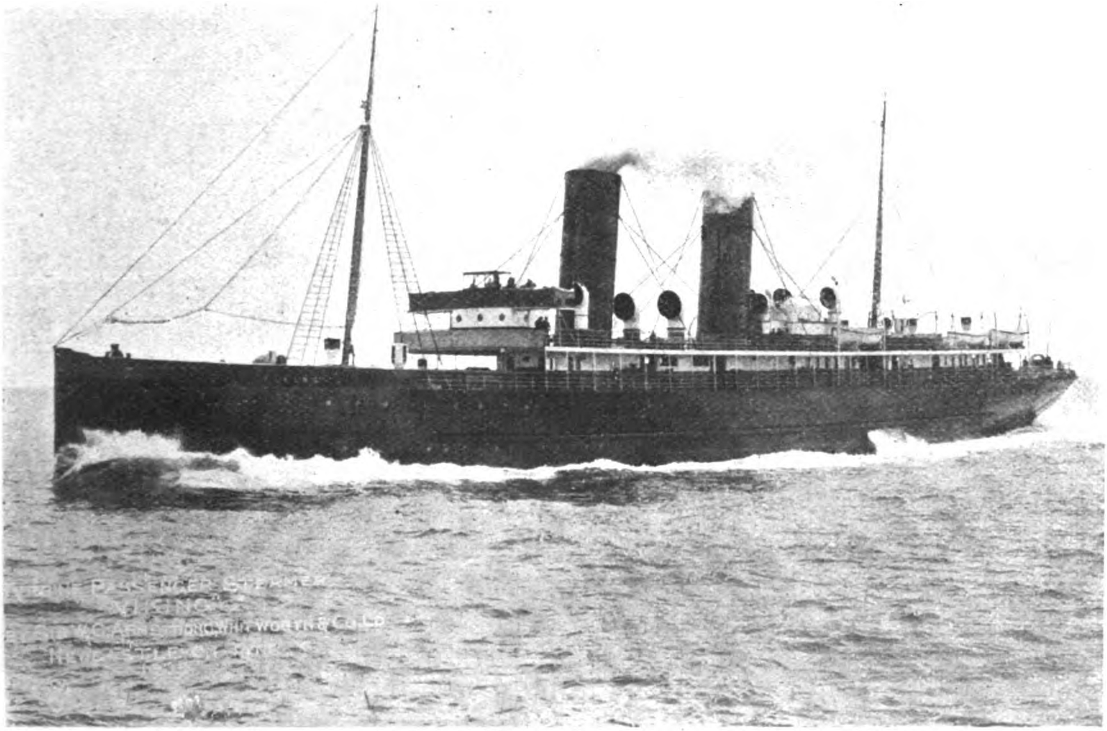


FIG. 1.—THE TURBINE PASSENGER STEAMER "VIKING."

Built by Sir W. G. Armstrong, Whitworth & Co., Ltd., Newcastle-on-Tyne, 1905.

These pumps discharge to the boilers direct or through an exhaust feeder on Parsons' system. The Parsons' patent vacuum augmenter is fitted in connection with the main condenser, enabling a high vacuum to be maintained.

An oil circulating pump is employed for lubricating the bearings; this drives the oil at a considerable pressure through all the bearings, and into a cooling and filtering apparatus on its way back to the pump. The stern-way turbines are arranged as usual within the low-pressure casings, and revolve idly *in vacuo* while the vessel is steaming ahead.

There are four double-ended boilers, carrying a working steam pressure of 160 lbs. per sq. in. These boilers are 15 ft. in diameter by 9 ft. 6 ins. long, and the two boiler rooms are divided by a water tight bulkhead. The funnels are fitted with outer casings, which are utilised as upcast ventilators, and for this purpose are connected to compartments in various parts of the ship. Each funnel is provided with a spark arrester on Denny speed for nearly seven hours, and although a very high power was developed, a considerable reserve was available in the boilers.

The *Viking* is 361 ft. long over all, and 350 ft. long between perpendiculars; her breadth is 42 ft., and depth to upper deck 17 ft. 3 ins.

The writer is indebted to Messrs. W. G. Armstrong & Co., of Newcastle-on-Tyne, for photographs accompanying this article.

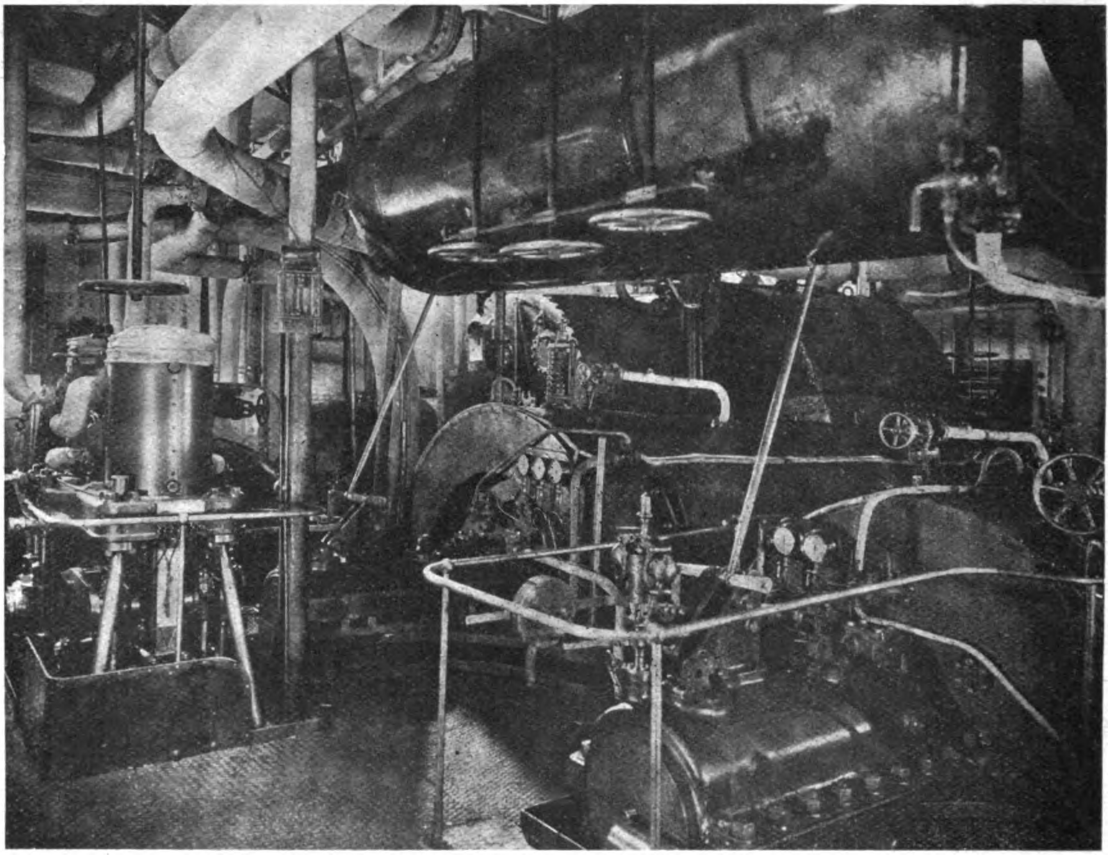


FIG. 2.—A VIEW IN THE ENGINE ROOM, TURBINE STEAMER "VIKING."

and Brace's patent system, and on the trial trip no signs of sparks or cinders were manifested when running at maximum speed.

On completion of the vessel two sets of trials, independently of the builders' preliminary tests, were carried out, the first of which took place off the mouth of the Tyne, under somewhat unfavourable weather conditions. On this occasion no attempt was made to enforce maximum conditions. On June 14th last the *Viking* was taken out for an extended sea trial. A course was set from Souter Point to Flamborough Head, 68·277 nautical miles, this distance being traversed in both directions. The southward run was made at a speed of 23·684 knots, and the northward at 23·375 knots, or a mean speed over the whole distance of 23·53 knots. The ship was kept at full

WATER SOFTENING.—It is stated that a water containing 20° of hardness will probably cause a 20 per cent. loss of efficiency in fuel, due to scale formation, more frequent cleaning out, and increased repairs; and this means an increase of 1s. per 1000 gallons in the cost of evaporation. Such a water, it is said, could be softened for 3d. per 1000 gallons.

A PORTAGE railway around the rapids of the Columbia River at the Dalles is being built by the State of Oregon, and a considerable amount of extension of railways in the district is projected; but the actual iron laid during the year was only 23 miles in Oregon, 13 miles in Idaho, and 53 miles in Washington. There are now 1,768 miles of single railway track laid in Oregon, 1,451 miles in Idaho, and 3,392 miles in Washington.

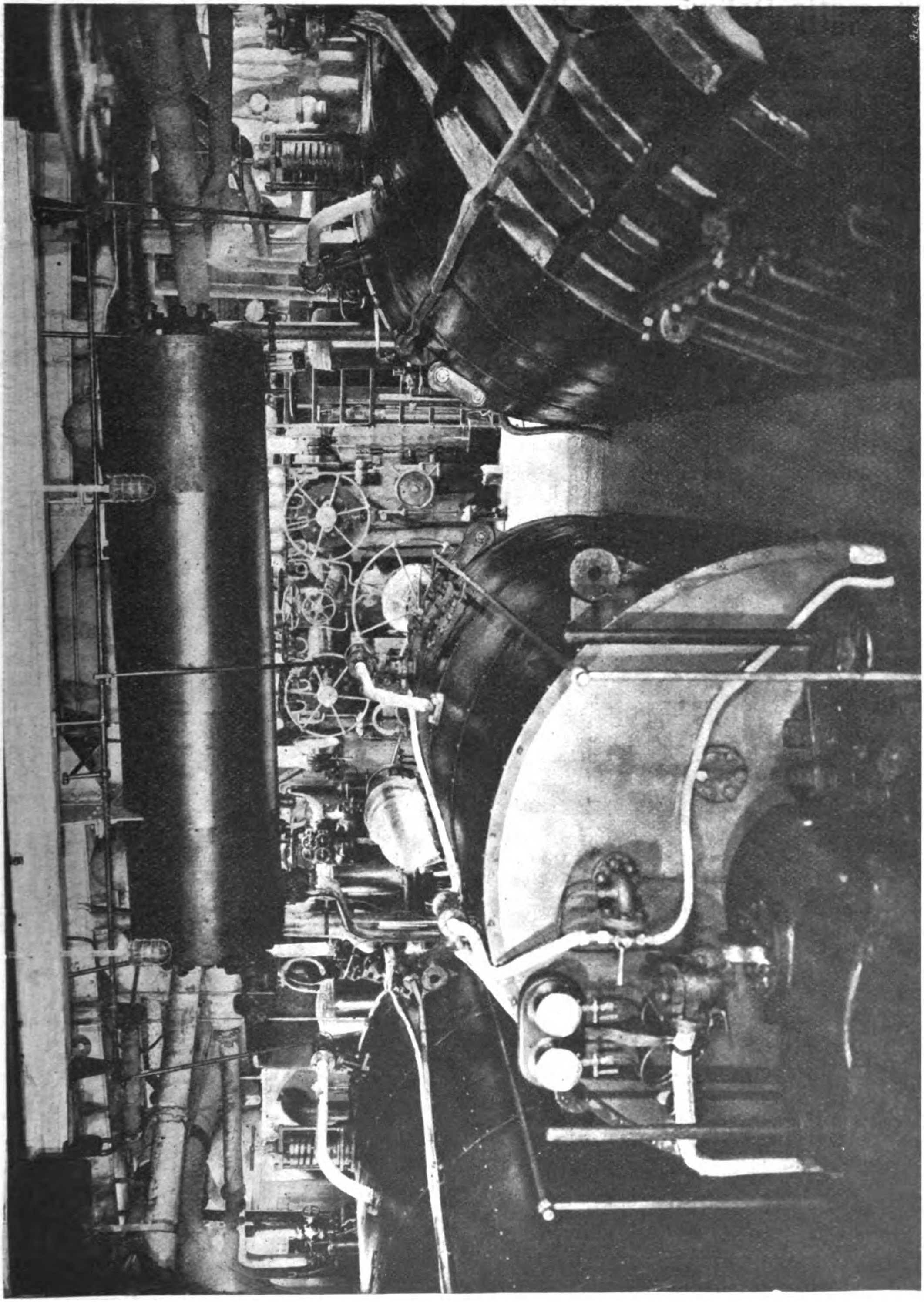


Fig. 3.—A View of the Turbines and Starting Platform, s.s. "Viking."

Automatic Railway Couplings.

THE universal adoption of an automatic coupling for railway vehicles would undoubtedly be an acquisition over the present methods of coupling generally in use upon our railway systems. It is, however, only a question of cost which hinders the entire adoption of one of the new forms of automatic coupler by the railway companies. Doubtless, if the transition could be made a gradual process, we might hope that the present method of coupling would eventually become obsolete.

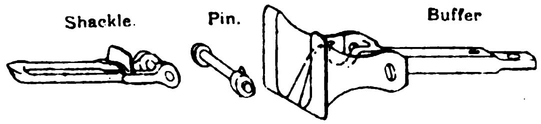


FIG. 1.

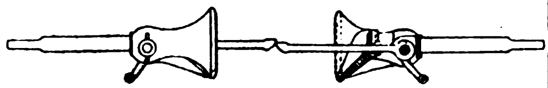


FIG. 2.

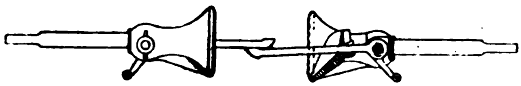


FIG. 3.

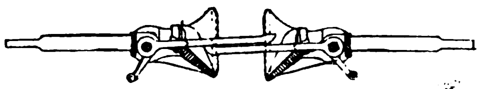


FIG. 4.

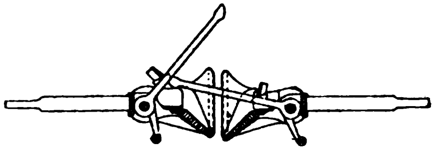


FIG. 5.

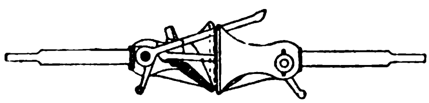


FIG. 6.

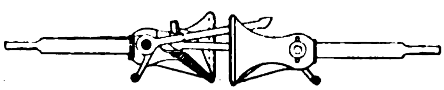


FIG. 7.

We are able to illustrate, and briefly describe, some of the automatic coupling arrangements which are now upon the market.

The "A.B.C." coupling, introduced by the New Allison Smith Automatic Buffer Coupler, Ltd., consists, as shown (Fig. 1), of three parts only, which are precisely alike on both ends of every vehicle. They are a steel buffer head, a shackle, and a pin. Every part is allowed considerable freedom, so that machining is unnecessary, except in the case of the pin holes,

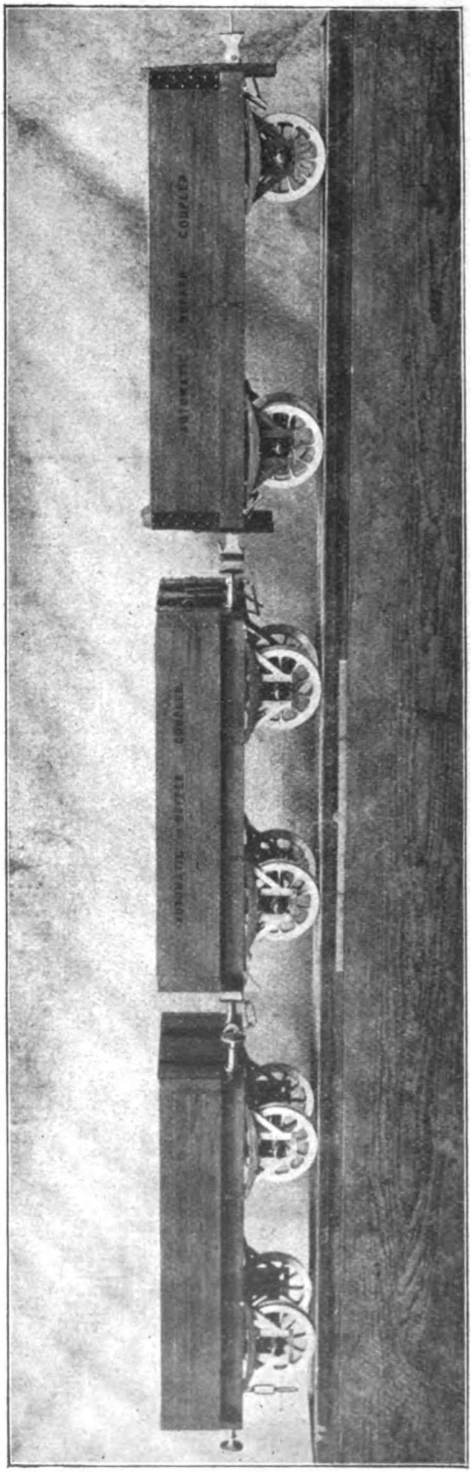
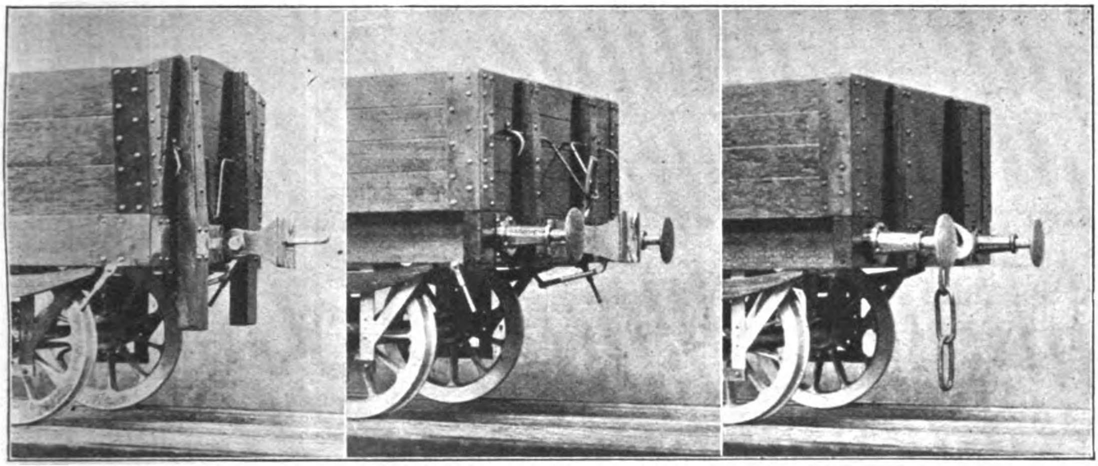


FIG. 9.—THE A.B.C. AUTOMATIC RAILWAY COUPLING.
MODEL GOODS WAGONS SHOWING THE THREE STAGES OF TRANSITION COUPLED-UP.

thus ensuring cheapness of production and preserving better surfaces to withstand wear and weather. The buffer head (weight 130 to 150 lbs., according to gauge) forms at once the buffer, the hook, the buffer plunger, and the end member of the draw gear. The plunger is passed through the frame of the vehicle, and is designed for ready connection to any convenient form of draw gear. The shackle (weight 27 to 30 lbs.), is a mild steel drop forging, provided with two small lever ends to which a suitable gear is connected for raising it into a vertical position when uncoupling is required. It is also provided with a stud of special design, which serves a double purpose. Firstly, to prevent any possibility of both shackles becoming engaged at once ; and, secondly, to secure a rigid connection between the shackle sides so as to prevent any possible pinching action upon the buffer casting which might interfere with its freedom of working. The shackle nose tapers to a point in plan, and is chisel-shaped in elevation, for reasons which will underneath the one opposite to it, and in moving forward will come into contact with the inclined surface of the hook (Fig. 4), up which it will be forced, pushing the other shackle before it until it attains an angle of about 45 degs. (Fig. 5). The lower shackle then drops over the hook and effects the coupling. Immediately after this action the buffer faces come in contact and check further movement (Fig. 6). Simultaneously the upper shackle drops on to the nose of the lower, securely locking it and rendering impossible disengagement due to shocks in running.

The act of coupling is precisely the same as just described, whatever the difference in level of the trucks may be, due to difference of loading, so long as the wagons are on comparatively straight roads. On curves, however, before the shackle can drop over its hook, the centre line of both buffers must be brought into alignment simultaneously with the action just described.

To permit of the radial or swivelling action of the



The A.B.C. Coupler. Intermediate Stage. Ordinary Couplings.

FIG. 8.—MODELS OF RAILWAY TRUCKS, SHOWING THE APPLICATION OF THE NEW A.B.C. AUTOMATIC BUFFER COUPLER.

readily be perceived from the description of its action. The pin is a simple parallel pin, with a keep collar and cotter to prevent loss.

The centre line of the shackle, looked at in elevation, passes about $\frac{1}{4}$ in. above the centre of the pin about which it turns ; if to this is added the distance of the point or nose above that centre line, it will be seen that if the extreme points meet with mathematical precision turning moment would be set up. The shackles must, therefore, rise together instead of becoming buckled as might be concluded. This action is secured by the construction adopted. The shackles and pin taken together very nearly balance about the point upon which they rest. There is, however, a preponderance in weight upon the pin side, which ensures a horizontal position when the couplings are out of gear.

When two trucks are being coupled, and there is the slightest difference in the level of the two couplings (Fig. 2), the shackle upon the lower one will be depressed with trifling resistance (Fig. 3) buffer, the plunger is made a moderately good fit in the buffer plate, and the buffer beam behind is backed off about $\frac{1}{2}$ in. each side, permitting a horizontal radial movement of $2\frac{1}{2}$ degs. on either side of the centre line. This radial action also plays a very important part while the wagons are being worked over sharp curves, because, especially in pushing, a rigidly-fixed plunger does not give the necessary flexibility and cannot accommodate itself where necessary. Provided that the point of the shackles will enter between the two buffing faces, the coupling cannot fail to act. If on curves of such abnormally short radius as occasionally occur in colliery sidings and on wharves, the point of the shackle will not enter between the buffing faces, all that is required is to raise the two shackles by hand into a vertical position, and drop them again after the buffers are brought into alignment. Another position rarely encountered in practice, but which is provided for, is when the couplings actually come into contact over the junction of a curve and a length of straight. When the couplings meet on sharp curves the first tendency of the shackles is to throw the buffers out of alignment. In the position under consideration, however, they do exactly the reverse. The lower shackle nose forces its way by a peculiar wedging action between the buffing faces. This has the effect of moving both buffers in opposite directions horizontally until both their centre lines are brought into alignment before the buffer faces actually come into contact. This permits the shackles to take up their coupled position.

The lower shackle always engages when wagons are coupled after loading, but it sometimes happens that at a loading platform wagons already coupled are reloaded in such a way that the relative height of the two couplings is reversed. With fairly equal loads in each wagon this is of no consequence, but with extreme differences of loading the shackles should be reversed by the hand lever.

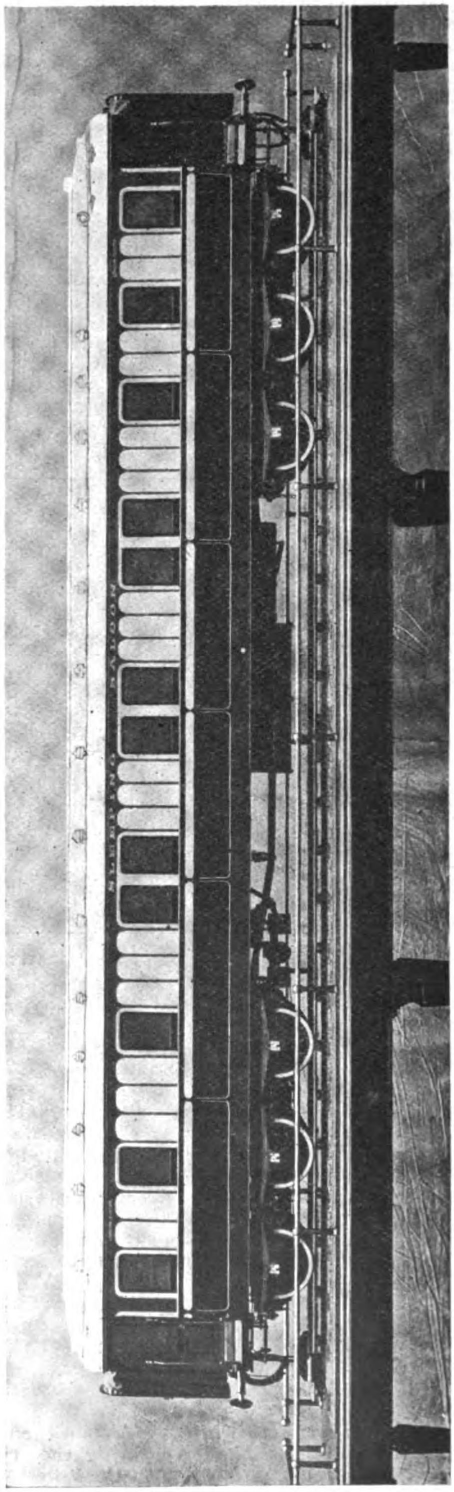
In Fig. 8 is given photographs of model railway goods wagons, by which are shown the present arrangement of buffer and coupling; the intermediate stage showing the "A.B.C." automatic coupler applied and the old buffers retained, and with holding-up gear which carries the shackle when wagon is coupled up to the unaltered gear; whilst the third picture shows the complete transition. The photograph reproduced in Fig. 9 shows three complete views of the model goods wagons shown in Fig. 8. The three stages, as will be seen, are coupled together.

(To be continued.)

A Splendid Model of the West Coast Joint-Stock Sleeping Saloon.

WE are enabled, by the kindness of Mr. C. A. Park, of the L. & N.W. Railway Carriage Department, to illustrate herewith the model of the West Coast Joint-Stock sleeping saloon, which is on view in the large hall at Euston Railway station. The model is built to the scale of 3 ins. to the foot. Below are particulars of the sleeping saloon which the model represents :—

Length over body, 65 ft. 6 ins.; width, 9 ft.; and height at centre of clerestory roof, 8 ft. 7 ins. (all outside dimensions). It is mounted on two six-wheeled bogies of 11 ft. 6-in. centres, with centres of bogies 43 ft. 6 ins. The extreme length of the vehicle over-all of buffers is 69 ft. 6 ins. The vehicle is arranged to sleep eleven persons, having seven single berths and two double, with corridor on one side throughout, together with vestibule entrances at each end. An attendants' and smoking compartments are provided at one end, and a lavatory compartment at the other. The passengers' compartments are also fitted with combined cabinet, writing-table, and wash-basin, together with everything necessary for toilet. The vehicles are fitted throughout with electric light on the "Stone" system, and heated by steam on the consolidated principle. Electric communication to call attendants is also provided, and the vehicles are fitted with both the vacuum and Westinghouse brakes complete.



A Model of the West Coast Joint-Stock Railway Sleeping Saloon Coach.

A Model Electric Tramcar.

By H. Green.

THE following is a description of a model tramcar which is made to a scale of $\frac{3}{4}$-in. to the foot. It is fitted with one tripolar motor, detail sketches of which are given in Figs. 2 to 6. It is wound for 12 volts, and is made to reverse by a switch which is placed under the driver's platform; the handle can be seen in side view of the car. The fenders under the platform are made to drop when anything is in the track, and catch on the gate. The car is also fitted with headlights and lamps over the doors, the doors being made to slide open and seats to reverse in the usual way. There are two controllers, one at each end, which start and stop the motor. The current is drawn from the overhead trolley wire by the trolley boom, and returns through a brush which presses on the centre of the trailing axle and through the wheels to the rail. The following are the leading dimensions:—Height from rail to handrail, 10 ins.; over-all length, 1 ft. $7\frac{1}{2}$ ins.; extreme width, $4\frac{3}{4}$ ins.; wheel gauge, 3 7-16ths ins.; wheels, diameter, $1\frac{1}{4}$ ins.; armature, diameter, $1\frac{1}{2}$ ins., width, $1\frac{1}{2}$ ins.; approximate weight, 8 lbs.

The frames are cut out of mild steel $\frac{1}{8}$ in. thick, with slots in for axle-boxes which are cast in brass. At each end of the frames are drilled two small holes, so that they can be screwed to two wooden cross pieces, and they in turn are screwed to two wooden supports which are for the car body. The wheelbase is $4\frac{1}{2}$ ins. The field-magnet is made of wrought Swedish iron, and is wound on the part as shown in drawing, with as much No. 24 D.C.C. copper wire as can be got on. The tripolar armature is also wrought Swedish iron, and is wound until each pole is full of No. 26 D.C.C. wire and connected in series. The bearings are in phosphor-bronze, as it is of a greasy nature, and wears well for shafts that run at a high rate of speed. The brush-rocker is made of brass 1-16th in. thick. There are two curved slots cut in it and two holes drilled in the bearing and fitted with two 7 B.A. screws, so that

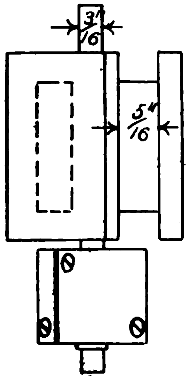


FIG. 2.—ARMATURE AND COMMUTATOR.

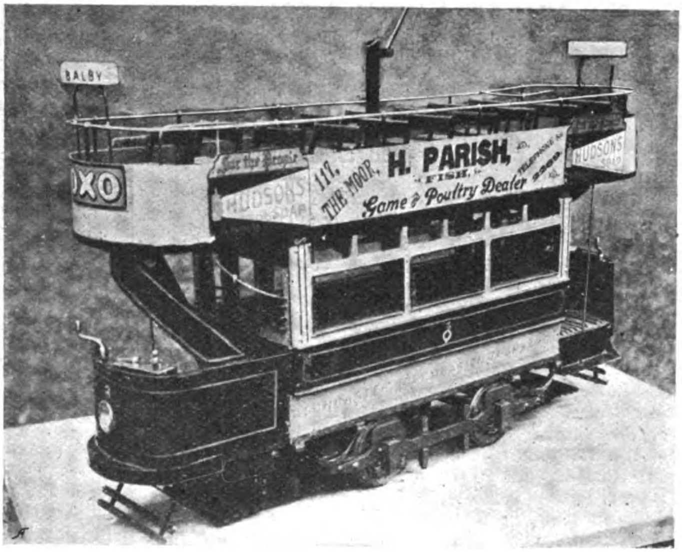


FIG. 1.—MR. H. GREEN'S MODEL ELECTRIC TRAMCAR.

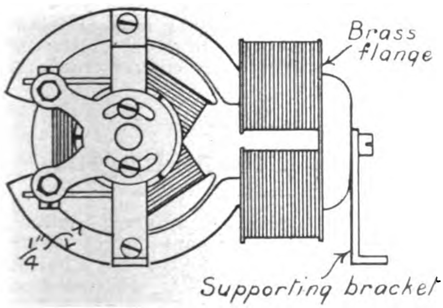


FIG. 3.—SIDE VIEW OF MOTOR.

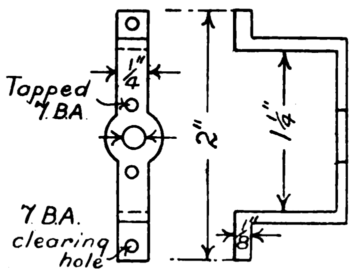


FIG. 4.—BEARING.

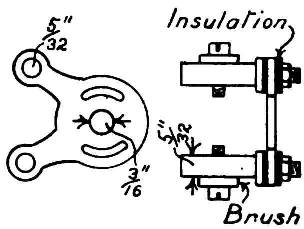


FIG. 5.—BRUSH ROCKER.

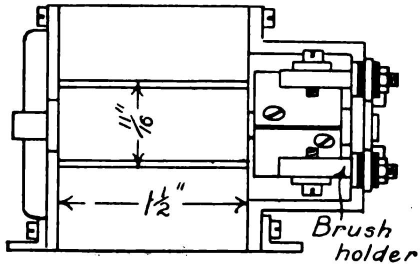


FIG. 6.—END VIEW OF MOTOR.

they lock the rocker in the proper position. The brush holders should, of course, be well insulated from the rocker. All the drawings are to scale, so that any dimensions can be taken off. The motor is to be fastened to the motor board by four brackets, one being fastened to each bearing and two at the back of motor.

Milling in Small Lathes.

By Chas. W. Cook.

(Concluded from Vol. IX, page 538.)

In this, the concluding article of the series, we shall deal with the speed and lubrication of the cutters.

The first named is of great importance, as upon this factor depends not only the successful and satisfactory completion of the work in hand, but also the life of the cutter; and as most cutters are troublesome to make, and expensive to buy, the question, what is the proper speed the milling cutter should be run at, deserves very serious consideration. To obtain a clear idea the worker must acquaint himself with the various factors that enter into the question of the rate of speed—some of these being the varying conditions and character of the work, the nature of the metal, the pitch of teeth and the diameter of the cutter, and the rate of feed, etc.; and as each of these have to be taken into account, it will be obvious that any hard and fast rule cannot be laid down.

For small lathe work we may disregard many of these factors, and confine our attention to the diameter of the cutter and the particular metal to be worked. Briefly, we may say that the speed of the cutter should decrease as the diameter increases; that is to say, the revolutions per minute the cutter makes must become less in number as the diameter of the cutter becomes greater; consequently a large cutter must be driven at a less number of revolutions per minute than one smaller in diameter.

The following table of speeds calculated by the writer will be found to be approximately correct, increasing in proportion as the diameter of the cutter decreases. The cutter used when making this table was 2 ins. diameter, and similar to those illustrated in the article on cutters:—

Metal.	Revs. per Minute.	Surface Speed in feet per Minute.
Steel	50	26
Wrought iron	90	47
Cast iron	120	62
Gunmetal and bronze	200	104
Brass	300	156

The above may be taken as safe speeds for light cuts for this diameter of cutter, and for a 1 in. cutter the speeds may be doubled, and so on in like proportion as the diameter decreases.

The rate of speed of cutters is often regarded as meaning the rate in feet per minute at which the edge of the teeth are moving (called the surface or lineal speed), as distinct from the number of revolutions per minute; and to find this we multiply the diameter of the cutter by 3·1416, or 3 1-7th, which gives us the circumference in inches, multiplying this result by the number of revolutions per minute, and dividing this by 12, which gives us the lineal speed of the cutter in feet per minute: thus—

$$\frac{\text{Diameter} \times 3{\cdot}1416 \times \text{r.p.m.}}{12} = \text{ft. per min.}$$

As, for example, the 2 in. cutter in the table working on brass at 300 r.p.m.—

$$\frac{2 \times 3{\cdot}1416 \times 300}{12} = 156 \text{ ft. per min.}$$

Next in importance to the speed of the cutter comes the question of the lubrication of the cutter, and the best lubricants to employ for the purpose; and it is not only essential that a lubricant should be used on and with some of the metals to prevent heating of the cutter teeth, and to produce a good finish on the work, but also that the lubricant used should not rust the work, the cutter, and the lathe, as nothing is more irritating some time after the work is finished to find spots of rust appearing on the polished surfaces of the apparatus; consequently a lubricant should be used that will not oxidise steel or iron; and of the many and various compounds used for lubricating, the writer recommends the following:—

1. Take, say, a quart of hot water, and in it dissolve as much common washing soda as it will take up; keep this as a stock solution, and when wanted take about the quantity required, and add four or five times the amount of water; mix, and use this as the lubricant.
2. Two parts of lard oil and three of paraffin oil mixed up together.
3. Two parts of paraffin oil and one part of turpentine, mixed well together.

Of the above, the first-named is about the best all-round lubricant, and it has the merit of being cheap and generally to hand; and in regard to the second, machine oil, although not so good, may be substituted for the lard oil, and the third gives the best results when used upon cast steel.

Brass and cast iron do not require a lubricant, but for steel, wrought iron, and some of the tough bronzes it should always be used, and plenty of it; and in conclusion, the writer would like to impress upon the mind of the user of the rotary cutter the necessity of always running his cutters true and keeping them sharp.

A Miniature Steam Engine.

The accompanying photographs show a miniature steam engine, the building of which occupied the odd moments of Mr. Charles E. Fish, of Baltimore, Md., U.S.A., for over two years. It is a vertical compound, with cylinders ⅜ in. and ⅝ in. in diameter and a stroke of ⅜ in. The valve travel is 7-64ths. The number of separate parts, counting nuts, bolts, screws, &c., is 368, the total number of pieces used in its make-up being 454. The smallest stud bolts are ·027 in. in diameter, and the largest ·05. All the studs are fitted with hexagonal nuts that measure 1-16th in. across the squares for the smallest, to 3-32nds on the largest. There are 76 hex-headed cap-screws and bolts of different diameters and length, the smallest being ·035 in. in diameter and 1-16th in. in length, and the largest ·041 in. in diameter and ½ in. in length, the head of each being filed to fit a wrench with an opening of 3-64ths for the smallest and 1-16th for the largest. Altogether there are 68 studs, 52 cap-screws, 24 bolts, and 114 nuts to hold the engine together.

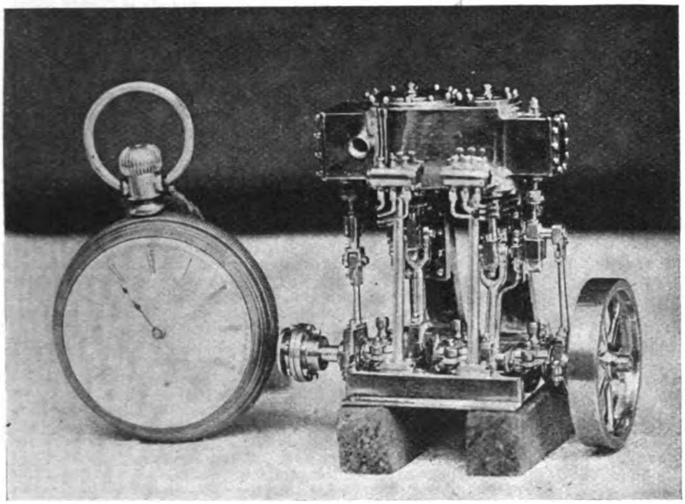


FIG. 1.—MR. CHAS. E. FISH'S MINIATURE STEAM ENGINE.

The cylinders, back columns, base, valve-stem brackets, and eccentric straps are made up of pieces of sheet brass and tubing sweated together with hard solder and finished by nickel plating; the other portions, such as the connecting-rods, front columns, shaft, eccentric rods, valve stems, piston-rods, &c., are made of machine steel. Some of the main dimensions are as follows :—

Connecting-rods, 15-16ths in. between centres; cylinders, 11-16ths in. centre to centre; height of engine from centre to shaft, $2\frac{3}{8}$ ins.; height of engine over all, $3\frac{1}{8}$ ins.; crankshaft, 5-32nds in. in diameter by 3 ins. long; high-pressure eccentric rod, 15-16ths in. long; low-pressure eccentric rod, 9-16ths in. long; piston-rods, 1-16th in. in diameter; valve stems, 1-32nd in. in diameter.

The work is done so nicely and the engine runs so smoothly, that it can be run as slow as 100 revolutions per minute, and it is strong enough to run with an air pressure of 110 lbs. per sq. in. Under this pressure it has shown, with an indicator, a speed of 4,700 revolutions per minute, and without the indicator attached runs considerably higher. All the work was done without the aid of a magnifying glass.

A SECRET WIRELESS SYSTEM.—Mr. A. T. M. Johnson, Carlton House, Shepherd's Bush Road, W., claims to have invented an apparatus for sending wireless messages exclusively to the one intended receiving station, and which, moreover, cannot be "tapped" in transmission. By a system of turning the electric current to a definite number of vibrations per second, in which a metal reed, fixed at one end and free at the other, is introduced in place of the usual coherer, it is contended that secret messages can be secured not only in wireless telegraphy, but in wireless telephony as well. The inventor is preparing for a series of long-distance tests of his system at Eastbourne, the results of which will be awaited with interest.

LONG DISTANCE TELEPHONES.—When the long-distance wire now being laid between Denver, Omaha, and Kansas City has been completed, there will be a direct telephone communication between New York and San Francisco, which are nearly 4000 miles apart.

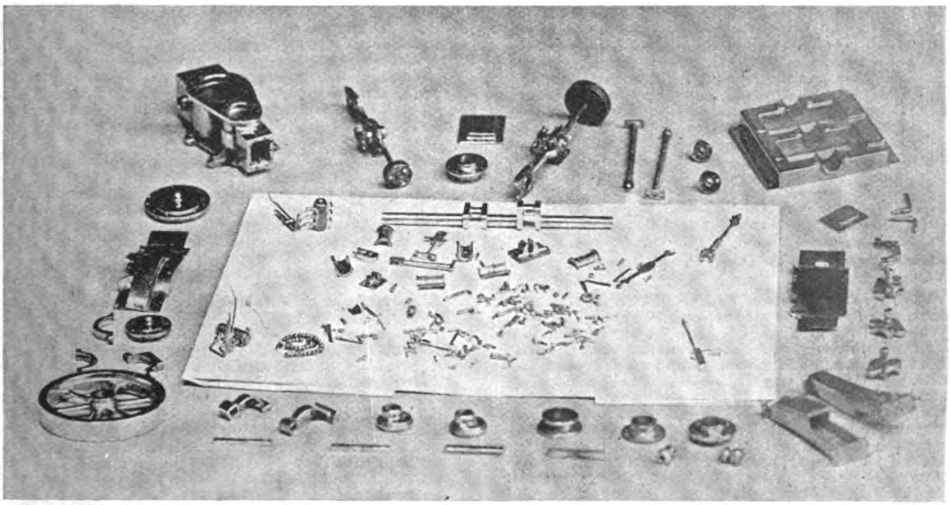


FIG. 2.—THE PARTS OF THE MINIATURE STEAM ENGINE READY FOR ASSEMBLING.

Practical Letters from our Readers.

[The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a nom-de-plume *if desired, but the full name and address of the sender* MUST *invariably be attached, though not necessarily intended for publication.]*

Casting Lead Tops on Carbon Plates.

TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—With regard to "Round Square's" method of casting lead tops on carbon plates described under the heading of "Workshop Notes," in your issue of the 20th ult., may I venture to say that unless some method of keeping brass screw in place is adopted before pouring in lead, the screw will lift out of the hole and float on the surface of melted lead, being much less in weight bulk for bulk? This could be obviated by using a short rod of some description to hold the screw in place until the lead cools.—Yours truly,

"PLUMBUS."

Queries and Replies.

[Attention is especially directed to the first condition given below and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-hand corner of the envelope "Query Department." No other matters but those relating to the Queries should be enclosed in the same envelope.

Queries on subjects within the scope of this journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied, wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed, and also a "Queries and Replies Coupon" cut out from the advertisement pages of the current issue. (4) Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of Replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor,* THE MODEL ENGINEER, *26-29, Poppin's Court, Fleet Street, London, E.C.]*

The following are selected from the Queries which have been replied to recently:—

[13,973] **Windings for ¼ h.-p. Electric Motor.** H. E. B. (Hornsey) writes: I should be glad if you could assist me with regard to the undermentioned. I have a motor which I brought with me from America, which was wound for 110 volts, but which I have unwound and wish to rewind as a dynamo for about 10 volts. The motor was supposed to be ¼ h.-p. The dimensions and particulars are as follows:—It is of the Simplex type, with a single coil similar to Fig. 5 in your handbook No. 10, with the exception that the coil bobbin does not extend beyond the field-magnet. The armature is of the plain drum type, wound in twelve sections for a 12-part commutator. Dimensions are:—Diameter of yoke, 2½ ins.; diameter of bobbin, 4½ ins.; length of yoke (inside flanges), 2¾ ins.; diameter of armature tunnel, 2 13-16ths in.; diameter of armature, 2½ ins.; length of armature, 3 ins.; length over all, 7 ins. Can you give me the following:—(1) Amount and gauge of wire for field and armature for 10 volts? (2) Number of amps.? (3) Speed to be driven? (4) Horse-power to drive same?

(1) Wind armature with No. 20 gauge D.C.C. copper wire; about ¾ lb. will be required, but get on as much as you can. Wind field magnet with about 3 lbs. No. 20 gauge S.C.C. copper wire; get on as much as you can and join in shunt to the brushes. (2) About 8 amps. (3) About 2,500 revolutions per minute. (4) If driven by a belt you would require an engine giving about ¼ b.h.-p. to drive at anything like full output.

[13,950] **500-watt Avery Dynamo.** N. W. G. (Edinburgh) writes: Would you kindly explain the following difficulties to me? I am making a 500-watt dynamo, 50 volts 10 amps., to the design of A. H. Avery. The plain drum armature, about 4 ins. diameter, is divided into 16 sections, and he says put two layers of No. 18 S.W.G. wire in each section. (1) Does this mean to wind the two layers of wire in one continuous length, or wind on first one layer, then cut off another equal length and wind on top of other, twisting the two starting and the two finishing ends together and soldering them to their respective segments in commutator, which is an 8-part one? (2) Would it be better to have a 16-part commutator, winding on first one coil of wire and joining to segments, then turning armature completely over and winding what may be called No. 1 coil on top of it, and eventually connecting it to its proper segments? (3) Is it better in a plain drum armature of this size to solder the ends of the wires direct to the copper segments, or through the medium of two copper strips soldered to segments and cut off flush with armature diameter? (4) Is it necessary to insert a thin piece of paper between each stamping in the core?

(1) This means that the armature is designed and intended to have 16 coils with a 16-section commutator; as there are only 16 spaces to wind the coils into, it becomes necessary to wind two coils into each space. These can be either wound side by side or one on top of the other; the latter being, perhaps, the more convenient way. Each coil is to have eleven turns in it, leaving one beginning and one finishing end for connecting up. If you use an 8-part commutator, then you can only wind in eight coils, one being in each winding space, and consisting of twenty-two turns of wire—all in series. (2) We should decidedly prefer 16 coils and a 16-part commutator; the coils must be all wound on before you do any connecting up. The method (assuming that the second half set is wound on top of the first set) is to continue winding right round the armature, winding the first coil from space 1 to space one, less than half-way round and simply go straight on. As soon as the spaces are all occupied by one coil in each, you commence to wind on top of them. You will find some diagrams in our sixpenny handbook on "Small Dynamos and Motors." Fig. 46, page 35, gives the complete winding for a 16-coil drum wound into 16 slots, except that the coils are shown side by side instead of one on top of the other. You could adopt this plan, but will find it rather awkward with the eleven wires; it will help you, however, to understand a drum winding. (3) We should prefer, with wire as thick as No. 18 gauge, to dispense with copper strips and to bring the wires twisted together direct down to the commutator bars. (4) No; you can coat each stamping on one side with a thin layer of shellac varnish, enamel, or paint, or even dispense with insulation entirely, as the black oxide on the stampings is almost enough in a small machine to prevent eddy currents. Try the varnish.

[13,922] **150-watt Avery-Lahmeyer Dynamo.** T. T. H. (Christchurch) writes: I wish to build an Avery-Lahmeyer dynamo to light my workshop. Will you please be kind enough to answer the following queries *re* same? Will field-magnets as enclosed sketch (not reproduced) give about 150 watts? If so, please give weight and gauge of wire for field-magnet and armature to give 30 volts 5 amps. Would plain drum or cogged armature be best? If cogged, how many slots please? Approximate speed.

This machine is scarcely large enough for 150 watts output. We advise an armature 2½ ins. diameter by 2½ ins. long, wound with No. 22 gauge D.C.C. copper wire, and fields wound with about 2 lbs. No. 23 gauge S.C.C. copper wire on each pole connected in shunt. About 8 ozs. of wire will be wanted for the armature. Make the yokes 1 in. thick. Armature, 12 slots, cogged pattern, wound with 12 coils, two in each slot, and connected to 12-section commutator; speed about 2,500 revolutions per minute.

[14,351] **Accumulator Difficulties.** M. J. P. (Bolton) writes: Will you please tell me what is the matter with my accumulators, which I have made from instructions given in S. Bottone's book, "Guide to Electric Lighting," page 109? I have made the plates as the instructions given. I have not pasted them, but I have been trying to form by means of the current from my dynamo, which is a drum armature of 10 volts 4 amps. After I have charged them 2½ hours I could get them to light a 2-volt lamp about 3 seconds, and then it dies out altogether, and when I further charged them for about half-an-hour, I could not get a light at all. I have been charging them separately. They are single cell accumulators—water, 4 parts; sulphuric acid, 1 part by weight; specific gravity, 1·843.

You have not continued the forming process for a sufficiently long time. It requires some days continuous charging to properly "form" simple lead plates, and a process of charging, discharging, and then recharging in the reverse direction is used to obtain best results. We advise you to study our sixpenny handbook No. 1, which is entirely devoted to the subject of small accumulators. Some information on the use of plain lead plates, or Planté plates, as they are called, is given in Chapter I. Give your accumulators about twelve hours charging continuously, and you should find an improvement.

[14,356] **40 c.-p. Dynamo Failure.** F. D. (Llanharran) writes: I have a small dynamo which is supposed to light five 8 c.-p. lamps at 2,500 revolutions a minute. The makers that I bought the materials from advised me to wind the limbs of magnets with seven layers of enclosed wire. I have done so, but cannot get any magnetism out of poles. I am sure there is nothing wrong

in circuit, as I have lit three 50-volt lamps and then cannot get any magnetism. I have also tried with three Leclanché cells. I filed all roughness out of poles and then wrapped a small piece of thin calico around poles which I just coated with a little shellac varnish to keep hard, then put seven layers of wire on each. I hope that you will be able to tell me what is wrong, and if seven layers is enough. If not, how many and whether wire is right size or not? As this is my first attempt I should not like to fail. Poles are 4 ins. wide by 2 ins. deep by ½ in. thick.

We cannot altogether understand your letter. If you will send a dimensioned sketch of the dynamo and give as full particulars as possible, we may be able to help you with some advice; but if you will read our sixpenny handbook No. 10 on "Small Dynamos and Motors," you will find a great deal of information on the windings of both field-magnets and armatures, and on faults and their remedies. Perhaps your field coils are connected so that they oppose each other. Leclanché cells are not of much use with a machine of this size. Chapter I of our handbook gives the direction of winding for field-magnets; it is important that the wire should be wound on so as to produce N. & S. poles; if wound wrongly you need not unwind the coils, but connect them so that the current goes in the reverse direction through those on one pole.

[14,448] **Electrotyping.** E. F. S. (Clapham Common) writes: I shall be glad, if not troubling you too much, if you will help me in my difficulty. I am trying to do some electrotypes in copper; size of bath is 2 ft. by 2 ft. by 6 ins., using $CuSo_4$ Sol. 25° B., and for electricity 2 qrt. Daniell cells. But the difficulty is I get such a slow deposit, usually very nodular, and it takes some days to completely cover the mould (gutta percha), which is about a foot square. Could I use a small water motor and dynamo? If so, please say where procurable, what current voltage is required for such work, and how water is used—per day or hour.

We advise you to study a book on electrotplating, such as "The Electro Plater's Handbook," by Bonney, price 3s. 3d. post free. A dynamo can be used. It should be shunt-wound, and give about 5 volts and 10 amps. at least; but you can find out just what to specify by consulting the handbook referred to, and comparing the figures given by your requirements. According to the rate of current, so will be the character of the deposit. As regards water motor, consult the water supply authority as to charge. Water motors and dynamos can be obtained from advertisers in The Model Engineer.

[12,596] **Magnet for Lifting Scrap Iron.** J. A. R. (Derwenthaugh) writes: I wish to construct a magnet, to suspend from the hook of a crane, to be capable of lifting a quantity of light scrap iron, such as sheet clippings, weighing, say, 3 to 5 cwt. Can you give me the necessary particulars to make one—the size, shape, winding, current, &c.?

The difficulty in designing such a magnet is that as the scrap iron will vary very much in shape and distribution, the magnet will have to throw out its magnetism to grasp the pieces in a direction and distance which can only be guessed at. We give you a sketch for a magnet which will probably pick up a sufficient quantity of the scrap, on the average, to satisfy your requirements. The yoke-piece and limbs should be made of good quality wrought iron. The coils can be wound direct on to the limbs, but it would be better to make brass bobbins to slip on to the limbs, so that the wire could be completely enclosed and protected from damage by the scrap. The coils have been calculated to take 20 amps. of current at 100 volts pressure, continuous current; they must be well insulated from the core upon which they are wound. The directions on winding field-magnet coils in The Model Engineer for December 17th and 24th, 1903, will help you. The joint A between the two coils must be well insulated, and the other ends connected to two terminals, which should be mounted on insulating material, and boxed in to avoid the chance of short circuits when the magnet is dropped into the scrap. The mains carrying the current to the magnet should have their ends well insulated for the same reason. This diagram shows the direction in which the coils should be wound so as to produce proper N. and S. poles. The wire is to be No. 12 gauge D.C.C. copper wire, and the quantity required is

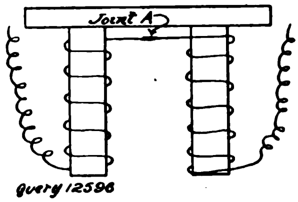


Fig. 2.—Winding Diagram.

about 90 lbs. each bobbin. If your voltage is different to that which we have assumed by any large amount, a new winding must be arranged to suit the voltage. The cores can be screwed into the yoke-piece, or fastened in any convenient way, as long as they make a good joint with it. There is no need to machine the yoke or cores. If more convenient, you can simply bend a large piece of bar iron into a horseshoe shape, so long as you keep to about the same dimensions and get on about the same weight of wire. The bar should have also the same area of cross-section—that is, about 7 sq. ins.

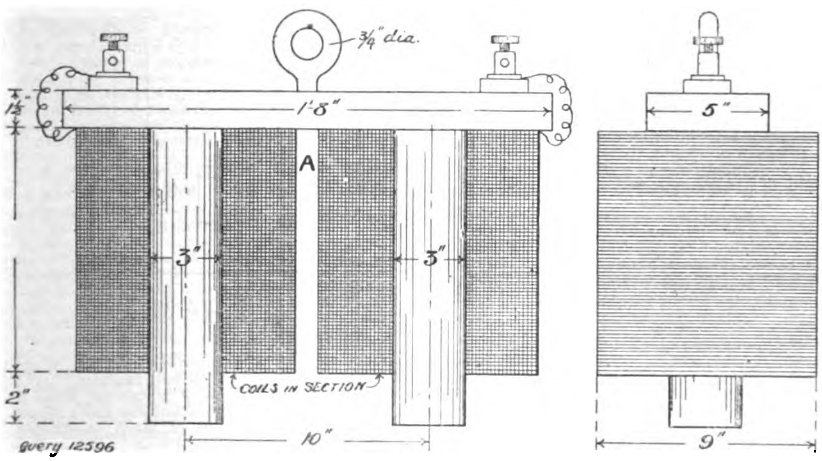


Fig. 1.—Magnet for Lifting Scrap Iron.

[14,352] **10-watt Simplex Dynamo Failure.** L. V. A. (Christchurch, New Zealand) writes: I have made a 10-watt (5 volts 2 amps.) Simplex dynamo, as described in your handbook, "Small Dynamos and Motors," but cannot get it to work as a dynamo. The field-magnet is cast iron, wound with ½ lb. of No. 22 D.C.C. wire. The armature is laminated 1¼ ins. diameter, 8-slot wound in four sections with 1½ ozs. of No. 22. It worked all right as a motor when connected to a 4-cell bichromate battery, but will not excite itself when driven at 4000 r.p.m., although it generated a current when the field-magnet was excited by the above battery. Seeing several querists advised to wind the armature with as much No. 25 S.C. as possible, I did so, but then could not get it to work as a motor or dynamo. The armature is properly wound, and free from leaks from wire to shaft. The magnets are mounted on a wooden base, and have N. and S. poles. The clearance was rather large, but have wound armature with soft iron wire, which makes the clearance 1-32nd in. I tried connecting the machine in shunt and in series, but it had no effect. Have also tried reversing connections between magnet and brushes, but no effect. I would like to get the machine to work as a motor. The battery is a 4-cell chromic acid, plates 4 by 1½—one zinc and two carbons. Any suggestions would be greatly appreciated.

You have done quite right in rewinding the armature with No. 25 S.C. wire, but as the machine does not run as a motor you have introduced a fault somewhere. Possibly you have a short circuit between two of the coils. The fault is not due to the No. 25 gauge wire. The field winding should be connected in shunt to the brushes. If a dynamo will not run as a motor it will certainly not generate current as a dynamo. Disconnect your armature coils from the commutator and try if there is a leak between any two coils. Try the brushes in different positions; the fault is evidently somewhere in the armature. For testing it as a dynamo, try a small lamp, say 8 volts 1 c.-p., as a test lamp. When starting a shunt wound motor the field should be excited before current is fully switched on to the armature; in a small motor this effect may be produced by lifting one of the brushes for a moment, so the current is cut off from the armature.

[13,994] **Small Ammeter.** C. H. C. (Herne Hill) writes: I wish to ask you three questions. (1) Please will you tell me the best way to construct small ammeter, reading from ·01 amp. to 3 amps.? (2) The best way to make an ohmmeter for reading

·5 ohm to 15 ohms ? (3) The easiest way to make a small voltmeter which will read from ·01 volt to 10 volts. I wish these instruments to be accurate.

(1) This range of reading is too great to be obtained on one scale if clear divisions are required, with ordinary electro-magnetic instruments such as you could make. The limit is about ten times the starting reading, so that you had better make three instruments having scales reading to ·1 amp. maximum, 1 amp. maximum, and 10 amps. maximum, starting in each from ·01, ·1 and 1 amp., respectively. You could make one instrument suitable to read from ·01 to ·1 amp. and then use it for the higher readings by shunting it with a wire of known resistance, so that only a fraction of the total current passes through the instrument, and therefore when the pointer is at, say, ·1 amp., it really means 1 amp., and with the second shunt it would mean 10 amps. You will find a description of how to make a small ammeter in our handbook on "Small Electrical Measuring Instruments." For reading up to ·1 amp. wire of No. 30 gauge would be about the mark, and this could be shunted for the higher readings ; first-rate workmanship will be necessary in mounting and balancing the needle and spindle. For information and rules on shunting instruments, see standard text-books on Electricity, such as "Electrical Engineering," by Slingo & Brooker. (2) The Wheatstone Bridge described in our handbook on "Small Electrical Measuring Instruments" may suit you. (3) See reply to section 1 *re* ammeter ; similar remarks apply here also. To apply one voltmeter to read as three, you would make it for the lower voltage, and then use auxiliary wire resistances in series with the instrument, so that the readings were multiplied accordingly to 1 and 10 volts at maximum. These resistances would be approximately 10 times, 100 times, and 1000 times the resistance of instrument, less the resistance of its coil.

[13,996] **4-in. Spark Coil.** R. S. (Edgbaston) writes : I am much obliged by your reply to my queries *re* above, but I hope you will not think me troublesome if I ask you for a little further information. I am not at all satisfied with my coil, and I should like, if possible, to make it a success, as I do not like being beaten. I have tried larger batteries as you suggested, but without any better results. The platinum contacts are 16-wire gauge, which is the size recommended. There does not seem quite so much sparking now, and I do not think the fault lies there ; in fact, I am almost convinced it must be in the secondary wire. It was rather faulty, having bare places here and there. Of course, I repaired these where I saw them, but I fancy some must have escaped my notice, and, if so, there is probably internal sparking going on. I think now I shall rewind the secondary wire, using silk-covered instead of cotton-covered, but before doing so there are one or two points on which I should be very glad to have your opinion. I used filter paper as directed for the division between sections. The tissue paper was simply put on to hold the wire together temporarily. I enclose an unfixed photo of coil (not reproduced). The outer covering is varnished, and underneath is a coating of paraffin. Is the disc on discharging rod large enough ? I made . nd put together coil, except contact-breaker and commutator. Having no lathe, I could not manage these. (1) Is there not too much space between the primary and secondary ? I found the primary slipped very easily into the ebonite tube, leaving a little space between top of wire and inner wall of tube. Then there is the thickness of the tube (⅛ in.), and the space between inner coil of section and the tube (3-32nds in.), making altogether ¼ in. space. I always understood that the closer the secondary wire can be brought to the primary wire, consistent, of course, with proper insulation, the better results can be obtained. (2) Would it be advisable to slightly increase the diameter of the iron core, so that when the three layers of wire are on it would fit tightly into the tube without leaving any space ? (3) Would it be better to use No. 16 wire and get four layers on instead of three of the No. 14, as could easily be done in the same space ? (4) Is single silk-covered wire better than D.C.C. for primary wire ? (5) Would it not be an advantage to have the metal disc of the section winder a little smaller, say 1¼ ins., instead of 1 13-16ths ins. ? This would bring the secondary a little closer to the primary, and also allow of a slightly larger quantity of wire being wound in each section. (One fault of my coil is, I know, that I was not able to get on the stipulated quantity of wire into the proper space.) (6) Is there any advantage in using *tinned* iron wire for cores, as advertised by the dealers in electrical things, and, if so, what ? Would not the tinning burn off when the core was annealed, as although the wire is sent out soft I should not make it up without annealing again ? (7) Do you think, if the secondary wire is wound equal to specimen sent, that all other matters being right I may expect to get the 4-in. spark from coil when wound with S.S.C. wire ?

This coil looks a creditable job ; we advise you to persevere ; success is often gained through failures. *Re* discharging rod : disc is quite large enough ; you will notice that the spark is longest when the point is positive. (1) No, we do not think the cause is in the clearance between primary and secondary. (2) No, do not put more iron in core yet. (3) No, do not put on four layers of No. 16 wire ; the three layers of No. 14 should be better. Of course, you can try the experiment without a great deal of trouble, if you feel inclined. You will increase the self-induction, and probably find it necessary to use higher voltage (4) No ; use D.C.C. There is no advantage in silk here. (5) You could try this, but we should prefer to seek the remedy elsewhere, as danger of internal spark will be increased. (6) No advantage in using tinned wire, but a thin coat of varnish is advisable. (7) Silk-covered wire will undoubtedly be an improvement, and we think if you use this and take great care not to get any short-circuited sections, you will get a 4-in. spark. We believe the fault is in one or more of your secondary sections.

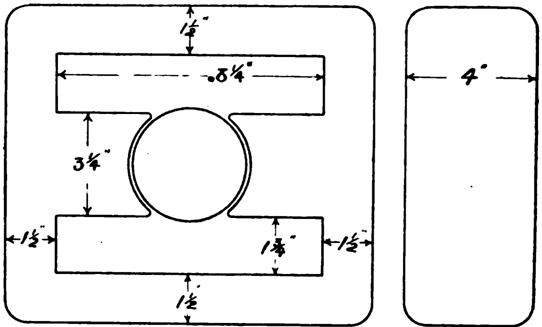
[13,977] **Contact-Breaker.** J. W. F. writes : Will you please answer the following question ? I have made a contact-breaker for 1-in. spark coil similar to that described in your valuable handbook for a 4-in. spark, except that the soft iron piece is ¼ in. instead of 1 in. thick. Now I find that this answers very well when contact is made on any part of the *spring itself*, that is, the soft iron is drawn in on to the core of the coil, but when contact is made in rear of the iron itself, or rather the small screw that secures the spring to it, there is no such effect—although there is a spark if the iron remains stationary. I found that the core was not sufficiently magnetised to attract the iron. Why was this ? I have tried more or less tension on the spring, also stronger and weaker springs, but to no effect.

Apparently due to bad contact between point of screw and hammer. It is absolutely necessary to have a platinum point to the screw, and a piece of platinum let into the vibrator at the point where the screw makes contact with it. Have you fitted these platinum contacts ? They should be of platinum wire at least No. 18 gauge in thickness ; the thicker they are the better. It is a question of cost, as platinum is very expensive.

[13,955] **Trembler Coil.** W. H. M. (York) writes : Will you please give windings and particulars for making trembler coil for motor bicycle ignition to take as little current as possible ? We have your handbook on coils, but thought that there might be something more suitable, having read that it was possible to make one to work at 2 volts.

We cannot advise you better than to make the ½-in. spark coil to the particulars given in our handbook, and to work at 4 volts. You must be very particular about the contact-breaker, which requires to be very sensitive, so use a delicate spring light hammer and large platinum contacts.

[13,102] **½ h.-p. Shunt-wound Meter.** H. C. D. (Jesmond) writes : I desire to construct a ½ h.-p. shunt-wound motor of the Lahmeyer type to work from 240 volts (local supply), revolutions about 3000 per minute ; and should be obliged by information on the following points :—(1) Diameter and length of armature, and also the best type to employ—ring or drum ? (2) If slotted core, how many slots ? (3) Number of conductors in armature ? (4) Quantity and gauge of wire on field-magnets ? (5) Dimensions of field-magnets (cross-section of pole-piece, &c.) ; cast iron proposed to be used ? (6) Size of commutator and number of bars ? A dimensioned sketch would be of much assistance. I have referred to Mr. Avery's "A B C of Dynamo Design," but he treats of less voltages than is available here. Any other information will be much appreciated.



Query 13102

LAHMEYER TYPE FIELD-MAGNET.

Armature should be of toothed drum pattern, 3½ ins. diameter, having 24 slots, each ¼ in. wide by ¼ in. or 5-16ths in. deep, to be wound with 24 coils, two in each slot. Wire, No. 26 gauge D.S.C. wire ; get in as much as you can. The total weight for armature will be about 1 lb. You will probably get about 36 turns in each slot—that is, about 18 turns per coil. Length of armature core is to be 4 ins. Commutator to have 24 sections ; outside diameter of useful portion to be about 2½ ins. ; length of brush surface 1½ ins. (can be less if desired, as a brush ¾ in. wide by ¼ in. thick will carry the current). Field-magnet to be wound with 6 lbs. No. 28 S.C.C. copper wire on each bobbin, the two bobbins to be joined in series with each other, and in shunt to the brushes. The insulation must be first-class throughout.

[13,970] **12-volt Lighting Accumulator.** B. M. D. (Low Fell, Gateshead) writes: I have three 4-volt 10 amp. accumulators. I want to use these for lighting 12-volt lamps. I have them connected in series, but they will not light a 12-volt lamp properly. I tried using 10-volt lamps, and they gave a very good light, but generally burnt out after about two hours' burning. Can you suggest any way of making the 12-volt lamps light properly? Would putting a cell into the circuit do any good?

If three 4-volt accumulators in series will not light up a 12-volt lamp—well then, either the accumulators are run down to some extent or there is too much resistance in the connecting wires; we suspect the cells. When in a fully charged condition, an accumulator gives about 2½ volts per cell, but this rapidly drops to 2 volts per cell when discharging, at which point it ought to continue for some considerable time; its voltage then gradually falls to 1·8 volts per cell, at which point the discharge should be stopped and the cells recharged. You will see by this that before recharging is necessary, the lamp will begin to go dull, and to get over this difficulty the usual practice is to have extra cells which are cut in as the voltage drops too low (one extra cell would do in your case), or to use an adjustable resistance, which is slowly cut out as the volts drop. Such an arrangement would suit your 10-volt lamps, which, by the way, ought to stand over-running for more than two hours; they may be low-priced ones.

[14,345] **Engine and Dynamo for House and Shop Lighting.** J. H. H. (Leeds) writes: I want to make an electric plant to light twelve 16 c.-p. and twenty 8 c.-p. 100-volt lamps for our house and shop. They will not all be required to be lit at once, the twelve 16 c.-p. will be lit about 3.30 to 11.30—that is, in winter; the other as occasion arises. Could you give me the sizes of field-magnet and armature, and the size and quantity of wire for same, and the horse-power it will take to drive same, then I think I can manage to get along with the work, as I want to have it finished for the winter, as we have such poor gas here in Leeds. I shall want a switchboard, etc.

You will need a machine of about 1,100 watts output, and will have to have an engine of *fully* 2 h.-p. to drive it. You will find instructions for calculating the sizes and windings of such a dynamo in the "A B C of Dynamo Design," price 1s. 2d. post free. For information as to wiring and lamps, see our one shilling handbook on "Electric Lighting."

The News of the Trade.

[*The Editor will be pleased to receive for review under this heading samples and particulars of new tools, apparatus, and material for amateur use. It must be understood that these reviews are free expressions of Editorial opinion, no payment of any kind being required or accepted. The Editor reserves the right to criticise or commend according to the merits of the goods submitted, or to abstain from inserting a review in any case where the goods are not of sufficient interest to his readers.*]

* *Reviews distinguished by the asterisk have been based on actual Editorial inspection of the goods noticed.*

A New "Star" Screw-cutting Bench Lathe.

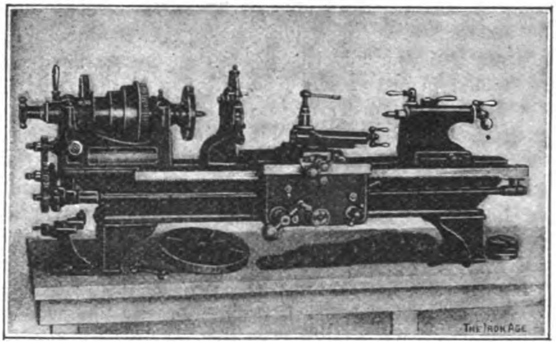
The latest "Star" lathe is a 5-in. centre bench screw-cutting lathe, especially designed for tool, model, and scientific instrument making, and for general experimental and laboratory work. Messrs. The Seneca Falls Manufacturing Co., Seneca Falls, N.Y., U.S.A., the manufacturers, claim that much work that is now done on large and expensive tools could more profitably be done on this lathe. The bed is 46 ins. long, broad, deep, thoroughly well braced, and accurately proportioned throughout. The rated size is 4½-in. centres, but the centres actually measure 5 1-16th ins. over bed, and 24 ins. between the centres. The countershaft has friction clutch pulleys easy to operate, strong and durable, also has self-aligning and self-oiling shaft bearings. The pulleys and friction bands are provided with self-closing oil cups.

The headstock has large hollow spindle, made from a crucible steel forging, with draw-in chuck for split collets up to ½-in. capacity, phosphor-bronze boxes, with improved end-thrust ball-bearings; the cone pulley has three steps for wide belt, and with strong back-gears gives six changes of speed; a push-pin on the head-gear allows the cone to be instantly locked or unlocked without using a wrench. The tailstock is the curved or cut-under pattern, and is arranged with side and adjusting screws for taper turning.

The carriage has long bearing on the ways, is gibbed to bed both front and rear. A cam locking device locks carriage to the bed when using cross-feed. The cross-feed screw has a graduated collar which reads in thousandths of an inch and can be set at zero in any position.

Either plain or compound rests are supplied and are made to easily interchange. The base is graduated 180 degs., and renders the compound rest capable of fine adjustment. Tool-post has improved collar and shoe, which exclude all dirt and chips and admit of quick, easy, and secure adjustment of the tool. If desired the English tool-post, in place of the regular (American) tool-post, can be furnished without extra charge.

The automatic cross and longitudinal feeds are actuated by a phosphor-bronze worm on the lead-screw, receiving its power from the head spindle through the spur gears; the lead-screw is splined and simply acts as a feed-rod; therefore, the only wear on the thread is in screw-cutting. The automatic feeds are almost indispensable for a large variety of work, as they secure more accurate results and smoother surfaces. The range of feeds is very large. The range for screw-cutting is extremely wide—cutting all standard threads, right or left (including 11½ and 27 ins.) from 3 to 64 without compounding the gears, and nearly all threads by compounding. When desired to cut both standard and metric threads, can furnish, for a slight advance in price, transposing gears and index for cutting international standard metric threads from 0·5 mm. to 8 mm. The lead-screw is cut from a master-screw by a new process, from



THE SENECA FALLS MANUFACTURING CO.'S "STAR" SCREW-CUTTING BENCH LATHE.

30 per cent. carbon steel, making an accurate, durable, and most desirable lead-screw. When desired to cut metric threads only, can furnish metric lead-screw and index in place of the regular lead-screw and index at same price. Patented spring nuts are used in connection with split washers to hold the change gears in place. They are easy and convenient to operate, and allow quick shifts of the change gears.

Each lathe is furnished with large and small faceplates, centre rest, follower rest, two hardened and ground point centres, a full set of change gears, and wrenches. Extra attachments, taper attachment, milling and gear-cutting attachment, and blocking can be furnished when desired. While these lathes are designed for working metals, with the addition of a hand-rest, screw chuck, cup, and spur centres, they are suitable for wood turning.

*A Guide to Model Railway Builders.

We have received a copy of a tastefully-printed handbook entitled, "Model Railways," which has just been published by Messrs. W. J. Bassett-Lowke & Co., of Kingswell Street, Northampton, as a guide to the purchaser of model locomotives, rolling-stock and railway materials. This book has some 72 pages and over 80 photographic and line illustrations, and should prove of great interest to all model railway enthusiasts. The first chapters include notes on the choice and scale of model railway equipment generally, and on the model locomotive in its many forms; Chapter III, Tin rail formations, the plans given in this chapter being arranged and signalled in accordance with proper railway practice; Chapter IV, on the scale model permanent way; Chapter V, on signals and signalling; and the final chapter on model stations and rolling-stock. The pages are illustrated by excellent examples of model railway work, and the book generally comprises such information as could not very well be included in the ordinary trade catalogue. Price 6d. net, or 7d. post free.

New Catalogues and Lists.

Clyde Model Dockyard Argyll Arcade, Glasgow.—We have received a copy of a leaflet describing the new models brought out by this firm. The list is illustrated, and contains descriptions and prices of the model steamer and grindstone which we have recently reviewed in these columns, novelties in the shape of "Box" and "Eddy" kites, and two new designs of model sailing yachts. Readers should ask for Pamphlet B, and mention THE MODEL ENGINEER.

The Editor's Page.

OUR new book, "The World's Locomotives," by Mr. Charles S. Lake, of which we gave a preliminary notice in these columns a few weeks ago, is now ready. As we then mentioned, it is a comprehensive digest of the latest practice throughout the globe, and contains 374 pages and over 300 illustrations. The price is 10s. 6d. net, 11s. post free from this office.

* * *

A Natal correspondent writes:—"I have just had another annoying experience of the careless way some of your advertisers carry out instructions contained in orders sent from the Colonies. I sent, in February, an order, accompanied by a P.O.O. for £3 for some castings and tubing. The goods arrived last week, and were found to be two boiler ends, two upcomers, and one pair of loco wheels short, and, with the exception of the two pairs of bogie wheels, all were wrong. I ordered four pairs of 3⅞-in. coupled wheels, and one pair of 3⅞-in. outside cylinder driving wheels. I got two pairs of 4¼ ins., and one pair of 5½ ins. The result is that, after waiting several months, and paying £1 2s. freight and landing charges, I shall have to make patterns and get the wheels cast here, as I cannot afford to wait another three or four months. I am not giving the name of the firm yet, as I have written to them and await their reply. I am making a 1-in. scale model of one of our very fine tender goods engines. Such engines lend themselves well to model-making, and, in a future issue, perhaps you will allow me to explain how this is. I have a suggestion to make which might be of considerable service to your oversea readers, and also to manufacturers and small tool makers. Let all model manufacturers send their price lists (illustrated) to either the public libraries of the principal Colonial towns, or to one of your readers who would be willing to receive them and allow people to consult them The catalogues should be as full as possible, and strongly bound, and they should be as well illustrated as possible, and always fully priced. Colonial buyers don't want to have to write home for prices of tools, etc., and then have to wait weeks or months longer than necessary. The manufacturer should advertise in your paper that he has done this, and also the names of persons and addresses at which their lists could be seen. I don't know how other Colonies are situated, but in Natal one has to send home for almost everything the model-maker requires, such as silver steel, most small tools, lathes, shapers, planers, chucks, turning tools, milling cutters, small and large tubing; square, half-round, or any other kind of mild or tool steel (except hexagonal or octagonal), sheet steel, and all model fittings. I would be quite willing to receive lists for this district, and allow all interested to consult any lists submitted to me."

Answers to Correspondents.

T. W. (Coskery).—Your scheme is feasible. The boat should not be more than 9 ft. long.

"NOVICE" (Cambridge).—The arrangement is quite suitable. Large blades would not be any advantage.

G. K. H.—We do not advise you to attempt to alter your petrol engine to work by steam.

A. G. A. (Newport).—Apply at our Expert Service Department.

A. J. McK.—Write to the makers of the turbine. We cannot possibly supply the information.

W. L. C. (Southall).—Your letter has been sent on to our correspondent.

G. W. (Firpark, Glasgow).—Please comply with our rules. See recent query replies for information on this matter.

W. N. (London).—"Small Dynamos and Motors," 7d., post free.

Notices.

The Editor invites correspondence and original contributions on all amateur mechanical and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected or not, and all MSS. should be accompanied by a stamped addressed envelope for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

This journal will be sent post free to any address for 13s. per annum, payable in advance. Remittances should be made by Postal Order.

Advertisement rates may be had on application to the Advertisement Manager.

HOW TO ADDRESS LETTERS.

All correspondence relating to the literary portion of the paper, and all new apparatus and price lists, &c., for review, to be addressed to THE EDITOR, "The Model Engineer," 26—29, Poppin's Court, Fleet Street, London, E.C.

All correspondence relating to advertisements and deposits to be addressed to THE ADVERTISEMENT MANAGER, "The Model Engineer, 26—29, Poppin's Court, Fleet Street, London, E.C.

All subscriptions and correspondence relating to sales of the paper and books to be addressed to Percival Marshall & Co., 26—29, Poppin's Court, Fleet Street, London, E.C.

Sole Agents for United States, Canada, and Mexico: Spon and Chamberlain, 123, Liberty Street, New York, U.S.A., to whom all subscriptions from these countries should be addressed.

Contents.

[*The asterisk (*) denotes that the subject is illustrated.*]

THE

Model Engineer

And Electrician.

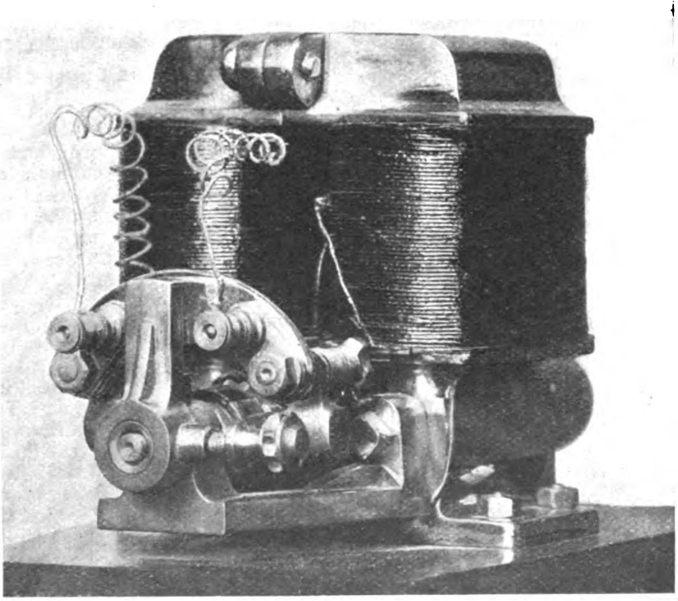
A JOURNAL OF PRACTICAL MECHANICS AND ELECTRICITY.

EDITED BY PERCIVAL MARSHALL, A.I.MECH.E.

VOL. XIII. No. 225. AUGUST 17, 1905. PUBLISHED WEEKLY.

A Small Dynamo for Charging Accumulators.

By J. K. COBB.



MR. J. K. COBB'S SMALL UNDERTYPE DYNAMO

THE small dynamo illustrated herewith is one I have specially made for charging up small accumulators, which duty it fulfils splendidly. The design is taken from the *M.E.* handbook No. 10, "Small Dynamos and Motors." All castings are from my own patterns; only wire, stampings, and insulating materials being bought. The field-magnet is cast from soft cast iron; after the two halves were fitted together and the armature tunnel bored, these were filled up and polished all over; and afterwards electro-plated. The bearing brackets, brush rocker, and pulley are in gunmetal, polished and lacquered; these brackets are of ample proportions, to secure rigidness, the bearings have a length of three diameters of shaft. The brushes are carbon; these are held in contact with spiral springs, the tension being adjusted by means of a collar on the brush-holder rods. The armature is an 8-slotted drum,

$1\frac{1}{4}$ ins. diameter by $2\frac{1}{4}$ ins. long; armature spindle is cast steel, the stampings being secured by a collar at one side and with a threaded screw and nut at the other. The commutator (8-segment) proved the toughest job of all, the segment bars being assembled and insulated around a gunmetal sleeve similar to the one described and shown in the above handbook (Fig. 54). The armature is wound (to Mr. Avery's type of winding shown in his "A B C of Dynamo Design," Fig. 40) with 5 ozs. of No. 21 D.C.C. copper wire. The field coils are wound with 2 lbs. No. 21 S.C.C. wire. The magnet winding is connected as a shunt to the brushes, as will be seen. The terminals are mounted on and insulated from the rocker arm. The machine is bolted to a polished laburnum baseboard, and with plated fields, lacquered brass work, shellaced windings, and French polished baseboard, it looks superb.

Workshop Notes and Notions.

[Readers are invited to contribute short practical items for this column, based on their own workshop experience. Accepted contributions will be paid for on publication, if desired, according to merit. All matter intended for this column should be marked "Workshop" on the envelope.]

A Pair of Mitre Wheels.

By "Lex."

The two photographs herewith show a pair of mitre wheels and the tools necessary to make same. The diagram (Fig. 1) shows how the templet for making the cutter is set out, and Fig. 2 shows the gauge for the teeth.

Referring first of all to the wheels, these are of

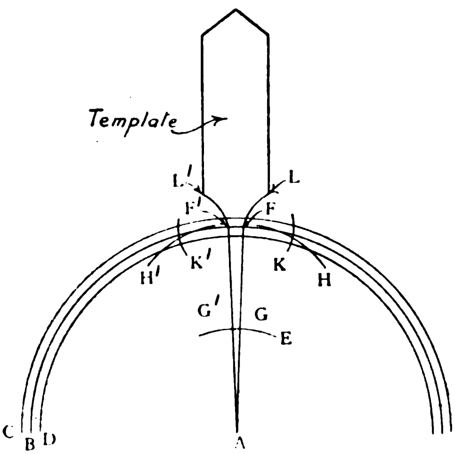


Fig. 1.—Setting out Templet for Cutter.

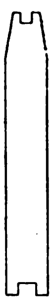


Fig. 2. Gauge for the Teeth.

mild steel, having 38 teeth of 20 diametrical pitch. The outside diameter is 2 ins., and the inside diameter is 1·3125 ins. The largest pitch diameter is 1·9 ins., the smallest pitch diameter is 1·2125 ins. The outside tooth thickness is ·079 in.; the inside tooth thickness is ·05 in. The length of tooth face is ·625 in. (this, by the way, is rather longer than is usually necessary; the general rule being to make the length of face five times the tooth thickness). The wheels are drilled ·75 in., and have keyways cut.

Taking the tools in the order shown in the photograph, the first is the templet for making the milling cutter. This is set out as shown in the diagram, and must be made very accurately. The second is the form tool. This is made to the templet

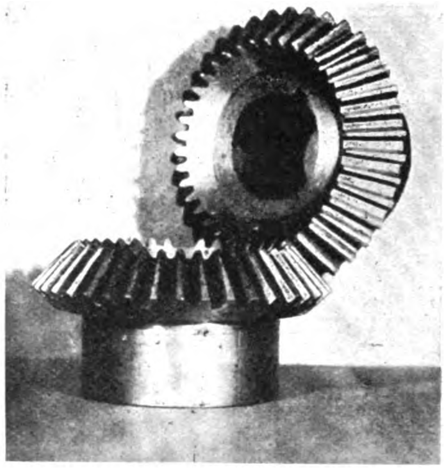


Fig. 3.—The Finished Mitre Wheels.

mentioned, out of a piece of tool steel of a convenient size. Its form must be the same right across the tool, so that its shape remains unaltered when it is ground. This tool must be hardened, and tempered dark straw. It is then ground and placed perfectly upright in the tool-holder of a planing machine, and canted so as to give the cutting edge clearance. The third tool is the former. To make this a piece of tool steel about ·625 in. by ·5 in. is taken and placed end-up in the planing machine vice canted at 25 degs. from the vertical. The end is roughed down with an ordinary tool, and then the form tool is used to plane out its counterpart in the former. This operation requires carefully doing, the work must be lubricated and very light cuts taken. The former must be hardened, and tempered dark straw. It may then be ground on the top, finishing off on an oilstone. It will be seen from the way in which this tool is made that however much it is ground it will always retain its shape. The former is a form tool for the lathe, and is used for forming and backing-off the milling cutter at one operation. The milling cutter is of tool steel 1·875 ins. diameter, ·3125 in. thick, and has ten teeth. It is roughly turned to the shape of the templet, and then put in the milling machine and gashed with a gashing cutter. After this, it is backed-off with the former, either on a backing-off lathe or on an ordinary lathe with a backing-off attachment. If done in this way it may be ground as often as necessary on the face without altering its shape. I may mention here that I hope soon to send a description of a simple backing-off appliance for the lathe which does its work quite as well as the most elaborate backing-off lathe.

Referring now to the diagram (Fig. 1) as stated above, the wheels are 20 diametrical pitch, which means that for every inch of diameter, measured on the outer pitch circle, there are twenty teeth on the periphery of the wheel. In our case the wheel is 1·9 ins. diameter on the pitch line, and will therefore have thirty-eight teeth. Having settled on the outside diameter of the wheels it is desired to make, and the pitch they are to be, we subtract two pitches (*i.e.*, for 20 pitch ·1 in., for 8 pitch, ·25 in.) from the outside diameter, and that gives the pitch diameter, viz.: outside diameter = 2 ins., pitch = 20, ∴ 2 ins. – ·1 in. = 1·9 ins. = pitch diameter. Then scribe a circle B from the centre A with a radius equal to half the pitch diameter, viz.: 1·9 ins. ÷ 2 = ·95 in. After scribing circle B scribe circles C and D, which are ·05 in. larger and ·05 in. smaller than B, respectively. Set the dividers at half the radius of the pitch circle—·95 in. ÷ 2 = ·475 in.—and scribe the segment E. Now find the tooth thickness on the inner pitch circle. To ascertain this subtract two pitches from the inside diameter and multiply the remainder by 3·1416, and divide the result by number of teeth and spaces in the wheel. The quotient is the tooth-thickness on the inner pitch line, viz.:—

$$(1·3125 \text{ in.} - ·1 \text{ in.}) \times 3·1416 \div 76 = ·05 \text{ in.}$$

Mark off this distance on the pitch line at F and F′, and join these two points to the centre. Set the dividers at half the radius, and from centre G scribe segment H, and from centre G′ scribe segment H′. Set the dividers at quarter the radius—*i.e.*, ·2375 in., and from centre F scribe segment K, and from centre F′ scribe segment K′. With the same setting scribe the segment L from the intersection of K and H, and segment L′ from the intersection of K′ and H′. The space included by L and L′ down to the inner circle is the shape of the templet.

If no gear tooth caliper is at hand, it is advisable to make a small gauge like Fig. 2, one end of which

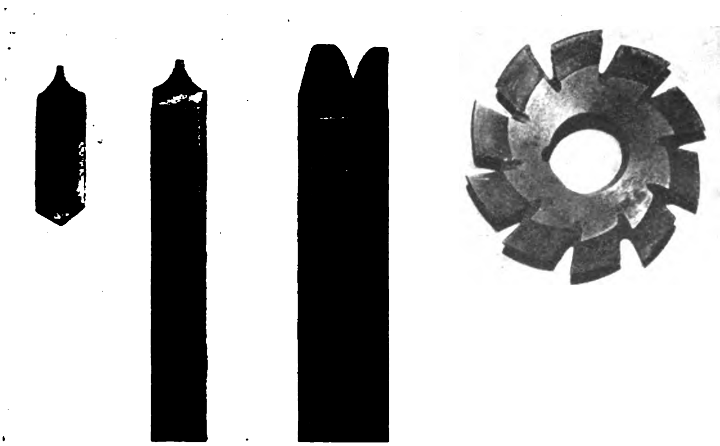


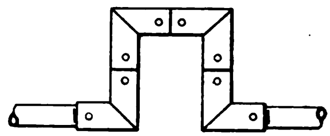
Fig. 4.—Tools used for Milling the Mitre Wheels.

gives the tooth thickness on the inner pitch circle, and the other end gives the tooth thickness on the outer pitch circle. This gauge should be cut out of a bit of flat steel, and should allow the tooth to enter an amount equal to the pitch. In the figure, one end of the gauge has an opening ·05 in. by ·05 in., and the other an opening ·05 in. by ·079 in., the first for the thin end of the tooth, and the second for the thick end. To find the tooth thickness at the thick end, divide the circumference of the outer pitch circle by the number of teeth and spaces in the wheel, viz.:

$$1·9 \text{ ins.} \times 3·1416 \div 76 = ·079 \text{ in.}$$

The diagram (Fig. 1) applies equally well to the setting out of spur gears, except that in spur gears all the measurements are taken on what is in bevel gears the outer pitch circle.

It will be noticed that a bevel gear cutter is considerably thinner than a spur gear cutter for the same pitch; the reason is, that to form the space between two teeth in a bevel gear the cutter has to be passed through twice, the wheel blank being



A Cheap Crankshaft.

moved round on i s axis for the second cut. The second cut acts mostly on the thick end of the tooth, removing very little metal (if any) from the thin end. It will be seen, therefore, that the cutter has to be of such a thickness as to pass between the thin ends of the teeth without removing too much metal.

Bevel gears cut on an ordinary milling machine are not cut theoretically correct, as the curve on the tooth should constantly change from one end to the other. It becomes necessary, therefore, to round off the inner ends of the teeth to the required curve with a file.

A Cheap Crankshaft.

By W. Howard.

Having bought a second-hand 5-in. B.G. lathe, minus the crankshaft, an idea occurred to me for replacing this part, which is illustrated by the accompanying sketch (see above). The crankshaft consists of four ¾-in. gas-pipe elbows, three nipples, and two lengths of ¾-in. gas barrel, costing altogether about 3s. I drilled ⅛-in. holes at each end of the elbows through the nipples, also where the two lengths of piping are screwed into their respective elbows, and pins were put through and burred over at the ends. No brazing was required, and the crankshaft has been in use for a considerable time and given every satisfaction.

A Heavy Wooden Driving Wheel for the Lathe.

By E. W. P.

The following is a simple way to make a heavy driving wheel for a lathe or circular saw:—The wheel here described is 3 ft. in diameter, and weighs 1½ cwt. First place together on the bench a number of ½-in. boards of any width edge to edge, and strike out a circle with a 19-in. radius. Cut out two circular pieces to the same radius, and nail them together to make a wheel 1 in. thick, with the grain crossing, as at A in the section, Fig. 1. Describe a circle with an 18-in. radius on one side; then, on a thin piece of board or cardboard, strike an arc with the same radius, six of which will make the circle. Place a piece of 4½-in. stuff on the arc, and mark down each side, and cut out the cardboard for the template. Then mark six patterns on a piece of 4½-in. by 3-in. stuff, and cut out. Nail these pieces on the prepared inch wheel to the line of the circle, as at B in the view (Fig. 2), leaving a hexagonal-shaped space. Having bored the centre for the crank, pack the space with scrap iron, old lasts, weights, &c., taking care to see, by means of a straightedge, that nothing is above the sides of the box. Now place the crank in position, at a perfect right angle with the wheel, or it will not run

FIG. 1. SECTION.

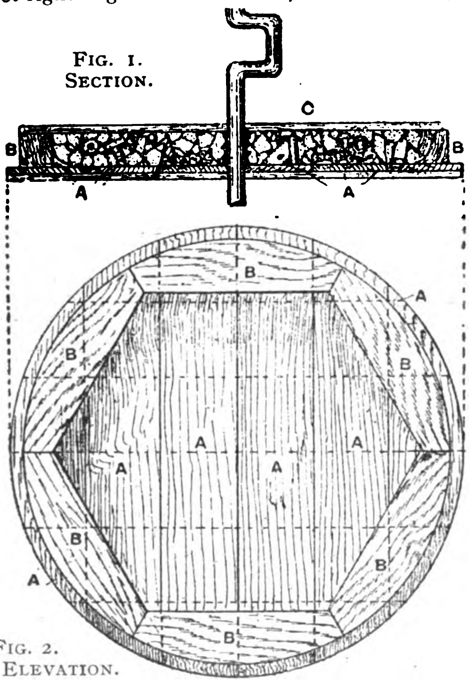


FIG. 2. SIDE ELEVATION.

A DRIVING WHEEL FOR THE LATHE.

true. Then mix up some cement in water, and pour in to fill up level with the sides, and when set nail a circle of ½-in. wood C (Fig. 1) over all. This results in a good heavy wheel at a far less cost than one of the same weight in a casting.—*Work.*

A Cheap Set of Accurate Gauges.

By J. GASS.

Herewith are a photograph and sketch of a set of cheap accurate gauges which I have made, and have found very useful when boring small holes. Every mechanic, both amateur and professional, knows the difficulty of calipering correctly small holes, especially if they are at all deep, and the cost of ordinary plug gauges is, to many readers, prohibitive; and here we have a set for little over the cost of an ordinary pair of inside calipers. The total cost of the five gauges shown in the photograph was only 1s. 10d.

A is a hardened steel ball, such as are sold by cycle and motor dealers, and are usually correct to ·0005 in., and therefore accurate enough for ordinary work. B is a piece of mild steel rod, which can be knurled or left plain; the diameter is about ⅛ in. under size of ball. The handle B is first sawn off and turned down, then the end is bored or cupped

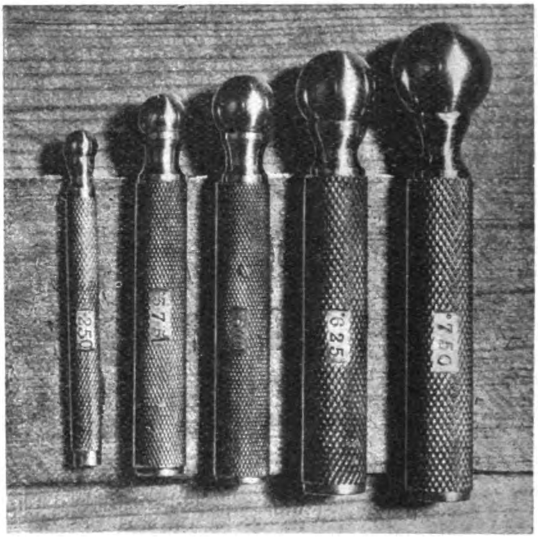


FIG. 1.—A CHEAP SET OF GAUGES.

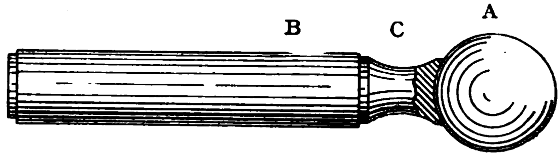


FIG. 2.—ELEVATION OF A GAUGE.

out to suit the diameter of the ball; then the cup and one side of the ball are tinned with ordinary solder. Now hold handle B in the vice, in a vertical position, and place the ball in the cup; apply the flame of a blowlamp at the point marked C, at the same time pressing on the ball with a piece of wood. Care must be taken not to get the ball too hot, or it will lose its temper, and become soft. When set, polish up in the lathe, and it is complete.

Making Electric Light Sockets Waterproof.

By W. T. MEINZER.

I recently had occasion to put some electric lights in a position exposed to water, and so I was forced to devise some means of making the sockets waterproof, since I have had previous trouble from water getting into the sockets in the base of the lamp and thereby short circuiting them. Before putting the lamp in I took a lump of soft putty and put it into the receptacle, and then screwed the lamp in, forcing the putty into all the crevices of the socket, and making it absolutely tight. I then unscrewed the lamp again, and cleaned the putty from the threads, so it would not stick there as it hardened.—*Power.*

The Latest in Engineering.

New Form of Mercury Arc Lamp.—The Jena Glass Works, Schott und Genossen, have brought out a new form of the mercury arc lamp, which, first described by Arons in 1896, has successfully been applied for special illumination purposes by Cooper Hewitt. The mercury arcs abound in ultra-violet rays, which are invisible to our eyes, and useless for ordinary illumination. As glass absorbs these ultra-violet rays, Heraeus last year tried quartz tubes, which are permeable to rays down to 220 $\mu\mu$. These tubes are, however, too expensive. The new Jena glass, styled "uviol," is permeable to rays down to 253 $\mu\mu$, and hence little inferior to quartz in this respect. These tubes are fitted with two pointed carbon electrodes, joined to platinum wires fused on to the glass, and they contain the usual small quantity of mercury. The tube-holder is fixed to a stand, so that the tube can be tilted in any position. As both electrodes are of carbon, either of them can be made the lower negative pole, which must be covered by mercury; otherwise it would soon be destroyed. The arc is struck by tilting the tube, on whose stand the resistances, &c., of the new uviol-mercury lamp are mounted. The rays from these lamps have powerful photo-chemical and also physiological effects; they irritate the healthy skin, and are supposed to cure lupus and skin diseases.

G.W.R. Non-Stop Runs. — On Monday, July 3rd, there arrived at Paddington Station, within an hour-and-a-half of each other, three trains, each having accomplished the long run of 254¾ miles from Plymouth without a stop. Two were "specials," run in connection with the North German Lloyd s.s. *Kronprinz Wilhelm*; while the other was the daily "Limited," which, as last year, is booked to do the journey in 4 hours 25 minutes. The actual times of the three trains were as under—

——	Mail Special.	Limited.	Boat Special.
	h. m.	h. m.	h. m.
Plymouth, Millbay crossing dep.	11.57 a.m.	..	12.50 p.m.
Plymouth, North Road .. ,,	..	12.35 p.m.	
Paddington .. .. .. arr.	4.19 p.m.	4.57 ,,	5.36 ,,
Average speed	56·3 miles	56·3 miles	51·5 miles

Altogether, it is a feat of which any railway might be proud. Sandwiched in between these three trains were three ordinary expresses, each booked to run over 100 miles without stopping, at speeds well over 50 miles an hour.

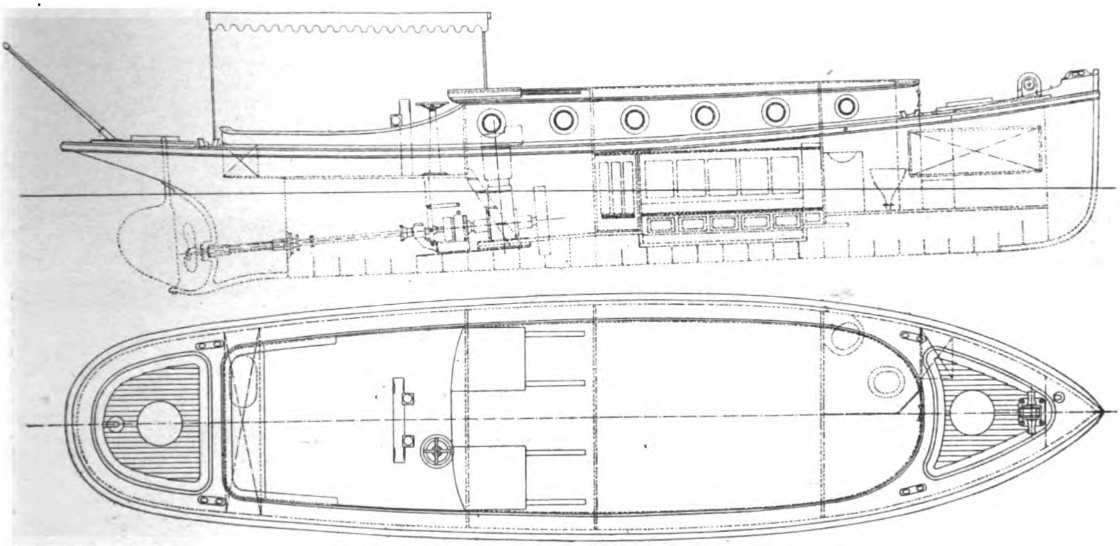


FIG. 1.—PLAN AND ELEVATION OF THE KROMHOUT MOTOR LAUNCH. (*See page* 150.)

Ball-Bearing Experiments.—In an article describing experiments on ball-bearings made at the works of the Société Alsacienne de Constructions Mechaniques, Mr. C. Gégauff states that it is impossible with any reasonable sized hub to carry the load on a large automobile wheel on two rows of balls only, and still get reasonable endurance. The load to be carried on one wheel may be taken as not less than 4 cwt., and the speed as 220 turns per minute. He suggests, therefore, that four rows of balls should be used. The maximum load (in kilogrammes) which can be carried by a ball-bearing without undue wear is, he states, given by the formula—

$$Q = \frac{20}{\frac{\pi n}{6000} + \frac{0{\cdot}5}{D}},$$

where n is the number of turns per minute, and D is the diameter in centimetres of an imaginary cylinder touching the balls internally.

The Kromhout Motor Launch.—The 40-ft. Kromhout motor launch entered for the Motor Yacht Club's Reliability Trials by Messrs. Perman and Co., Ltd., left Amsterdam recently, the crew consisting of three—two English yachtsmen and a Dutch engineer. The boat, of which we are able to reproduce drawings and a photograph, is 40 ft. long on the water-line, her beam being 8 ft. 8 ins., and draught 3 ft. 10 ins. She is completely decked in, with the exception of a cockpit aft. A 12 h.-p. Kromhout motor, working with ordinary paraffin, drives her at about 7 knots per hour, consumption being about 9 pts. per hour. At this speed, judging by reports of her trials, she should prove a formidable competitor in the trials, both on account of reliability and low consumption. The hull is built of steel throughout by Messrs. Goedkoop Ijmuiden, and displaces some 12 tons.

The L.B. & S.C. Railway.—There is a possibility that the brilliant chrome, with which many thousands of more than one generation of travellers have become familiar as the highly distinctive colour of the passenger engines on the London, Brighton & South Coast Railway, may disappear in a comparatively short space of time. Several proposed changes in this direction are under consideration, and among other colours experiments are being made with green (a dark tint), plum, and mauve. Goods and shunting engines, which up to the present have boasted a livery of dark green, will, in all probability, in the future be garbed in a more sombre black. Several other changes and developments in the locomotive stock are in contemplation.

Superheated Steam.—Doubts are sometimes expressed as to whether the use of superheated steam effects any appreciable saving of coal, though the reduction in the weight of steam consumed is admitted. Some figures due to Mr. Strahl, of the Prussian State Railways, and quoted by Mr. H. H. Vaughan, the superintendent of motive power for the Canadian Pacific Railroad, in a paper read before the American Railway Master-Mechanics' Association are, therefore, of interest. The figures are as follows :—

Superheat. Deg. Fah.	Percentage of Saving Water.	Coal.
18	2·5	2
36	5	3·5
54	8	5
72	10	7
90	12·5	9
108	14·5	10
126	16	12
144	18·5	13
162	20·5	14·5
180	22	16
198	24	17
288	34	24

FIG. 2.—THE KROMHOUT MOTOR LAUNCH.

A New Ship Propeller, patented by R. S. Crawford, carries an ingenious setting of the blades on the screw, which is claimed to give a better grip on the water, with less slip and less broken water. The blades are not arranged perpendicularly to the shaft axis, but are "inclined aft from roof to tip," being curved circumferentially. The tip of one blade overlaps the base of the next. The result seems to be that the equivalent of one old blade is made up by a set of the new ones, perhaps catching more water, and releasing it with less back suction.

STEAM TURBINES.—Steam turbines are commonly supposed to require that the supply of hot vapour be furnished at a high pressure ; but a recent innovation proposes to use exhaust steam on low-pressure turbines. This phase of economy in prime movers will be watched with much interest.

Automatic Railway Couplings.

(*Continued from page* 136.)

ANOTHER ingenious device is introduced by Mr. William Downing, of 69, Burgoyne Road, Sheffield, which is a simple and effective arrangement of mechanism by means of which vehicles can be coupled and uncoupled without the use of shunting poles, and by which the dangerous practice of passing under or between the buffers of such vehicles is rendered unnecessary. Drawings are herewith reproduced which serve to explain in some measure the proposed arrangement. Fig. 10 is a side elevation and plan of the apparatus engaged with the drawhook of an adjacent vehicle provided with a similar apparatus. Fig. 11 is a plan of the apparatus with its position upon the wagon indicated only, to prevent confusion. A cross shaft A is supported in suitable bearings B, under the wagon frame, and upon each projecting end is fixed a hand lever C, by means of which the apparatus is operated from either side of the vehicle. Upon the shaft A and near its centre is secured a single or double arm D, which, when the shaft is turned in one direction in its bearings B, is raised from its normal or pendent position, and is lowered by a reverse movement. Upon each side of the drawhook E is pin-jointed a depending bar or arm F, the opposite ends of these two bars being similarly connected with one end of the coupling link G, and also to a single or double carrier, its opposite end being pin-jointed to the before mentioned single or double side arm D. The carrier is made with projecting parts upon which the coupling link G rests.

These component links and arms when in their

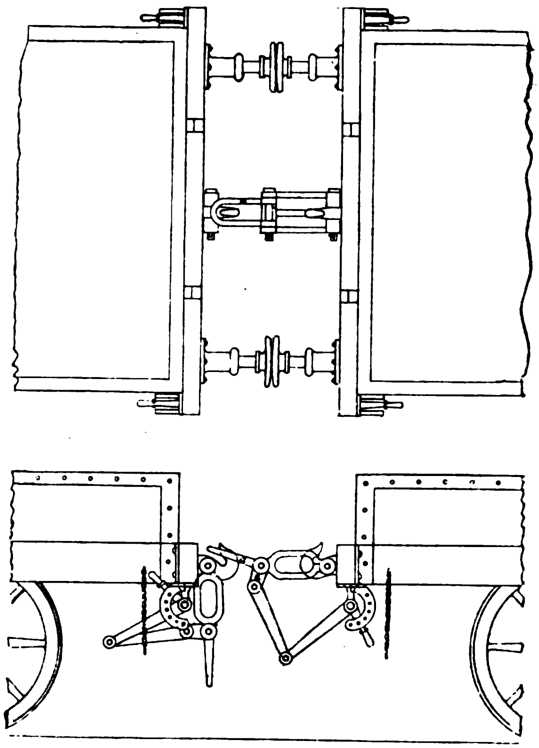


FIG. 10.—PLAN AND ELEVATION OF COUPLING ARRANGEMENT.

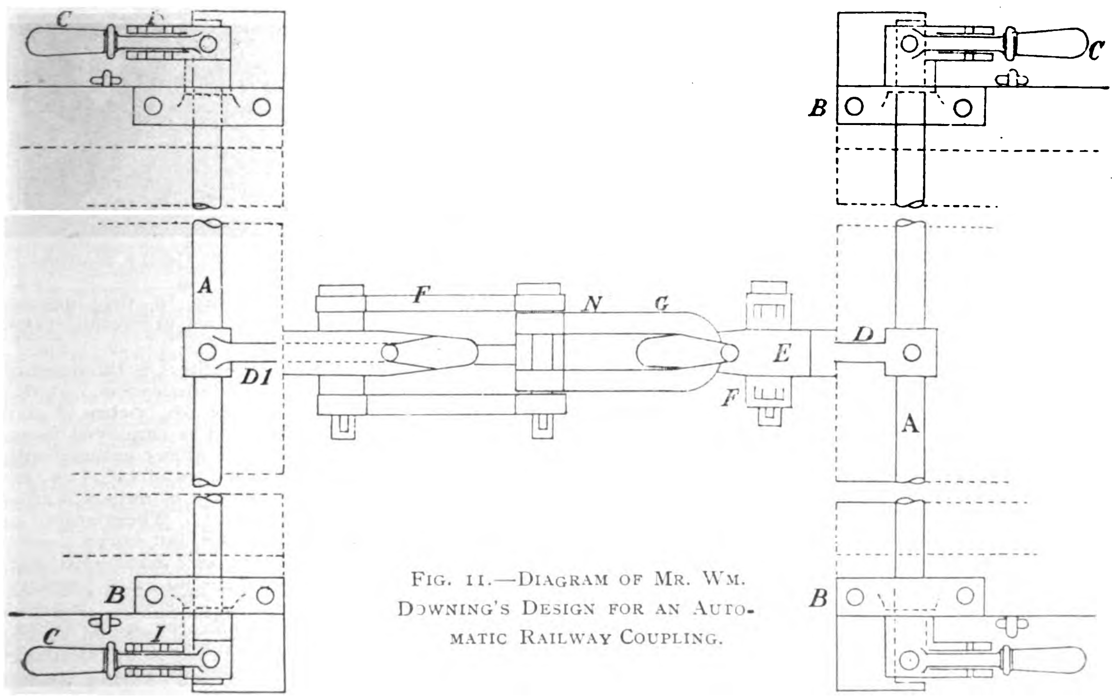


FIG. 11.—DIAGRAM OF MR. WM. DOWNING'S DESIGN FOR AN AUTOMATIC RAILWAY COUPLING.

normal position (or out of use), assume by gravitation the position shown on the right-hand side of the figure or thereabouts, the coupling link resting in an oblique position upon the projections of the carrier.

It is arranged that the hand levers C shall move between a double segmental guide, provided with a number of pinholes and a retaining pin, or a rack and pawl may be substituted if preferred. When two adjacent wagons provided with this invention are in position to be coupled, the hand lever C on either side of the vehicle is forced downwards, and this movement turns the shaft A, raising all the connected parts with the coupling link G, and eventually bringing the link directly over the drawhook E, upon which it is then lowered as shown in the drawing.

In the application of this mechanism to railway carriages or coaches, and for the purpose of drawing back and tightening the hooks and links, when coupled, it is proposed to screw-thread a portion of the length of the draw bar, and place upon it a toothed wheel (which is held in position between fixed plates) and which can be rotated from either side of the carriage by a toothed wheel operated by a cross shaft provided with suitable handles.

Another invention, which we also are able to illustrate, is that of Messrs. Rushforth & Sowden's, Imperial Chambers, 62, Dale Street, Liverpool. This patent automatic coupler is a simple and efficient arrangement, which can be fixed practically in a few minutes, there being no alteration to present rolling-stock necessary. It will couple and uncouple on curves, can be used with present couplings, and, in short, meets all the requirements of the railway companies. The coupler has been thoroughly tested on some of the Great Northern Railway Company's wagons with their other rolling-stock, on one occasion coming from Yorkshire with a train load of goods wagons, and returning thither. The photograph (Fig. 12) shows the gear attached to a pair of G.N.R. goods wagons.

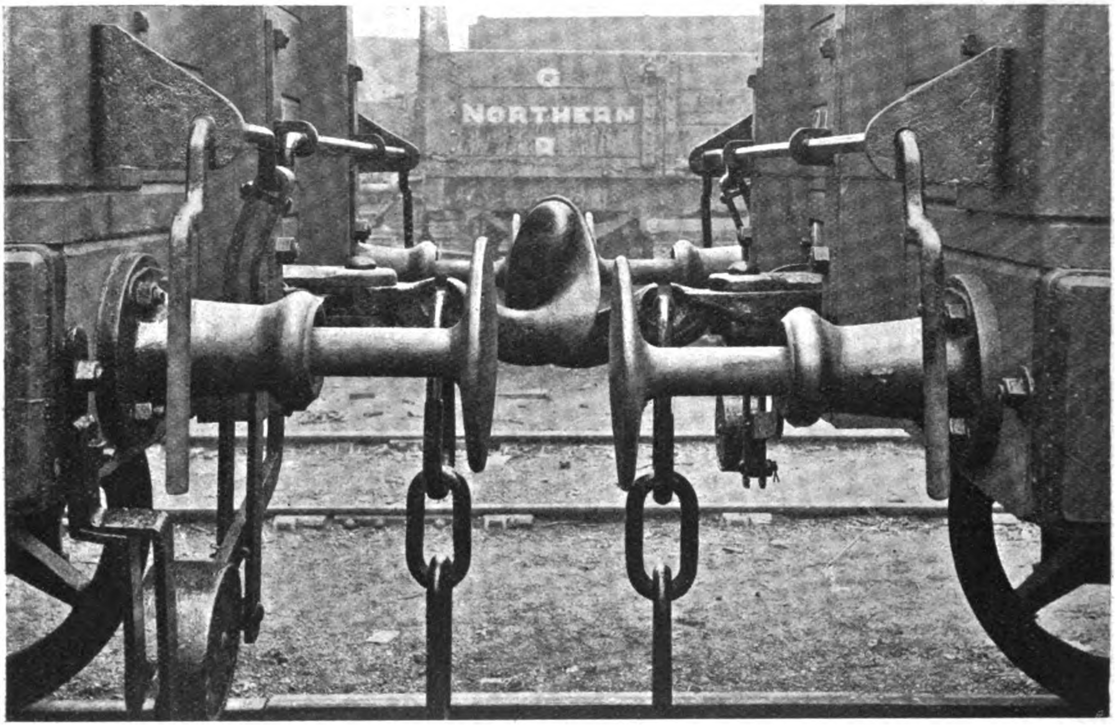


Fig. 12.—Messrs. Rushforth & Sowden's Patent Automatic Coupler, applied to Goods Wagons.

Another New Fuel.—Recent tests of molasses as a fuel show that under proper conditions 1 lb. of the substance will evaporate 2 lbs. of water. At present, waste molasses is sprinkled on bagasse (spent sugar-cane) on its way to the furnace. Molasses has been used as a fuel in Hawaii, Java, Cuba, and Egypt.

A New Explosive.—" Vigorite," is the name of a new explosive recently tested in Bavaria. It was invented by Prof. Schultz and Mr. Gehre, and a new type of nitrous compound is employed in its manufacture. This compound, when combined with saltpetre, gives extraordinary results. The explosive is not affected by friction or impact, and is not influenced by damp or frost. When ignited in the open air it does not explode, but burns slowly. During the tests comparisons were made with gelatinous explosives, dynamite, special black powders, etc. The results showed that " Vigorite " is about ten times more powerful than the most violent explosive. Works will before long be constructed at Lohr-on-the-Main for its manufacture.

Lessons in Workshop Practice.

By A. W. M.

(*Continued from page* 124.)

XXI.—Practical Notes on Selecting and Using Small Dynamos and Motors.

Dynamos.—The kind of armature fitted to any dynamo, and system of winding employed for its field coils, will determine whether it is adapted for general purposes or for some particular kind of work only. When selecting a machine, therefore, you should ascertain what kind of armature it has and the type of winding on the field-magnet. If the armature core is solid, the machine will not be suitable for use on long periods of running; the armature will become hot and the machine will probably have to be stopped after running for about an hour to allow the armature to cool, though it may work very well during this time. A machine having an armature with a laminated core should be selected if it is to run for more than an hour at a time; such a machine would also be more efficient and take considerably less power to drive it, so that if the driving power is limited and you want to get as much output as you can from the dynamo, the

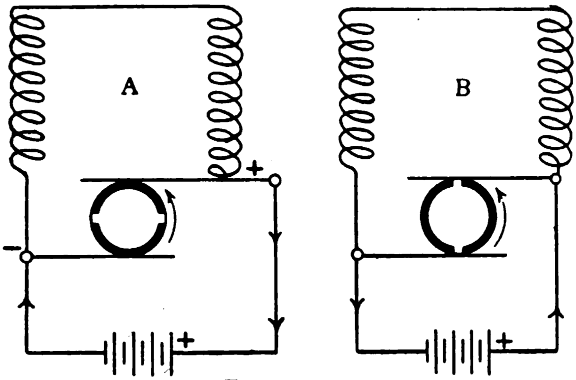


FIG. 1.

result will be very much better if the armature has a laminated core. Where efficiency does not matter and the machine is to be used for experimenting during short periods, a solid core may answer sufficiently well.

The single coil armature, called a shuttle or Siemens **H** pattern by reason of the shape of its core, gives very good results when used for lighting lamps, electro-plating on a small scale, and general experimental use, even working an induction coil or driving small motors. It is, however, not good for charging accumulators: though an ingenious user may succeed by some device in charging small cells, it is better to regard the single coil armature as practically useless for this purpose, the reason being that such an armature gives a current which is not steady, but drops to nothing when the coil is at the neutral position, at which moment the brushes touch both sections of the commutator simultaneously and short circuit the accumulator, permitting it to discharge the current previously put into it by the preceding half revolution of the armature. As shown in Fig. 1, A is the dynamo sending current in to the cells, and B the brushes touching both sections of the commutator, permitting current to flow back into the armature.

Polar armatures, such as the tripolar and quadripolar patterns, are not of much advantage for dynamo use; they are inferior to the shuttle armature for such work as that pattern is adapted for, and very little superior to it for charging accumulators: it is better to choose a proper ring or drum armature when it is desired to advance from the single coil type. As regards results in working, ring and drum armatures may be regarded as equally good; the drum is less liable to sparking, especially when running in an unequal magnetic field; but if the ring armature has a comparatively large number of sections in its commutator, and therefore its winding divided into coils of few turns each, there is practically no difference in this respect: It is, however, important that a ring armature should run true: this type, being more difficult to mount on the spindle than the drum, is liable to have the core eccentric to the spindle, causing vibration when running. Drum armatures should always have toothed cores up to about 2 ins. diameter, at least, if made with smooth cores it is doubtful whether such small armatures will excite the field coils; six is the lowest number of coils to adopt as good practice; four coils can be used; but the current then fluctuates to a considerable extent, and so low a number is preferably avoided.

The system adopted for winding the field-magnet is of much importance. A simple series winding should not be used unless the machine will always be worked at maximum current output or near it, because the winding of a series machine is calculated on the assumption that a certain current of constant value will be flowing through the coils; this kind of winding is also unsuitable for charging accumulators and electro-plating, as, if any current flows back from the cells or bath the polarity of the machine will reverse, so that it will send a current in the reverse direction, damaging the accumulator plates or the surface of the work which is in the bath: it is a winding, however, which is suited for working one or more arc lamps. The shunt system of winding is a safe one to adopt: it is a most useful winding for lighting lamps, and is the correct one to use for charging accumulators and electro-plating. It is not well adapted for fusing or heating wire, or working induction coils, motors or arc lamps, though in experienced hands it can be used for all these purposes. It is the best winding for the novice to commence with.

The compound system is useful for driving motors, an arc lamp, or an induction coil; it is suitable for general experimental work for heating and fusing wires; it can be easily converted to simple shunt by disconnecting the series winding. One of its chief functions is to keep the voltage constant when used for lighting incandescent lamps the number of which is not kept constant. But though this automatic method of regulation of the voltage with a varying load is fairly successful with well-designed large machines, it must not be expected to give such close regulation with small machines; it is also necessary that the machine should run at constant speed—even a large machine will not be accurately self-regulating if the speed varies. There are different conditions to be observed for each of these systems of winding when testing a dynamo, as, if the test is not made in the right way, the result may be quite unreliable.

Testing a Series Wound Dynamo.—If the machine is run at the correct speed for which it was designed to give its full voltage, it will only give that voltage when the correct amount of current is taken from the armature. The reason for this is that the whole amount of current given by the machine must pass through the field-magnet coils; therefore, as the strength of the magnet depends upon the number of turns of wire in the coils multiplied by the ampères of current flowing through them—the ampère turns as the proper term is—it follows that the magnetism will only be at the right strength when the full current is flowing through them at which they were designed to give their proper effect. If you have a series wound machine to test, the first thing to do is to get it running at its proper speed; if this is not marked on the terminal board, you must guess it as near as you can. The diameter of the armature will be a guide, a rough rate being a surface speed of 1,500 to 2,000 ft. per minute for the circumference.* With no load on at all—or open circuit, as it is called—no current will be generated, and the machine will not be doing any work, because no current can flow through the field coils as the circuit is open. If a voltmeter be applied to the terminals it will not indicate any volts at all, or perhaps just show a slight deflection due to a very small voltage and current generated owing to residual or permanent magnetism existing in the iron of the field-magnet. A novice may conclude from this that the dynamo is out of order, and that there is something wrong with it, and be confirmed in his opinion when, after putting on a load of perhaps several lamps, the machine still failed to give current. This conclusion might be quite erroneous, as the failure of the machine to give current would very likely be still due to the resistance of the circuit being too high to permit enough current to flow and excite the field-magnet. More lamps should be added in parallel to the others to reduce the resistance of the circuit, until a point is reached at which the machine commences to give current: the voltage will then rapidly rise if the machine is in order. More lamps can be added until the correct output is obtained, provided the driving is regular: the machine will then maintain a steady output. If more lamps are now added in parallel, so as to draw more current, the voltage may not rise or may commence to drop, depending upon the design of field-magnet; but having reached a steady output, this should be considered as the correct load at which the machine is to be worked, assuming that the coils do not become too hot. If they get over heated, it means that you are taking too much current from the machine and must reduce it until the coils keep at a moderate temperature; perhaps you will then find that the volts are too low or the machine will not excite with the smaller current. This means that the speed must be increased until you get the required voltage with the lower rate of current. Fig. 2 is an explanation of these remarks by means of diagrams. C shows the machine with open circuit on at which stage it does not excite, the minute current taken by the voltmeter having no effect. D shows the machine loaded with a circuit of three lamps, but it still does not excite, as the resistance of the circuit is too high to permit sufficient current to flow to start it. At E the number of lamps has been increased to six, reducing the resistance of the circuit to the correct amount, so that sufficient current flows and the machine excites. It will be hereby understood that the series wound dynamo is only suitable for working with one definite value of current such as would be taken by an arc lamp or several arcs in series or a fixed number of incandescent lamps.

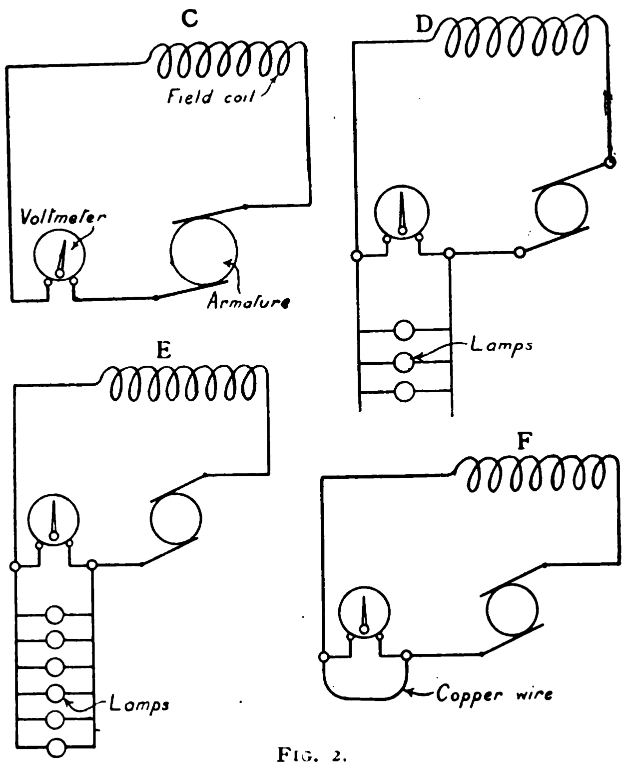


FIG. 2.

One way of testing if a series wound dynamo is in working order, is to short circuit the terminals; to do this, join a piece of moderately thick copper wire to them as F, Fig. 2, whilst the armature is running. If there is nothing wrong with the machine, it will immediately excite; in fact, the rush of current will very likely cause the armature to slow down so suddenly that the driving belt may be thrown off; but certainly the sudden drag upon the armature is unmistakeable and proves at once if the machine is in order. Such a rough test would, of course, not be applied to a large dynamo, but for sizes below 500 watts it may be used, and if one end of the copper wire is only allowed to touch its terminal for an instant the drag on the armature will only last while the circuit is complete, and the shock may be mitigated.

(*To be continued.*)

* A table of usual speeds for different sizes of armatures is given in MODEL ENGINEER handbook No. 10.

A ½-in. Spark Coil.

By E. J. Szlumper.

The photographs here reproduced are taken from a ½-in. spark coil which I have just completed. As the build is rather a departure from the ordinary run of coils, it may be of some interest to readers of The Model Engineer.

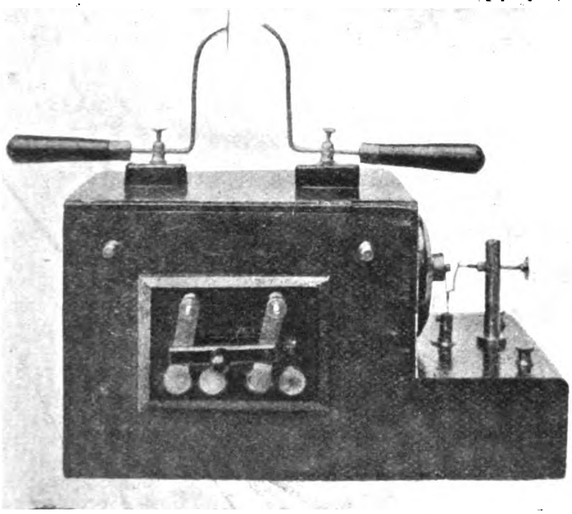


Fig. 1.—A ½-in. Spark Coil.

The dimensions of the coil proper are taken from the handbook on Induction Coils. Primary winding, two layers of No. 18 d.c.c., wound on a core ⅝ in. in diameter, and composed of a number of very fine iron wires. The primary is insulated from the core by a layer of shellaced paper, and after it was wound on a piece of linen was glued on over all, and coated with shellac until it was hard; this makes a good insulating tube.

The secondary consists of ¾ lb. of No. 36 s.c.c., wound in four sections. The bobbins for the sections are built up of brown paper tube about ⅛ in. thick, with cardboard ends. The tube was first made in one piece on the primary; when hard, it was cut to connect length, and the ends glued on. Each layer of the secondary was coated with shellac, and between every two layers was wound a piece of paper. Shellac makes a very satisfactory insulation for the bobbins, but as I find the loose connections to dischargers and secondary terminals shaking about inside the box, and sparking to each other, I intend to fill the whole of the interior with paraffin wax. It will be seen from the photograph that I have substituted a reversing switch for the usual type of commutator. I did this because there is not much room to spare by the contact-breaker, and it relieves the side of the box.

The switch is placed on a separate baseboard, which is screwed on the side of the box. The switch arms are pivoted on two binding screws, and the four studs are made of carpet pins. The contact pillar is the only part not made by myself. This I had turned for me by a friend. It is made of gunmetal, and is 2¼ ins. in height. The contact screw is made from a steel bolt, with the top of a carpet pin sweated on the head. As I could not tap the pillar to fit, a hole was drilled through, and a nut sweated on one side; by using a lock nut the screw can be fixed very firmly.

The armature is of the vertical type, with a head of soft iron the same diameter as the core. The dischargers are made of ⅛-in. brass wire, with walnut handles made from tool handles, and slide through large terminals, which are mounted on wood blocks. The disc is made of sheet brass 1¼ ins. in diameter. The secondary terminals are situated on the side of the coil above the reversing switch. The condenser is of the usual type; the paper sheets are made from foreign notepaper soaked in paraffin wax. After they had dried they were placed one by one on a piece of blotting-paper, and a hot iron run over them to remove the superfluous wax. The lugs are separate strips of tinfoil laid on the tinfoil sheets, and the whole pressed together. The body of the coil is made of ½-in. mahogany, highly polished, and all the brasswork is polished and lacquered.

I have used the coil with two 4-volt pocket accumulators in parallel, and it has worked very well, giving its full spark and lighting Geissler tubes to perfection.

All materials, except discharger handles, terminals, &c., were bought in the rough. An accidental shock from this coil is anything but pleasant.

In conclusion, I should like to say that The Model Engineer and your sixpenny handbook have been invaluable aids to me.

The divisions of coil are as follow:—Length, 10½ ins.; breadth, 5½ ins.; height, 6 ins.; height of discharger from top of coil, 4½ ins. The photograph Fig. 2 shows the coils before being mounted.

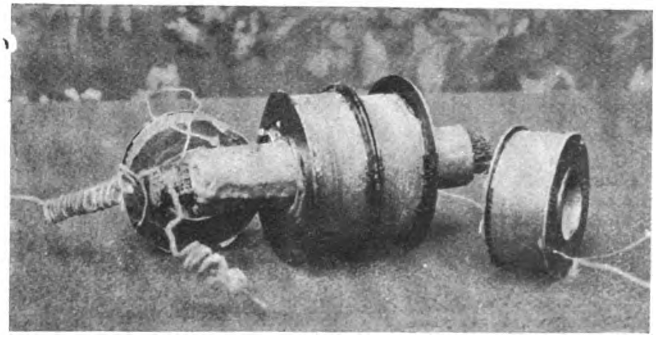


Fig. 2.—The Primary and Secondary Coils.

Platinum.—95 per cent. of the world's production of platinum comes from the Ural district, especially South Verkhotursk, Perm, North Verkhotursk and Cherdynsk. Total production for 1902 nearly 6 tons, about 4½ cwts. less than 1901. There are two or three refineries in Russia, but most of the product is exported in its raw state.

A Model Surface Condensing Tandem Compound Marine Engine.

By "BEGINNER."

THE engines here illustrated are of the inverted, vertical compound type, with four cylinders, and outside valves and valve gearing; cylinders arranged in pairs, the two high-pressure over the two low-pressure cylinders, with distance-piece between them. The exhaust steam from high-pressure cylinders is delivered through copper pipes direct to low-pressure steam chests; the low-pressure exhaust, through copper pipes into back columns, and from thence to condenser. The cylinders are two of 1¼ ins. diameter high-pressure, and two of 2½ ins. diameter low-pressure; stroke, 1¼ ins.; speed, about 40 ft. per minute. Cylinders are cast separately in brass; thickness, 5-32nds in. Steam ports in high-pressure, ½-in. by ⅛-in.; exhaust ports, ¼ in. wide; low pressure steam ports, 1 in. by ⅛ in., and exhaust ports, 1 in. by ¼ in. Drain taps are fitted to low-pressure cylinders; also starting valves to admit steam top and bottom of low-pressure cylinders, independent of the slides.

The valves are single ported, and made of hard brass, 1-16th in. lap, 1-32nd in. lead.

Pistons are cast brass, turned up true, and each fitted with one ring ¼ in. in breadth.

Piston-rods of mild steel, 13-32nds in. diameter at bottom and secured to steel crossheads by 5-16ths in. nuts; the low-pressure pistons being secured to rod by nuts of same diameter; tail end of rods 9-32nds in. diameter; also the high-pressure rods, the rods being coupled together with a stepped scarfed joint, with sleeve slipped over and held in position by four ⅛ in. diameter steel bolts. Tail end rods through top of high-pressure cylinders 3-16ths in. diameter. Rods are kept steamtight by means of glands and stuffing-boxes packed with best cotton rope stranded to the required size.

Connecting rods are of mild steel with two marine ends to crosshead, and one to crank pin; brasses fitted in halves and adjustable.

Valve motion is of mild steel, the spindles being ¼ in., 3-16ths in., and 5-32nds in. in diameter, the and are arranged so that they can be withdrawn for repairs. The high- and low-pressure spindles are coupled by means of a short arm secured by nuts top and bottom. Valves are adjustable on the spindles, and the latter are fitted with guides which are adjustable. The reversing links are solid, of marine type, working in circular brass discs, which are fitted in butt ends of low-pressure valve spindles. Eccentric rods and pulleys of steel, and straps of brass. The reversing of the valves is occasioned by means of a worm wheel and pinion; the latter is driven by a small inverted vertical engine having a cylinder ½-in. bore by ½-in. stroke.

The *bed* is of cast brass, with square recesses for journal brasses, which are adjustable and provided with steel caps, each being held in place by two bolts ¼ in. diameter.

Condenser is of cast brass, having about 70 sq. ins. of tube service; the tubes are thin brass, and secured in tube plates by stuffing-boxes with screwed nipples, and packed with cotton strands soaked in tallow. Doors and tube plates secured to condenser with ⅛ in. diameter bolts. An inspection door is fitted on the back of condenser.

Air and Circulating Pumps are both of cast brass. Air pump 1¼-in. bore by ⅝-in. stroke, fitted with foot and head valves; the latter are of thin brass scraped up to a good fit. Air pump is worked by a set of links from crosshead of forward engine. The circulating pump is a double-acting bucket, the valves in separate boxes being circular balls. this and feed pump, which is a single-acting plunger, are coupled together and worked by links from the after engine crosshead.

Crankshaft is of mild steel, built up and balanced by extension of crank webs. It is joined in centre by circular couplings and bolts. Diameter of shaft throughout being 9-16ths in.

For the Bookshelf.

[Any book reviewed under this heading may be obtained from THE MODEL ENGINEER *Book Department, 26–29, Poppin's Court, Fleet Street, London, E.C., by remitting the published price and the cost of postage.]*

THE HAND CAMERA AND WHAT TO DO WITH IT. By W. L. F. Wastell and R. Child Bayley. London: Iliffe & Sons, Ltd. Price 1s. net; postage 3d.

This work has taken the place of the book by W. D. Welford. It will be found to deal with modern hand cameras of all types, and to give full instructions for all those forms of photographic work which involve the use of a hand camera, or follow from its employment. No form of photography at the present day is so popular, yet no form wants more skill and knowledge to get the best out of it. The authors are well known as users of the hand camera for many years, and the information they give is copious, practical, and reliable. The volume is neatly bound in cloth and contains some excellent reproductions of hand camera pictures by the authors.

THE engineer of the Association Normande des Propriétaires d'Appareils à Vapeur, M. Maréchal, who has carried on interesting investigations on the steam engine and the proportion of calories actually utilised, has arrived at the conclusion that, even with the most perfect systems, as much as 59 per cent. of the total heat developed goes to the condenser. When the engine is exhausting to atmosphere 63·6 per cent. of the heat is dissipated.

PERFECT COMBUSTION.—For perfect combustion 8 lbs. of oxygen are required for every pound of hydrogen, and 2⅔ lbs. of oxygen for every pound of carbon. With the contracted damper opening of the modern locomotive this perfect combustion cannot be obtained. One remedy that has been suggested is the staying of the firebox with hollow stays having an inside diameter of ¼ in. and not over 3-16ths in. The amount of air that can be admitted through 1,000 or more of these hollow stay bolts is sufficient to improve the combustion very materially. Another good result of having air passing through the stay bolts is that the risk of burning them is decreased, the expansion of the bolt is reduced and the likelihood of the plates cracking is largely avoided.

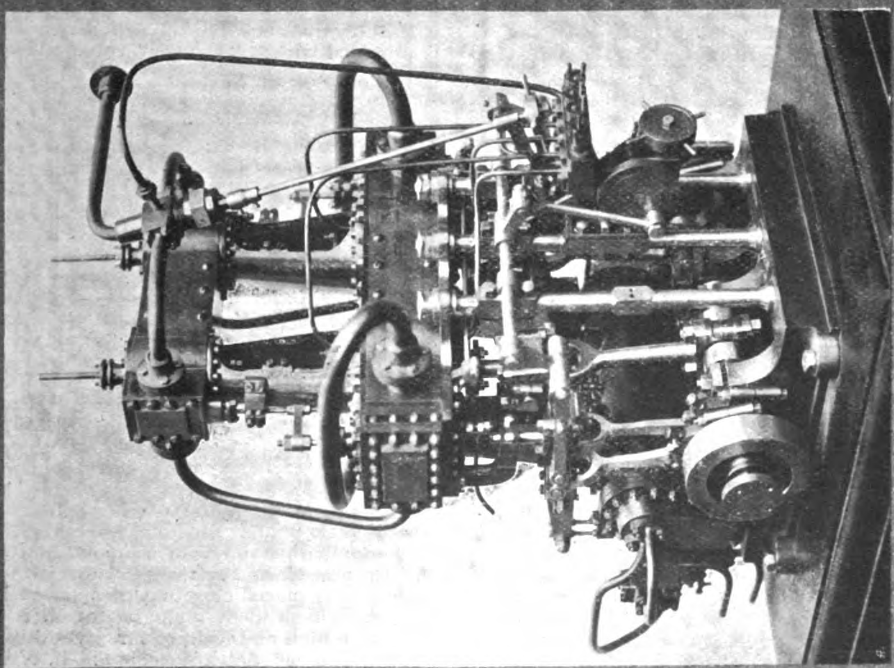


Fig. 1.—Front View.

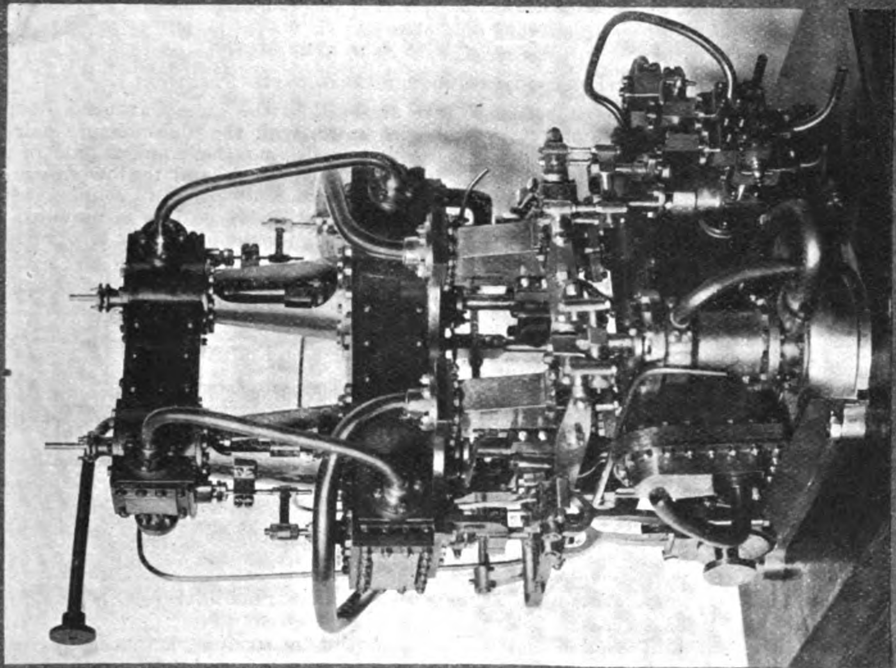


Fig. 2.—Rear View.

A MODEL SURFACE CONDENSING TANDEM COMPOUND MARINE ENGINE.

Notes on Locomotive Practice.

By Chas. S. Lake.

(*Continued from page* 10.)

The Latest Developments in British Locomotive Practice.

During the past few months there have been recorded one or two notable developments connected with locomotive engineering in this country, and by the time these notes are in print it seems probable that the number will have been increased. Locomotives of new types for their respective lines have been put to work upon the Great Northern, Great Western, and London and North-Western Railways, whilst developments in respect of enlarged proportions for existing types of engines have, in addition, taken place upon the G.W. and L. & S.W. Railways. On the Great Northern Mr. H. A. Ivatt, the chief locomotive engineer, has produced from the Doncaster Works a four-cylinder compound express locomotive of the 4—4—2 or "Atlantic" type, similar in many respects to his famous 251 class locomotives already illustrated in these pages. The new engine has the same pattern of boiler, and also the same diameters of wheels and disposition of wheelbase as in the 251 class, but a marked difference exists in the provision of the four compound cylinders, which are arranged in the same transverse plane at the bogie centre, with the high-pressure pair between the frames driving the cranked axle of the first pair of coupled wheels, and the low-pressure outside driving the second pair of coupled wheels. A separate set of valve gearing is provided for each cylinder, that for the outside or low-pressure being of the Walschaerts type, actuating valves working above the cylinders, and those for the high-pressure inside being of the ordinary link motion pattern, with the valves between the cylinders. The engine is provided with a "change" valve, allowing it to be worked either simple or compound at the will of the driver. Two reversing levers are provided, with sectors placed close together on the footplate. Thus an independent range of cut-off is arranged for in the high and low-pressure cylinders.

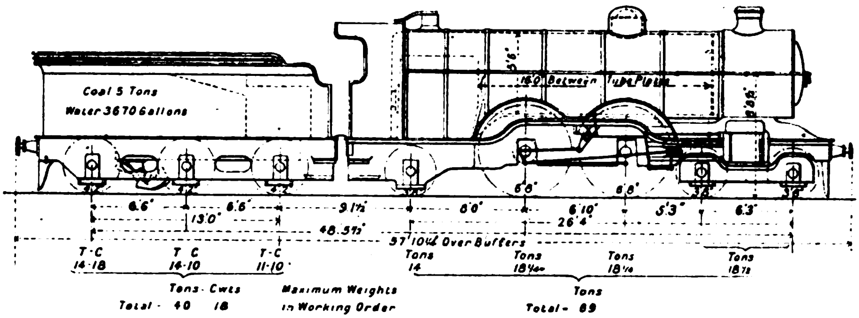


Fig. 23.—Four-cylinder Compound Express Passenger Locomotive, G.N.Rly.

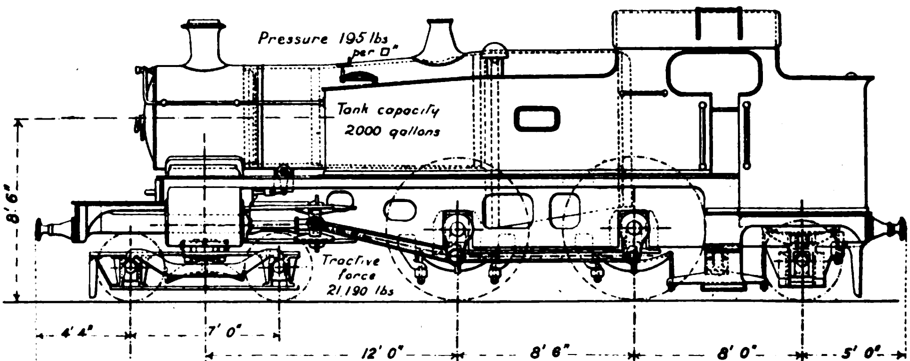


Fig. 24.—Latest Type of Passenger Tank Engine, G.W.R.

The principal dimensions are:—H.-P. cylinders, 13 ins. diameter by 20 ins. stroke; L.-P. cylinders, 16 ins. diameter by 26 ins. stroke; coupled wheels, 6 ft. 8 ins. diameter; coupled wheelbase, 6 ft. 10 ins., total wheelbase, 26 ft. 4 ins.; boiler diameter outside, 5 ft. 6 ins.; length between tube plates, 16 ft.; total heating surface, 2,500 sq. ft.; grate area, 31 sq. ft.; working steam pressure, 200 lbs. per sq. in.; weight on coupled axles, 36½ cwts.; weight of engine (without tender) in working order, 69 tons. A standard six-wheeled tender is provided having capacities of 5 tons of coal and 3,670 gallons of water.

On the L. & N.W.R. Mr. Geo. Whale, the chief mechanical engineer, has recently introduced a new class of locomotive having inside cylinders 19 ins. diameter by 26 ins. stroke, and three pairs of coupled wheels, 6 ft. 3 ins. diameter on tread. The front end of the engine is carried upon a four-wheeled radial truck, thus making the 4—6—0 type, and the boiler is of large proportions, having 2,049 sq. ft. of heating surface and 25 sq. ft. of grate area. The design conforms in respect of details to Mr. Whale's 4—4—0 type express engines of the "Precursor" class. The new locomotives have been specially designed for working heavy express passenger trains between Crewe, Preston, and Carlisle, on which sections some exceedingly trying gradients have to be negotiated.

Two additional de Glehn compounds have been put to work on the Great Western recently. They are numbered 103 and 104, and have about 10 per cent. larger dimensions than those of "La France," the prototype de Glehn locomotive introduced on an English railway. The two new engines are now working on the principal G.W.R. services, including the "Limited" expresses running from Paddington to Plymouth and *vice versa* without stopping. The high-pressure cylinders are 14 3-16ths ins. diameter by 25 3-16ths ins. stroke; low-pressure, 23⅝ ins. by 25 3-16ths ins. stroke; coupled wheels, diameter 6 ft. 8½ ins.; total heating surface, 2,755 sq. ft.; grate area, 33·35 sq. ft.; working steam pressure, 227 lbs. per sq. in.; tractive force, 27,713 sq. ft.

The de Glehn compound locomotive of similar design built by the Vulcan Works Co., of Newton-le-Willows, Lancashire, for the G.N.R., is just completing at the time of writing, but it is as yet too early to give the dimensions. The five "Atlantic" type locomotives designed by Mr. D. E. Marsh, the recently appointed locomotive engineer to the L.B. & S.C.R., will also be delivered very shortly They will resemble in many respects those of Mr

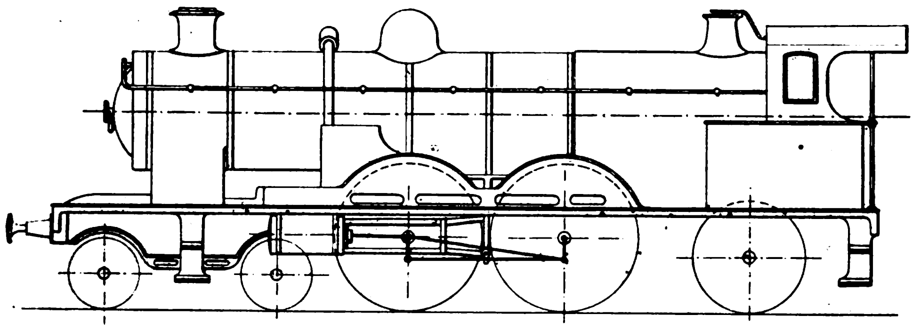


FIG. 25.—ONE OF THE NEW DE GLEHN COMPOUNDS ON THE G.W.R.

A new type of passenger tank engine has recently made its appearance on the Great Western Railway, having outside cylinders and the 4—4—2 wheel arrangement. Some of the proportions closely follow those of the "County" class express locomotives on the same railway, but a slightly smaller boiler is used. The engines, which are intended for fast passenger service on limited distance trains, have dimensions as follows:—Cylinders, 18 ins. diameter by 30-in. stroke; coupled wheels, 6 ft. 8 ins. (the largest used anywhere for tank engines); coupled wheelbase, 8 ft. 6 ins.; total wheelbase, 32 ft.; boiler (coned), diameter front end, 4 ft. 5¼ ins.; boiler diameter, firebox end, 5 ft. ½ in., total heating surface, 1,518 sq. ft.; grate area, 20·35 sq. ft.; working steam pressure, 195 lbs. per sq. in.

On the London & South-Western Railway Mr. Dugald Drummond has rebuilt the 720 class of four-cylinder simple express locomotives of the 4—4—0 (uncoupled) type designed by him some years ago for heavy passenger traffic. Larger boilers have been fitted having 1,760 sq. ft. of heating surface, but in the main the dimensions, except for those of the boiler, have not been altered. The larger boilers will, however, greatly increase the efficiency of the engines, as with four simple cylinders all taking high pressure steam, those originally fitted were hardly adequate in generating power.

H. A. Ivatt's 251 class engines on the G.N.R., but will have several noticeable features identified with "Brighton" practice as introduced by the late engineer, Mr. Billinton. Mr. Dugald Drummond's new 4—6—0 type passenger engines with four simple cylinders are nearing completion at Nine Elms works. Altogether the present year will have been a remarkable one in the annals of British locomotive engineering.

(*To be continued.*)

HEAT OF STEAM.—According to the *Export Implement Age*, a square foot of uncovered pipe, filled with steam at 100 lbs. pressure, will radiate and dissipate in a year the heat obtained by the economic combustion of 398 lbs. of coal. Thus, 10 sq. ft. of bare pipe corresponds approximately to the waste of two tons of coal per annum.

WIRELESS TELEGRAPHY FOR RAILWAY TRAINS.—The Chicago & Alton Railway Company has decided to supply with wireless telegraph apparatus all the trains between Chicago and St. Louis, which will not only keep the trains in constant communication with the stations—thus, it is hoped, rendering collisions almost impossible—but also permit the passengers to send what messages they please.

A Small Winding Machine.

By J. A. Dickinson.

THE machine about to be described is intended chiefly for model work, but may advantageously be used for more substantial jobs, if made large enough for the work in hand.

It consists of a baseboard and two upright pieces (A, B, C, Fig. 1), which latter are secured at a distance apart large enough to allow of a fairly long bobbin being wound. The baseboard (in this instance) is 10 ins. long by 5 ins. wide by ½ in. thick, and the uprights are 6 ins. by 4 ins. by ½ in., placed 8 ins. apart.

Bearings.—The general construction of the bearings is shown in Fig. 3; but as they differ in detail, they will have to be described. A is a block of wood 1 in. by ½ in., with a hole (equal to diameter of shaft D, Fig. 1) bored about three-quarters of the way through, when the block is cut out with a chisel to the shape shown at B. A piece of wood cut to the shape shown at C is next made, which piece must be a good fit in the slot just described, and form a true circle with the corresponding hole in the block. This done, the remaining portion is cut as shown at D (Fig. 3), and a lid made to slide over the whole length of the block—like the lid of a domino box. The holes are then lined with red-lead putty to ease the running. In the case of the bearing H, the hole is bored right through, and the shaft made long enough to take the handle on the other side of upright. In J′ and P a ¼-in. set-screw is secured into the block to take the winged nut, as at E (Fig. 3).

The uprights B and C should be slotted ⅜ in. wide for a distance of, say, 3 ins. up, so that the shaft J may be raised or lowered by means of the winged nuts and set pins to suit the diameter of any bobbin up to, say, 3½ ins. or 4 ins. At the bottom of the slot in B a semicircular hole should be cut for the reception of the brake K (Figs. 1 and 2). The bearings E, H, J′ and P can then be screwed in place on the uprights. This done, a piece of silver steel rod, or other approved material, ¼ in. or 5-16ths in. diameter, is cut to a length of 8¾ ins., and tapped from each end towards the middle to receive the two nuts L and M. The thread is then cut off, either by file or in the lathe, for a distance of ½ in. at one end—the end which fits into the bearing E, and for 1¼ ins. at the other, which latter end is filed square for about ¼ in. along from the end to fit in the handle. Of course, any other approved method of securing handle to

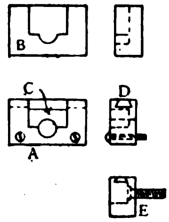


Fig. 3.
Details of Bearing.
(*Not to scale.*)

shaft would do just as well. To place a bobbin on the shaft, all that is necessary is to slide the lid of the bearing E and lift out the shaft—of course, the nut M being previously screwed on from the handle end before the handle is fitted. The washer N is then placed on the shaft, followed by the bobbin which is secured tightly on the shaft by means of the other washer and nut O and L; after which the other end of shaft can be replaced in its bearing. A similar piece of shafting (J), cut to a length of 7¾ ins., is next secured in the bearings as before described.

Q and Q1 are pieces of ⅛-in. silver steel rod, tapped at both ends to receive nuts, and placed in the positions shown in Figs. 1 and 2. The carrier for the wire is very simple, and can easily be understood from the drawing. The block R is bored so as to be a good sliding fit on Q and Q1. The arm is made from steel rod brazed to the block R at any desired angle. A top (S) is then brazed on to the arm to carry the swivel T and pulley U, which may be an old castor, with a blind-maker's pulley substituted for the wheel.

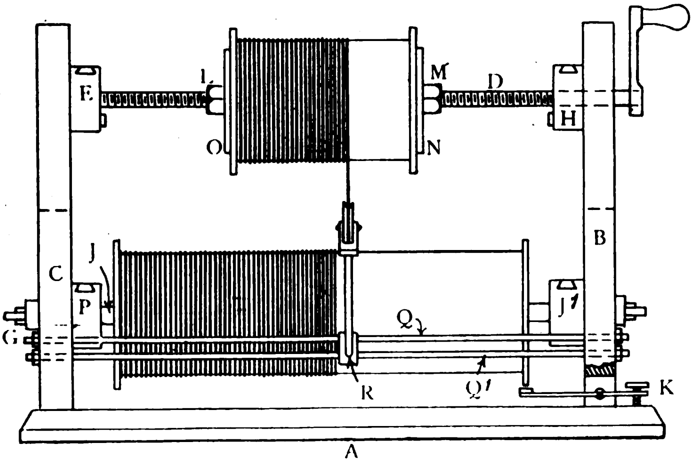


Fig. 1.—Front Elevation.

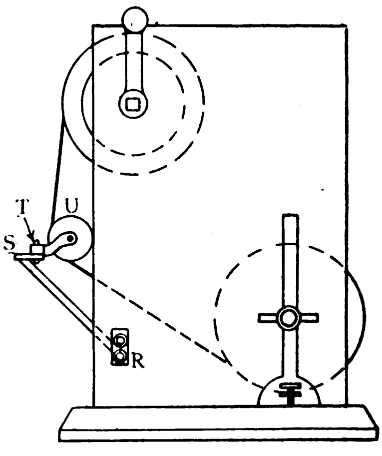


Fig. 2.—End Elevation.

A Small Winding Machine. (*One-third full size.*)

Brake.—This is shown at K (Figs. 1 and 2). and is for the purpose of preventing any slackness in the winding, thus obtaining a fairly tight wind. It merely consists of a piece of stout brass shown in Fig. 1, which should be capable of being bent to any angle according to the diameter of bobbin, and fitted with a piece of indiarubber to engage on the rim of the reel. It is secured in the middle by an ordinary wire netting staple driven into a block of wood secured to the base in the semicircular hole before referred to. A hole is then drilled in the other end of the brass a bit larger in diameter than the screw, which is then passed through the hole and tapped into the base, thus allowing of the adjustment of the brake to any desired pressure.

A description of the handle is hardly necessary, as the reader, if not having a ready-made one by him, can rig up one to suit his own convenience. The rods Q and Q1 should be kept well oiled, as also should the swivel T and pulley U, or else there might be some difficulty in getting the wire to run evenly. As the wire gets along the bobbin, the carrier slides along the rods, thus keeping the layers nice and rigid.

This little machine requires only a small amount of trouble in making, and is very inexpensive, and will be very useful to makers of medical and shocking coils, or, in fact, any other branch of electrical work.

The S.M.E. at Chatham and Rochester.

THE annual summer all-day excursion took place on Thursday, July 27th, when twenty-five members and friends journeyed from St. Paul's Station to Chatham to visit the Dockyard. The party was met at Chatham Station by Mr. W. Munro, who had most kindly consented to act as guide during the day. The Dockyard was reached at 11.30, and, under the guidance of Mr. Huxham, of the Chief Constructor's Department, a tour of inspection was made. To enumerate all the items of interest seen would be impossible. Perhaps the most interesting item was the partly completed hull of the first-class cruiser *Shannon*, laid down in January of this year; the colossal dimensions of the ship much impressed the party, as well as the great exactness with which the huge plates were fitted together. The workmen leaving for dinner shortly after the party arrived enabled a close inspection of the interior of the vessel to be made, and the pneumatic tools for riveting, chipping, etc., were shown in operation for the special benefit of the members, as also the large shearing, planing, and punching machines for working the plates. The large machine shops were gone through, and the party then visited most of the large basins and docks where warships of every description and age were to be seen, special notice being taken of the new 180-ton shear legs, and the new crane, which is capable of lifting 120 tons. The party left the Yard at 1.45 on a two-mile walk back to the centre of the town, passing on the way the Memorial arch to the Royal Engineers who fell in the Boer War, unveiled by his Majesty the day before. The heat of the day and the clouds of dust made the rest for lunch, which was found ready for the party at the Globe Restaurant, very acceptable, and after ample justice had been done to the good things provided, the party took entire possession of a passing 'bus, and proceeded in the direction of Rochester. The 'bus ride provided some of the most exciting moments of the day, the main street being, for the most part, "up," and side streets of a steep and tortuous character having to be traversed instead, along which the 'bus hurtled, swayed and jolted in most delirious fashion. Rochester was at length reached safely, and the party welcomed by Messrs. Pitts and Eddison, of Messrs. Aveling & Porter, Ltd., and conducted by those gentlemen over the very fine works of the company. These much exceeded in size and completeness what the party expected, and it was found that a whole day would not have been long enough to make a complete inspection of the works, where the world-famous steam rollers and traction engines are turned out at the rate of one a day. The works are most conveniently situated on the banks of the Medway, all the raw material being conveyed to the works by water. The company employs upwards of 1,500 hands, and the various shops are filled with a very fine collection of machinery, some of a very special nature for dealing with the various parts of their engines expeditiously. The foundry is very extensive, and the blast furnaces were seen in full operation; and the party were fortunately in time to see one tapped and the process of running one of the largest castings used in a steam roller. Steam rollers and traction engines are made throughout the works, from pattern-making to painting, and several were noticed undergoing steam and brake tests preparatory to being taken to pieces for shipment. Two of the largest traction engines ever built by the firm, which were almost ready to be despatched to Siberia, were also viewed. The time spent here passed all too quickly, and much that was of great

SOME MEMBERS OF THE LONDON SOCIETY OF MODEL ENGINEERS AT ROCHESTER.

interest had to be passed over very rapidly. At the close a hearty vote of thanks was proposed by Mr. Greenly to the directors and to Messrs. Pitt and Eddison for permission and guidance over the works. The party then boarded the same 'bus, specially retained, back to Chatham and tea, after which a short walk to see some of the landmarks of Chatham, under the able leadership of Mr. Munro, was taken, until the time arrived for the return to London, which the party reached at 8.45, all agreeing that one of the most enjoyable all-day outings of the Society had come to an end. Thanks are due to Mr. Herbert G. Riddle for the excellent way in which he made arrangements for the comfort of the members.

The "Holiday" Competition.

DURING the present holiday season, we have decided to award every reader who sends us a description and original photographs of anything of engineering or model-making interest he may encounter during his vacation, which shall be sufficiently good to warrant insertion in our journal. The prizes vary in value from 5s. to 10s. 6d., according to merit. All winning competitors will receive a notice of the value of the prize awarded, when they can choose the tools or other articles they may wish sent to them. All entries should be accompanied by a separate letter, marked on the envelope "*M.E.* HOLIDAY COMPETITION." This letter should include the title of the article and any other information not necessary for publication. The article should be written *on one side of the paper only*, with the name and address of the sender on the back. The photographs and separate sketches enclosed with the contribution should similarly bear the name and address of the sender, otherwise delay may arise in the awarding of the prizes. It is essential that the copyright of the photographs must be the property of the senders, and the covering letter should contain a declaration to this effect. The competition will close on October 16th.

HERTZIAN WAVE MEASUREMENTS.—The new oscillation valve of Prof. J. A. Fleming, F.R.S., makes ordinary electric oscillations measureable on a galvanometer by separating out the two opposite currents. It consists of a bulb enclosing a carbon filament, as in an incandescent lamp, the filament being surrounded by a metal cylinder, and the bulb highly exhausted. Negative electricity passes through the vacuum from the hot filament to the cylinder, but not in the reverse direction. With a dead-beat galvanometer, the valve can take the place of the coherer as a receiver in wireless telegraphy, the signals giving long and short deflections on the instrument.

A Model Hotchkiss Gun, and How I Made It.

By ARNOLD RILEY.

HEREWITH are photographs of a model Hotchkiss gun which I have made from the drawings given in Vol. III of THE MODEL ENGINEER. I did not read the articles, but only worked from the drawings given. First of all I made sketches, with dimensions of all the parts. In a few

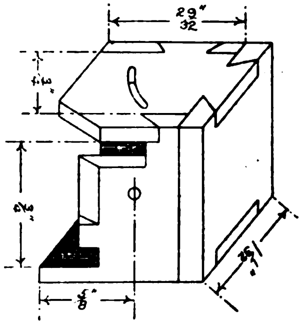


FIG. 1. THE BREECH BOX.

cases I made full-size drawings to see if the parts would work to these sizes. I then made a few alterations, as I determined to make it all of steel. I decided to make the barrel first, as this would be the worst to do, on account of the bore and rifling. I thought if I could get a rifle barrel this would simplify matters a great deal; so I went to a local gunsmith's, and there obtained a Winchester rifle barrel about 2 ft. long, hexagonal in shape. This, when turned up, was too small towards the breech end, so I shrunk a piece of Bessemer steel on, then turned and finished the barrel off complete (Fig. 2), except the chambering, which I did later.

I now commenced the sleeve—bored, turned, and ground it on to the barrel to a nice easy fit; then

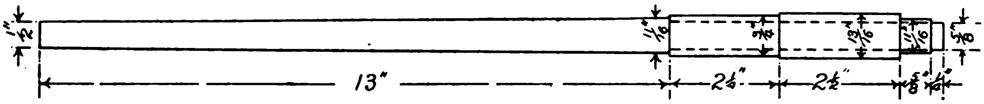


FIG. 2.—THE GUN BARREL.

made the recoil spring-box, and fitted both into the rocking bracket. Next I made the piece which fits on the barrel-end which holds the breech-box. Then I made the breech-box itself and the mechanism inside. This breech-box (Fig. 1) I made entirely without screws; this way takes longer making, but when finished is much stronger and more serviceable. Then I made the recoil-box which fits at the side of the gun, with its mechanism; then the cradle and stand.

I now purchased a box of ·22–13–45 Winchester cartridges, and chambered the barrel out to suit. Building the gun up, and working it by hand, I found that it worked the wrong way about. By the drawings given, to fire the gun the breech has to be away from the cradle—*i.e.*, in its recoiled position—whereas it ought to be hard up against the cradle; so I now had to re-make the recoil mechanism, so as to work the reverse way. I finished by making the shield and sights.

Now came the critical time—the testing of the gun by firing the first shot. My friend and I fastened it to the work bench, and fixed a small dynamo base casting of about 20 lbs. weight against both looked out to see if any gun was left, and I am glad to say it was all there, and all right. We then tried two other shots without the aid of the box. Since then I have fired about thirty rounds.

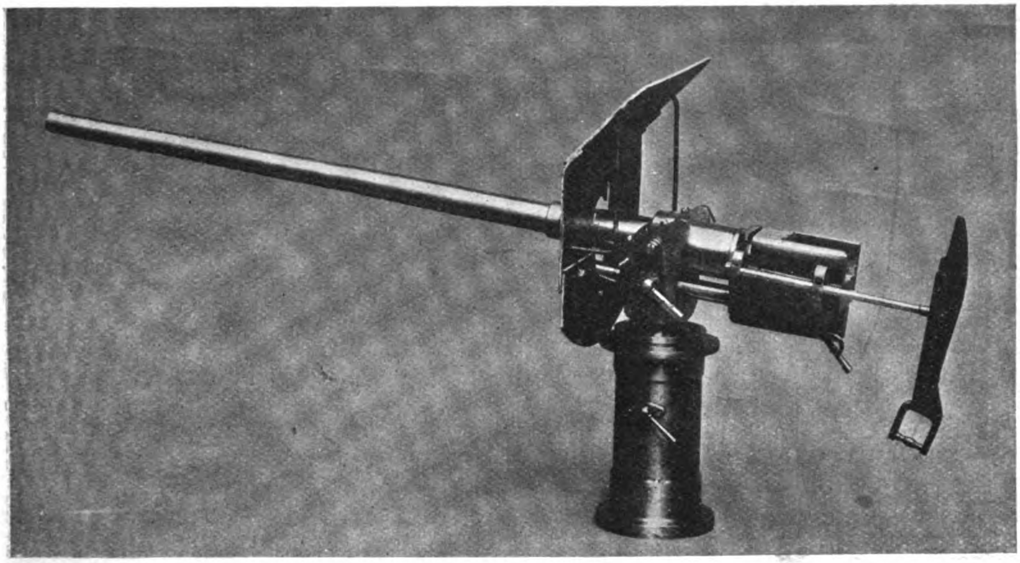


Fig. 3.—Mr. Arnold Riley's Model Hotchkiss Gun.

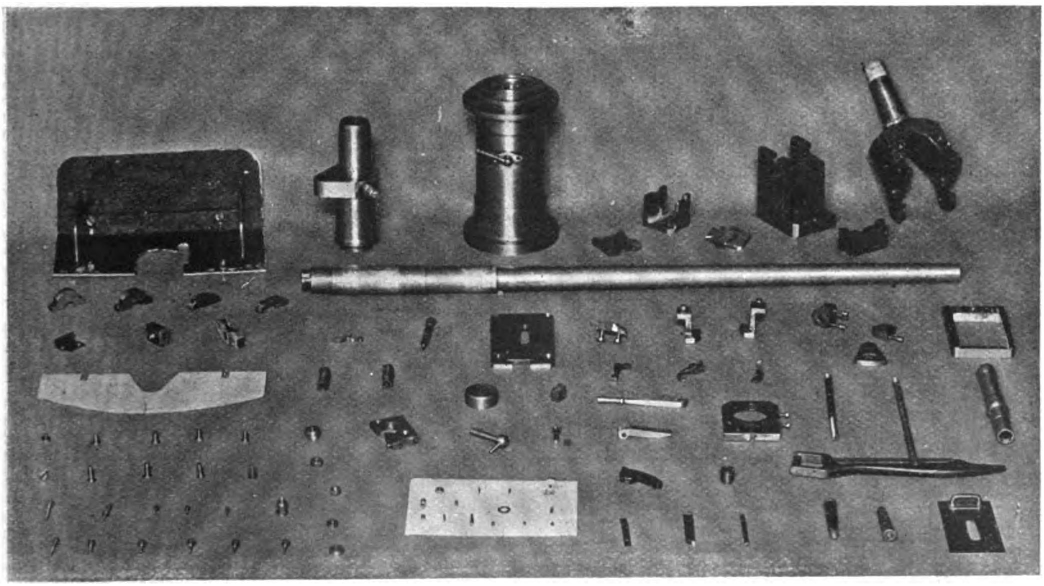


Fig. 4.—The Parts ready for Assembling.

the wall for a target. We put a large box beside the gun, and got behind the box. I then gave the trigger a light hit with a small hammer. There was a loud report, then silence and a smell. We

I completed the gun in just twelve months, the total hours spent in the making being 270.

The gun is composed of 167 parts, including all the screws, of which there are 40.

Practical Letters from our Readers.

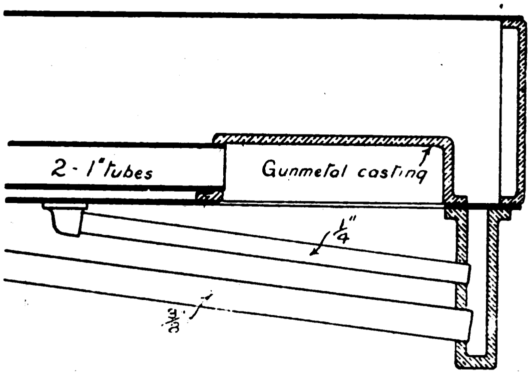
[*The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a* nom-de-plume *if desired, but the full name and address of the sender* MUST *invariably be attached, though not necessarily intended for publication.*]

A 1-in. Scale Model Goods Locomotive.

To the Editor of *The Model Engineer*.

Dear Sir,—As I mentioned in the letter you recently published in the Editor's Page, I am making a 1-in. scale model of one of the very fine Natal Railway goods engines. These engines have many points of interest to the model builder, and have very large boilers and fireboxes in conjunction with small driving wheels. The following are some of the leading dimensions:—Length of frames, 31 ft. 11 ins.; length of tender, 21 ft. 1⅜ ins.; width over platform, 8 ft. 6 ins.; gauge, 3 ft. 6 ins.; coupled wheel (four-pair), 3 ft. 9½ ins. diameter (ten spokes); bogie wheels, 2 ft. 4½ ins. diameter; cylinders (outside), 20½ ins. by 24 ins.; smokebox, 4 ft. 4 9-16ths ins. long; boiler barrel, 11 ft. 11¼ ins.; firebox (Belpaire), 9 ft. 9½ ins. long by 6 ft. 2½ ins. wide; diameter of boiler and smokebox, 5 ft. 11 ins. All boiler sizes are external over cleading.

To enable this engine to negotiate the curves, many of which are of only 300 ft. radius, and some reverse curves at that, on a 1-in-30 gradient, the leading coupled wheels are flangeless, and their centres are at 4 ft. 3 ins. The valve gear is on the Walschaerts system. I am making my boiler of the water-tube type, with a 4-in. solid drawn generator and ⅜-in. and ¼-in. water tubes, with upcomers as well as downcomers, as shown in the design in "The Model Locomotive," and with



Part Cross section of Model Loco Boiler.

a couple of 1-in. fire tubes, as shown in sketch. What do you think of the modification in the boiler construction? It will give about 100 sq. ins. extra heating surface, and will yet allow for a good range in water level. I may put some water tubes across the combustion chamber, in addition.—Yours truly,

Natal, S. Africa. W. G. E.

[The only drawback to the alteration is the extra number of joints, and, again, large tubes must be used, otherwise the draught through them will be poor. The construction offers no advantage in very small boilers.—Ed., *M.E. & E.*]

Queries and Replies.

[*Attention is especially directed to the first condition given below, and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-hand corner of the envelope "Query Department." No other matters but these relating to the Queries should be enclosed in the same envelope.*

Queries on subjects within the scope of this journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied, wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed. (4) Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of Replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor,* The Model Engineer, *26—29, Poppin's Court Fleet Street, London, E.C.*]

The following are selected from the Queries which have been replied to recently:—

[13,938] **Small Plant for Electric Lighting.** C. S. (Bristol) writes: I am hoping to light my workshop with electric light, and would be very grateful if you could answer me the following questions:—(1) What size (candle-power and voltage) lamps would I require for lighting my room (18 ft. by 12 ft.) in five places, and also two lamps in a small dark-room adjoining, making seven lamps altogether? (2) What size (b.h.-p.) oil engine would I require to drive the dynamo? (3) What voltage and watts must the dynamo be? (4) Would it hurt sometimes to drive it off the same engine as I am driving a 5-in. screw-cutting lathe? (5) What b.h.-p. engine would I require to drive lathe and dynamo together?

(1) This is rather a matter of taste; we may assume six 8 c.-p. lamps for the workshop and two 5 c.-p. lamps in the dark-room, say about 60 c.-p. total. (2) Oil engine should give ¾ b.h.-p. (3) A dynamo to give about 200 watts, say 35 volts and 5 to 6 amps. (4) The trouble with these small lighting plants is to get steady running; if you drive a lathe as well it will not affect the steadiness much, provided you get a fair amount of flywheel effect, such as would be obtained from a length of shafting and several pulleys. You want to wipe out the effect of starting and stopping the lathe and variation in cut, &c., as much as possible. (5) Engine for both lathe and dynamo should give about 1¼ b.h.-p.

[13,925] **Size of Parts of 500-watt Dynamo.** R. E. S. (Manchester) writes: I am making a 500-watt dynamo (Manchester type). I got the size of the field-magnets out of "Small Dynamos and Motors." Will you please tell me if a shaft ⅝ in. diameter will be large enough, and bearings 2 ins. in width? Also, will a commutator 2 ins. wide by 2¼ ins. diameter be correct? Do I need 24 slots for the armature (drum), and would you have a 24 or a 12 bar commutator. The armature is 4½ ins. diameter.

We advise you to make the shaft ⅞ in. diameter at the centre of core and ¾ in. diameter at the bearings, which should be then at least 2 ins. in length. The sizes you give for commutator will do very well; presuming you are winding for, say, not less than 25 volts, a brush 1 in. wide would do very well to carry the current, so you need not have more than 1½-in. length of useful surface if you are at all tied for room. If you are winding for 100 volts, a ⅝ in. wide brush would be ample. We advise you to have 24 slots in the armature core and wind with 24 coils, two in each slot, commutator to have, of course, 24 bars; 12 coils, however, would do for anything up to 100 volts and 12-bar commutator, but would not run so nicely. We do not advise less than 24 slots in the core for either case.

[14,354] **Small Dynamo Failure.** T. W. B. (Dartford) writes: I have made a 5-volt 2-amp. Simplex dynamo to instructions in "Small Dynamos and Motors" (armature 1½ ins. diameter, drum 8 slots, commutator 8 bars, winding in eight sections). No. 22 s.s.c. wire used throughout. It runs well from 800 to 1000 r.p.m. from a 4-volt 18 amp.-hour accumulator, but I cannot get anything out of it as a dynamo, although I have tried everything I can conceive, both with speed (which is derived from powerful water motor), changing connections, and exciting the field-magnet coil with two Leclanché cells. I have wound iron wire over the armature to decrease air space, which is about 1-32nd in. I wanted to charge a 4-volt pocket accumulator from this dynamo. Could you give me any advice as to finding what fault I have made, or what are the likely causes of failure in my case? Also a diagram of connections. Do you think that the field-magnets are magnetised enough? If not, what is the smallest current required to do same? In winding both the field and armature, I found there were a few inches of wire which would not work in, so I cut them off. Would that matter? or would failure result if I did not have quite the full weight specified. If you can give me a few hints as to remedy, I shall be greatly obliged.

You have encountered a common difficulty with small drum armature dynamos—viz., failure to excite; especially is this the case if the armature does not run very close to the pole-pieces. The best thing to do is to increase the number of conductors on the armature, and use silk covered wire, so as to get on as many turns as possible. We advise you to rewind the armature with No. 25 gauge s.s.c. copper wire; get on as much as you can. Use an 8-volt 1 c.-p. lamp to test with and run at about 4000 revolutions per minute. If you can get the machine to excite, do not worry about the higher volts, but use some resistance wire in series with your accumulators, say, about 3 yds. of No. 28 bare German silver wire. Leclanché cells are not of much use to excite the fields; a bichromate battery of two or three cells in series is better. The slight shortage of wire is not the cause; it is due to the large gap and insufficient residual magnetism. For connections see our handbook. Also try the brushes in various positions.

[14,450] **Small Dynamo Construction.** H. K. M. (Bearwood) writes: Thanking you for advice some time ago, I should be much obliged if you could assist me in the following: I am making a dynamo as near as possible to the one described by J. B. Emmont on leaf from THE MODEL ENGINEER herewith, with cog ring armature. In the making of the wrought field-magnet it got accidentally made 4½ ins. inside height, instead of 3½ ins. Now, if I increase diameter of armature to 3¾, will this put matters right? Also, could you state what S.W.G. wire I shall require to get output at 10 volts. I suppose painting field-magnets will not hurt?

The 3¾ ins. diameter armature will be an improvement. Use the same field winding and No. 20 gauge D.C.C. for the armature. You can adjust the voltage by altering the speed accordingly—higher speed, higher voltage; lower speed, lower voltage. Painting the field-magnet will do no harm at all.

[14,344] **Electric Trolley.** C. R. T. (Tufnell Park) writes: I am making an electric trolley as described in THE MODEL ENGINEER of May 11th, 1905 (page 439). However, as I wish to make mine a little larger, I shall be very glad if you will kindly answer the following queries. The armature is tripololar, 1½ in., by 1½ ins., pole-pieces 1 3-16ths in. by ¾ in. What gauge and weight of wire would be the best to wind them with to take from 4 to 8 volts? About how many amperes will it take? If possible I should like the same gauge wire on poles and armature. Could you also give me a sketch of switch and connections for switching in or out four cells of an accumulator to run the motor at different speeds?

We advise you to use a series winding for your motor, and not a shunt winding as used by the author of the article, series being more suitable for traction work. Wind the armature with No. 24 gauge D.S.C. copper wire and the field-magnet with No. 20 gauge D.C.C. copper wire, both coils being connected in series with each other and in series with the armature. Get on as much wire as you conveniently can on both armature and field-magnet. The weights should be rather more than those given in the article in proportion to the enlarged size of your motor. By winding the field coils as a

FIG. 1.

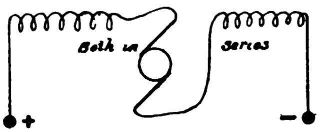


FIG. 2.

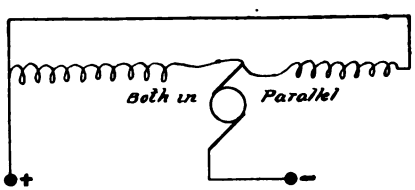
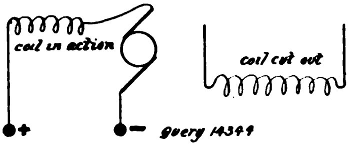


FIG. 3.



DIAGRAMS OF CONNECTIONS FOR AN ELECTRIC TROLLEY.

series winding you will be able to try them in two ways—namely, with both the coils in series with each other and in parallel with each other (Figs. 1 and 2). This will have a perceptible effect upon the speed with a given voltage, and is worth trying to find out which method suits best. Of course you must take care that the coils are connected to produce N. and S. poles. Further, the motor would run with a single field coil only in series with the armature, the other being cut out of circuit, and thus give a third effect (see Fig. 3). Herewith is a sketch of switch for accumulator. It is necessary for the switch

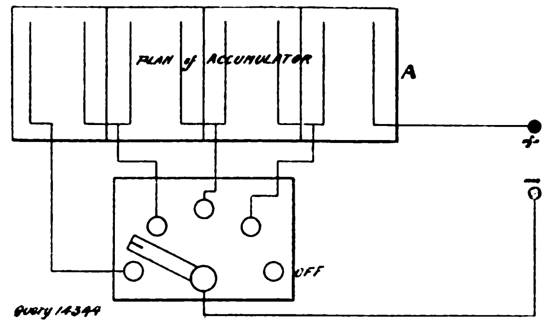


FIG. 4.—REGULATING SWITCH FOR ACCUMULATORS.

contact to be of less width than the distance between any two of the contacts, so that it can never touch two contacts at the same moment as this would short-circuit the cell. We point out that this method of speed control will cause the cells to be unequally discharged, so that you should take the precaution of testing the voltage of the separate cells and having them recharged, as soon as the end one (A) or any other has been discharged to a point at which its voltage is 1·8 volts. It would be advisable to change over the connections from time to time, so as to avoid always running down the same cell. Fig. 4 shows regulating switch similar to that shown in Chapter 3 of our Handbook No. 24 (page 33).

[13,968] **Converting a Telephone Magneto Machine to Lower Voltage Dynamo.** T. W. (Hackney) writes: A short while ago I bought a dynamo which had been taken from a magneto telephone. I have got most of THE MODEL ENGINEER series of Electrical Handbooks, but can only find a reference to this kind of dynamo in the book about Telephones, but this does not help me. I should like to know what I could use it for? I tried it on a bell, a small lamp, and a galvanometer, but it had no effect, although by touching two wires from it I got a strong shock. The dynamo is made up of four magnets, with a Siemens H-armature, wound with thin wire tied in place. What I want to know is: (1) Can I use it for lighting? If so, what alterations must I make on it? (2) What voltage and candle-power lamp should I use? (3) If it cannot be used for lighting, what use can I make of it? I do not want to make a telephone. I may mention that during the three or four months I have been a reader of your paper I have got much useful information from it.

(1) Yes, the armature is probably wound with too fine gauge wire to be of any use for lighting lamps; we advise you to try rewinding it with No. 24 gauge D.S.C. copper wire, and regard it as an ordinary shuttle armature machine. You can either fit an ordinary two-section commutator, joining one end of the coil to each section, in which case it will give continuous current, or you can use it connected to a pair of slip rings, or with its present contact arrangement, in which case it will give out alternating current. Either kind of current will light small lamps. (2) The voltage will vary directly as the speed, so you can adjust it to suit your lamps. Try running at about 3000 revolutions per minute, and use an 8-volt or 6-volt 1 c.-p. lamp as a trial. We should prefer to fit a two-section commutator and take off continuous current, as alternating will only be effective with special apparatus except lamps. (3) See above.

[13,948] **300-watt Dynamo Windings.** L. H. (South Kensington) writes: I herewith enclose a rough copy (not reproduced) of the castings of a 50-volt 6 amp. dynamo. Will you please tell me how much wire I shall want for the field-magnets, also for the armature? The core is 1⅞ ins., which, if I allow 1-16th in. all round, will make the stampings 1¾ ins. What sort of stampings should I want? The gauge and the amount, as the armature would want to be 4½ ins. in length.

Armature stampings to have 8 slots, each 5-16ths in. wide by ½ in. deep, and wound with eight coils, two in each slot; wire to be No. 22 gauge D.C.C. copper wire; get on as much as you can; about 8 ozs. will be required; commutator to have eight sections. Mr. A. H. Avery, of Fulmen Works, Park Street, Tunbridge Wells, would supply the stampings. He sells them at so much per inch of length. Field-magnet to be wound with about 3 lbs. of No. 23 gauge S.S.C. copper wire on each core; both coils to be joined in series with each other, and in shunt to the brushes; speed about 2,800 revolutions per minute. You can adjust the volts within limits by running at higher or lower speed. Get the armature to run rather closer than 1-16th in. if you can, say 1-20th in. clearance.

[13,974] **200-watt Dynamo Windings.** "SHEFFIELD" writes: I am making a small two-pole dynamo of the following dimensions for 35 volts 6 amps., 2,400 revolutions per minute. The armature is 3·5 ins. long, 3 ins. diameter, built up of 140 lamination of twenty-four cog drum type. Each slot is 0·125 in. by 0·5 in., each lamination is separated by paper, and is varnished each side. I am wiring the armature for a 24-part commutator. What would be the width of these bars? The wire upon the armature is about 1·5 lbs. of No. 18 S.W.G. D.C.C., of sixteen conductors in each slot, taking 384 conductors about 5·5 ins. long; in all 58·2 yards. I am wiring the armature as follows:—Starting at slot No. 1, leaving the end loose, No. 1 to No. 13, 13 tap for commutator 13 to 2, 2 to 14, 14 tap for commutator 14 to 3, 3 to 15, 15 tap for commutator, and so on, until once around containing eight conductors in each slot, which I am calling the bottom coils, which are only half full. Now starting with the top with eight more conductors in each slot, this time filling each slot in its turn, starting with the top 13 to 1, 1 tap for commutator 14 to 2, 2 tap for commutator 15 to 3, 3 tap for commutator, and so on until around once more, this time filling each slot up and connecting the finishing end 12 to the loose end of No. 1 for the last connection to commutator, thus completing the circuit. The slots are slightly out of parallel with the shaft. Does this matter? The pole-faces are turned so as to clear the armature by ·0625 in. It is 3·5 ins. long; the yoke is 3·5 ins. high by 2·4 ins. diameter. I am trying to put upon the two field coils 5.5 lbs. of No. 20 S.W.G. D.C.C., about 440 yds. in all, upon a tin cylinder with vulcanised ends to slide over the yoke.

The commutator bars can be any convenient width; about ⅛ in. is a fair dimension. For armature winding, see our handbook on "Small Dynamos and Motors," Fig. 48, page 36; you seem to have the right idea according to your description. When winding into slot 13 you keep to that side of the shaft, so as to have shortest length of wire. In the figure referred to in our handbook, the coils are wound side by side. It does not matter if the slots are not quite parallel to the shaft. Your field wire is of too thick a gauge for efficiency; No. 22 gauge would be better.

[13,958] **Cells for Series Fan Motor.** S. DE N. (Camberwell) writes: Will you kindly help me on the following subject? I have made a 4-volt series fan motor by the kind help of the *M.E.* (Query 12,165, June 13th, 1904), and I now wish to make a set of batteries to work same. I came across a leaf of a trade catalogue (name not known) some time ago, which I have enclosed, giving a description of a set of I type Edison Lelande cells, which you see they claim will work their motor 125 hours. I have your book, "Electric Batteries," but you do not give how to make this type of cell. I likewise looked through my back numbers, and I see a form of Leclanché cells is given in "Practical Facts about Batteries," June 25th, 1903, but it differs from the cells in "Electric Batteries," but the sizes given in this handbook seem near about the same as this catalogue gives. Could you kindly tell me—(1) Would a set of these cells work my motor anyway near the time they claim for theirs? (2) If so, could you give me sizes of jars, zinc and cases to hold copper oxide? (3) How many of these cells would I require? (4) Do you think the bladder valve on cell is preferable to the oil to exclude the air from electrolyte? If oil is used, would it not cover the elements when cleaning cells out, or how is this prevented? (5) By the appearance of picture in "Electric Batteries," there is one plate each of zinc and the copper oxide in each cell. Is that correct? (6) Probable cost to make these cells, myself, a novice.

(1) We cannot say precisely; it depends upon how much current your motor takes. Best thing to do is to make a trial. (2) The larger you make your batteries the better; actual sizes do not matter; but the zinc plate should be about the same area as the iron plate. (3) The chief drawback to this cell is its low voltage, which is only about ¾ volt per cell, so that you would require six cells in series for a 4-volt motor. (4) We advise you to work to the description in THE MODEL ENGINEER. (5) There is one plate of zinc and one plate of iron, with copper oxide attached in each case. (6) See MODEL ENGINEER, page 612, following the description of the battery.

[14,432] **Running Small Motor from the Mains.** W. B. (Barry) writes: I have been looking in several books, also your "Small Motors and Dynamos" handbook, to try to find the dimensions and windings to make a small motor to run direct off a 230-volt continuous current circuit. I see in several of your answers to queries that you recommend to run a small motor in series with a resistance; but as a motor running on a low voltage will require more current than if running on a high voltage, I should like to make one to run direct from the mains. I want to make one to blow an organ which a weight of 24 lbs. will bear down lever, which requires about 20 strokes a minute; and I should deem it a great favour if you would advise me the best dimensions and windings, as I have looked in back numbers of your valuable paper THE MODEL ENGINEER for the last three years, but cannot see what I want. I have had several valuable hints from your paper, but I can't find this one, so awaiting a reply at your earliest opportunity.

See our handbook No. 14, page 50 and Chapter IV, for small motors to run direct from electric light mains. Use a series winding and gear motor down to a crank wheel, so as to give desired number of strokes per minute; the 1-6th h.-p. size would probably suit; 220-volt speed will not be much increased at 230 volts. It would be a good plan to put a flywheel on the motor shaft.

[14,426] **Amalgamating.** H. W. (Harrogate) writes: Can you tell me how to amalgamate or cover brass wire and the insides of brass cups with mercury? Will it be sufficient to clean the brass with emery paper, and fill the cups, or will treatment with an acid be required? These are for mercury contacts for electrical apparatus, and the cups, when once filled with mercury, would be left full, and the wire hooks dropped in when contact is desired.

Mercury readily amalgamates with brass if the surface is clean. It will be sufficient to merely put the mercury into the cups. As regards the wire, you may find it necessary to use a dipping acid; but try the cleaned wire first.

[14,427] **Bichromate Battery for Hand-Lamp.** A. S. (Walkford) writes: I have here a chemical electric hand lamp, but I do not know how to charge it. The body of the lamp forms a container, which is divided into six compartments. Fixed to the cover of the container are 24 carbons and zincs, which are connected up in series, and allow four to drop into each division. As you unscrew the cover, the zincs and carbons are raised out of the fluid, and, of course, the light goes out. I have taken it to a chemist, and he tells me the solution required is bichromate of potash and sulphuric acid. What I should like to know is—(1) Whether the sulphuric is to be mixed with the bichromate of potash, or whether kept separate in alternate compartments? (2) Whether the sulphuric acid is to be pure or diluted? (3) If diluted, to what specific gravity?

The chemicals are to be mixed together, as follows, into a solution which is placed in each compartment. Bichromate of potash 1 part by weight, concentrated sulphuric acid 2 parts by weight, water (ordinary) 6 parts by weight; add the acid to the water very slowly; also see our handbook No. 5 on "Electric Batteries," post free 7d. A better solution is chromic acid powder, 5 ozs., water, 2 pts., concentrated sulphuric acid 3 ozs. But the first will answer very well.

[14,425] **Winding for Small Dynamo.** S. B. (Plumstead) writes: I am constructing a small dynamo, as shown in Handbook No. 10, page 18, Fig. 8. The field-magnets are cast iron 4 ins. high, 2 ins. wide, and ⅜ in. thick. The wire space on same is 2 ins. by 2 ins., and each limb holds ½ lb. No. 20 D.C.C. wire, and would hold more. The armature is 1½ diameter by 2 ins. long, and is an eight-cogged drum, in four sections, and is wound with about 2 ozs. No. 24 S.C.C. wire. What output may I expect from the machine? Would a water motor from the household supply be powerful enough to drive the same? Could you tell me what back numbers of THE MODEL ENGINEER give instructions for making one? If you don't think the above wiring is correct, I should be very glad of your advice and corrections. I have built the armature with ordinary sheet tin laminations. Will they do or must they be charcoal iron?

Wire on field-magnet is of too thick a gauge. We advise you to re-wind with No. 22 gauge S.C.C. copper wire, and to get on as much as you conveniently can up to a depth of about ⅜ in. Join both coils in series with each other, and in shunt to the brushes. Armature winding will do as it is. At a speed of about 4000 r.p.m. you should get about 6 or 8 volts and 1½ amps. Test it with an 8-volt 1 c.p. lamp. The voltage can be adjusted by running at higher or lower speed. *Re* water motor. You will find particulars in THE MODEL ENGINEER for December 15th, 1901, and also September 3rd, 1903, and pages 10 and 11 of our Handbook No. 9. It depends very much upon the pressure of water supply, but in all probability you could drive such a small dynamo very well in this way. *Re* armature laminations. If material is tinned iron, they will do; but this material is also made of soft steel, and may not then be suitable. Test a piece by means of a magnet: if it is attracted by it, the material can be used.

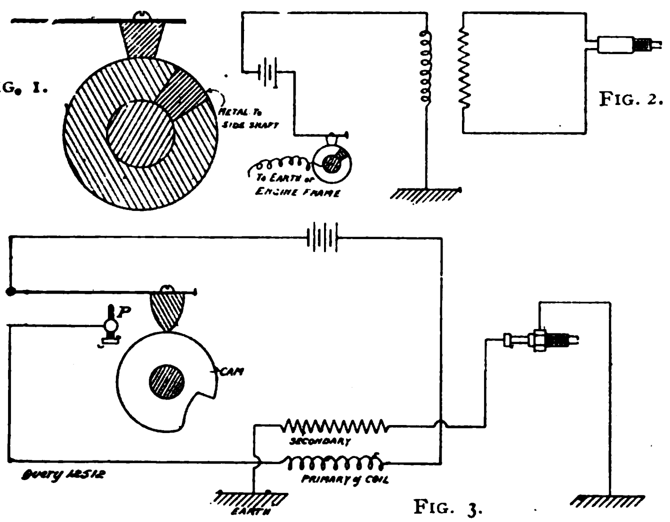
[14,394] **Small Series Machines.** H. S. (London) writes: Kindly answer me the following queries: (1) Can a 10-watt dynamo be made as Fig. 5, page 16, in your book, "Small Dynamos and Motors," and wound as a "series" machine? (2) For the purpose I require, it must be with drum armature eight slots. Kindly give winding for field-magnets and armature. (3) Can the armature be wound for a four-part commutator? (4) Would this make any difference in the amount of wire that would be required if wound for eight-part commutator? Please give above for 5 volts; also 10 volts.

(1) Yes, but we presume you understand that a series machine will only work with a given load, or within very small range. (2) Wind armature with No. 22 gauge D.S.C. copper wire for 5 volts, and No. 24 D.S.C. for 10 volts. Get on as much as you can. Wind armature with eight coils, two in each slot, and an eight-section commutator. Wind field-magnet with No. 20 gauge D.C.C. copper wire. Weights are given in the winding table on page 46 of our handbook. (3) Yes, four coils and four-section commutator can be used; but we should prefer eight, as above. (4) Wire is practically the same for either number of coils; four coils would take slightly more, perhaps. For a given speed the voltage will only be obtained at one definite rate of amperes output. On open circuit the machine will not excite, and it will only do so when a certain speed and current output is reached, which means when the re-

sistance in the outer circuit falls to a certain critical value. These remarks apply to all types of series-wound dynamos.

[12,512] **Fitting Spark Ignition to Oil Engine.** H. C. D. (Orcheston-St.-Mary) writes: I am making an oil engine from castings supplied by Messrs. Madison & Co. I enclose a drawing (a copy of those sent with castings) of the arrangement of valves, &c., at back of cylinder. Can you tell me (1) What alterations to make, so that I can use electric spark ignition instead of hot tube—with drawing? (2) What size coil would be necessary to supply spark? I have a small one about 2½ ins. long, giving a very small spark. (3) Can you also kindly explain the drawing enclosed (not reproduced) to the left of the words "tap for oil," as I do not understand the drawing of the "air regulator"?

You would have to bore through into the combustion chamber and insert a spark plug. This would be connected to the coil and contact-breaker. You would have to fit an insulated collar on the half-speed shaft, so that only at one point in every revolution



FITTING SPARK IGNITION TO OIL ENGINE.

of the half-speed shaft the circuit in the primary of the spark coil would be closed, as shown at Fig. 1. The circuit would then be as Fig. 2. Another and rather similar method would be as shown in Fig. 3. In this case, instead of an insulated collar on side-shaft (half-s. s.) you use what is really a cam. When the cam revolves it allows the spring contact-maker to touch the platinum point P, and so make circuit through the primary. (2) A coil of at least ¼-in. spark length in air will be needed. (3) By screwing in or out the set-screw shown on your drawing, the amount of air drawn in at that pipe is limited. Judging from your drawing, air is admitted at two places, viz., here, and also at the main air inlet valve, which works by suction. We cannot give further particulars from this drawing, but no doubt you will be able to sift the matter out when you have the actual castings before you. We trust these details will assist you.

[14,438] **Accumulator Plates; Spark Coil.** J. H. B. (Redcar) writes: Will you please answer me the following questions? (1) Is the chloride of lime used in forming accumulator plates, the same as is used for disinfecting purposes? (2) What quantity should I put in one quart of water? (3) Do litharge plates want forming? (4) What current will No. 20 soft iron wire carry for resistance coils, same to be stretched on hardwood? (5) I have an unfinished spark coil; primary wound with two layers of No. 18 D.C.C. The secondary is wound 5 ins. long by ½ in. deep with enclosed sample of wire. What size wire is this? (6) How much more shall I put on to obtain a ½-in. spark? I have a condenser.

(1) Yes. (2) Continue to put in the chloride of lime until the water does not absorb any more. (3) No; but you must not expect the accumulator to hold its charge well until it has been recharged several times. The first charging should be continued until the liquid gases well. (4) About 6 amps. (5) No. 36 gauge. (6) You will probably require a total weight of ¾ lb. for the secondary; see our Handbook No. 11.

[14,431] **Batteries; Electric Lighting; Induction Coil.** J. W. W. (London, N.). writes:—I enclose three queries, together with stamped addressed envelope, for replies to which I shall be thankful. (1) Batteries. I have amalgamated some zinc plates for a bichromate battery, which I do not very often use. As recommended by Mr. Early in a back number of THE MODEL ENGINEER, I kept the zinc plates, without the carbons, in a pot covered with water. According to Mr. Early, this should preserve the amalgamation; but I have found that the mercury gradually comes off and collects at the bottom of the jar in a globule. Do you know of any method of preventing this, and keeping the plates in good condition? (2) Electric Lighting. (a) I have what professes to be an 8-volt ½-amp. lamp. Can you tell me of any simple way of testing the amount of current flowing through it without using a voltmeter or ammeter? I have a standard Daniell cell. (b) What should the candle-power of the above lamp be? (c) How many lamps should I require for an ordinary deck room lamp? (3) Induction Coil. I have just finished a spark coil, built after the pattern laid down in Chapter 4 of your little book on "Induction Coils" (MODEL ENGINEER series, No. 11). Particulars are as follows:—*Core:* Bundle of soft iron wire, 23 gauge, 6 ins. long, and 11-16ths in. diameter; covered with one layer, half-lap, of ½-in. tape. *Primary:* Two layers No. 20 D.C.C. wire wound on top of tape-covered core. *Insulation* between primary and secondary consists of three layers of 5 ins. width stout calico stitched on, and then a covering of two layers of thick brown paper. *Secondary:* Wound in four sections, 10 ozs. No. 36 S.C.; layers are insulated with paraffined paper; bobbins are 1 in. long, 1 in. internal diameter, and 2½ ins. external diameter; 3 ozs. of wire on each two middle bobbins, 2 ozs. on each two outside bobbins. *Condenser:* Tinfoil sheets, 3½ ins. by 6 ins.; 50 sheets, paraffined paper between each sheet; ½-in. margin all round tinfoil. (a) When I put two ordinary bichromate cells (plates 6 ins. by 1½ ins.) on to coil, I can only get a continuous spark of ¼ in. (carefully measured). Battery solution was not fresh, but consisted of $K_2Cr_2O_7$ and H_2SO_2, as mentioned in book on "Primary Batteries" (MODEL ENGINEER Series No. 5). I can get small sparks from the iron core or the primary terminals by a wire from the secondary electrode, the other being insulated. Can you suggest any reasons why spark is not longer? There is a small spark at contact-breaker while working. Do you think condenser is too small or, perhaps, leaky? (b) How many of above-mentioned bichromate cells (single fluid) can I safely put on? (c) Do you think that the trouble is due to the insulation of the condenser not being quite perfect? (4) How much current would the coil take when giving ¼-in. spark?

(1) This should only be excess of mercury, as an amalgam is formed between the mercury and zinc all over the surface of the latter. We should advise a small pool of mercury at the bottom of the jar, so that the zinc is standing in the mercury. (2) Electric Lighting. (a) We can only recommend you to use an ampere meter. One amp. will deposit ·005084 of a grain of copper per second. If you have an accurate sensitive balance and can rig up a voltmeter, you may find out the current flowing through the lamp from this figure; the current must be kept constant. (b) About 1 c.p. (c) Depends upon your requirements. One such lamp may suffice; make a trial. (3) Induction Coil. (a) The primary winding is wrong. No. 18 gauge wire is given in our handbook as the proper size. Increase the battery power. As the coil gives ¼-in. spark now, it will probably give ½ in. if you have a more powerful battery. Try three to four good bichromate cells in series. If the condenser was at fault, you would scarcely get any spark at all. You can easily try by disconnecting the condenser. (4) Cannot say exactly—probably 2 or 3 amps.; depends partly on the way the coil is used.

[14,392] **Small Accumulator Troubles.** E. J. S. (Bapchild) writes: I have six negative grids I wish to fill in, and on referring to your book on Small Accumulators, I see that you recommend precipitated lead. This I have tried, and find that it will cost about 18s. to fill all six plates. Can you tell me if I use litharge and sulphuric acid, will that answer the same purpose, and come cheaper; and is there any further process besides pressing the paste into the plates? Or is there any other kind of paste that will do? The plates are 4 ins. by 3½ ins. by ¼ in. Or had I better buy plates already formed, as they will only cost about 10d. each? The fact is I have bought a second-hand accumulator, and on being told that the plates were to be properly cleaned, as it was only the lead that was wanted, I did clean them, and now the charge will not stop in longer than about one hour. The moment I received your book I could see I had done wrong. I have filled the positive plates in all right by the recipe you give in your book.

Litharge can be used; it should be mixed into a paste with 1 part sulphuric and 2 parts water. It is merely pressed well into the grids and smoothed off. This method is very largely used. We should recommend you to have a try at making the plates yourself. Remember to give a prolonged charging until the liquid gases well for the first charge. Twelve to twenty-four hours or more are often necessary; and do not discharge until the first charge is complete. Also note that an accumulator may not hold its charge well at first, but should improve with each successive charge.

The Editor's Page.

A READER in Natal, whose letter on the difficulties attending the purchase of model engineering supplies direct from the manufacturer in the United Kingdom appeared on this page in our last issue, sends a further interesting communication on the same topic. In this letter he proposes a remedy, and, in most cases, we do not think that any formidable obstacle would arise were his suggestions adopted. However, we shall be very glad to hear from any other of our large circle of Colonial readers on the subject.

* * *

"Would it be possible for you, in connection with your 'Expert Service Department,' to have a special buyer, who would, for a fixed commission, undertake to purchase, inspect, and stamp with a specially designed stamp to prevent substitution, machines, tools, models, &c. (either new or second-hand), for Colonial and foreign readers of your most useful and interesting paper. Such an office would be able to get us goods on the best terms, and we might then be sure that the goods were of the right quality, which, as an Englishman, I am sorry to say, is by no means always the case when orders are sent direct, some firms seeming to think that anything will do for the Colonies. As a matter of fact, none but the best of the class ordered should be sent, as, if anything is wrong, long delays occur before the purchaser can get any deficit made good, besides which, it leads to loss of trade, as one can generally rely on Americans sending the goods as advertised. Some years ago, I imported a patent lathe shaper, which cost £15 15s., or thereabouts. When it arrived, I found that none of the sliding surfaces had been scraped true—they were left showing the planer or lathe (as the case might be) tool marks, and were rough to the touch. When I tried to fit the vice table to my lathe saddle it would not go on, though I had sent the slide as a guide, and when this was made to fit the ram did not work truly. I could get no redress. On another occasion I ordered from a well-known firm of English lathe makers a hard steel mandrel, and collar to be fitted to my headstock. When it arrived and was put to work, an iron turning got into the oil hole and jammed the mandrel. On taking the mandrel out, I found both mandrel and collar scored over 1-64th in. deep. This surprised me, and I tried them with the tang of a file, which easily scratched both. Since that I have sent to America for my tools, including two lathes costing £70 (second-hand), and got the tools I wanted according to catalogue specification in every respect. Had you had such a department I should certainly have made use of it, as I should have saved duty, &c., by getting English goods. I have also seen lathes of their make here that they would never dream of showing at home—centres not meeting, pulleys and hand-wheels with blow holes fitted, &c. Can you wonder at the Americans gaining ground under such circumstances? If you can see your way to acting on this suggestion, you will, I feel sure, confer a boon on your Colonial readers which will be greatly appreciated."

Answers to Correspondents.

J. C. S. (Harrogate).—You must experiment. See our handbook, "Model Steam Turbines," price 6d., post free 7d., from this office.

A. W. S. A. (London, N.W.).—We understand that the Wirral Model Yacht Club's *Era* covered a given distance at a speed of ten miles an hour. The boat was described in our issue of Nov. 26th, 1903. See the articles on Speed Steamers in the issue of June 11th, 1903.

W. F. (Reading) and J. L. (Bradford).—We cannot consider your queries as within the scope of the department.

F. S. Y. (Croydon).—Many thanks for your letter. We do not think it of sufficient general interest to publish.

Notices.

The Editor invites correspondence and original contributions on all amateur mechanical and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected or not, and all MSS. should be accompanied by a stamped addressed envelope for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

This journal will be sent post free to any address for 13s. per annum, payable in advance. Remittances should be made by Postal Order.

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Contents.

[*The asterisk (*) denotes that the subject is illustrated.*]

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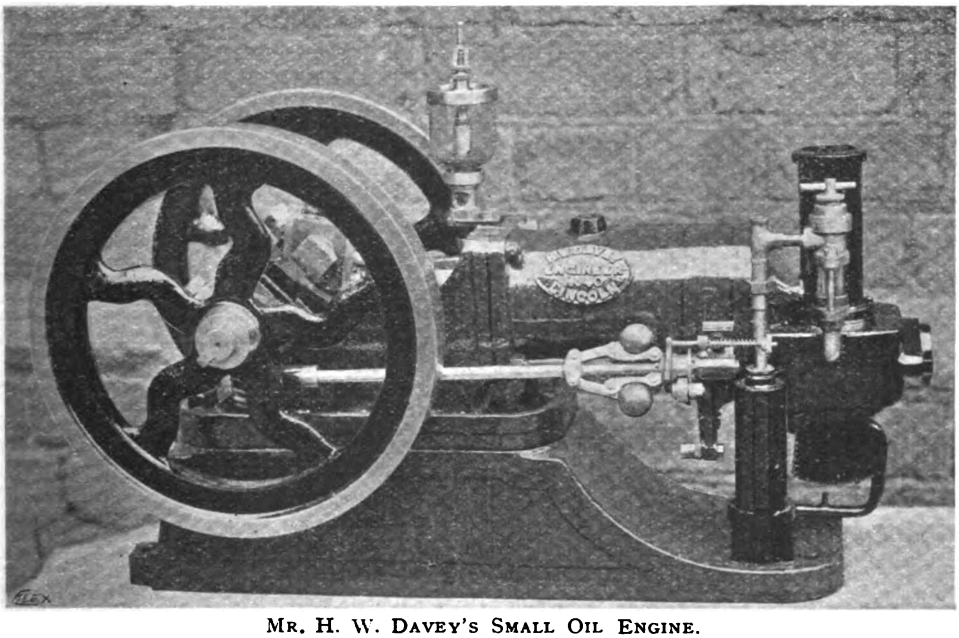
A Small Oil Engine.

By H. W. DAVEY.



MR. H. W. DAVEY'S SMALL OIL ENGINE.

THE photograph herewith reproduced represents a small horizontal oil engine, of ⅓ h.-p., which I fitted up a short time ago for the purpose of driving a small corn-grinding mill, which object the engine fulfils splendidly. The dimensions of engine cylinder are 2¼-in. bore, 4½-in. stroke; flywheels are 13 ins. diameter, and weigh 20 lbs. each. Ordinary paraffin is the fuel used, and the lamp that heats the ignition tube also heats up the vaporising chamber. The oil is admitted to the vaporiser by the needle valve and sight-feed plainly seen in the illustration. After being vaporised in the hot chamber, it is drawn by the piston to the admission valve, where it is mixed with a suitable supply of air, and admitted into the cylinder for compression and explosion by the ignition tube at the back end of cylinder.

The governor, which can be seen on the side shaft in the photograph, holds open the exhaust valve when the engine runs above speed, preventing a charge from being drawn into the cylinder until the speed decreases.

I may say that, although the name-plate on this engine describes the maker as an engineer, he is really quite an amateur, having been greatly helped by THE MODEL ENGINEER.

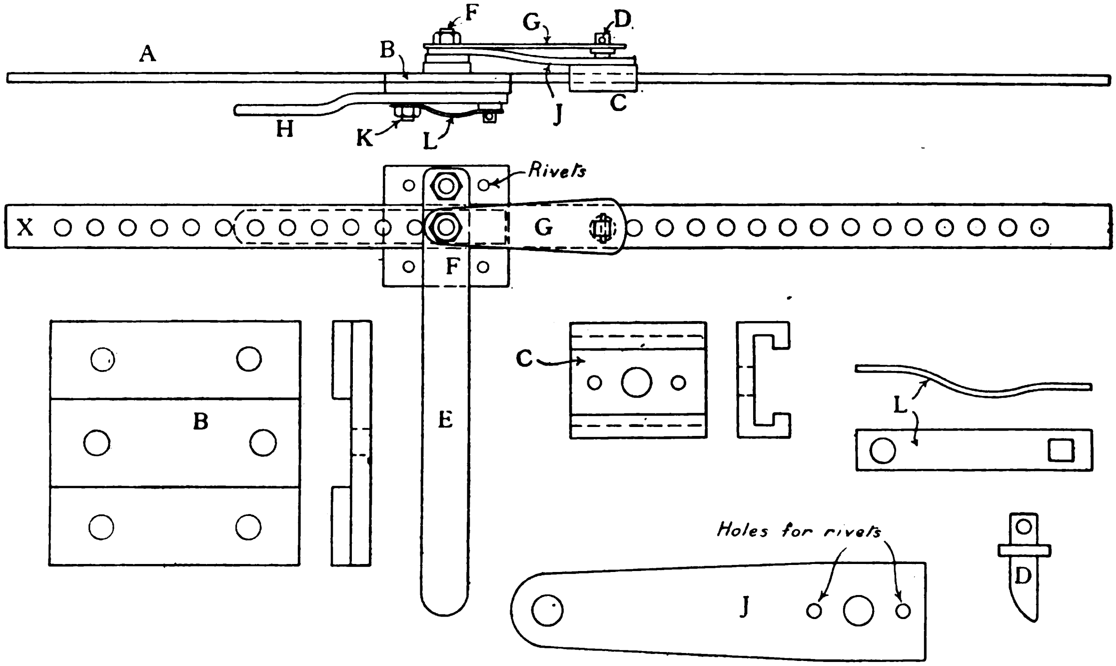
Workshop Notes and Notions.

[Readers are invited to contribute short practical items for this column, based on their own workshop experience. Accepted contributions will be paid for on publication, if desired, according to merit. All matter intended for this column should be marked "Workshop" on the envelope.]

A Novel Wire Strainer.

By John Heyes.

This tool consists of an iron bar drilled at intervals with holes. The bar slides through a guide, as shown at B in the drawing, consisting of a flat iron plate, with the flat sides riveted on with countersunk rivets; along B slides a piece of iron, shaped as shown at C; this iron piece is riveted on to J. Through J and C a hole is drilled to receive D, consisting of a piece of steel turned as shown and the ends filed. The square at top has a hole drilled through to take a small pin; over this square, on D, is slipped a strong spring (G), with a square in one end to fit top of D; the other end of spring ha sa hole to fit over E. The bolt F is passed through hole in handle (as shown), then J is put on over the handle, and the spring G over J, and bolted up. Through the end of handle a bolt is passed to fasten it down to B. These bolts should have pins through them to prevent them working loose. The action consists in the part C sliding along a hole length on bar; when handle is pushed forward the bevelled edge of catch D allows it to slide from one hole to another. When pushed forward, but when over a hole, the spring forces it into the hole. Now, on pulling back the lever the bar is pulled back a hole length. If there was anything pulling at the bar, it would want something to hold it whilst a fresh hole was being obtained with catch D. Whilst in this position the bar is held with a catch similar to D, passing through guide frame B. A bolt (K) also passes through frame B; over this bolt passes the spring L; one end has a square hole to fit square on catch; this square is placed over catch, and held in position by tightening the nut on bolt K. I intend attaching to the end of bar A a Dutch tong arrangement. As it is, I have lifted over 350 lbs. from the floor by fastening a strong wire to wall, and the other end to H, the guide block being at X end of bar, and the weight attached to the other end with a rope over a pulley, the bar being racked through guide block.



Details of a Novel Wire Strainer.

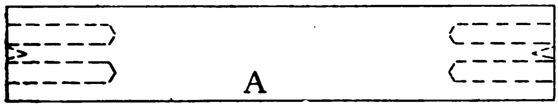
A Method of Making Wing Valves.

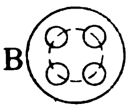
By W. F. G. Bradford.

The following method of making wing valves, with three or four wings, suggested itself to me two or three years ago, when requiring valves for a model force pump. For valves with only 3-16ths in. or $\frac{1}{4}$ in. stem it does not seem worth while to make patterns and obtain castings.

All the material required is a piece of stick brass or gunmetal, slightly larger in diameter than head of the valve required. Truly centre each end for turning, not countersinking for lathe centres till the last thing. On one or both ends scribe a circle equal to the stem of valve. Equally divide this into three or four as desired; dot punch, and drill parallel with axis of stick, using a drill which suits the space required between the wings, taking great care to drill to the same depth each time, this depth to equal length of stem.

Now countersink each centre mark as much as possible in very small valves without running into the already drilled holes. The turning may now begin, but great care must be exercised, and very fine cuts taken, on nearing the holes, in turning stem; and if in a single-geared lathe difficulty is experienced with the S.R. tool or hand tool, pursue this part of the work by carefully filing whilst revolving, with safe edge next collar or head of valve. Partly shape each valve, and caliper carefully to match them, and when satisfied, cutting off with parting tool may be continued. Have the heads sufficiently thick to permit of a screwdriver slit being taken a short distance in, as this will be





A Method of Making Wing Valves.

found very useful when grinding in, and preparing the seatings. This last operation can be performed in the lathe, very good results being obtainable.

A less shapely, but still satisfactory valve can be made by turning straight away, and then before cutting off, file three equal flats on the stem. But, of course, the flow in this case is not equal to that resulting with the former more detailed valve.

A Rivet Head Former.

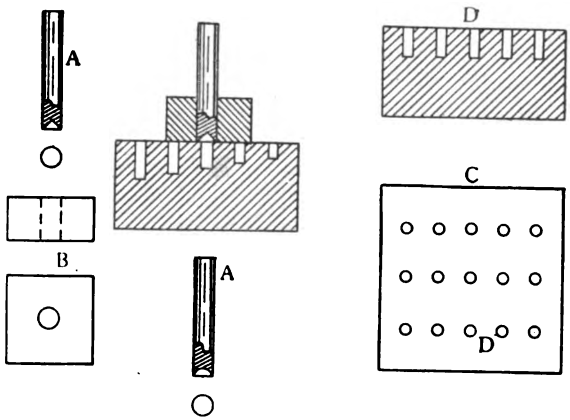
By J. H. P. B.

The sketch herewith shows a simple rivet head former, fitted with cup and conical head punches. A A represent the punches; these are made of good quality steel, turned to a sliding fit to suit the hole in guide B, one end being made to suit cup or snap head; these should then be hardened in the usual manner. The guide B is made of cast iron, a hole being drilled in the centre to take the punches. The block C is also C.I., holes D D being drilled in the top side to take various diameters and lengths of rivets. This will be found a useful tool where several odd size copper rivets are required, as they can easily be made from copper wire of the right size.

A Peculiar Electrical Effect.—According to the *American Electrician*, a peculiar effect on patients while being electrically treated has, under certain conditions, been observed. It appears that while under treatment the hands and faces of the patients would sometimes become black, especially if the weather were cold; and on a thorough examination being made, it was found that this peculiar condition only occurred when the chair on which the patient was seated was positive and the crown of the head negative. In the room were open fireplaces, and in them were placed oil-heaters to keep the room warm; and it was discovered that the minute carbon particles given off by the burning oil in these lamps, although too minute to be visible in the air, were the cause of the hands and faces of the patients becoming dark. When the polarity of the chair and the crown of the head were reversed, the phenomenon could not be obtained, nor could it be produced on days when the oil-stoves were not burning.

The Latest in Engineering.

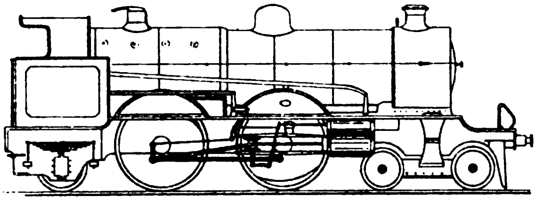
New Steamer for North Pole Expedition.—The famous Arctic explorer, Lieutenant Peary, intends this summer to start on another voyage in search of the North Pole. The steamship in which he is to make the attempt is the *Roosevelt*, which has been built in Maine expressly for the voyage. The hull of the vessel is of oak, with heavily-braced oak and hard pine timber. The hull has been constructed by Messrs. McKey and Dicks, Buckport, Me., and the machinery by the Portland Company, Portland, Me. The length of the ship is 180 ft., and the breadth 32 ft. She has three masts, and is rigged as an ordinary three-masted schooner. Under ordinary conditions it is intended to use the sails alone, but auxiliary steam power may be used when required, either to increase the speed or to force the vessel through the ice-floes. The engine-power is sufficient to enable the vessel to proceed under steam at a good rate of speed, without any dependence on the sails, if such a course should be necessary. The hull is very heavily constructed, so as to enable it to resist all pressure, and the cross-braces, which are spaced about 3 ft. apart, start at the bow and extend aft as far as the boilers, which are slightly astern of the middle of the ship. The keel is of 16-in. square oak, and the timber used to brace the bow is 16 ins. by 24 ins. oak. Outside of the bow, in the vicinity of



Details of a Rivet Head Former.

the water-line, there is an extra thickness of 3-in. planking, which is covered with ½-in. boiler plate. The main engines are about 1,400 h.-p., and are of the usual compound marine type. The cylinders are 24 ins. and 52 ins. in diameter, and 30-in. stroke. The propeller shaft is 12 ins. in diameter, and carries a four-bladed propeller 8 ft. in diameter; and provision is made for removing two of the blades, since two-bladed propellers are considered safer and more effective than four-bladed for ice-breaking. There is a single Scotch boiler, 10 ft. in diameter and 12 ft. long, with three furnaces. There are also two Almy water-tube boilers.

The New de Glehn Compound Locomotive, G.N.Rly.—The particulars of the new de Glehn four-cylinder compound locomotive, designed and built for the Great Northern Railway Company by the Vulcan Works Company, of Newton-le-Willows, Lancs., which Mr. Chas. S. Lake was unable to include in his "Notes on Locomotive Practice" in last week's issue, have just come to hand. The engine has H.-P. cylinders, 14 ins. by 26 ins.; L.-P. cylinders, 23 ins. by 26 ins.;



THE NEW DE GLEHN COMPOUND LOCOMOTIVE, G.N.R.

coupled wheels, 6 ft. 8 ins. diameter; total wheelbase, 2,514 sq. ft.; grate area, 31 sq. ft.; and working steam pressure, 200 lbs. per sq. in. The boiler is 5 ft. 1⅝ ins. diameter outside, 11 ft. 11 ins. long, and is pitched with its axis 8 ft. 10 ins. above rail level. The firebox is 10 ft. in length.

Improved Railway Car Axles.—During 1904 an important improvement in the manufacture of railway car axles was patented in the United States, Europe, and Canada, and a plant for the manufacture of axles by this method is to be erected in Germany shortly. The process consists in taking a heated steel billet, round, octagonal, or hexagonal in cross-section, and depositing it in a system of dies

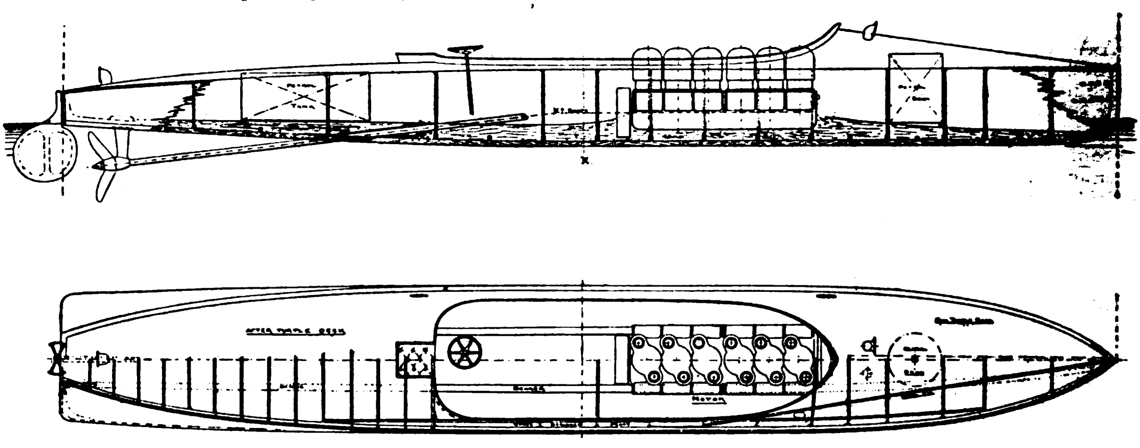


FIG. 1.—PLAN AND ELEVATION OF THE 300 H.-P. MOTOR LAUNCH, "BROOKE I."

all of which are split horizontally in order that the upper halves may be lifted so as to enable the billet to be introduced. The dies are then closed by heavy hydraulic pressure, and while the middle part of the die system, embracing the centre part of the axle, remains stationary, the two outer parts, one at each end, are moved longitudinally towards the stationary centre part, filling and upsetting the metal, inside and between, then ejecting and shearing off the surplus metal, and finally, by a special arrangement of heading dies, forming the inside collars. Additional strength, as compared to the hammered axle, is claimed for this method, because the outer hard skin remains intact, and the flow of the metal exists throughout the entire cross-section of the billet instead of only on the surface, and the entire axle is exposed to an immense static pressure from end to end, which should beneficially affect the structure. It is also claimed that by this rapid method of forging and by doing away with rough turning and centreing—this latter being done in the upsetting action—as well as by effecting a reduction of 80 to 90 per cent. in scrap, a saving of 33 per cent. is made in cost of manufacture, when taking the difference in prices between billets and rough turned axles.

Racing Motor Launches.

The New 300 h.-p. Boat, "Brooke I."

AMONGST the English racing fleet on the Solent this year, one of the most prominent boats is a racer which has just been built and engined by Messrs. J. W. Brooke, of Lowestoft, for the joint ownership of Captain B. D. Corbet and Mr. Mawdsley Brooke. The length of the launch is just under 40 ft., so as to comply with the 12-metre limit; the extreme breadth is 5 ft. 6 ins., and the draft of water at the greatest immersed section of the hull is 12 ins. only.

Notwithstanding that the cutting down of weight has now reached a fine art, this boat has been given a good factor of safety; it is all very well to design a hull on the egg-shell principle of construction, but quite a different matter when one is pounding in a rough sea in a cross-Channel race, and straining the motor to make record time. And when dealing with such enormous power as this launch possesses, it is absolutely essential to pay great attention to strains due to propulsion, and to determine the size and distribution of the various material, so as to meet these various forces.

As shown in Fig. 1 herewith, the motor bearers are of ample strength, extending the full length of the launch, and in conjunction with the American elm keel they form a splendid backbone to the whole fabric, giving great longitudinal strength, and affording a solid foundation for the 300 h.-p. motor.

The strength of the boat, although by no means inadequate, has been increased by the addition of steel angle-bars, stringer plates, and tie angles.

The diagonal lines of this boat are long and narrow, showing just a slight roundness as they extend from bow to stern; they should, as the boat forces her way ahead, offer very easy pathways to the streams of displaced water. The underwater body has been kept fairly flat, merging into a nicely rounded bilge, which in its turn is gradually lost as it approaches the transom. She has been given a very fair freeboard, combined with a good fore turtle deck, ensuring ample protection in any ordinary weather, and for negotiating bad weather a portable light steel superstructure can be fitted completely over the well, with just a small aperture aft for the steersman. This is shown on the accompanying drawings, for permission to reproduce which we are indebted to our interesting contemporary the *Motor Boat*.

After the design of the hull, the chief consideration in a racing launch is the motor, and in this case it is a six-cylinder engine developing over 300 h.-p. (shown in the accompanying photograph). It is very compact, and when looking down at it from the deck it seems hardly possible that each cylinder accommodates a piston 10 ins. in diameter and the crank-case a six-throw 8-in. stroke crank. Each cylinder is cast separately with its water-jacket; two water inlets are provided to each cylinder, one above the exhaust valve, and one above the combustion chamber. By this it will be seen the cold water enters at the right places.

As seen in the construction plans of the boat, the valve chambers are not set square with the motor; this helps to keep the crank-case narrow, with considerable saving of weight. The inlet and exhaust valves are both mechanically operated, and made interchangeable, the inlets being on the starboard side, and the exhausts on the port. The hollow cam-shafts are operated by large outside spur wheels, and by slightly moving the shafts the exhaust valves are arranged to lift on the compression stroke, in order to facilitate starting. Each shaft has seven bearings, thereby ensuring perfect alignment and easy running. The cast-steel crank-case is in two sections, with five intermediate bearings for the crankshaft; the bolts holding these down are continued up, and perform the same operation for the cylinders. Six large inspection doors are arranged on each side, through which all the connecting-rods and bottom ends can be easily got at if required.

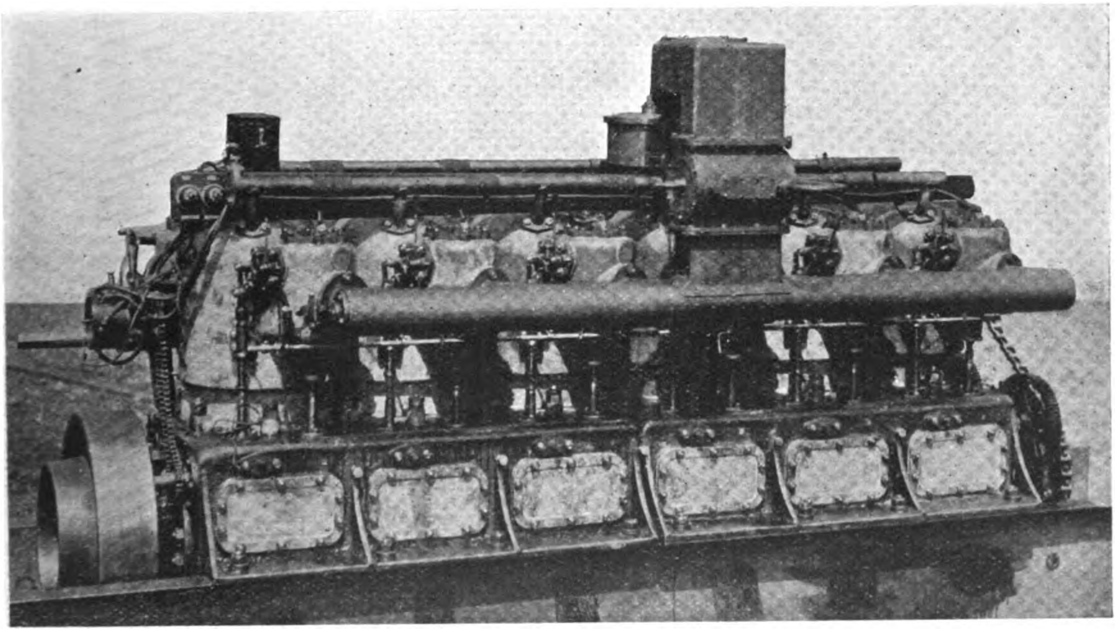


FIG. 30.—THE 300 H.-P. ENGINES OF THE MOTOR LAUNCH, "BROOKE I."

The flywheel carries an internal metal-to-metal expanding clutch, which conveys the power through two universal joints to the reverse gear, which is of the ordinary jar type, a through forward drive being obtained.

Before the races a very smart piece of work had been accomplished by the builders, Messrs. J. W. Brooke & Co. Whilst running a trial at Southampton early last week, an exhaust valve stem had broken, and the valve had jumped into the combustion chamber of the sternmost cylinder. The piston, on rising, drove the valve through the head, and burst it. Mr. Brooke went off to Lowestoft, a gang of moulders was started on a new cylinder on Monday night. The cylinder, which weighed over 2½ cwt., was cast on Monday at mid-day, and it was machined and completed by Friday evening, work never ceasing for a minute during 4 days 22 hours, one gang of men being followed by another, and relief men coming on at meal times. Mr. Brooke returned to Southampton with the cylinder, and by Saturday night the engine was again ready.

The eliminating race on August 1st did not turn out a success, only four competitors were able to start, and of these the *Napier* broke down soon after starting, *Napier II* being the only vessel to complete the race. The *Brooke I* and St. Cumming's *Competitor* broke down at the fifth round, the former, whose bilge pump was choked, having made the better time.

FIG. 3.—MOTOR BOATS IN SOUTHAMPTON DOCKS AWAITING THE RACES.

The reliability trials, however, was a most representative gathering. Some of the competing boats are shown in the accompanying photograph awaiting the regatta.

THE HARDEST METAL.—The success of tantalum as a material for electric lamp filaments has drawn attention to the remarkable properties of the metal, and may lead to many demands if the supply can be sufficiently increased. Chief of these proper ties, as Dr. Mollwo Perkin points out, is extreme ductility combined with extraordinary hardness. A diamond drill, rotating 5,000 times a minute for three days and three nights, penetrated only a quarter through a sheet of tantalum 1-25th in. thick; and the diamond was much worn. This hardness suggests the use of the metal for drills, in place of the diamond.

For the Bookshelf.

[Any book reviewed under this heading may be obtained from THE MODEL ENGINEER *Book Department, 26–29, Poppin's Court, Fleet Street, London, E.C., by remitting the published price and the cost of postage.]*

ASTRONOMY FOR THE GENERAL READER. By C. F. Chambers, F.R.A.S. London: Whittaker and Co. Price 1s. net; postage 3d.

This book is an interesting one, in that it gives the general reader a comprehensive conception of the fascinating science of astronomy. It is an exceptionally cheap book, and comprises some 250 pages and 130 illustrations. We can therefore heartily recommend the work to any of our readers wishing to know something about the wonders of the heavens.

CASSELL'S CYCLOPÆDIA OF MECHANICS (Fourth Series). Price 7s. 6d.; postage 6d. extra.

The fourth volume of this well-known series of reference books sustains its excellent reputation for usefulness to the mechanic. It comprises 350 pages and over 7,000 well-indexed items.

WIRELESS TELEGRAPHY.—The wireless telegraph system is being tried on the Chicago and Alton Railway, and trains running at 50 miles an hour have received messages at a distance of 30 miles from the sending station.

An Amateur's Steam Models.

By Henry J. Croft.

THE photographs shown herewith are of my two model horizontal steam engines and boilers. Fig. 1 is the result of my first attempt. The cylinder is ½-in. bore, 1-in. stroke, which I purchased; but it was so badly made that I practically re-made it, with gratifying results. All the other parts are made from scrap, except the flywheel, which I bought. It is mounted on a sheet brass plate, which is screwed to a majolica ware bed, marked out to represent brickwork, and makes a very firm one. With 10 lbs. of steam it will travel over 1,500 revolutions per minute. The boiler is all copper, 10 ins. high, 4½ diameter, with a 1½-in. central flue and five ⅜-in. cross tubes, all made from one sheet. All the fittings I made, except the steam gauge (which serves both boilers). Water is supplied from the tank seen at side with a hand-pump, the exhaust steam keeping the water very hot.

The one shown in Fig. 2 is a reversing engine; cylinder ¾-in. bore by 1½-in. stroke, lagged with mahogany. It is built up from ⅛-in. thick solid-drawn brass tube, with flanges brazed on. The reversing motion is Stephenson's link. Lever, quadrant, and

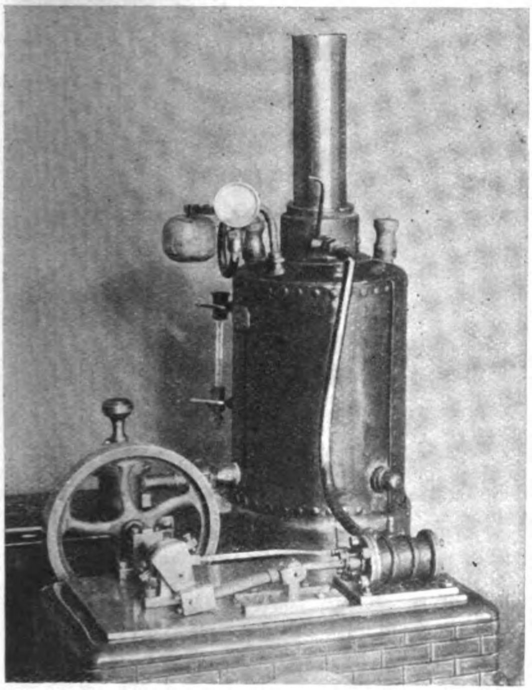


Fig. 1.—A Model Engine and Boiler.

top of link can be just seen in photograph. All parts were made from scrap, as in the smaller one, and likewise mounted on brass plate, with turned brass pillars on mahogany base. It does not travel quite so fast as the smaller one, owing to its not being able to keep up so much steam pressure. The boiler is all copper, and was really made for a launch. It has a conical flue, 2 ins. to 1 in., a top with cross tubes, and all necessary fittings. I intend to fit pump to it eventually. All turning was done in a small watchmaker's lathe (being just able to get the length of shaft between centres),

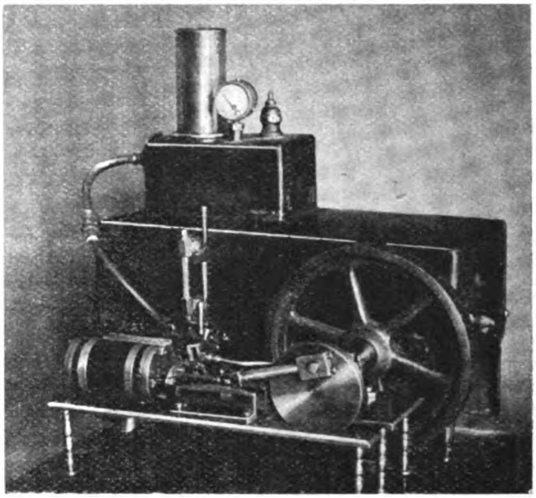


Fig. 2.—A Model Reversing Engine, and Boiler.

and with a bow, which is rather tedious work beside a foot lathe.

I may say that I am indebted to The Model Engineer for many wrinkles, and have taken advantage of them in these models.

The "Holiday" Competition.

DURING the present holiday season, we have decided to award every reader who sends us a description and original photographs of anything of engineering or model-making interest he may encounter during his vacation, which shall be sufficiently good to warrant insertion in our journal. The prizes vary in value from 5s. to 10s. 6d., according to merit. All winning competitors will receive a notice of the value of the prize awarded, when they can choose the tools or other articles they may wish sent to them. All entries should be accompanied by a separate letter, marked on the envelope "*M.E.* Holiday Competition." This letter should include the title of the article and any other information not necessary for publication. The article should be written *on one side of the paper only*, with the name and address of the sender on the back. The photographs and separate sketches enclosed with the contribution should similarly bear the name and address of the sender, otherwise delay may arise in the awarding of the prizes. It is essential that the copyright of the photographs must be the property of the senders, and the covering letter should contain a declaration to this effect. The competition will close on October 16th.

Lessons in Workshop Practice.

XXI.—Practical Notes on Selecting and Using Small Dynamos and Motors.

(*Continued from page* 154.)

By A. W. M.

Testing a Shunt-wound Dynamo.—This method of field-magnet winding is quite opposite in its working to the series system of winding in this respect, that whereas the series wound dynamo will not excite at all at no load, that is open circuit, the shunt-wound dynamo is more likely to excite on open circuit than if a load is on; and again, if it is tested by means of a piece of thick copper wire as a load, it would not excite at all. If the machine is a small one, say, not larger than about 60 watts, it may be tested to ascertain that it is in working order by means of a hand wheel or the driving wheel of a lathe; do not put any lamps or other load on, or connect anything to the terminals, but merely drive the armature at suitable speed. If the dynamo is in order, a peculiar humming sound will be heard, and the armature will commence to run stiffly as soon as a certain speed is reached, whilst sparks may appear at the brushes, these effects disappearing when the speed is reduced. You may now feel assured that the machine is in working order and try it with a load on; it is at this stage that the novice may be puzzled to find that perhaps the dynamo does not excite, though working well without any load. When this occurs, it merely indicates that the resistance of the circuit which has been connected, whether lamps, resistance wires, or accumulators, or whatever form it takes, is too low to permit the machine to excite. As an example take a very small machine indeed, about 10 watts output, a size often made by the novice as his first attempt, the machine excites well on open circuit, so the novice tries it with some load by connecting a 4-volt lamp, thinking that as the machine has been wound for 10 volts, he is well on the safe side in trying a lamp requiring very low voltage, with the result that the machine fails to light the lamp. The reason for this would be that though the lamp requires a voltage so much lower than that which the dynamo is intended to give, and which it does give with only a voltmeter on, the lamp takes a comparatively large current to light it well, and its resistance is too low, so that any current which may be generated by the armature is practically diverted through the lamp, and there is not sufficient flowing through the magnet coils to cause the field to build up, as it is termed. By joining two or three such lamps in series with each other, or connecting a 10-volt lamp of small candle-power, say, 1 c.-p., the machine may excite at once, and light the lamps. A similar difficulty would most likely appear if the machine was used to drive a motor which was wound with wire of a thick gauge, or shunt wound; in the latter case, the low resistance of the armature would prevent the dynamo from exciting, and the remedy would be to lift up one of the motor brushes for a moment and drop it again, when the dynamo had reached its voltage; the motor field-magnet would be thus excited, its armature start running and give a counter electro-motive force which would then act as a resistance, and the dynamo would probably drive it satisfactorily; but if the load on the motor caused its armature to slow down to a low speed, the dynamo would loose its excitation again and the voltage drop to zero. The diagrams in Fig. 3 explain these remarks; in G a voltmeter only is connected, and the dynamo excites; H shows a single lamp connected, the dynamo failing to excite; K shows three such lamps connected in series; the dynamo excites and gives full voltage. The governing principle is therefore the resistance of the circuit which is connected to the dynamo; the higher this resistance is the higher (within limits) will be voltage of the dynamo; the lower this resistance is the lower will be the voltage, until a point is reached at which it will suddenly drop to zero and the dynamo refuse to excite.

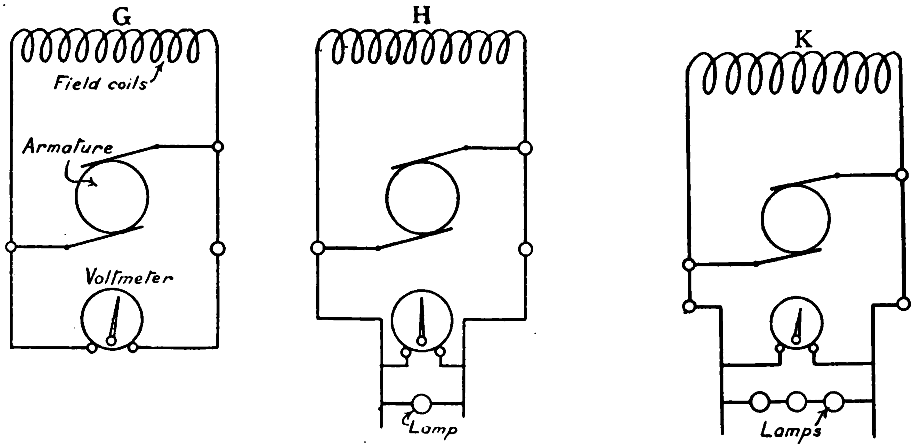


FIG. 3.

As the voltage on open circuit is always considerably higher than that which it will be at full load, the novice is liable, when the dynamo is driven from an engine, to overrun or burn up the filaments of his lamps if he happens to put a very light load on, even though the dynamo may not be running at more than its normal speed. To guard against this, the best thing to do is to put on full load, or rather more, at once. If the voltage is then too low, it shows that the speed of the dynamo is not high enough, or that too much current is being taken from the machine. Switching off lamps one at a time will decrease the current, and the voltage will rise steadily.

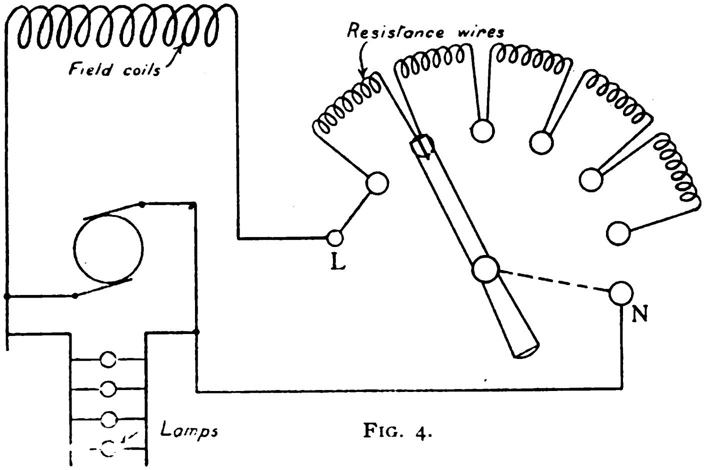


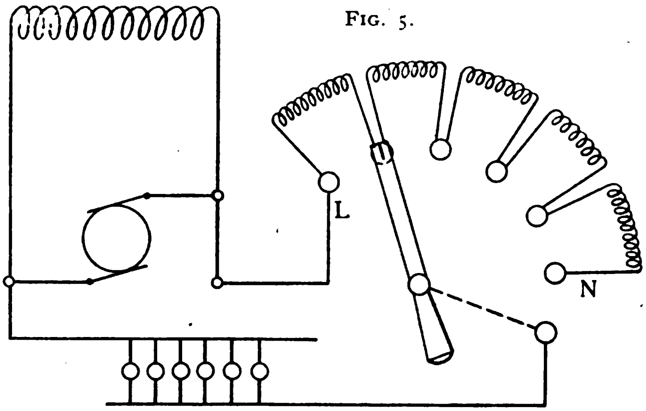
FIG. 4.

Though the voltage of a shunt-wound machine thus rises and falls according to the load, it is more under control than the voltage of a series wound machine. If the armature has a comparatively low resistance and the field-magnet worked up to a high degree of magnetic density, there will be very small variation between full load and, say, one quarter load voltage; this winding, however, does not give very satisfactory results when the dynamo is used to supply current to an arc lamp, and can only be used to a limited extent for fusing or heating wires. It is the best type of winding for use when charging accumulators or for electroplating and electro-chemical work. A convenient method of regulating the voltage with a varying load is to interpose an adjustable resistance in circuit with the field coils (see Fig. 4). When the dynamo is working at full load, the switch is at L, all the resistance being thus cut out of circuit, the field coils receive the full amount of current allotted to them; when the load is decreased owing to lamps being switched off and the voltage rises, the switch is moved towards N, thus interposing resistance in series with the field coils and decreasing the amount of current flowing through them; this causes a reduction in the magnetism of the field-magnet, and the voltage falls; by adjusting the amount of resistance, the voltage can be kept at the correct value for any load.

Another method is that shown in Fig. 5, where the resistance is interposed in series with the load, the movement of the switch being as before; in this method the dynamo volts rise as the load is decreased, but the volts at the terminals of the lamps are regulated to their proper amount as the excess volts are absorbed in the coils of the resistance. The first method is the more economical, but the second is very convenient and to be preferred for such purposes as charging accumulators or electro-plating, where the resistance of the circuit may be so low at first that the dynamo would not excite without some extra resistance being interposed. After all, with small machines, the amount of energy wasted in such a resistance is not a serious matter, and is generally less important than convenience in working; the two methods may be used together with advantage.

Testing a Compound wound Dynamo.—As this type of winding combines the effects of both shunt and series machines, the causes of failure to excite, peculiar to either, are neutralised. If the machine is run without any load, the shunt winding will enable it to excite; if a circuit is connected which has a resistance below that at which the shunt coils would work, then the series coils provide sufficient magnetism to make the machine build up its voltage. The simple way to test such a dynamo is to treat it at first as a shunt-wound machine, and run it at normal speed without any load; if in working order, it will give the same kind of indication. It is a good plan to temporarily disconnect the series winding, so that you may be sure if the machine fails when the series coils are connected, you will know that they are causing the trouble. Having satisfied yourself that the machine excites without the series coils, connect them in circuit and run it at such a speed that it gives the correct voltage without any load on; then put on the load very gradu-

FIG. 5.



ally. If lamps, switch on one at a time until you are taking the full current; note the effect on the voltmeter. If the machine is correctly wound and proportioned so as to be completely self-regulating, the voltage should not alter, but remain the same from no load to full output, provided the speed has not altered. This is the real object of compound winding, and large machines can be compound wound to give very close regulation, but such accurate results should not be expected from a small machine. There are two ways of connecting the shunt-wound coils. In the first, which is called the short shunt method, the ends of the shunt winding are connected to the brushes exactly as for a plain shunt-wound machine; the armature current is then split up into two portions, one flowing through the shunt coils, and the other, which is the whole current flowing in the outer circuit of lamps, &c., passing through the series coils (see Fig. 6). The second method is called the long

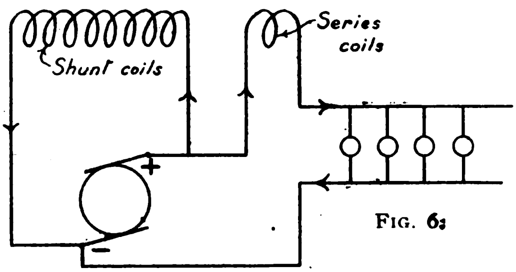


FIG. 6.

shunt, as one end of the shunt winding is connected to the outer end of the series coils, instead of being connected, as before, to the brush; the result is that all the current generated in the armature passes through the series coils before dividing (see Fig. 7). The effect of either system may be considered as

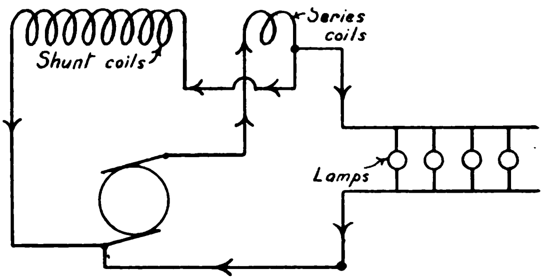


FIG. 7.

the same. Though compound winding on small machines may not give good results as regards regulation of voltage, it is very useful, as it will prevent the dynamo from loosing its excitation when the resistance of the outer circuit varies very much, as would happen when current is used to work an arc lamp or induction coil, the carbons of an arc lamp must be made to touch when starting the arc, and the contact-breaker of a coil is closed when making circuit, so that in each case a shunt machine is liable to drop its voltage to nothing, owing to the very low resistance of the circuit.

(*To be continued.*)

PLATINUM, at the same time the most ductile and the most infusible of metals, is now quoted at a higher price than gold, its value having increased more than three-fold since 1890. More than half the quantity is produced by the Compagnie Industrielle du Platine Paris, which produces a little more than three tons yearly, valued at £720,000, from its mines.

A 2½ Horse-power Motor Cycle.

By S. BEALE and J. KIRBY.

THE photograph herewith reproduced depicts a 2½ h.-p. motor cycle, the bicycle and ignition being the only parts not constructed by us.

The castings were obtained from the Noble Motor Company (Pocock Street, Blackfriars, London, E.C.), and is the early type of engine brought out by them, their latest 2¾ h.-p. engine being actuated by a different gear. As no two engines are alike in construction, it is not our intention to give a dimensioned account of same, so will content ourselves with giving our experiences as pure amateurs (neither of us being in any way connected with engineering), of the difficulties encountered and overcome in the construction of this our first motor.

In the first place, our lathe is only a 3½-in. screw-cutter, and to bore the hole in cylinder for exhaust pipe we had to chuck the cylinder crossways on faceplate, which necessitated our building the lathe head up to 5 ins., the hole for exhaust pipe being ⅞ in. diameter, with screw, 16 threads to the inch.

The first things taken in hand were the flywheels, which weighed, before being machined, 24 lbs., being 6 13-16ths ins. in diameter by 1¼ ins. on face, and for which job we had to make a 12-in. faceplate to bolt them on to. The turning, boring, etc., proved a very hot job, and we were not sorry when they were finished, as we could not keep a tool up to them very long, owing to the surface of wheels being chilled. However, with a bit of patience and a good deal of pedalling, they were satisfactorily finished.

The crank cases were then machined, and holes bored to receive bushes, which were of phosphor bronze. The shafts were then turned from 1¼ ins. diameter mild steel. The reason we turned them from so large a diameter was to leave a large shoulder to bed up to the wheels, the shafts being screwed into same, and riveted over. The two-to-one gear was then taken in hand, the hole being bored in crank case and bushed with phosphor bronze. The shaft was then fitted, and gear wheel and cam keyed on, the number of teeth in wheels being 16 and 32.

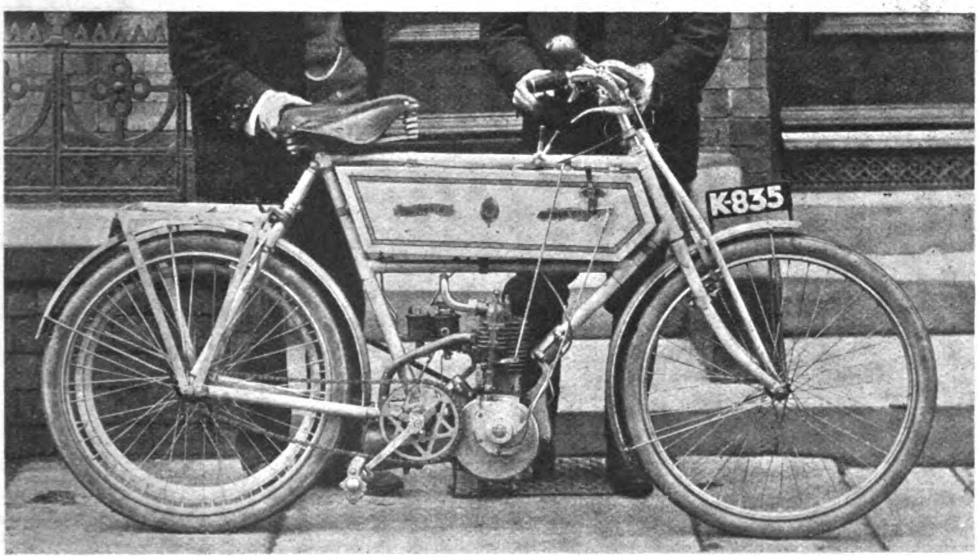
The crank pin was also turned from mild steel rod, being screwed into one wheel and riveted over, while into the other wheel it is turned taper, being pulled up with a lock nut. The connecting-rod, which is also of phosphor bronze, only required boring each end to receive crank and piston pins.

The piston was a delicate piece of work, requiring careful machining. It has three rings, these being turned up from a casting, the pin being fastened by two gudgeon pins.

The cylinder was chucked on faceplate, and hole bored first for exhaust valve stem, the valve seat being turned at same time. To enable us to bevel the valve seating, we made a milling cutter from an old file, and screwed it on to a piece of rod of the same diameter as valve stem, this method enabling us to get a smooth seating, and only requiring a very little grinding in, the valves being turned same bevel as cutter. The inlet valve is a separate casting, and was machined with the above method, afterwards bolted to cylinder head with two 5-16ths-in. set pins, being made gas-tight with a copper washer.

The valves are worked with a tappet gear, tappets being fastened on a single square rod, which actuates both valves, a square groove being planed out of side of cylinder to form a guide for same. The pulley was turned from a casting, being screwed and fastened on to shaft with a lock nut. Diameter of cylinder $2\frac{3}{4}$ ins. by 3 ins.; wheels, 6 13-16ths ins. by $1\frac{1}{4}$ ins.; inlet valve, $\frac{7}{8}$ in.; exhaust valve, 1 in.; valve stems, cam, tappets and tappet rod all being case-hardened.

In conclusion, we might say that all the threads in cylinder, shafts, and also on pipes were cut in the lathe, having no taps suitable for same. The machine is a decided success, the engine taking any hill without pedal assistance whatever, and is quite capable of exceeding the speed limit. The engine was commenced last September, the making of it not being hurried, as we did not wish to register it until this year, it being registered in February, and has been running ever since.



MESSRS. S. BEALE AND J. KIRBY'S $2\frac{1}{2}$ H. P. MOTOR CYCLE.

Autogenous Welding of Metals.

In the Fouché blowpipe, demonstrations of the working of which were given at the works of Brin's Oxygen Co., Westminster, recently, engineers will find an instrument of great power and flexibility. The Fouché blowpipe is simply a flame of acetylene gas blown in the usual way with a blowpipe, but with oxygen gas, so that the resulting temperature is enormous, not only because acetylene is endothermic in manufacture, but because the flame contains no inert diluent nitrogen. To show the effect of temperature, a heavy iron bar was melted upon a Newcastle firebrick. The corner of the firebrick was run to liquid, and finally a piece of calcium carbide was liquefied. A piece of the carbide which had thus been liquefied and placed in water, gave off acetylene, showing no chemical change, though the carbide had been quite liquid. The Fouché blowpipe should be of very great service in the workshop, and also in the field. By its aid a broken locomotive frame could be welded. It should be useful at sea for repair work, and in a thousand ways it will prove of service. The apparatus is simple and consists of a supply of the two gases, a suitable water seal, and the blowpipe. A rod of pure iron serves as a soldering stick or making-up supply. It is said that some of the carbon from the flame combines with this pure iron and converts it into mild steel. The blowpipe is, of course, applicable to other metals. The superiority of the acetylene-oxygen flame over the oxyhydrogen flame lies in the fact that for each cubic meter of oxygen, there are theoretically required two cubic metres of hydrogen, but the flame produced is so oxidising that practically it is necessary to employ a double quantity of hydrogen. Theoretically, $2\frac{1}{2}$ vols. of oxygen are required for each volume of acetylene, but in practice only 1·7 vols. of oxygen are used. The flame of acetylene is much less diffused and the heat is, therefore, better applied, and less is wasted in heating up surrounding metal needlessly. Thus, for the two mixtures the heat per cubic metre will be for acetylene 5,238, for hydrogen 2,473 calories. These and other considerations are said to account for the fact that ten times as much hydrogen as acetylene is required for a given piece of work, or one and a half times as much oxygen.—*Electrical Review.*

SMART BRIDGE WORK.—Recently a 120-ft. iron and steel span of the bridge across Crum Creek, on the Baltimore and Ohio Railroad, was removed and replaced by an entire new bridge between train-time on that much-travelled road, without the least disturbance of traffic. The actual time occupied by the work was just six minutes.

Traction Notes on Road and Rail.

By Chas. S. Lake.

Midland Motor Omnibuses.

The Midland Railway Company, who for some years past have had in operation a horse-drawn omnibus service between St. Pancras and Victoria, *via* Charing Cross, have recently placed a motor omnibus on this route; and should this prove successful, as there is every reason to believe it will do, the service will at a later stage be entirely worked by motor vehicles. For the time being only four journeys are made in both directions per day, the timings being arranged, so far as is possible, with a view to connecting the most important express trains leaving and arriving at the termini of the three companies—viz., Midland, S.E. & C., and Brighton & South Coast. The omnibus carries fourteen passengers, and a uniform fare of 3d. per passenger is charged for the complete journey in either direction.

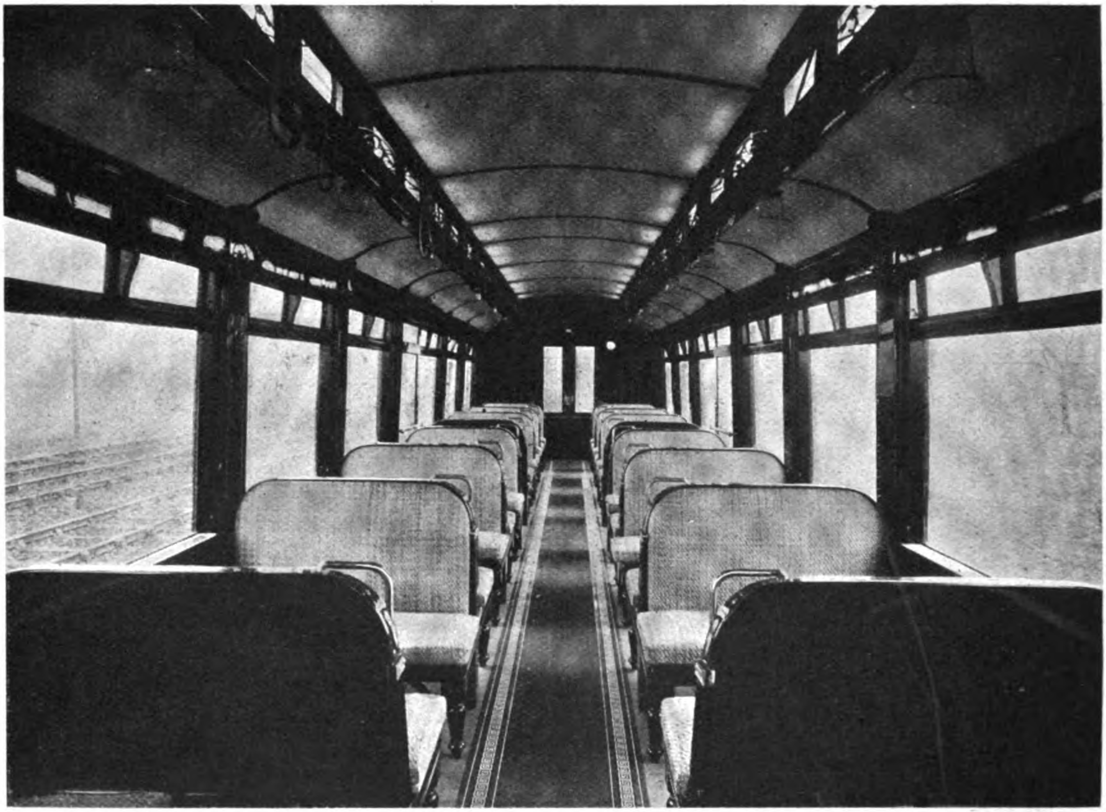


Fig. 1.—Interior of Car: Great Northern and City Railway.

Motor Omnibuses for Mid-Sussex.

A syndicate has been formed for the purpose of providing a motor omnibus service in Mid-Sussex, and by means of this service the inhabitants of several important villages will obtain facilities, hitherto not enjoyed by them, for reaching the railway. Direct communication will be opened up between Lingfield, Handcross, Cuckfield, etc., and the L.B. & S.C.R. main line at Haywards Heath, and the advantages of this will doubtless be felt by everyone concerned. The first bus intended for this service has recently been delivered by Messrs. Dennis Bros., Ltd., of Guildford, and a trial trip of 34 miles, at which representatives of the Press were present, demonstrated the suitability of the vehicle for the work it has been designed to perform.

Seating accommodation for thirty-four passengers (inside and out) is provided, with an additional space for packages. The engine is of the enclosed vertical type, with four cylinders, 4 1-5th bore by 5 3-5ths stroke, developing 24 h.-p. at 900 revolutions per minute. The transmitting shaft is of the Dennis spring drive type, by means of which jerking at starting is dispensed with.

The ignition is high tension electric, and the Eisemann magneto is also fitted. The omnibus is well and comfortably appointed throughout, and on the trial trip was found to run with perfect smoothness, although the roads were unusually loose in places.

THE ACCIDENT ON THE L. & Y.R.

Commenting upon the recent lamentable accident on the Liverpool and Southport section of the Lancashire & Yorkshire Railway, an evening contemporary remarked: "There is now harnessed to the shafts a monster (electricity) which is only as yet imperfectly understood."

Whatever the engineer's view of this might be it is difficult to say, but of course all who have acquainted themselves with the circumstances know that the cause of the accident was wholly disassociated with the form of traction employed.

ROLLING-STOCK ON THE GREAT NORTHERN AND CITY RAILWAY.

The type of car used upon the Great Northern and City Railway is illustrated herewith. The dimensions of the motor cars and those of the trailer cars—one of the latter being shown in the photograph—are the same, viz., as follows:—Total length over platforms, 49 ft. 6 ins.; length over corner pillars, 40 ft. 8 ins.; width over panel at window belt, 9 ft. 4 ins.; total over-all height, mounted on trucks, 12 ft. 2 ins.

The motor cars have vestibuled platforms, but the trailing cars are provided only with collapsible gates and railings, as on the Central London Railway. The motor cars have McGuire trucks, and the trailer cars have heavy service trucks, with 3 ft. diameter wheels spaced out 6 ft. apart between centres. The motor trucks carry series wound direct-current geared motors, working on the line pressure of about 550 volts, the current being collected by two collector shoes per truck. Each motor has a capacity of 125 h.-p. The trains really consist of three motor cars and four trailer cars, but the number of vehicles is generally restricted to a smaller total, especially during the "off" hours of the day. The motor cars seat seventy-one and the trailers seventy-three passengers. Each train of seven cars weighs 200 tons loaded, and seating accommodation for 505 passengers is provided. Sliding doors are fitted at the centre and at both ends of the cars, and the roof is of the clerestory type, with swinging sashes pivoted for ventilation. The inside finish is of teak and mahogany, moulded and panelled with an artistically decorated roof framing of lincrusta millboard, moulded and painted. A maximum speed of about 33 miles is attained by the trains, and an average speed of 16 miles is maintained, including stops at the three intermediate stations. The cars illustrated were built by the Brush Company.

THE "GAS AND OIL ENGINE RECORD."—We have received copies of Nos. 1 and 2 of a new and excellent journal dealing with the manufacture and application of gas and oil engines. The paper is edited by Mr. W. A. Tookey, who is well known to our readers as the author of several books on the above and kindred subjects, and is published monthly, price 3d., post free 4d., the yearly subscription being 3s. The editorial and publishing offices are 2, Grocers' Hall Court, Poultry, London, E.C.

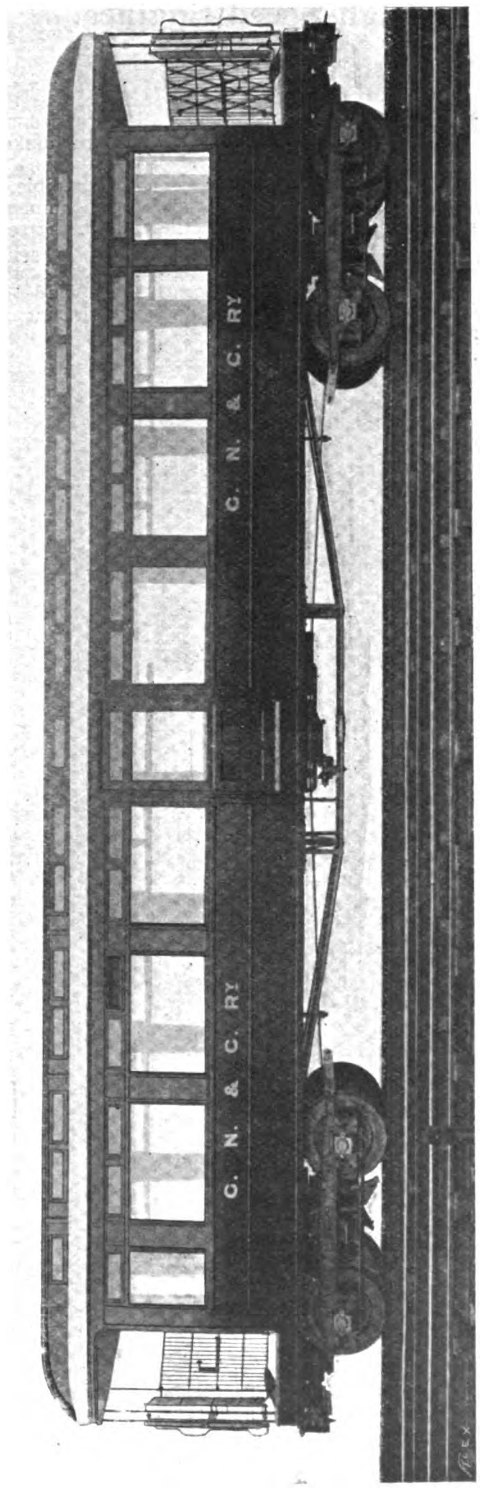


FIG. 2.—ONE OF THE NEW TRAILER CARS FOR THE GREAT NORTHERN AND CITY RAILWAY.

High-Speed Engines.

By H. Muncaster.

(*Continued from page* 111.)

WORKING details of the standard or bed are given in Figs. 18 to 22. This form makes, perhaps, a type of engine that can be produced at a less cost than would be possible in any other type. It has other points to commend it, such as its extreme compactness, its being self-contained, and its neat appearance.

We do not claim that the design is new, although several large engines have recently been made on the same lines for high-speed direct driving of dynamos.

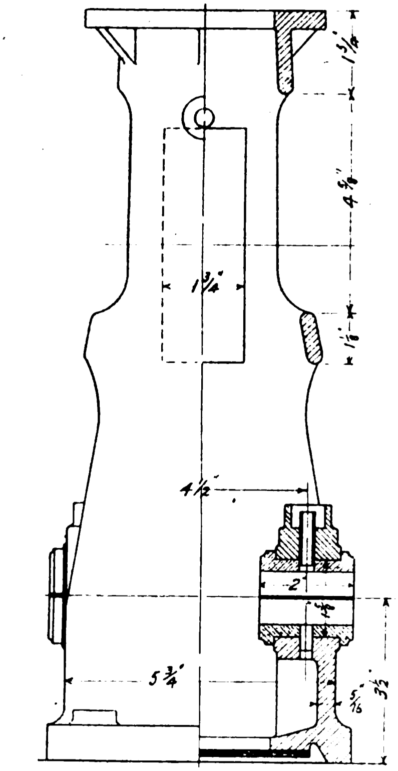


Fig. 18.

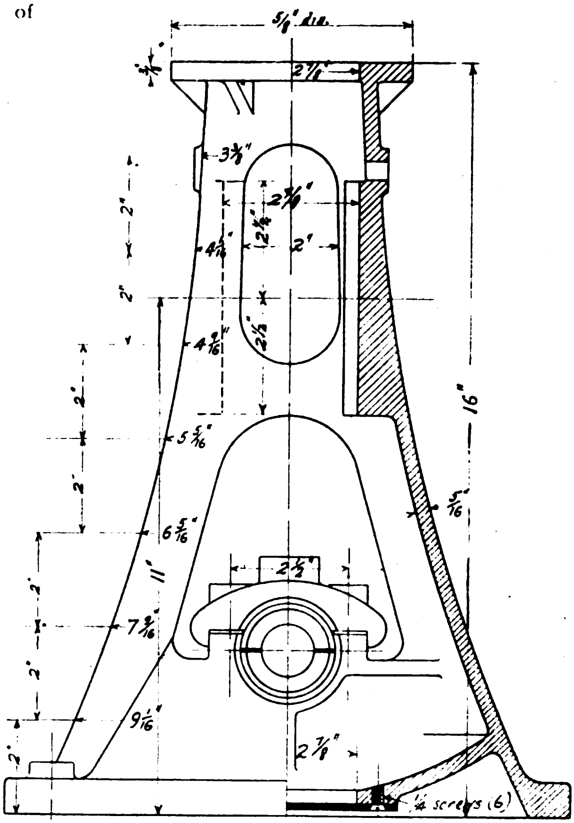


Fig. 19.

Details of Standard for a High-Speed Engine.

No great difference exists between the engine here illustrated and that made by Messrs. Hayward, Tyler & Co. a quarter of a century ago. Indeed, we might go back further and find a similar design. An old book of designs published in 1853 gives details of an engine with a similar standard, the cylinder, however, being at the lower end.

It is difficult to find any type of engine that is not merely a development from some previous type. The inverted engine was at first objected to on account of the drip from the piston-rod stuffing-box falling on the crank, &c., and it is more than probable that this objection kept back the designer from following what seems the most desirable practice, until the demands of the screw propeller compelled the engineer to put the cylinder on top.

We need only mention the table engine as an illustration of the complications that were adopted to ensure the piston-rod working out of the top of the cylinder. At the same time the comparatively long stroke made it desirable to economise space, and in this respect the table engine was a means to an end.

A review of the steam engine shows its progress to be merely a development controlled by the requirements of the service to which it was applied; and that practically no important feature has been invented in connection with the steam engine since Trevithick and others put it into a workable form, the modern engine having been gradually evolved from this.

Take the case of the marine engine, of the performance of which a great deal is sometimes said. A careful search into the records reveals the fact that step by step the demand for more power has been responded to by increased steam pressure.

The need for more economy in fuel has been emphasised as ships were required to take voyages of longer and longer duration. This led to the use of compound engines, the success of which encouraged the attempts at still further taking advantage of the economy to be derived from high rates of expansion, and the triple and quadruple expansion engines followed, as a matter of course. The necessity of getting powerful engines into a limited space led to a gradual increase of speed, and, as a result, increased efficiency and reliability. In most cases, the circumstances have compelled the engineer to adopt modifications, sometimes with a feeling of misgiving, which in actual work were so successful that the designers were themselves surprised, so that probably when the principles are thoroughly understood the results obtained may be still more satisfactory.

In the case of the locomotive, the same remarks apply, the advance made in, say, half a century, is scarcely noticeable, except that the increased traffic and the need for more economy has induced a heavier class of engine and a greater steam pressure. The necessity of a larger boiler has resulted in a higher centre of gravity, and has limited the size of the driving wheels. Locomotives on any railway are all more or less copies of locomotives on any other railway, with a few local features retained.

With regard to the stationary engine, the development has been due to the necessity to economise fuel. It used to be a commonplace amongst the textile manufacturers that the only dividend it was possible to earn was the result of the economy of a good engine over a poor one. The fact that steam engine economy was a vital factor led the engineers to give careful attention to motive power for mill work. It resulted in a crop of useless inventions, generally of a complicated nature, which eventually found their way to the scrap heap.

Perhaps in no case have the peculiar demands met with more favourable results than in the case of the engine for the direct driving of electric installations. The high number of revolutions required has resulted in a marked degree of economy of fuel, and probably, what was less expected, a decreased cost for upkeep in repairs and renewals, and a less first cost than would be possible under other conditions.

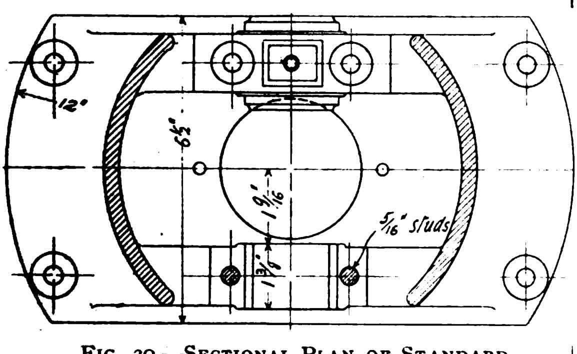


FIG. 20.—SECTIONAL PLAN OF STANDARD.

It must be of considerable interest to the model maker to compare some obsolete type of engine with the latest practice, and to trace the causes that have led to the change; such a process must have a very valuable educational result. And we should strongly recommend younger readers of *M.E. & E.* to trace, if possible, the prototypes of any models they may take in hand.

We have said that the type of engine under consideration is adapted to economical manufacture. There is, however, an amount of pattern-making to be done that where only one engine is to be made the saving is not very apparent.

The pattern will be in halves joined along the centre line, as Fig. 19, having core prints at the top and bottom; the flanges should be loose. The openings should be cut in the pattern to a thickness of 5-16ths in., so that the sand will meet the core and give it support. The outside edges of the opening will be rounded in the pattern. It will be simplest to round the edges on the inside with a file in the casting itself.

A core-box will be necessary; it will be easily curved out to the inside dimensions of the casting,

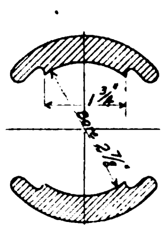


FIG. 21.

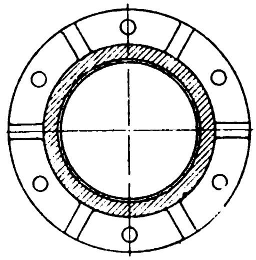


FIG. 22.

SECTIONS THROUGH STANDARD.

and the pieces forming the guides and the pedestals afterwards fixed in. This will be found to be a very simple matter.

It will be necessary to make templates of the curve for the side: these can be marked off by offsets similar to those shown in Fig. 20, which are 2 ins. apart. A similar curve allowing for the 5-16ths in. thickness will be required for working the core-box to. Bosses will be required as shown, for the holes for the lubricators for the slide-bars; also for the holes for the foundation bolts. The pedestal cups will be as shown for the box type of bed. Allowance will, of course, be made for facing the flange to the finished size given—viz., ⅜ in. thick, and on the edge for polishing to 5¼ ins. diameter. The method of machining the bed has already been indicated: this matter will not present much difficulty to any one possessing a decent lathe.

As the lesser of two evils, the stuffing-box will in this case be bolted to the cylinder; the arrangement shown in the details of the cylinder will be inverted.

In the casting there is no right and left hand, and one side is in every respect like the other. At every part the centre line passes through the centre of gravity of the section. The strains due to the load on the piston will therefore be of a simple character, and it will be possible to make a bed sufficiently strong with less material in this than any other form. This fact may be considered when extreme lightness is desired.

(*To be continued.*)

AT the Barton Quarries, near Darlington, there is a stratum of stone which is said to offer peculiar resistance to the electric current. The North-Eastern Railway is using the stone on its electric line to Tynemouth.

The Wirral Model Yacht Club at Liscard.

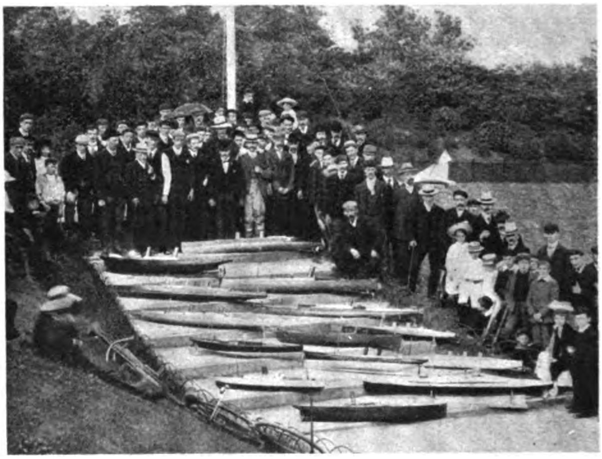
ON Saturday, July 8th, the above club held a friendly social with the steam members of the Sefton Model Steamer Club on Liscard Lake, Central Park. This was the first function of its kind ever held by two model yacht clubs in the United Kingdom.

The visitors were represented by Mr. H. Carter's *Kate*, a very pretty model of an Atlantic liner. Messrs. W. Hughes, senr. and junr., were represented by two very serviceable torpedo boats, which steamed up and down the lake in a very businesslike manner. Mr. S. Thompson's *Disappointment* was a most uncommon kind of model, having twin screws driven by a pair of horizontal engines, the propeller shafts being geared together by means of bevel wheels. Mr. J. Smith, senr., had one of the prettiest little twin-screw steam yachts ever seen on Liscard Lake, but owing to some slight derangement of the machinery he was not able to get a run out of her, which was much regretted by the Wirral members, as she was said to be a very speedy boat. Mr. J. Smith, junr., had in his *Zephyr* a very serviceable looking model, whilst Mr. F. Roberts' *Lily*, with its white funnel, presented a very conspicuous appearance.

The Wirral Club were represented by two very fine torpedo-boat destroyers and a cargo steamer in Mr. J. Kirkpatrick's *Doris*, *Scout*, and *Priscilla*. Messrs. J. Tharme & Sons, as usual, were well to the fore with three very fast torpedo boats, the *Express*, the *India*, and *Banshee*. Mr. W. R. Weaver's invincible *Era*, the fastest model in England, and winner of THE MODEL ENGINEER'S Silver Medal, was also in evidence, and, judging from the remarks of the spectators respecting the speed she showed on Saturday, she will prove a hard nut to crack should another boat strive to wrest her title from her. Mr. J. B. Birche's *Three Sisters*, another very fast torpedo-boat destroyer, was also in evidence, and so also was Mr. H. Ashton's *Dart*, which, however, unfortunately meeting with an accident at the commencement of the proceedings, was out of it altogether.

This exhibition of models was one of the finest ever seen on Liscard Lake, and although the speed of the Sefton steamers did not come up to the Wirral boats, for a club only established last year their boats did them great credit, both for speed and finish.

After a most enjoyable afternoon's sport on the lake, the visitors were entertained to tea by the Wirral members in the Park House, kindly lent for the occasion by the Parks Committee, when the opportunity was taken by the members of both clubs to discuss, in a friendly manner, the events of the afternoon. The Vice-President (Mr. G. H. Willmer) spoke on the lessons to be learned from the afternoon's proceedings, and also proposed the prosperity and future success of the Sefton Model Steamer Club. Mr. P. Roberts, the hon. secretary, suitably replied on behalf of the visitors, and issued, on their behalf, a hearty invitation to the Wirral members to come over to Sefton Park and have a friendly run on their lake. Mr. W. R. Weaver also spoke of the advantages that would be derived by the members of both clubs by the afternoon's proceedings, and said that Sefton and Wirral were the first clubs in the United Kingdom to inaugurate such a contest as they had had that afternoon, a thing to be proud of, and an event that they all could look back upon with very great pleasure in years to come. Mr. Roberts, senr., spoke about the advisability of having model boilers properly made and properly tested, so as to avoid at any time accidents occurring when running steamers on public lakes. Mr. G. Hastings alluded to the handicapping of model steamers so as to get the best all-round results out of the models, and he hoped the two clubs would soon meet again and have a good time on Sefton Park Lake. He also stated that in the course of his business he had occasion to see a good many steam models in different parts of the country, and he could say, without any fear of contradiction, that no steamer club he had ever seen had any boats that could beat, or come any-



THE WIRRAL MODEL YACHT CLUB AT LISCARD.

where near the speed of the Wirral boats. Mr. W. R. Weaver then suggested that both clubs should try and arrange a friendly contest with each other, and this was most enthusiastically taken up by the members of the Sefton Steamer Club, and the Wirral members have arranged to go to Sefton Park on August 26th.

A USEFUL NEW MATERIAL.—Calxia, a new substitute for terra-cotta and plaster, is a mixture of 45 parts of calcined gypsum, 30 of water, 10 of albumen, 9 of alum, 4 of sulphate of magnesia, and 2 of borax. It is stronger and lighter than terra-cotta or plaster.

A STEAM TURBINE'S LONG RUN.—It is said that a Brown-Bouverie-Parsons steam turbine at the Donnerswerk mine, in Silesia, has been in continuous operation for over two years, with a run of over 17,200 hours. A recent examination showed no trace of wear either in the bearings or in the buckets in the wheel.

A Model G.N.R. 10-Wheeled Tank Locomotive.

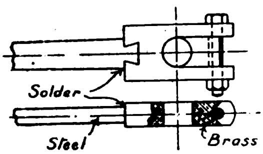
By Claude H. Gaggero.

THE following is a brief description of my model ½-in. scale locomotive, which is my first attempt at loco building. It has proved a success, in spite of many disheartening experiments which sometimes looked like failure. To relate all my experiences in her construction would occupy far too much space.

Having had no previous experience in fitting, I started the cylinders and motion first. I bought two sets of horizontal engine castings, using these cylinders and eccentrics; and as I ordered them before a certain date, I got cylinders bored, a few holes drilled, etc. It would have been impossible for me to bore the cylinders accurately, as I only have a plain lathe, with no slide-rest. The valve and eccentric rods are 1-16th in., and the piston rods ⅛ in. diameter, silver steel. All the screws I made myself out of iron nails (cutting the slot in head with a fretsaw), and are 1-16th in. diameter. The valves are on top of the cylinders, so that the screws which fasten the horizontal engine cylinders to the bedplate fasten these to the main frames. The rockers are built up of sheet and tube brass, and work on a 3-32nds-in. steel rod fastened across the frames. Slip eccentrics are used, and are placed between the cranks.

The wheels are of cast iron, and were bought ready-made; they are screwed tightly on axles turned from large nails. The crank axle is built up; it is ¼ in. diameter (crankpins 3-16ths in.), and the webs are ⅛ in. thick mild steel; it is screwed tightly together, and sweated, one joint excepted—viz., one between an inner web and the centre portion, so as to enable the eccentric sheaves to be put on and taken off should they require repair, etc., at any future time. Bogie and trailing axles are 3-16ths in. diameter, and coupled axle is ¼ in. diameter. The connecting-rods are forged from large nails, with brass big-ends dovetailed and sweated on. These big-ends, however, are not of orthodox design, being forked and finished, as small sketch (not to scale) will show. The coupling-rods are cut and filed from an old fretsaw frame,

Fig. 1.—Big-end of Connecting-Rod.



and the crankpins for same are turned from ¼-in. brass rod. I made a small pocket screwdriver out of a broken hacksaw blade, especially for all small screws.

The main frames and buffer beams are of thick tin plate, and the axle-boxes are thick pieces of brass soldered on. A rubber pad intervenes between the bogie and the engine frame cross-stretcher, and the trailing wheels are in a pony truck with vertical spring control. The bogie pin is soldered to the engine stretcher, and works in a slot in the bogie frame. The buffers are built up of tube and sheet brass, are fitted with springs, and have a 3-32nds-in. silver steel centre pin.

I next made patterns for the funnel, steam dome, safety-valve seating, and footplate edging; and got a plumber to make me brass castings from them (not then having a foundry of my own—I have just finished making one). When I got the castings, I first finished the footplate edging, and made the footplates and running board in one piece of tin plate, fixing this with screws (all of which I made myself).

The boiler now occupied my attention, and for a few months I was engaged in constant experiments. It is of the "Smithies" type, with 2-in. inner and 2¾-in. outer barrels. I made the boiler proper from a piece of solid drawn copper tube with ends (1-16th in. thick sheet copper) jambed in hard against a copper ring fixed with screws, and the copper tube hammered over. (This was a tedious job.) I put an ⅛-in. brass stay in the centre, and this barrel is 10⅜ ins. long outside. It has five 3-16ths-in. water tubes and a built-up downcomer. The water tubes are screwed into the downcomer, and have a nut on the inside of boiler plate at front end. All joints are thoroughly sweated with soft solder. The outer barrel I made of tinplate, and as it took me ten full hours to do the bending to shape alone, I shall never adopt this method again. The smokebox is separate (of tin), and has a hinged spun-copper door at the front.

The boiler fittings include whistle, safety-valve, regulator (a plug cock in cab), and test cock. I made a hand pump to feed the boiler, and it worked very well indeed, but the check valve on the boiler did not. After a lot of trouble I got it so as not to leak back; but then, try as I might, the valve (being so small) would not come back properly on its seat, and it then leaked worse than ever. Result—no boiler-feeding apparatus. I also made a water gauge as described in The Model Engineer some time back, using bent brass elbows and rubber connections to glass; but this leaked unless the rubber connections almost met in the middle of the glass, so I had to abandon this and plug up the holes.

When the boiler was fixed on the engine, and steam got up with a temporary spirit lamp, the engine would not go. The first regulator (an orthodox one, so far as outside appearance goes) leaked badly, but invisibly, so I fitted a plug cock regulator. Then she would not go—steam rushed up the funnel without the engine moving; so I had to pull her all to pieces to see what was wrong with the slide-valves—nothing. I found that the pistons wanted packing, and this done, and engine re-erected, she went all right. But the troubles were not at an end yet. On this trial the water ran low, and the solder round the back end of the boiler melted, the nut at front end of stay stripped, and the end came out with a terrific explosion, snapping the steam pipe and tearing off the back plate like pieces of paper.* No one was hurt, however, except the engine, which had the rear part of the frames rather damaged. I had to take her all to pieces again to get them straight, and I took a few advantages of this event. I made a new back end without plugged-up water gauge holes, and fitted the final regulator, which has a filtering pipe inside the boiler. The second plug cock regulator had an ⅛-in. bore, and therefore was a large

* This is what caused me to hammer the ends of tube over; prior to this such was not done.

clumsy thing. All went merrily now, and the rest of the loco was very plain sailing.

Although I have been relating all these boiler experiences, I have mentioned nothing (except a temporary spirit lamp) as to firing. For the most part I rested the buffer beams on supports, and put a Bunsen burner underneath, getting up a good pressure, and then lifting the engine on to the floor and letting her run for as long as she would ; and it was when I was so lifting her that the already mentioned boiler explosion occurred, forcing my hand off the back buffer beam, and letting the engine drop, which was how the frames were damaged. My object on these occasions was more to get the engine to go than to get her to run continuously.

I made some experiments with a paraffin blowlamp, this being a grand success, giving an enormous heat—too much, in fact : it would almost have melted all the solder on the model. My chief objection to it was the tremendous noise it made ; and also to refill I would have to turn out flame, let out air, fill, pump up, re-heat coil, and then adjust the valve again—all just for the usually simple operation of stoking ! Now the engine has a spirit lamp similar to that of THE MODEL ENGINEER locomotive. There is a tin drum at back of engine, with centre-punch dots made from inside before fitting together, to imitate rivets ; a 3-16th-in. brass pipe comes from the middle (seen in photograph), and runs all round the firebox, feeding six ⅜-in. wicks and one ¾-in. wick, the wicks being asbestos fibre. The whole of the bunker is a spirit tank, and feeds the drum *via* a small semi-rotary slide-valve and a short piece of 3-16th-in. brass pipe.

The side tanks (dummies), cab, and bunker are all of stout sheet tin soldered, together with short angle pieces at intervals, and have an edging of small size copper wire soldered on.

The dummy and non-working fittings are as follows :—Handrails (of tinned iron wire), two small headlights (of one piece of sheet tin) with heads of brass collar studs soldered in for chimneys, and heads of ivory studs cemented in and painted green and white for lenses ; several lamp brakes, drawhooks and chains, vacuum brake connection, steps (with dummy rivet marks), and destination boards, the one in the front being square, and revolving as on the real engine. It is marked with these places—" Enfield," " High Barnet," " Alexandra Palace," " Main Line." The word " Barnet " should just be seen in the photograph.

The painting is done in enamel, and is correct except for the shade of green, this being darker than the original—first, because I could not get the right shade ; secondly, to withstand heat. The lettering is in " Ardenbrite " gold metallic enamel, and is done with an ordinary pen, the lining-out being done with a drawing-pen. The letters do not show well in the photograph, as there is hardly sufficient contrast of light between gold and green.

Since building this loco I have bought " The Model Locomotive," and at some future time I hope to rebuild this model on much more scientific principles, so far as the motion goes. Some of the improvements I shall make may be enumerated as follows :—New frames (of sheet steel), new crank axle (brazed), spring-born axles, scale wheels, slide-bars (at present she has none of these, but since fitting up the motion I have seen simple methods of construction in " The Model Locomotive "), boiler-feeding apparatus and water-holding tanks, new valve gear reversing from cab, etc.

I may add that the whole of this loco, except two of the plug cocks, boring of cylinders, e c., and the castings necessary, is my own work.

The following are her chief dimensions : Length—without buffers, 18 ins. ; with buffers, 19¾ ins. Width—over footplates, 4 ins. ; over steps, 4⅜ ins. Height from rail—to top of chimney, 7¼ ins.; to centre of boiler, 4⅝ ins.; to footplates, 2 3-16ths ins. Diameter of driving and coupled wheels, 3 1-16th ins. Diameter of bogie and trailing wheels, 1¾ ins.

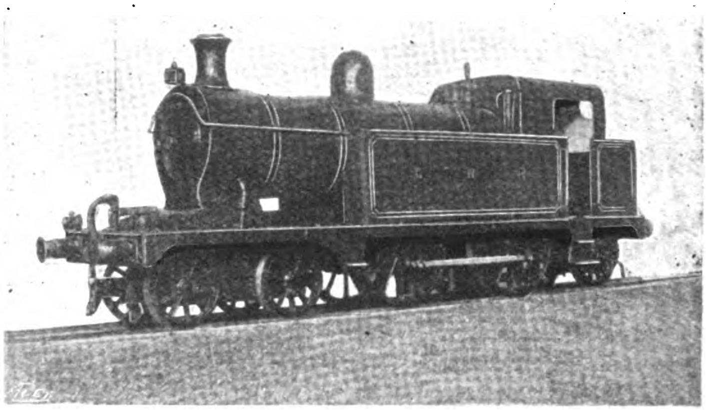


FIG. 2.—MR. CLAUDE H. GAGGERO'S MODEL G.N.R TANK LOCOMOTIVE.

Cylinders, ½-in. bore by 1-in. stroke. Steam ports, 1-16th in. by ⅛ in. Exhaust ports, ⅛ in. by ⅛ in. Port bar, 1-16tn in. wide. Valve travel, 5-32nds in. Lap, 1-64th in. Firebox, 1⅞ ins. by 5 ins. Single pipe flame superheater, ¼ in. diameter. Heating surface, 41½ sq. ins. Rail gauge, 2½ ins.

NEW LOCOMOTIVES FOR INDIA.—One hundred and forty additional locomotives will be supplied to the North-Western Railway of India before the busy season of 1906.

A NEW SUBMARINE CABLE.—The cable steamer *Stephan*, of the North German Cable Works at Nordenham, is reported to have successfully completed the laying of a cable between Menado-Yap and Guam, for the German-Holland Telegraph Company, of Cologne. The length of this cable is nearly 2,000 miles, and the greatest depth attained, 2,300 ft. By it the Dutch-India Colonies and the German Carolines are placed in communication with the American Pacific cable. The *Stephan* next proceeded to Shanghai to lay a cable 130 miles in length along the coast, which will foim a part of the Shanghai-Yap cable, of which the main line is now being constructed by the North German Cable Works, and which will be laid next winter.

Practical Letters from our Readers.

[The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a nom-de-plume if desired, but the full name and address of the sender MUST *invariably be attached, though not necessarily intended for publication.]*

A Single Eccentric Reversing Gear.

To THE EDITOR OF *The Model Engineer*.

SIR,—Glancing through an old mechanical publication, dated 1878, I noticed a method for reversing engines which (if not previously noted in your Journal) might be of interest to your readers. I do not know if it is workable, but it appears to me to have some possibilities over the "slip" eccentric, which has been recommended, under certain circumstances, in your paper :—

"Fig. 1 is a view (lengthways) of shaft, which is

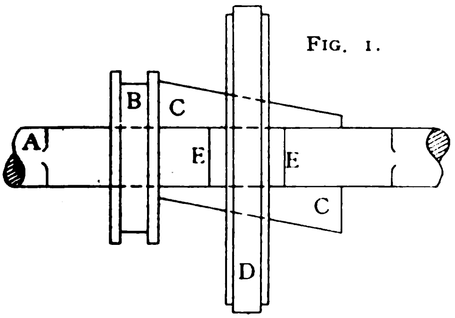


FIG. 1.

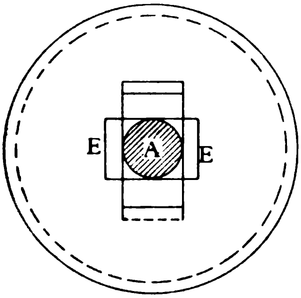


FIG. 2.

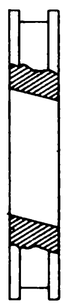


FIG. 3.

A SINGLE ECCENTRIC REVERSING GEAR.

square ; B is a disc which slides on shaft A ; C C, two wedges fixed to disc B ; D is an eccentric with an oblong slot (shown in Fig. 2 and in section in Fig. 3) ; the slot and wedges are the same width as shaft A. E E E E are plates fixed to the shaft, to keep the eccentric D from moving lengthways of shaft, by allowing it to move at right angles. In sketch the eccentric is in the centre of wedges, and therefore revolves true with the shaft ; but if the disc B were moved towards the right or left, it would raise or lower the eccentric D ; so when properly connected to an engine it would reverse the valve. Disc B is moved with a fork and lever, it has no sticking points, and can be reversed at any part of the stroke."—Yours truly,

J. C. T.

Bicycle-Driven Dynamos.

To THE EDITOR OF *The Model Engineer*.

DEAR SIR,—I feel interested in "Auphsyde Crank's" letter. Only last week, during a sleepless night, the idea occurred to me to drive a small shunt-wound dynamo from a motor bicycle, in exactly the same way as your correspondent suggests.

I have been thinking of getting a motor bicycle, but living 250 miles from a generating station introduces a difficulty in the way of charging accumulators.

My idea is probably impracticable, as the workings of a restless brain are not always of value. I shall be glad to see the idea criticised.—Yours truly,

Shetland. HENRY P. TAYLOR.

To THE EDITOR OF *The Model Engineer*.

DEAR SIR,—Referring to the letter of your correspondent "Auphsyde Crank" in issue of THE MODEL ENGINEER for August 3rd on bicycle-driven dynamos, I believe this method of driving a dynamo was used during the late Egyptian campaign, under Lord Kitchener, for charging accumulators to work the *x*-ray apparatus out there. I remember reading a description and seeing a reproduced photograph of the arrangement, but forget what periodical it was in. The method adopted was by belt from the bicycle driving wheel.—Yours faithfully,

Manchester. HERBERT WOOD.

Mr. Nicole's Model Atlantic Liner.

To THE EDITOR OF *The Model Engineer*.

DEAR SIR,—Would Mr. Nicole kindly publish in THE MODEL ENGINEER complete drawings of his model Atlantic liner which was illustrated in the issue for July 27th ? I consider his to be one of the most realistic *working* model steamers of the larger "non-fighting" type that have yet been described in THE MODEL ENGINEER. We have already had working drawings for model battleships, cruisers, etc., but none from which an up-to-date model liner could be built.

Re "Oona's" letter in July 20th issue, I should like to suggest that a space be devoted in THE MODEL ENGINEER every fortnight to reports of club doings, races, illustrations of successful yachts, etc. ; and that a register of model yacht clubs be published every month, either in the literary portion of the paper, or as an inserted leaflet among the advertisements.—Yours truly,

"SOU'WESTER."

Generating Acetylene Gas.

To THE EDITOR OF *The Model Engineer*.

DEAR SIR,—Having seen somewhere a note mentioning the discovery that acetylene gas could be produced by mixing carbide with some efflorescent salt, I decided to try the experiment. The generator was made out of a sample Fry's cocoa tin—a small affair, about 2 ins. diameter and 4 ins. high—fitted with a dished close-fitting lid. Into the lid was soldered the burner, a short piece of 3-16th-in. outside diameter brass tubing, bent at right angles, with the free end flattened together, and a jet punched in it to form a burner. The charge was made by first putting a few very small pieces of carbide on the bottom of the can, then a layer of pulverised washing soda, another layer of carbide, and another of soda until the vessel was full.

The lid was then pressed tightly in place, and the can shaken, in order to thoroughly mix the soda and the carbide, which must be loose. A light was then applied to the jet—from a safe distance, of course—with the result that the characteristic flame of acetylene was seen. In about half an hour, however, the flame went out. The container was then very hot, but whether from conduction from the flame, or from the chemical action, I do not know—probably from both.

Thinking that the cessation of gas producing was due to the soda next the carbide becoming dehydrated, I shook the apparatus, and again applied a light, getting a flame for about a minute. I then took off the lid, and put in more soda, and tried again, but could get no further gas-flame. I then carefully examined the charge, and found on all the pieces of carbide the usual white coating denoting overheating. I therefore came to the following conclusions as the result of my experiment :—

(1) That the carbide must be *thoroughly pulverised*, and thoroughly mixed with soda, either before or after putting into the generator—the latter preferably.

(2) The generator must be kept cool by some artificial means—say by a water-jacket (I refer to *all* generators, whether with attached or separate burners).

(3) That in mixing the charge the soda should be far and away in excess.—Yours truly,

NATHAN SHARPE.

Kincardine-on-Forth.

The Model Electric Travelling Crane.

TO THE EDITOR OF *The Model Engineer*.

DEAR SIR,—In the diagram of connections for the model electric crane in your issue of August 3rd all the motor armatures are connected in parallel,

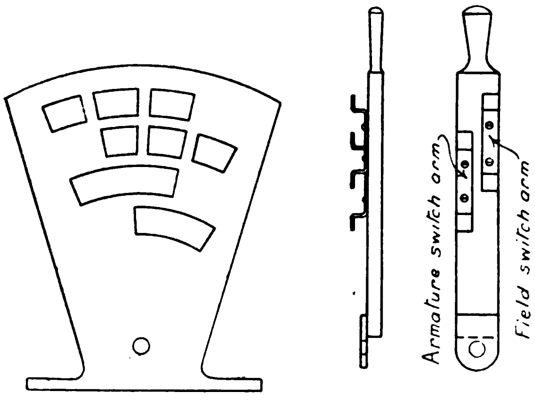


FIG. 1.—A DOUBLE THREE-WAY SWITCH.

so that when one motor is running its armature is short-circuited by the other two. This can be obviated by having a double three-way switch, as in Fig. 1 herewith.

I enclose also an altered diagram of connections (Fig. 2), where it will be seen that only five collect-

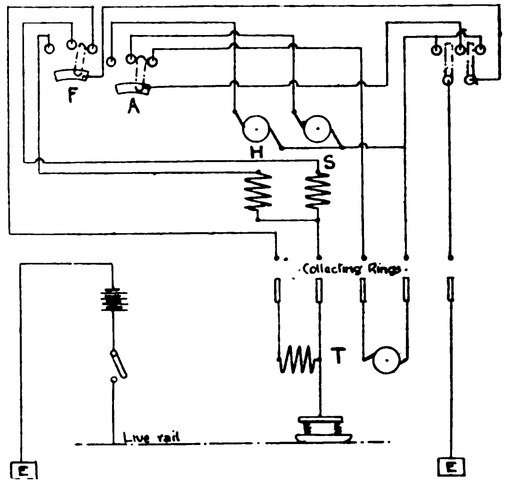


FIG. 2.—AMENDED DIAGRAM OF CONNECTIONS.

ings rings on the pivot are required, instead of six, as in the original design.—Yours truly,

" SYDOX."

Queries and Replies.

[Attention is especially directed to the first condition given below and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-hand corner of the envelope "Query Department." No other matters but those relating to the Queries should be enclosed in the same envelope.

Queries on subjects within the scope of this journal are replied to by post under the following conditions :—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied, wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed. (4) Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of Replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor,* THE MODEL ENGINEER, *26—29, Poppin's Court Fleet Street, London, E.C.]*

The following are selected from the Queries which have been replied to recently:—

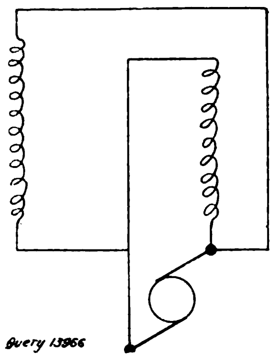
[14,383] **Small Gas Engine.** R. C. (Manchester) writes : I have got your handbook on " Gas and Oil Engines," and I read that the author does not consider it beyond an amateur to design a gas and oil engine, provided he knows something of machine construction. I have decided to attempt to design a 1½ b.h.-p. vertical gas engine having two cylinders, and convertible to an oil engine. Would you kindly give me the following particulars :—(1) Bore of cylinders and stroke ? (2) Angle between cranks ? (3) Size of gas valve, air valve, and exhaust valve ? (4) Length of connecting-rod ? I want the engine to drive a dynamo having a 2-in. pulley, and running at 2,220 r.p.m. ; and as the greatest permissible pulley ratio is 6 : 1, the engine will have to run at 370 r.p.m. (5) Can I get this speed from the above engine, or shall I have to have a greater pulley ratio ? If so, what ratio ? (6) What factor is it that governs the speed at which a gas engine runs ? For instance, suppose I want to construct two 1 b.h.-p. gas engines, one to run at 100 r.p.m., and the other at 2,200 r.p.m., what will be the difference in construction or valve setting ? (7) Can you refer me to a book which is not too expensive ? (8) Do the same laws hold good with a vertical engine as to a horizontal one ? (9) What would be the difference in speed between no load and full

load of the above engine? (10) When I have finished the design, would you be kind enough to criticise it?

We advise you to start on a one-cylinder engine. (1) 3½-in. bore, 5-in. stroke. (2) See above. (3) Gas valve, 7-16ths in. diameter; air valve, 1 in. diameter; exhaust valve, 1 in. diameter. (4) Approximate, 15 ins. Engine should run at from 400 to 450 revolutions easily. This will give you 2,400 revolutions at dynamo, with 6 : 1 gearing. (5) Yes. (6) The governor. See handbook—chapter on governing. (7) Grover's Gas Engine book, 5s. 4d. post free. (8) Yes. (9) About 5 per cent., with a fairly good governor. (10) Yes, certainly.

[13 966] **Windings for Small Dynamo.** C. A. M. (Troyeville, Johannesburg, S.A.) writes: Sorry to trouble you again, but I shall be glad if you can enlighten me as to the following. I have a dynamo—or rather it was bought as a motor from the Universal Electric Supply Co., Manchester. It is an undertype machine. I now want to convert it into a dynamo. I have rewound the fields with No. 26 c.c. wire (sample enclosed). The armature is not yet wound, as I am ordering the laminations from the above firm; but I intend winding it with No. 22 c.c. wire (sample enclosed). Will that be all right, if connected in shunt? The armature is to have eight coils (drum), two coils in each slot

WINDINGS FOR A SMALL DYNAMO.



and is 2 ins. diameter by 2½ ins. long. I can't remember now what amount of wire I have on the field coils; but in Query No. 12,619 I think I stated what amount was on. I have ordered 10-volt lamps for the machine. Can I expect that voltage from it when running at 2,500 r.p.m.? I enclose sketch as taken from one of the firm's catalogues of the motor. It is the No. 2 size. I have ordered your book on "Small Dynamos and Motors" from the same firm. How many 4 c.p. 10-volt lamps can I expect the machine to light?

As you cannot say what weight of wire is on the field-magnet, we can scarcely advise you if it is suitable; but if you have anything like 1 lb. or more, then it is too fine a gauge for 10 volts. But as you have the coils wound, you had better try the machine; if it does not seem to start up or work well, try putting the two coils in parallel with each other, and in shunt to the brushes, as per sketch, and try again. No. 22 gauge wire will do very well for the armature. As regards output, we cannot say what you may expect, unless you can send a dimensioned sketch—possibly 40 watts. The number of lamps will depend upon what current they take; small lamps vary in this respect. You should be able to get 10 volts easily. The voltage can be varied by running at higher or lower speed.

[14,395] **Electric Cooking Utensils.** W. L. P. writes: I should be much obliged if you would answer me the following queries:—(1) What kind of wire is used for winding the resistance of an electric kettle? (2) Can you recommend a wire that will last a decent time? (3) Can you tell me the resistance (about) of, say, 100 yds. of a certain gauge which would carry about 5 amps.? (4) Where can it be obtained?

(1) The construction of electric heating and cooking appliances is by no means easy; various forms of heaters are used, and there is no particular kind of resistance wire which we can specify. (2) Try manganin resistance wire buried in sand or asbestos to keep it in its place; it should be wound on to some incombustible material. Enamel baked at very high temperature is used; but it would be probably out of your reach to do this. (3) Try No. 28 gauge; 5 amps. should bring it to a high temperature and yet not fuse it. The resistance is, approximately, 344 ohms per 100 yds. (4) Manganin wire can be obtained, in all probability, from the Universal Electric Supply Company, 60, Brook Street, C.-on-M., Manchester.

[14,164] **Telephones.** H. G. P. (Devizes) writes: Many thanks for your answer to my recent queries. Will you be so kind as to help me in the following matters? (1) I have put up two telephones, 150 yds. apart, using No. 10 galvanised iron wire for line, and using two pumps for earth returns—one at each end. The speaking is quite plain, but the bells will hardly ring. We are using four No. 2 Leclanché cells at each end. Is this enough for ringing the bells. The bells are professionally made, the bobbins wound with No. 24 or 26 wire. Would you tell me the cause of bells not ringing loud? (2) Has the National Telephone Company powers for taking down, or causing to be taken down, a private telephone wire in cases where the said wire crosses the public road? If you can give me any advice on the above, I should be much obliged?

(1) You do not enclose a sketch of your connections, so we cannot say definitely what is the cause of the trouble. You might try putting the cells half in series and half in parallel. This will reduce the resistance of your battery somewhat. (2) You have to get permission from the local authority to run wires across a public road. No telephone company has any power to take down, or cause to be taken down, any wires on a *public road*.

[14,390] **Electric Tramcar Brake.** "APPRENTICE" (Bristol) writes: Will you kindly answer me the following questions (1) Would it be possible to apply an electric brake to a tramcar by increasing current?—*e.g.*, supposing motor on full load takes 6 volts by increasing current to, say, 8 or 9 volts, apply brake. (2) Could it be made to work by a magnet arrangement by increasing current it cut off motor and cause brake to act; brake and motor are understood to be connected in parallel on same circuit.

(1) If you increase the volts, you increase the speed. A method of using the motor as a brake would be to cut off the supply from the armature of the motor entirely by means of a switch on the car, and leave it to still flow round the field coils. At the same time, the brushes being connected by means of a thick copper wire, or short-circuited, as it is called, the armature would then require great effort to turn it, and therefore act as a brake. (2) Yes, say, by means of a magnetically controlled switch so arranged that its magnet did not pull the switch over until the voltage reached a certain value. The brakes could be pulled on by means of a spring, the lever being held by a catch which was opened by the pull of an electro-magnet as soon as it became of sufficient power due to the increased voltage. An automatic switch worked by the brake lever could cut off current from the motor at the same moment. In each case the rise in volts would operate an electro-magnet arranged to effect the switching operations, etc.

[14,300] **Small Transformer.** J. W. T. (Upper Tooting) writes: *Re* small transformer. Thanks for referring me to back numbers 137, 138, 139 for information. Although I have carefully read same, I must admit they are too far advanced for me to fathom. As I have been travelling about for the last few years my back numbers have not been kept. Could you turn up or work out windings for transformer? It takes 205 volts (periodicity 85) to deliver 20 volts 5 amps.

Make a ring of plain armature stampings; outside diameter 4¾ ins., inside diameter 3 ins., depth 1 in. Wind on, first, a primary winding of 1,230 turns of No. 24 gauge D.C.C. copper wire and over this wind a secondary winding of 126 turns No. 17 gauge D.C.C. copper wire. The secondary volts can be adjusted exactly by winding on, or unwinding a few turns of the secondary wire. The iron core must be insulated with tape or paper before the primary is wound on; some insulation should also be interposed between primary and secondary. The method of winding is pre-

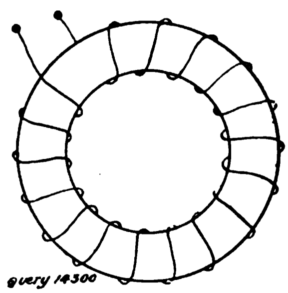


DIAGRAM OF TRANSFORMER WINDINGS.

cisely similar to a ring armature, and it does not matter in which direction either primary or secondary is wound, provided it is continued in the same direction throughout.

[14,268] **Standard Morse Taper.** M. W B. (Atherstone) writes: (1) What are the standard Morse tapers, and how many of them are there? (2) What is the correct taper for the cones of mandrel for back-geared lathe (3-in. centres)? (3) Where can I get small strips (say 5 ins. by 1 in.) of thin sheet steel for packing up slide-rest tools, etc.?

(1) The standard Morse taper is reckoned to be ⅝ in. to the foot, and, as far as we know, there is only one standard. (2) This varies according to the whim of the maker, the taper we use being 1 in. in 7 ins., or ¼ in. in 1¾ ins.; but, as a matter of fact, anything about this is near enough. (3) An ironmonger or tool stores will get this for you. We use all kinds of strip for this purpose, as thin sheet (strip) brass, copper, saw blades, flat iron, &c. There is no necessity for thin sheet steel.

[14,278] **Re-winding Dynamo to Drive Motor.** W. S. (Dublin) writes: Would you please oblige me *re* the following: I have a locomotive driven by a Thompson B2 motor wound for 6 volts. I use a dynamo giving about 18 volts 3 amps. to drive same. Will it improve matters if I re-wind motor for 12 or 15 volts; and what gauge wire ought I to use? There is room on armature shaft for about an extra ¼ in. of laminations. Will the addition of these make any difference in the power? The dynamo is Thompson's 4 amps. 20 volts. But I can only get the above 18 volts 3 amps. with foot drive, so I want motor wound to best advantage.

Is your dynamo shunt-wound? If so, it would probably drive the motor better if it was made compound by adding some series coils, say a couple of layers of No. 16 gauge wire wound on top of the shunt coils. We should be inclined to try this before altering the motor winding. We presume the motor is series wound; if not, by all means convert it to series. Adding laminations will not do any good if the armature core is now as long as the bore of the pole-pieces. Be careful to see that the series winding is in the same direction as the shunt, so that it adds to the magnetism. If necessary, take off a layer or two of shunt to make room.

[13,630] **Spark Cell Ignition for Gas Engine.** J. J. (Kidderminster) writes: I should esteem it a favour if you will be kind enough to advise me by post, or through the Queries and Replies column of The Model Engineer, how to wire up my small gas engine (2½-in. bore, 5-in. stroke, Barker's castings). I have a wipe contact, Bassee-Michel coil (trembler), and a 10 A. H. Lith-anode accumulator.

The following diagram shows the connections and circuit of coil ignition gear for gas engine. The primary circuit is from positive

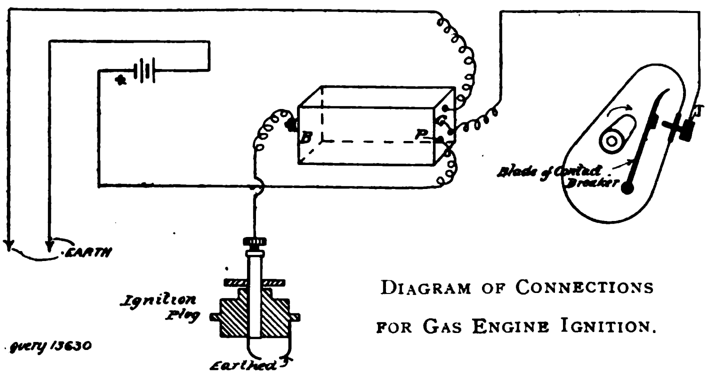


Diagram of Connections for Gas Engine Ignition.

of accumulator to positive of coil, through primary and out at G to insulated screw T, and on to blade of contact-breaker, and so to frame of machine (*i.e.*, earth), and back to negative of accumulator. The secondary B is lead to insulated portion of spark plug, the current jumps the gap, and so to earth, &c. We trust these details will assist you.

[14,380] **Building ¼ h.-p. Motor or Dynamo.** C. F. W. (Lewisham) writes: I should be very much obliged if you would answer me the following queries. I have your Handbooks Nos. 10 and 14 respectively, "Small Dynamos and Motors" and "Small Electric Motors." In the latter book, in Chapter 4, is given a design for a motor to supply circuit. I intend shortly to build such a motor, using the ¼ h.-p. scale; but I should also like it to work as a dynamo. Do you think it would work well as such? As a dynamo, I should want it to light a few lamps, for say, a workshop. I like the design and appearance of the machine, and should like to keep to it, if you recommend me doing so, modifying details a little, such as self-lubricators, split bearings, &c. Please state whether the same winding is to be used as given in table, and give output (volts and amps.); also any hints that might assist me, as this is my first machine beyond a model. Perhaps I had better say I have every convenience for making a thorough good job of it mechanically.

If you adopt a shunt winding, such a machine will act both as a dynamo and a motor, running in the same direction in each case. The voltage that it will give as a dynamo will be approximately the same as that of the main supply, for which it was wound as a motor; but it will require to be driven at slightly higher speed. This machine would only be suitable for use on a continuous current supply and not on an alternating current supply. As a dynamo, it should supply current for about fifteen 8 c.p. lamps, as a maximum load. The same winding is to be used as given in the winding tables; it should take 450 watts to give full power as a motor and give out about 400 watts as a dynamo—rather less than more.

[13,786] **Accumulators; Blower or Fan.** "Cyclor" writes: I have made a small lamp as per Chapter 2 in "Electric Lighting"; except that I have used a lens in place of glass in front, I propose to use it for a cycle lamp with a 4 or 6-volt H.E. lamp and with a 4 or 6-volt accumulator; also to charge and maintain with gravity cells as per same handbook. Have read articles in The Model Engineer, December 17th, 1903; also March 10th. 1904. Proposed size of accumulator:—For 4-volt 2½-amp. 8-hour light with H.E. lamp, 2¼ by 1¾ by 3¾ ins.; weight, 16 ozs. For 6-volt 1¾ amp. 6-hour light, H.E., 4¼ by ¾ by 4¼ ins.; weight, 20 ozs. (1) What current does a 4-, 6-, or 8-volt H.E. lamp consume? (2) Which of above two proposals would you recommend—4- or 6-volt? (3) How many, and what size, gravity cells to charge either of above? (4) If I use, say, five gravity cells to charge 4-volt installation, how long and how often can I use lamp (5) How many plates, and what size, should there be in accumulator? (6) If I use lamp for, say, five or ten hours per week, what amount of copper sulphate would the cells consume? (7) I have a small domestic blower, as rough sketch (not reproduced), something similar to the one described and illustrated in The Model Engineer for March 2nd, and driven same way. The machine to be taken on knees and nozzle placed on fire-bar. It is rotary fan type and is for three fans or blades; but I have taken them off, as they were worn and broken. Hand-wheel is 19½ ins. circumference in slot, and pulley is 2¼ ins. circumference. Average revolutions—handle, 180 per minute; spindle, 1,620 (about). (*a*) Can I drive above by a motor? (*b*) What motor is most suitable in Handbooks Nos. 10 and 14? (*c*) What power will it absorb (volts and amps.)? (*d*) Can I couple direct on one spindle? (*e*) Can I mount motor and blower in one stationary box, blast to be taken by flexible pipe? (*f*) If so, what sort and size of piping to use, where obtained, and what price? (*g*) How much clearance should I give blades of fan? (*h*) Would another pattern blower be better for working off motor (ventilating fan type, say), will you please advise. (8) As I have a quantity of telephone wire, covered with cotton (?), with red and blue stripes on it, what can I use it for, and what current will it carry in volts and amps?

(1) Impossible to say exactly; it would depend upon the candle-power of the lamp. You must rely upon the maker when purchasing an accumulator, and it is advisable to try and obtain the lamp from the same firm, as small lamps vary very much, and a maker of small accumulator outfits would probably stock lamps to suit his cells; about ¾ amp. would be near the value. (2) As you intend to charge by primary cells, the 6-volt would be preferable if lamps were of same candle-power as the current would be less at the higher voltage. (3) A gravity Daniell cell gives about 1 volt and you require 2½ volts to charge each 2 volts of accumulator, so that a 6-volt accumulator should require eight gravity cells. (4) The best way would be to have two accumulators, so that one is always charging. It is not good to run accumulators right down, or to leave them standing for any length of time in a discharged condition. Reckon quite two hours' charging for every hour during which the lamp is used. Even if only used for half an hour or so, the accumulator should be filled up again at once, if possible.

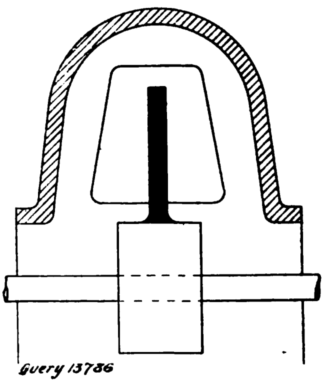
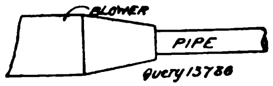


Fig. 1.

Gravity cells should always be giving out a very small current, and never left on open circuit. (5) See our handbook on small accumulators. (6) You must find this by trial; copper sulphate is cheap. (7) Blower: (*a*) Yes, an electric motor is very suitable for this work. (*b* and *c*) Any design absorbing about 20 watts; the speed of blower will determine what power it will consume. (*d*) Yes this would be the better method of driving. (*e*) Yes, you must provide air access to the inlet of blower. (*f*) Piping should preferably be the same diameter as outlet of blower, but 1 in. diameter would do. Join on to the blower by means of a conical fitting (Fig. 2) to avoid air friction, and avoid sharp bends in the pipe. Ordinary rubber hose would do with an iron nozzle. If pipe is of

FIG. 2.



metal, it can be zinc or iron gas barrel, or the tube used for electric light wiring. Apply to advertisers in THE MODEL ENGINEER, or to ironmongers. Messrs. Melhuish & Sons, of Fetter Lane, London, would probably be able to supply you. (*g*) Fan blades should be well clear of casing, somewhat in the proportion of sketch (Fig. 1). (*h*) No; this is the best pattern of blower to force air through a pipe. (8) Telephone wire: Use for connections to motor or lamps; probably carry 1½ amps.

[14,381] **Electric Motor for Model Motor Boat.** H. F. (Herne Hill) writes: Will you please advise me on the following points? (1) Would an electro-motor, with tripolar armature, 1½ ins. in diameter, taking 4 volts, be suitable for driving a model of the motor boat *Titan III*; length, 2 ft. 6 ins., beam, 6 ins. (all external measurements), using one of Avery's new propeller blades (illustrated in THE MODEL ENGINEER of May 18th, 1905)? (2) Would the following method of constructing the boat be practicable? I shall obtain six pieces of 1-in. planking, 2 ft. 7 ins. by 7 ins.; then I shall cut one piece roughly to the shape of plan of boat, cutting out portion in the centre, and cut each piece so that when fitted together they will form a rough model of the boat, when it can be finished up. If you could suggest a simpler method than the above, I should feel much obliged, as I have only comparatively few tools at my disposal.

(1) If the motor is a well-made one, it should drive a boat of this size very well; it should be series wound. The propeller is a most important item; it should be of fine pitch, so as to allow the motor to run at as high a speed as practicable; but you should not expect to get best results with the first propeller tried. The thing to do is to try several of different shapes, sizes, and pitch, until you find one which pleases you. But go on the principle of allowing the motor to run fast, as you will economise current. (2) This method is a well-known one, and often used; it economises time in shaping both inside and outside of the hull. You can safely use it. The pieces can be secured together with temporary screws, and when roughed to somewhere near correct shape, glued together with marine glue. The construction is further strengthened by means of bracing strips inside. Canadian yellow pine is, perhaps, the best kind of wood to use.

[12,730] **Early Firing in Small Gas Engine.** A. C. (Manchester) writes: I have just constructed a small gas engine, ½ h.-p. tube ignition, water-cooled cylinder, Otto cycle; exhaust is worked from side, and gas and air is sucked in automatically at one time from another valve. My trouble is it fires back too soon before it has got over the centre. I have tried the burner higher up the tube, but I get an occasional mis-fire, and, what is more, it does not ignite any later. No matter where I put the burner, I can get it going, but at such a terrific speed that it would knock itself up very soon; and the moment I reduce the gas it will stop on account of igniting too soon. If it ignited a little later, I could reduce the speed. I cannot get it by making the mixture poorer, as the slower it goes, it ignites before it turns the centre. This engine will go about 2000 revolutions or nothing Tube is hot enough and compression good—is it too good?—compression space with piston right in ¾ in. I should be glad to have your valuable opinion for a remedy. I have tried tube (¼ in.) from 4 ins. to 6 ins. or 7 ins. long, with no better result. I have looked for a remedy in back numbers of MODEL ENGINEER. I am sure that gas engine construction more gone into in your valuable paper is just what is required, and almost sure a publication in the form of your well-known sixpenny handbooks would well repay you. Does the heating up of cylinder affect the power of explosion in a gas engine?

It is a difficult matter to decide precisely what is the cause of your trouble, as you have already taken all the usual and ordinary precautions to prevent early firing. There is one thing you omitted to state, however—that is, whether your engine *ever did* run properly, or whether it has *always* given this trouble since it was built. If the latter is the case, you may have a troublesome job to put matters right, as the design may be at fault. On the other hand, the ignition hole leading from tube to combustion chamber may need enlarging, *or* closing up, to get the desired time of firing. The time of firing can be altered to a great extent by varying the size of the bore of this passage. We advise you, first of all, to bush the existing hole with a piece of thin brass tubing, driven tight in. Watch the results carefully. If this has *some* effect in right direction, insert a tube with slightly smaller bore still, and try again. It is often found that starting with a hole of certain bore, either *increasing* the bore *or decreasing* it, causes later fires. If this takes no effect, you should see what decreasing the compression does. This will be an awkward job possibly. The simplest way would be to take a trifle off the length of the connecting-rod at the big end by chipping and filing or in the shaper. Then supposing you found this did not improve matters, you could insert a thin plate to replace the metal previously cut off the rod. Or you might cut down the total volume of mixture admitted to the cylinder by inserting a check in the air *and* gas supply. This is, however, not a good plan, for the total pressure generated would thereby be reduced, and the power of engine diminished considerably. Are your valve settings all right? And are there no sharp corners in the combustion chamber which become red-hot after she has been running a few moments; and no carbon deposit which might also become hot and cause the charge to be fired from the cylinder instead of the tube? You could settle this point by running with the tube for a few minutes until everything has warmed up, and then put the tube burner out, and see if she goes on running. If she does, it is evident the charge is being fired spontaneously, due to compression, and the heat of the cylinder and combustion chamber. We regret we cannot give you more definite information, and trust these few remarks will help you somewhat. For fuller information on this subject see our new handbook on "Gas and Oil Engines," by W. C. Runciman, price 7d. post free.

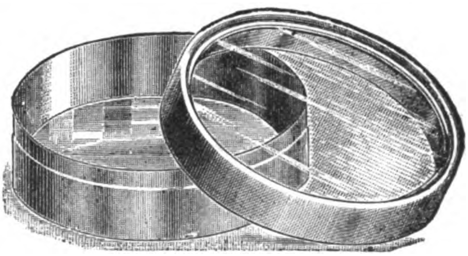
The News of the Trade.

[*The Editor will be pleased to receive for review under this heading samples and particulars of new tools, apparatus, and material for amateur use. It must be understood that these reviews are free expressions of Editorial opinion, no payment of any kind being required or accepted. The Editor reserves the right to criticise or commend according to the merits of the goods submitted, or to abstain from inserting a review in any case where the goods are not of sufficient interest to his readers.*]

* *Reviews distinguished by the asterisk have been based on actual Editorial inspection of the goods noticed.*

*A Workshop Requisite.

The illustration we give herewith represents a metal box, 2 ins diameter, which is being supplied by The Charles Cohen Tool Co., 34



AN AIR-TIGHT METAL BOX.

Barbican, London, E.C. This box, being air-tight and with a glass lid, will be found most useful in model engineers' workshops, also to watch and clock makers, for holding small articles, such as screws, accessories, etc., etc.

Yachts and Motor Launches.

Mr. R. P. Kitchingman, of 11, Marlborough Terrace, Kirkley Street, Lowestoft, informs us that owing to his continued orders for full-size craft, he is unable to undertake any further orders for model work, but is prepared to design or build yachts and motor launches for all requirements.

New Catalogues and Lists.

Portable Accumulators, Ltd., 210, Shaftesbury Avenue, London, W.C.—We have received an illustrated leaflet from this firm giving prices and particulars of their batteries for phonographs, piano-players, and other musical instruments. Lists will be sent to readers of THE MODEL ENGINEER upon application.

Scott Homer, Beecher Road, Cradley, Staffs., have sent us their illustrated price list of model engines, dynamos, motor drilling machines, and finished parts. The list will be sent to home readers upon receipt of stamp to cover postage, and to foreign and colonial readers post free upon application.

The Editor's Page.

WE have just published another handbook in THE MODEL ENGINEER sixpenny series, entitled "A Guide to Standard Screw Threads and Twist Drills." So much uncertainty and confusion prevails amongst amateur mechanics, and amongst some professionals too, as to the special features and the advantages and disadvantages of the various screw threads used on small work, that we think this handbook will meet with a wide appreciation. The author, Mr. Geo. Gentry, has gone into the whole subject very carefully and thoroughly in his own private workshop, with the result that the information he gives is of a thoroughly useful and practical character. He gives full particulars, including diameters, pitches, and tapping and clearing sizes, of the following threads :—Whitworth Standard, British Association, bicycle screws, V. Standard, U.S.A. Standard, International Metric Standard, and watch and clock screws ; while a further section gives in tabular form the gauge numbers and sizes of twist drills up to ½-in. diameter. A noteworthy feature of the book is that all the tables are printed on one side of the paper only, so that if desired they can be cut out and mounted for ready reference in the workshop.

* * *

The illustration and description of a fine specimen of a cast-iron plate which we published in our issue of July 27th, has brought us several letters from readers who have similar plates of identical design in their possession, which have been cast in local foundries in this country. Curiously enough, one of these plates was also cast some thirty years ago by a namesake of Mr. Simpson, who was responsible for the production of the plate illustrated in our pages, but we understand that there is no relationship existing between these two exponents of fine foundry practice. In reference to this correspondence, Messrs. Drummond Bros., Ltd., write to say that, of course, they make no claim to be the only firm who could make excellent repeats if desired of this plate. Their point is that it is a very difficult thing to produce a result quite as good as the original, and they doubt if it has often been done.

* * *

In case some of our readers may wish to obtain plates of this kind, we reproduce the following from among the various letters we have received :—"I have examined the photograph carefully and compared it with a pattern used at the firm where I am employed. They are identically the same. This pattern has now been in use for the last twenty-eight years, and during that time hundreds have been cast, and they still continue making them. If you wish I can obtain one bronzed in antique green or brown at a cost of 1s., postage extra, so that you can compare same, or any number you may require at the same rate. Being a reader of your paper I was deeply interested in your article on same, and could not help writing you.—A. BANNELL, 74, Onley Street, Unthank Road, Norwich."

* * *

The Model Manufacturing Company writes :—"Referring to the letter on your Editor's Page of 10th inst. from a Natal Correspondent, we would be glad if you would kindly give us this opportunity of stating in your next issue that we would be very pleased to comply with the suggestion of your correspondent and send out copies of our illustrated Locomotive Catalogue and also Tool Lists in the way he suggests."

Answers to Correspondents.

"Loco" (Hornsey).—We will write you shortly.

F. W. S. (Western Australia).—We regret that we have not been able to award you a prize.

Notices.

The Editor invites correspondence and original contributions on all amateur mechanical and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected or not, and all MSS. should be accompanied by a stamped addressed envelope for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

This journal will be sent post free to any address for 13s. per annum, payable in advance. Remittances should be made by Postal Order.

Advertisement rates may be had on application to the Advertisement Manager.

HOW TO ADDRESS LETTERS.

All correspondence relating to the literary portion of the paper, and all new apparatus and price lists, &c., for review, to be addressed to THE EDITOR, "The Model Engineer," 26—29, Poppin's Court, Fleet Street, London, E.C.

All correspondence relating to advertisements and deposits to be addressed to THE ADVERTISEMENT MANAGER, "The Model Engineer, 26—29, Poppin's Court, Fleet Street, London, E.C.

All subscriptions and correspondence relating to sales of the paper and books to be addressed to Percival Marshall & Co., 26—29, Poppin's Court, Fleet Street, London, E.C.

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Contents.

[*The asterisk (*) denotes that the subject is illustrated.*]

THE

Model Engineer

And Electrician.

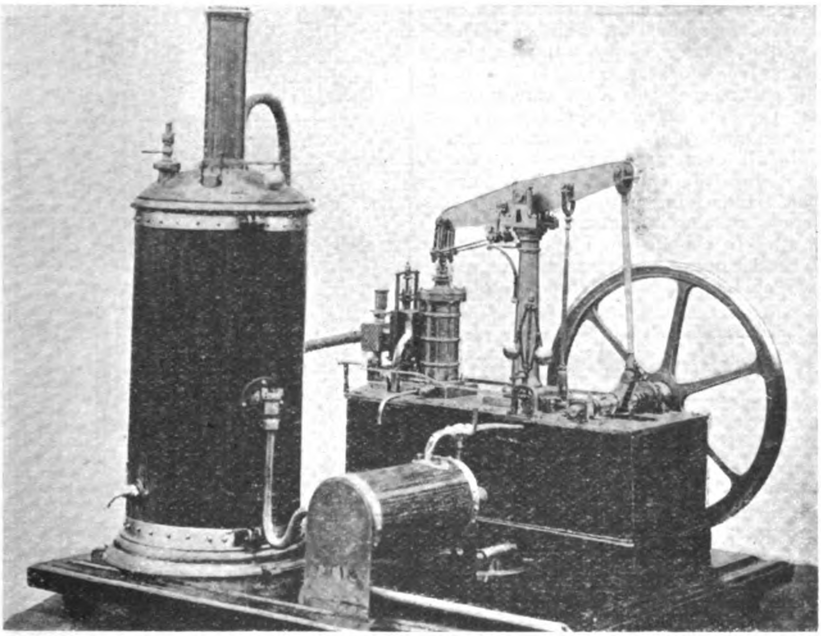
A JOURNAL OF PRACTICAL MECHANICS AND ELECTRICITY.

EDITED BY PERCIVAL MARSHALL, A.I.MECH.E.

VOL. XIII. NO. 227. AUGUST 31, 1905. PUBLISHED WEEKLY.

A Model Beam Engine and Vertical Boiler.

By J. W. BARTLETT.



MR. J. W. BARTLETT'S MODEL ENGINE AND BOILER.

THE following brief description and photograph of my model beam engine may prove interesting to many readers of the *M.E.* It will be seen by the photograph that the engine is mounted on a wooden box 9 ins. long, 4 ins. wide, and 3½ ins. deep, painted and lined to imitate brickwork. To this the steel bedplate (9 ins by 4 ins. by ⅛ in.) is bolted with six bolts. The centre column is a casting turned and finished 4⅞ ins. long, and is bolted to bedplate from the underside; on top of this the two bearings which carry the beam are bolted. The beam, a piece of mild steel, is 6¼ ins. long, 1 in. wide at centre, tapered to ½ in. at each end, and ¼ in. thick. Through this five holes are drilled, slightly tapered, for the reception of the five steel spindles, which after being turned in lathe are driven into them; these form the connections for the connecting-rod, pump, beam pivot, piston-rod guides, and piston-rod, the working ends of each being fitted with adjustable brasses. The cylinder is brass, bored to 1 in. with a stroke of 2¼ ins. The top cover is secured to cylinder with six 1-16th in. bolts; the bottom cover is left square which makes a better finish to cylinder than if it were round; six steel bolts passing through bedplate, cover, and cylinder flange hold all firmly in place. The ports are circular, steam ⅛ in. and exhaust 3-16ths in. diameter, the motion being imparted to slide-valve by a small rocking-shaft fitted to bedplate under slide-valve chest. The eccentric is the simple slip type, which enables the engine to be run in either direction. To the slide-valve cover is screwed the throttle valve. A lubricator fitted on top supplies the necessary lubricant to cylinder. The crankshaft and connecting-rods, which are of steel, were next completed; also main bearings, governors, and flywheel, which is a casting turned to 7½ ins. diameter, and is of iron.

The pump, which has a stroke of ⅝ in. and 5-16ths in. diameter, is fitted to underside of bedplate inside the box. In the mahogany stand a small brass well is fitted, from which the pump takes its water; from the pump it passes through the feed-water heater, and thence into the boiler. I may say the feed-water heater is similar to the one which was described in THE MODEL ENGINEER, December 1st, 1900, and I use the exhaust steam from engine for this purpose. It is mahogany lagged and French polished, and answers its purpose very well. The boiler was made from a piece of brass tube, 10 ins. long, 4½ ins. diameter, and 1-16th in. thick. The fireb x is a bell-shaped casting, riveted to boiler shell with copper rivets spaced ¼ in. There are five ¼-in. brass tubes connecting firebox with combustion chamber. The fittings are:—Water gauge, safety valve, water filling plug, clack valve, and blow-off cock.

I find a small gas ring is the most convenient method of firing, the ring being passed through a circular hole in the stand right up into the firebox. I have lagged it all over with mahogany, and French polished it, the lagging being held in place by German silver bands ½ in. wide; small round-headed brass screws passing through these make a nice finish to all. In conclusion, I may say the building of this model occupied three years of my spare time, by which I mean two or three hours of an evening.

Workshop Notes and Notions.

[Readers are invited to contribute short practical items for this column, based on their own workshop experience. Accepted contributions will be paid for on publication, if desired, according to merit. All matter intended for this column should be marked "WORKSHOP" on the envelope.]

A Height Micrometer.

By R. J. MITCHELL.

In accurate mechanical work it is very often needful to ensure exact parallelism and measurement between two fairly large and intricately shaped surfaces of a casting which has been machined and scraped, to ensure the ultimate attainment of accuracy. The exact measurement of this thickness is difficult where the article cannot be held between the jaws of an ordinary micrometer, for it is by no means easy to adjust a scribing block point to any absolute height unless a set of test pieces is available, and these are awkward, expensive, and must be numerous to give a range of only slightly differing heights. The tool indicated in sketch is intended to supply the place of a set of test pieces; by its aid any vertical height up to 2 ins. may be readily gauged in increments of half a thousandth of an inch—a range which would require a great number of test pieces.

As will be seen, the tool really is an inverted micrometer screw, arranged so that its face is in the same plane as the surface of the plate when the reading is zero. When any definite height is required to be attained, the screw is turned round until this is reached, and then the point of a bent scriber, held very firmly, is adjusted until it exactly touches the face when slid over, without any jar being felt as it leaves the edge of the face. Having by this means "made" a gauge of the particular size needed, it is used, of course, in the generally

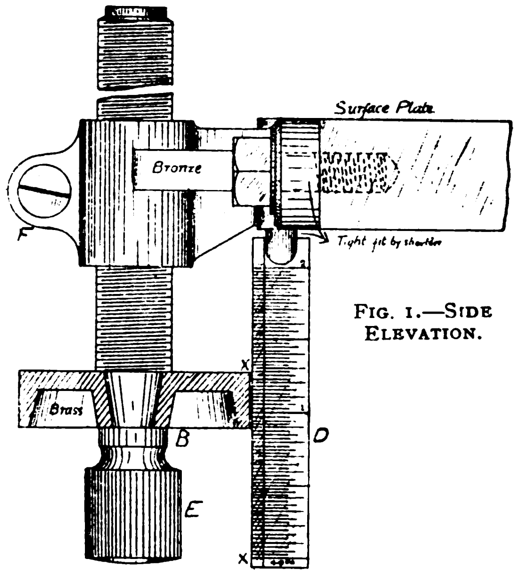


FIG. 1.—SIDE ELEVATION.

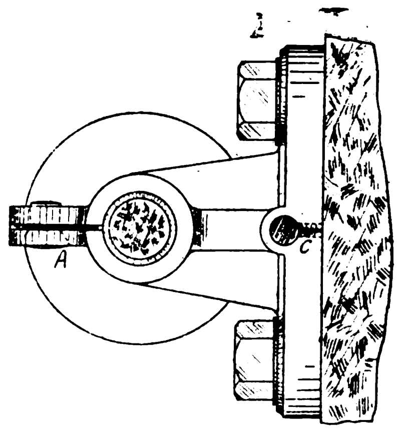


FIG. 2.—PLAN.

A HEIGHT MICROMETER.

accepted way as an external "feeler gauge." In this connection it might be said that the method advocated by the writer (in the issue for February 23rd last) for setting a boring bar electrically might be with advantage used in this testing of surface accuracy. It must be remembered, though, that an extremely weak cell is best, and a detector galvanometer is better than a bell as a "touch indicator"; otherwise sparking would spoil the result and be misleading.

With regard to the making of this tool, the writer is aware that, for a great number of those to whom this might be of interest, any hints on this would be quite superfluous; but for those not so proficient a fuller explanation may be of use. The first step should be to face up one edge of the surface plate exactly at right angles with the face; to test this, lay a straightedge across at right angles with the faced part, press it firmly so that it is really in a line across the end, and then slide a large square across the surface plate, and when the rule and edge of square blade are parallel the end will be at right angles. The thickness of most plates is insufficient for an ordinary test with a square to be reliable. When a casting has arrived of the bracket, which should be amply long in the boss, this should be faced up at the back, and the two holes marked out extremely carefully on both

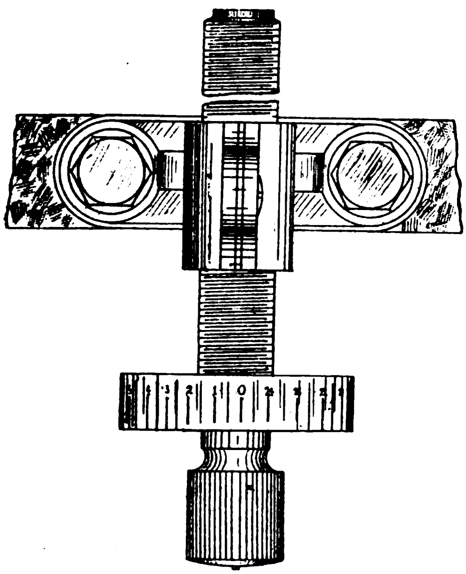


FIG. 3.—FRONT ELEVATION.

plate and back of bracket, which having been done, the top of the back-plate and the top of the boss should be filed so as to be in one plane, and exactly at right angles with the already finished back. The bracket should now be mounted on a faceplate, and the boss centred.

The screw next claims notice; it is best made from high quality cast steel, water annealed—*i.e.*, dipped out from a black heat into very soapy water mixed with machinery oil. This gives the steel a curious property of turning very easily, and yet not tearing—essentially needful when a screw of fine pitch; in this case forty to the inch is contemplated. Cut the screw in the usual way, and leave it about five-thousandths over the ultimate size, and then chase this off until the screw is half a thousandth big, and as exactly parallel as possible. Before cutting off turn the conical part shown at B, and a screw at the end of this, say a quarter Whitworth, for the thumb grip E to screw on to. The measuring ring above should also be turned in place, and must be very true. Now the screw may be parted off, and should be faced very carefully at its measuring end with a tool well "got up." The slight excrescence left here may be removed with a fine file and scraper. To harden the screw, first besmear it very copiously with a mixture of soap and blacklead; this protects the fine threads from being "burnt." Heat slowly, and very evenly; among the ashes on a brazing hearth if possible, or with a gas blowpipe on pieces of torn up asbestos, until a dull red heat is attained, and then quench in a large volume of acidified ($HgSO_4$) water by very slowly and evenly lowering the screw until entirely immersed. Leave the screw in the water to thoroughly cool, and then withdraw, dry, and screw the end B, which need not be hard, into a chuck in the lathe, and finish off by holding two pieces of soft wood, supplied with a trace of flour emery and lots of oil, diametrically across the screw whilst it revolves. By this means a highly polished screw is made.

The casting on the faceplate should now be drilled out in the lathe to the nearest possible size, and finished by a small boring tool to the exact size of the diameter at the bottom of the thread (gauge to ensure this could be soon made from a piece of brass rod). To cut the internal thread it would be best to mount as a tool a chaser of the required pitch in the tool-post, and feed it up to its work very slowly until the screw is a very tight fit, at which it should be left. When the saw cut is made at A, the screw will be found to be a nice, smooth, shakeless "fit." The measuring ring should be divided into twenty-five divisions, and these into half divisions. Means of accomplishing this have, I believe, previously appeared in the *M.E.* The other work is straightforward; and there now remains the final adjusting, which should be done as follows:—

When bolted on to the edge of plate, arrange that no part of bracket is on the same level as that of surface of plate; if this should be so, take a little off end of boss in lathe, and then, if possible, procure another plate, and lay it on its face overhanging top of screw. Tighten up F, and move round the measuring ring until the zero at its edge X is exactly in a line with the zero line on rule at the edge. Before all this the screw should have, of course, been turned until its surface just touched that of the overhanging plate. Now remove the bracket, and tighten up very firmly the small grub screw at C; put where it cannot be tampered with, and then rebolt to plate also very firmly. Now turn screw back, and find out if the two zeros coincide as before. If not, adjust so that they do, and tighten up all over except screw F, which should be so that screw is fairly tight. It will be seen that a turn of the screw is equal to twenty-five thousandths of an inch.

Hints on Drilling.

By W. EARLY.

One of the most awkward jobs that fall to the lot of the amateur mechanic is that of drilling a hole diametrically through a circular rod or piece of turned work, such as the screw hole in the contact pillar for a spark coil. The difficulty lies in the fact that the drill seems to have an antipathy to following a true diameter, and will run off at a tangent, thus spoiling the piece. Of course, a **V**-centre in the tailstock of lathe is a great help, but even this does not entirely overcome the difficulty. It is, however, a very great improvement if the entrance and exit of the drill are accurately marked out on the work, and a simple rig for accomplishing this is described below: it occurred to me a day or so ago when I was engaged on job as described.

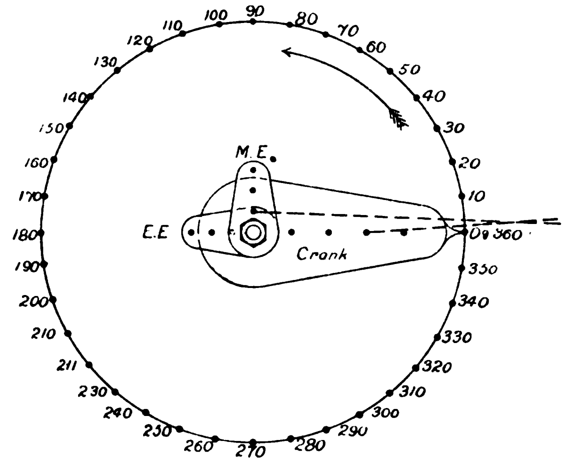
Cut a narrow strip of postage stamp edging and lap it tightly round the work, fastening the ends together. Make a punch mark on work to form the first centre, and put a corresponding pencil mark on the paper. Now make a mark on opposite side of work and paper, as nearly exact as possible. Twist the paper round so that the mark just made on it comes opposite to punch mark on work. If the other mark on work agrees with that on paper, it is in the correct place; if not, halve the difference and put the second punch mark there.

Now drill from both sides with a fine drill, so that the two holes meet in the centre. If a slight inaccuracy is in evidence, owing to the drill running out of truth, it can be easily corrected when the full-sized drill is run through. The whole operation of marking out only takes a couple of minutes, and the drilling can be done with confidence, whereas if the drill is started and run from one side only, a very slight error in supporting the work causes the drill to be considerably out of truth when it comes through.

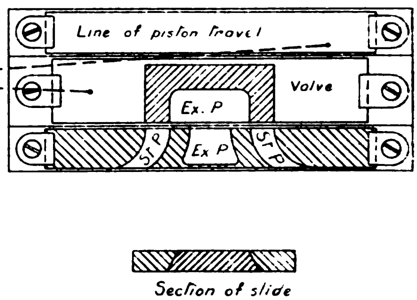
A Useful Valve Model for Beginners.

By J. R. G.

This model I have found very instructive and useful for working out the conditions resulting from various valve and eccentric travels. It is simply and easily made by anyone who can use a few tools. It possesses great advantage over the usual cardboard models sold, as this one can be adapted to any particular case required, whereas the cardboard model usually gives an explanation for one fixed standard of valve having a certain given travel, lap, and lead. The model consists of a piece of thin sheet metal, about 15 ins. long by 6 ins. wide, upon which at one end is set out a circle giving the various crank angles. In the centre of this circle is fixed a small turned pin for the crank to turn upon. The crank proper is put on a small sleeve, upon which is slipped the smaller cranks representing the eccentrics for driving the valves, both main and expansion. These may be moved in relation to the crank so as to give any required advance of eccentric due to lap and lead of the slide-valve. The whole can then be fastened by means of a small nut on the end of the sleeve, which is screwed up for this purpose. The centre line of crank and eccentric are divided up so as to give various travels of piston and valve. These small cranks are also cut from thin sheet metal, and a few of these could be kept in hand and left blank, so that they would only require a small centre pop putting in for the travel required. One leg of the trammels is fitted or works in this centre pop, the other leg working in a similar centre pop on the slide for the valve travel. For the crank and piston travel I use a pair of trammels, in one end of which is fitted a marking pencil for marking off the various positions of the piston in relation to the crank angle on the top part of slide arrangement (see sketch). The position of valve can also be seen, showing clearly all the movements that take place at the various positions of the crank and piston. The slides are made from small bar, the two outside ones being fixed to the body of the model, the inner one being movable to represent the valve.



A Useful Valve Model.



Upon these three bars are fixed, by means of small clips shown, three strips of white paper. A drawing of the valve in section is placed on the centre strip (either full size in case of a model, or to some suitable scale if a large engine). On the bottom strip of paper is set out the port-holes in the cylinder face, and on the top strip is marked the positions of piston travel. The trammels can be set with centres equalling the centres of the connecting-rod and eccentric rod, thus giving the movements of valve and piston very truly. When the problem has been solved, the strips of paper can be taken off, marked at back with all particulars, and kept for future reference. This model can also be used for expansion valve arrangements by using two slides instead of one, and the extra expansion eccentric, which can be clamped in position with the other, provision being made for it on the sleeve-carrying crank. This model will explain to the young engineer in a short time all the important operations of the slide-valve with their time of action in relation to the angularity of crank and the travel of the piston in portions of the stroke. I think the accompanying sketch will make all clear.

The Latest in Engineering.

A Suction Producer-Gas Motor Yacht.—The gas engine in conjunction with a suction gas producer, if properly designed, is the most economical generator of power (apart, of course, from natural sources) which the world has known. The consumption of fuel with such a plant is as low as 1 lb. of anthracite per b.h.-p. per hour. A good compound condensing steam engine uses from 2 to 5 lbs. per b.h.-p. per hour, according to size and type. With the oil engine the consumption is approximately 1 pt. (= 1 lb.) paraffin per b.h.-p. per hour. Anthracite costs about 19s. per ton, and paraffin about 125s. for the same quantity. It will, therefore, be seen that the respective costs for fuel are :—For the oil engine, 6·6 ; for the average good steam engine, 3½ ; for the producer gas plant, 1. Then, again, with the growing use of the spirit and the oil motor for small powers it seems to be evident that in the course of time the world will not produce sufficient oil to keep pace with the demand ; or, at least, the price of this fuel will so increase as to make the use of the engine employing it no longer sufficiently remunerative. The advantages, however, of the internal combustion motor for many purposes, and particularly for certain classes of marine work, are so obvious that it is desirable to retain it.

A paper was recently read before the Institute of Naval Architects by Messrs. Thornycroft upon the subject of gas motors, and shortly following this it was found that the principle had been thoroughly thought out by Herr Emil Capitaine. It is interesting to note that the first recorded instance of a vessel being propelled by an internal combustion motor was the auxiliary yacht, *Djezirely*, belonging to the Marquis d'Hare d'Aubaid, which, in the early sixties, was fitted with a Lenoir engine. This engine was of a heavy type and used gas as its fuel ; but in this case the gas was generated on shore and stored under pressure in cylinders or tanks aboard the vessel. The introduction of the explosion motor using oil or spirit as fuel followed, and it is only in recent years that the importance of the self-contained gas producer plant has been realised.

Herr Emil Capitaine has fitted several vessels with his gas engines and producers, with which he has achieved some quite remarkable results in sheltered waters on the Continent. The yacht herewith illustrated is constructed on the "Capitaine" system, and was entered for the Motor Yachts' Club Reliability Trials, and is the first vessel of its kind to run in the open sea. This yacht which, out of compliment to the inventor of this system of propulsion, has been christened *Emil Capitaine*, is built as a sea-going small motor yacht and is fitted with permanent cabin accommodation.

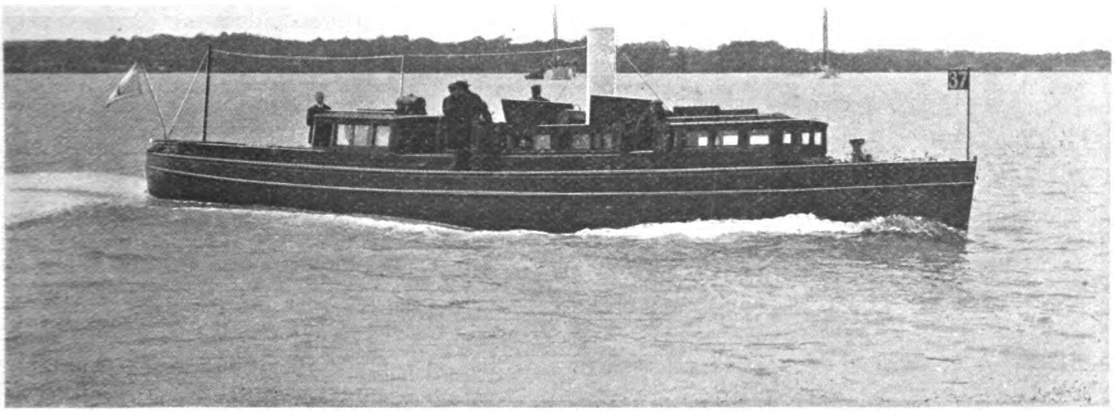


FIG. 1.—THE SUCTION PRODUCER-GAS MOTOR YACHT, "EMIL CAPITAINE."

The hull is built of galvanised steel plates, and has a length of 60 ft. with a beam of 10 ft., and is designed on the Thornycroft principle, which has been adopted in many of their boats, whereby a broad flat stern is obtained, and the propeller works in a tunnel. This ensures great steadiness without causing the stern to settle down unduly when running in the water, and further a clear and unobstructed flow of water is maintained to the propeller. The yacht is provided with two saloons—one forward and one aft—both of which are handsomely lined throughout with polished teak. Lavatory conveniences are arranged off the after saloon. The boat is intended primarily as a day boat, but there would be no difficulty in arranging bunks in the forward saloon for sleeping accommodation. A neat hand winch is fitted right forward for manipulating the cable. In the after part of the boat is provided a steel lined well, with automatic draining valves, suitable for carrying luggage, or a motor car if desired.

Altogether this vessel should prove a handsome, comfortable, and economical cruising yacht, and one which should be able to keep the sea in all reasonable weather. The power for propulsion is derived from a suction producer gas plant in conjunction with a specially designed gas engine. These have been built by Messrs. Thornycroft from designs and on the principle invented by Herr Emil Capitaine. The engine is of the vertical enclosed type, having four cylinders each 8¼ ins. diameter by 11-in. stroke, and, running at 300 revolutions a minute, gives about 75 h.-p. on the brake. The inlet and exhaust valves are all mechanically operated, the camshaft being placed above the top of the cylinders and slightly out of the centre line, the valves being actuated by means of rocking levers. The camshaft is hollow and carries in it a sliding shaft which, by means of radial arms projecting through slots in the camshaft, operates the low tension ignition strikers. The longitudinal motion of this inside shaft, which is controlled by the governor of the engine, varies the time of ignition, advancing it as the speed of the engine increases. Arrangement is provided whereby the timing of the magneto machine is simultaneously varied to correspond with the point of ignition.

The engine itself is controlled by means of a throttle valve in the induction pipe connected by a special arrangement to the governor. There is besides, provision for completely cutting out the electrical circuit when the speed of the engine exceeds a certain limit. Half compression gear is provided for starting the engine, which is done by a separate 6 h.-p. Thornycroft motor through the medium of a belt. The half compression cams are automatically thrown out of action by means of an attachment to the governor, when the engine is running at normal speed.

A centrifugal pump, driven off the engine, is provided for supplying cooling water to the combustion heads and cylinder jackets. The exhaust is also water-jacketed, and the gases are discharged up a funnel, no silencer being required. A reciprocating oil pump of special design is provided for forcing oil in turn to all bearings. Special provision is made to facilitate the cleaning of the cylinders, valves, etc., and a peculiar feature of the engine is that although the combustion heads are separate from the cylinder barrels, yet the explosive strain on the combustion heads is not taken by the connecting bolts, but by the whole frame-work of the engine. Doors are fitted in the lower part of the engine casing to provide access to bearings, etc. At the forward end of the crankshaft is a pulley for driving a gas dryer and a centrifugal pump for pumping the heated and dirty water from the gas purifier.

The gas producer is of the ordinary cylindrical shape. It is lined with firebrick and has three charging doors in the top which deliver into a conical annular hopper. A firegrate and air and steam inlet valve are provided in the lower part, as usual. A special feature of the gas producing plant is the arrangement for drying and purifying the gas without using any solid material in the scrubber as is usual. The hopper of the producer carries enough anthracite for a ten hours' run at a speed of about ten to twelve miles per hour. The total floor space occupied by the engine and producer is 12 ft. 6 ins. by 9 ft. 4 ins., and the height in each case is 6 ft. 8 ins.

Discharging Colliers.—An important alteration is to be made at Devonport Dockyard in the method of discharging cargoes of colliers brought into the Camber. It has been the practice to discharge coal by raising it from the hold by a crane, and conveying it to ordinary wagons drawn by horses, and then hauling it to the place of storage, but this procedure is to be abolished. A line of rails has been laid from the storage ground at East Lock roads round to the Camber jetty-side. Special trucks have been constructed, on which are fitted four buckets, each capable of holding a ton of coal. These buckets will be filled on the ship, and worked to the trucks by means of Temperley transporters, and the latter fittings will also be fixed at the East Lock Road to empty the buckets on to the stacks. It is calculated that the new system will result in from thirty to forty horses and wagons, and a proportionate number of teamsters and labourers, being dispensed with.

A Large Air Compressor.—A vertical five-stage air compressor has recently been constructed in England by Peter Brotherhood, the inventor of the Brotherhood steam engine. At a speed of 120 revolutions per minute it has a capacity of 10,000 cubic ft. of free air per hour compressed to 3,000 lbs. per sq. in.

Water-tube Boilers.—Some 80,000 h.-p. of Babcock & Wilcox boilers are being put into the new power station intended to generate current for the electrification of the Long Island Railroad, which will eventually be tied in with the tunnel system of the Pennsylvania Railroad under the Hudson and East rivers and Manhattan Island.

A Novel Type of Boat.—A French engineer, M. de Lambert, has just built a novel type of boat, which is called in the French press the Skating Boat, but which it would be more fitting to call a "supermarine," for the boat glides along the surface of the water by means of five inclined planes fixed on its bottom at certain distances. When the boat is not moving these inclined planes are several centimetres below the water; but so soon as the 12 h.-p. motor engine is started, then the inclined planes are raised and the boat soon glides upon a mixture of air and water until, as the resistance is diminished, it is reported to attain rapidly a speed of from 26 to 28 knots, a speed which motor boats of 80 h.-p. cannot always reach.

A Powerful New Salvage Steamer.—A remarkable-looking vessel of a bull-dog man-of-war appearance, named *Wrecker*, was launched recently from the ship-building yard of Messrs. Ramage & Ferguson, Ltd. The christening ceremony was performed by Miss Armit, daughter of Mr. Armit, of the East Coast Salvage Company, Ltd., for which company the vessel has been specially built. The *Wrecker* is 140 ft. long, 30 ft. beam, and 13 ft. hold. She will be propelled by twin-screw engines made by Messrs. Ramage and Ferguson, Ltd. When completed, the vessel will be the most powerful and efficient salvage steamer in the United Kingdom. Her steam pumping power will be fully 4,000 tons per hour; she will be provided with all the latest improvements in pneumatic drilling and cutting tools; electric light throughout; also a portable saw-mill, driven from one of her powerful steam winches. There is accommodation for forty persons on board. The *Wrecker* is the second salvage steamer the builders have constructed for the East Coast Salvage Company.

A New Anchor.—Experiments have recently been made at Trieste with a new type of anchor, known as the Langston, from the name of the inventor. In connection with the anchor is a tube and pump connected with the ship, and water is pumped into the tube till the anchor has reached the bottom, descending at the rate of 12 ft. per minute. Some time after it had time to "grip," a steamer with engines of 500 h.-p. could not drag it.

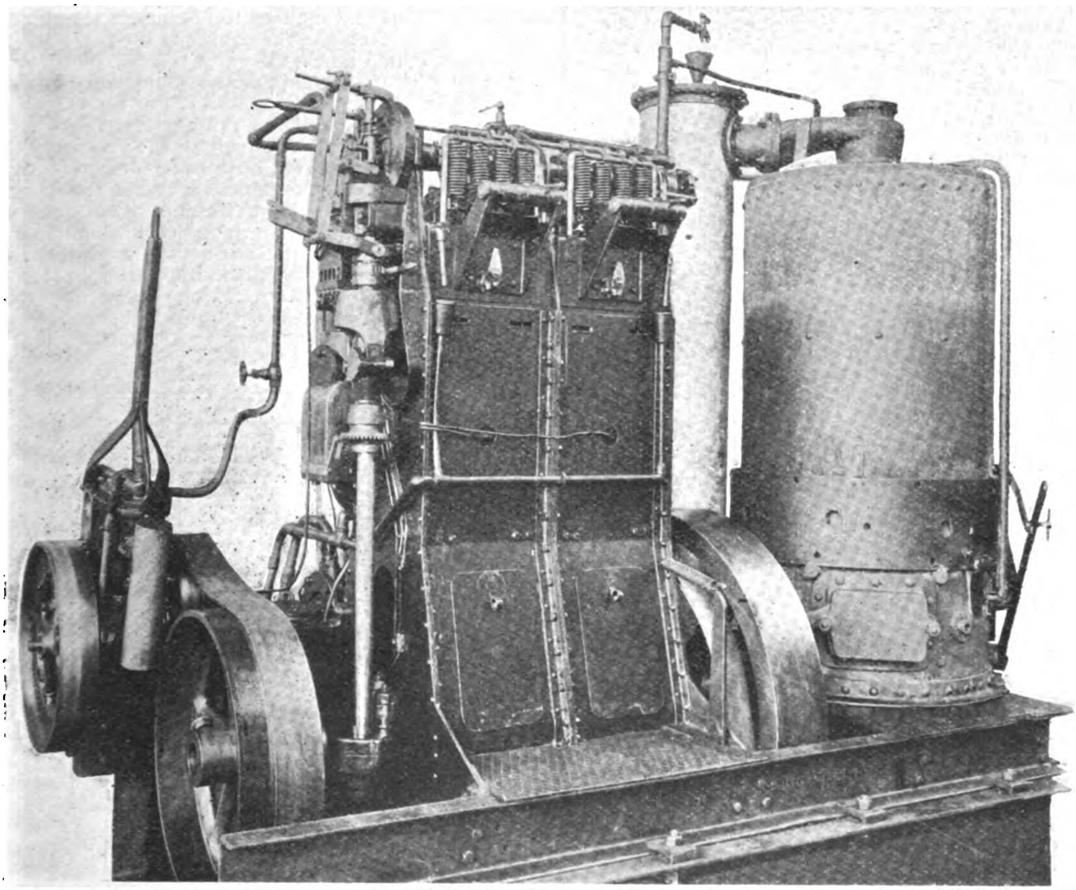


Fig. 2.—The Engines and Plant of the Suction Producer-Gas Motor Yacht.

The Generation of X-Rays by a Wimshurst Machine.

By Malcolm E. MacGregor.

Having just fitted up an *X*-ray apparatus for my own use, perhaps a few hints as to its management might be of interest to some of The Model Engineer readers. I use one of Dollond's improved high tension machines, which has a 9-in. cylinder, and under favourable conditions it gives a good 9-in. spark. The tube is one of Cox's records, which I find works well in all weathers. The screen is one of barium-platino-cyanide. If the machine is of fairly large size, the best results can undoubtedly be obtained by connecting the tube to the main dischargers. The anode of the tube should be connected to the positive (+) discharger of the machine, and the cathode of the tube should be connected to the negative (−) discharger of the machine, having in circuit a ½-in. spark-gap. When a tube is connected like this, it should light up at once, and continue to give out X-rays without a flicker, if the machine handle be turned at about three revolutions per second.

If it is found the tube only lights up with an intermittent flash, and the machine discharges itself on the outside of the tube, either in the form of a brush discharge, or in sparks, the tube has too high a vacuum for the machine. To remedy this, the tube should be carefully heated all over with a spirit lamp, which appears to reduce the vacuum slightly. If result is still unsatisfactory, the tube has probably too high a vacuum for the E.M.F. of the machine, and a tube which has a lower vacuum must be substituted. Another method which seems to give good results is to cover the annex of the cathode (the concave aluminium disc) with a ring of tinfoil or gold paint, and to extend it from the cathode terminal of the tube up to about one-third of the tube's length.

But if when a tube is connected to the machine it is filled with a red-purple glow, instead of showing the well-known canary-yellow light of the X-rays, then the tube is of too *low* a vacuum. This is a bad sign, as it is very seldom that anything can be done to remedy a tube like this. There is only one way that I know of to *try* to remedy a low vacuum tube, and that is to connect it to the machine the reverse way to what it should be—*i.e.*, connect the anode of the tube to the cathode of the machine, and the cathode of the tube to the anode of the machine; and after working it this way for five minutes, better results are sometimes obtained, but this is very doubtful.

When a machine is a small one, the tube should be connected to the outside coatings of the Leyden jars, connecting the anode of the tube to the *negative* discharger's Leyden jar, and the cathode of the tube to the *positive* discharger's Leyden jar, having the dischargers ¼ in. apart. The reason for this is that the outside coatings of the Leyden jars are always of opposite polarity to the dischargers to which they belong.

When a tube is connected as above, a series of flashes are seen in the tube, and for this reason it is little or no use for screen work; but splendid radiographs may be taken with a machine only giving 1-in. to 1½-in. spark.

For screen work the tube should be connected as directed where the tube was connected to the main dischargers. The screen should be held with the coated side facing the operator's eyes, and the subject which is to be examined placed close against the back of the screen, the whole being held as near the tube as possible.

In taking a radiograph, the dry plate should be covered with black paper, and the subject laid upon the plate (sensitive side uppermost). For a hand radiograph the tube should be held 6 ins. to 8 ins. from plate, and an exposure of from one and a half to two minutes given. For metallic objects an exposure of a few seconds is usually enough.

As to the plates to use, any good make will do, such as "Ilford," Cadett's "Lightning," and Edwards' "Cathodal," etc. It is generally better to use "medium" plates than the "extra rapid," and to use the developer the maker of the plates recommends.

I have tried to make myself as clear as possible, but should any reader not quite understand, I shall be always pleased to reply to any questions that are in my power to answer.

Lessons in Workshop Practice.

XXI.—Practical Notes on Selecting and Using Small Dynamos and Motors.

(*Continued from page* 178.)

By A. W. M.

THERE are two faults likely to cause trouble with a compound winding; one when the series coils short circuit the shunt coils (this is caused by stripping of insulation between the coils); the series coils being wound on top or under the shunt coils. If, for instance, the copper of the two sets of windings should touch, say, at A (Fig. 8), by reason of defects in the insulation, the shunt coils would be practically short-circuited by the series coils, and no current would flow through them. As this would also form a short circuit to the brushes, the machine would not give any useful output. The other fault is wrongly connecting the series coils, so that the current flows through them in the opposite direction to that in which it should go; instead of adding to the magnetism produced by the shunt coils, they then act in opposition to them, and produce precisely the wrong effect, as the

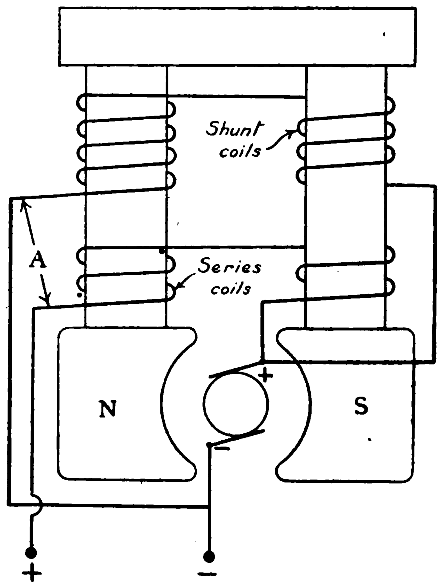


FIG. 8.

object of the series winding is to increase the magnetism in the field-magnet and thus raise the voltage generated by the armature when an increase of current occurs. Correct and incorrect connection of the series winding is shown by the diagrams in Fig. 9, the direction of current being indicated by the arrows. It will be noticed that they all point in the same direction when the connections are correct, and in opposite directions when the connections are incorrect.

Any shunt-wound dynamo may be converted to a compound-wound machine by merely winding a set of series coils on top of the shunt coils, and though it by no means follows that such a dynamo would be a good compound machine as regards regulation of voltage, it would yet have less tendency to lose its excitation when supplying current to a circuit of low resistance and probably give improved results for the particular work already mentioned. The amateur need not concern himself with the methods which may be adopted to pre-determine the correct proportion of series winding by designers of large machines, but simply wind one or two layers of thick gauge wire on top of the shunt coils and make a trial. For machines having more than one bobbin of wire on the field-magnet, a single layer on each can be used. For machines having a single bobbin two layers, or three if the bobbin is of small length. A few turns can be taken off or more added, according to results. Adopt a gauge of wire which is ample to carry the total current generated by the armature, say, a current density of not more than 1000 amps. per

ing current to them until the voltmeter once more indicates that the dynamo volts are normal. At this second stage multiply the amperes flowing through the magnet coils by the number of turns in the coils and it will give the ampere turns required by the machine at full load to keep the voltage up to normal. The difference between the value of the ampere turns at no load, and that required at full load is the value of the ampere turns which must be supplied by the series winding, which is then calculated as the number of turns of series coils multiplied by the current at full load which will be flowing through them.

To be strictly accurate, two corrections should be made. First, the full load should be increased by an equal amount of current to that taken by the shunt coils at no load ; secondly, the voltage should be raised at full load to a value which is equal to the voltage which will be lost in the series coils when carrying maximum currents ; the amperes

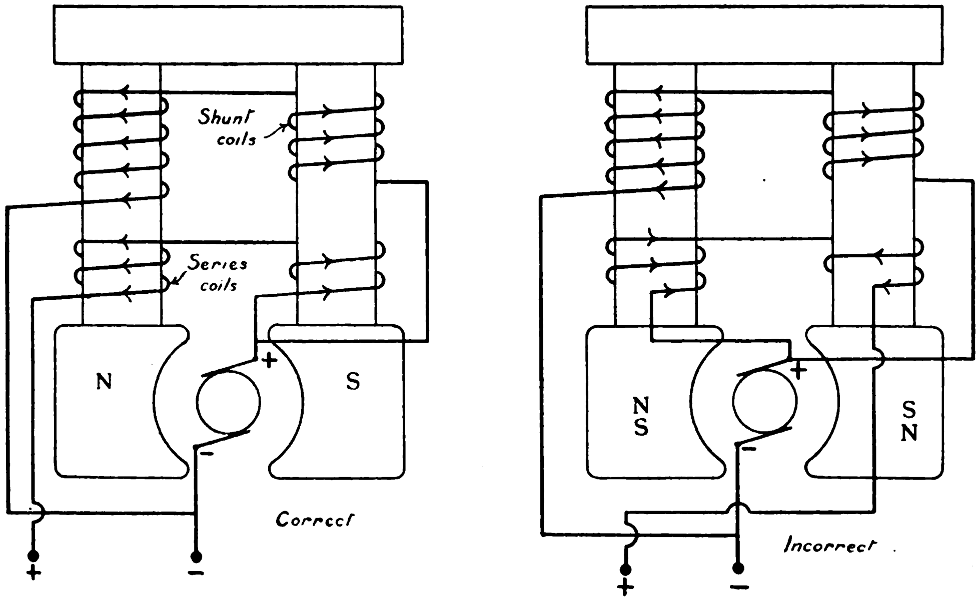


Fig. 9.

sq. in. of sectional area. There is a way of determining the amount of series winding with great accuracy, though it is essentially a practical workshop method, and may be useful to those who are endeavouring to obtain a regulation of voltage as near as practicable. The shunt coils are wound on first and the total number of turns counted ; the machine is then run at its normal speed, with the shunt coils separately excited from another dynamo or battery giving exactly the voltage at which the machine is to work, the only load on the dynamo being a voltmeter. At this stage the amperes flowing through the magnet coils are measured : the value obtained multiplied by the number of turns in the coils is the ampere turns required to produce normal voltage at no load. The full load of the machine is now put on, and the voltage will fall and be indicated by the voltmeter. Now increase the amperes in the shunt coils by raising the voltage of the dynamo or battery which is supply-

flowing in the series coils will be slightly different according to whether the machine is connected as long or short shunt. The speed must be kept constant, as the compounding will only be correct for that particular speed.

It will be noticed that a machine can be over compounded, so that its volts are higher at full load than at no load, and by this means the loss of voltage in the leads to the lamps can be compensated. Unless the dynamo has been designed with an ample amount of iron in the field-magnet and armature, it will not give good results as a self-regulating compound machine.

(To be continued.)

A mixture of one part pitch, one part resin, and one part plaster of paris is said to be a good cement for coating acid troughs.

Picturesqueness in Model Railways.

By E. W. Twining.

We have had from time to time in the pages of The Model Engineer many excellent articles on the planning, laying-out, and equipping of model railways; in no case, however, has the picturesque feature (the landscape, if I may be allowed to term it, of the country through which the line passes) and architectural correctness been touched upon.

There are many model railway engineers who do not sufficiently study this beauty of landscape and scenic effect in their miniature railway systems, a bare track upon which they can run their locomotives being often considered sufficient. O.hers with more ambitious ideas decide to have signals, a station or two, bridges and tunnels; and of these last it may be said that few study accuracy of detail in their structural work or adopt any definite architectural style. Most amateurs make their tunnels too high and too narrow, or else completely circular in section; bridges with spans too short or otherwise out of all proportion to the scale of rolling-stock and line. These are points that should be considered if the truth, beauty, and realistic appearance of the whole is an object to be kept in view.

Of these four items—signals, stations, bridges, and tunnels—it is my purpose in this article only to treat of the last two, and to do so in such a way as will enable the amateur to make his line both picturesque and architecturally correct.

The first item I pass over because there remains practically nothing to add to the articles which have

Fig. 1.—Eastern Entrance to Tunnel near Twerton, G.W.R.

already appeared in these columns on signals electrically controlled and otherwise, except that I would suggest, now that the attention of model engineers is being directed to electric traction by Mr. Greenly's fine design for a locomotive, which will necessitate the laying of a "third rail," that signals should be worked by solenoids fixed at the base of the pole in a watertight box below the ground level, either of low resistance connected up in series with the third rail, or high resistance in bridge between the third rail and line rails, the third rail being divided up into block sections and supplied with current at each section by feeders, either well insulated and laid underground, or open

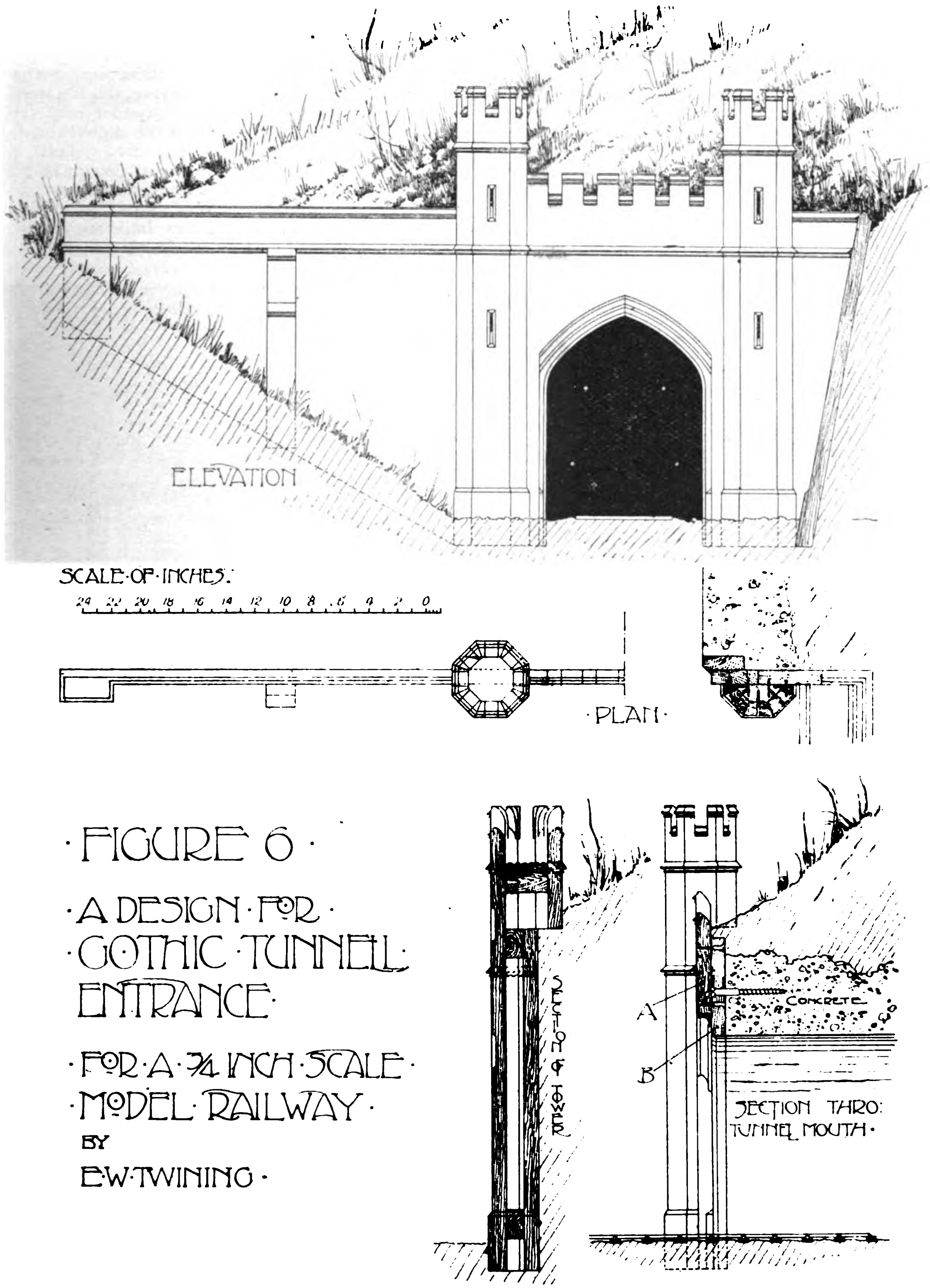
Fig. 2.—Western End to Twerton Tunnel.

wires run on the telegraph poles. By this means the movement of a switch, in the form of a lever in the signal-box, will switch in or leave dead the section in advance of a train as desired, the semaphore arm being on or off as the case may be.

Of the second item, I can only say that I personally fail to see the utility of introducing stations at all, unless the scale of the railway be a large one. It is practically impossible to make a "model" of a railway station, which is to be used in the open air, capable of standing all weathers for any length of time. I refer, of course, to a perfect model with timber-built booking offices, waiting rooms (with glazed windows), awnings over platforms, etc. Anything but an exact miniature of a real station more often than not looks crude, and detracts from, rather than adds to, the beauty of the line. Moreover, unless some mechanical or electrical arrangement is made for stopping and starting trains, the stations are useless; besides which, no *miniature passengers* can alight from or depart by the trains.

The last two railway accessories are, in the opinion of the writer, *par excellence* the picture makers of a railway. I will refer to them in the order named above.

Of bridges, I would strongly deprecate any attempt at modelling lattice girders, or bridges of any of the steel girder types, unless they be made true models, properly designed. This is, of course, quite possible, but the labour involved would be great. One sometimes sees on a model track bowstring girders, the arc of which is almost a semicircle, making the depth nearly equal to half the span. Models, too, of the Forth and other famous



· FIGURE 6 ·
· A DESIGN · FOR ·
· GOTHIC · TUNNEL ·
ENTRANCE ·
· FOR · A · ¾ INCH · SCALE ·
· MODEL · RAILWAY ·
BY
E. W. TWINING ·

bridges are almost always built of wood, the fact of their being of wood being quite apparent.

There is very little grace or beauty in steel girder bridges of the ordinary lattice type, except perhaps to the engineer with his head full of formulæ, who loves to calculate the stresses set up in each member by the passing of a train.

If we turn to the construction of models of masonry arches, the case is different. No reason exists why a viaduct or single arch should not be modelled in wood, because if painted with a carefully chosen colour the effect of stone or brickwork can be admirably reproduced, especially if some definite style of architecture is adopted, either Classic, Renaissance, or Gothic. Such a bridge would look infinitely more artistic and picturesque than a "wooden-steel" structure. Of these three styles, I think the Gothic will be the most easily copied. In the other two the mouldings of cornices, etc., would be much too intricate to model on a small scale; whilst the Gothic possesses the advantage of extremely simple mouldings.

Personally, the writer prefers the Gothic style, and who being familiar with the Great Western Railway between Bristol and Bath can say that Brunel's Gothic work on that portion of the line is not beautiful? I may specially mention the three-span bridge over the Avon at Bristol, on either side of which, by the way, a hideous steel bridge has been built, completely spoiling and partly hiding it. And, again, the two tunnels near Twerton, each with pointed Gothic entrances, flanked on either side by embattled turrets, nestling amid the trees in a private estate, but which can be seen from the railway carriage window.

For the benefit of those who do not often travel to Bristol, I give views of three out of the four entrances—Figs. 1 and 2 being the eastern and western ends of the longer tunnel respectively; and Fig. 3 one of the ends of the short tunnel, both ends in this being alike. Fig. 4 is a sketch of the bridge over the Avon before mentioned; and Fig. 5 a single arch carrying the line over a cart road near Saltford, also on the G.W.R.

Now few model railway builders attempt to copy these imposing pieces of work. There seems to be an idea prevalent that anything to hide the "end of a hole" does for tunnel mouths; consequently their lines are lacking in romantic scenic effect. It is, therefore, my object to give a short description and drawings showing how these Gothic tunnels and bridges may be made by those about to build a railway, or by those who think they may enhance the charms of their back garden landscapes on their already existing tracks. The dimensions are given to suit the $\frac{3}{4}$-in. scale gauge of $3\frac{1}{2}$ ins., and are for a single line track; these measurements may be varied in proportion to suit other scales or double line.

The scale drawing (Fig. 6) shows a tunnel mouth in the Tudor Gothic, which style not only yields a good effect, but is less difficult than a Classic one

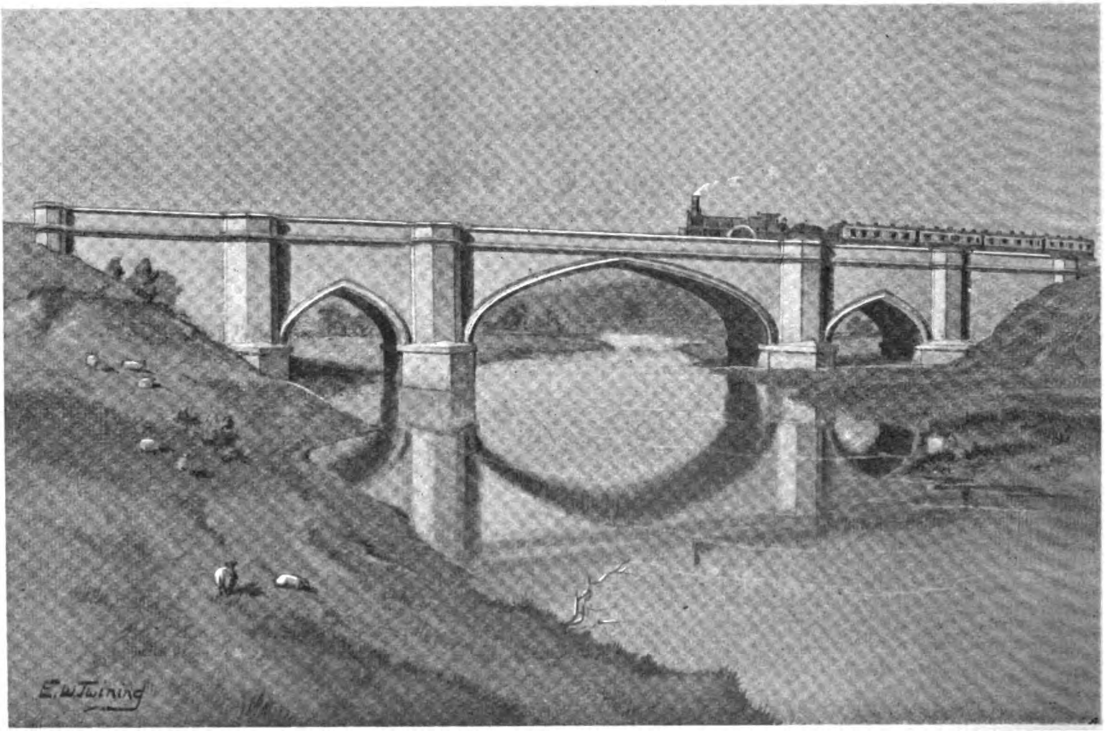


FIG. 4.—GOTHIC BRIDGE OVER THE AVON NEAR BRISTOL, G.W.R.

to model, at the same time involving very little more work than the common red brick-and-mortar style.

(*To be continued.*)

The Manœuvring of Turbine Steamers.

WHILE it has been admitted, practically on all hands, that the steam turbine has considerable advantages over the reciprocating engine for ship propulsion, and that it is almost certain to be very widely adopted for high-speed vessels, there continues to linger some doubt as to facility in stopping and starting, reversing, and generally of manœuvring turbine-driven steamers into piers and confined harbours. This doubt should be largely dissipated by the results of the official trials of the *Dieppe*, built for the London, Brighton, and South Coast Railway and the Western Railway of France, for service between Newhaven and Dieppe. The trials which were carried out between the two ports named were interesting more for the novel requirements in respect of stopping and manœuvring than for their speed; but in this latter respect the performance of the steamer was certainly remarkable, in view particularly of the fact that the length of hull was limited, owing to the tortuous nature of the channel within Dieppe Harbour. This required that the length should not exceed 281 ft. on the load-line. Fortunately, a scheme has now been approved, which, when carried out, will straighten the crooked paths. In the meantime the dimensions of the *Dieppe* had to be as follows:—Length over all, 282 ft.; length on the water-line, 280 ft. 6 ins.;

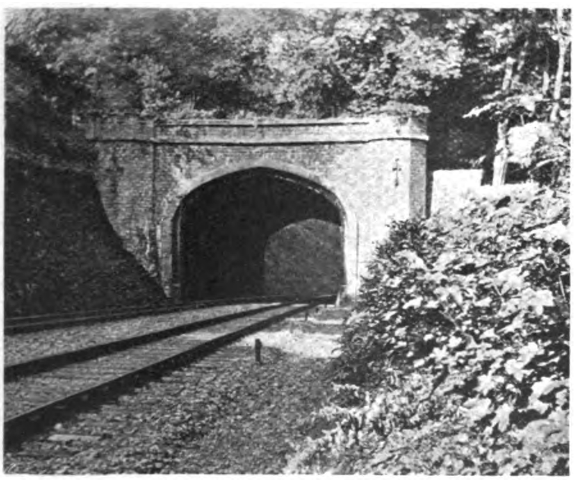


FIG. 3.—SHORT TUNNEL NEAR TWERTON, G.W.R.

breadth, 34 ft. 8 ins.; 'depth, 14 ft. 6 ins. On trial the mean draught was 9 ft. 3 ins., and the displacement 1,360 tons. The vessel was required to make the double passage within such time as necessitated a speed of 21·19 knots. The run to the French port on Thursday, July 6th, was made at the average of 21·523 knots, and the return voyage, on the following day, at 21·764 knots, giving a mean speed for the double run—nearly 130 sea-miles—of 21·523 knots. When we come to describe this vessel fully, we shall give the details of engine performance, etc. In the meantime, it may be said that the three shafts, each fitted with single screws, and operated—the centre shaft by a high-pressure turbine, and the two side shafts by low-pressure turbines—run at a mean speed of about 640 revolutions per minute. As we have already indicated, however, the interesting features were the rapidity with which full speed could be realised, and the

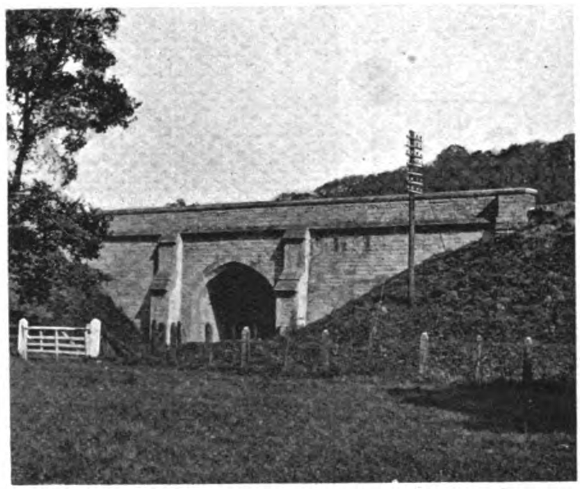


FIG. 5.—OVERBRIDGE NEAR SALTFORD, G.W.R.

time taken to reverse. Moving away from the quay, only the low-pressure wing-shafts and propellers were in use, as this greatly facilitated manœuvring. When the vessel had got into the centre of the harbour, and the order was given, "Full speed ahead," barely 2½ minutes elapsed before the high-pressure turbine was running at a speed of over 600 revolutions per minute. From the time that the vessel left Dieppe Quay until she was passing the lightship at the entrance to the harbour only four minutes elapsed, notwithstanding the tortuous nature of the harbour; this of itself is a very satisfactory performance in respect of manœuvring. Before the vessel had entered Dieppe, the contract required that when running at a speed of 12 knots she was to stop within 10 metres. Two boats had been moored to mark this distance, and for two miles in advance of the first boat the *Dieppe's* turbines ran at the rate of revolution which previous performance on the measured mile had determined as necessary to give a speed of 12 knots; within six seconds of the order, "Full speed astern," the turbines were running astern, and in 41 seconds the ship herself was moving astern, the distance traversed from the time the order was given to reverse until the ship began to go astern being 100 yards—several yards less than the requirements of the contract. Thus, as regards speed and manœuvring, every condition of the contract was fully satisfied.—*Engineering*.

A New Photographic Flash-Light. — The studio flash-light of a French photographer consists of a large parabolic reflector of aluminium, with a series of incandescent lamps around its edge, and in the centre an arc lamp with three carbons—one fixed and two movable. The small lamps enable the photographer to give the subject the best pose. When this is done, pressure on a rubber bulb draws the movable carbons across the fixed one, producing an arc for the fiftieth of a second, but closing a circuit which energises an electro-magnet and pulls the carbons away. The brilliant flash is said to give life-like portraits.

H.M. Scout "Adventure."

By Chas. S. Lake.

PRECISELY what is meant by a "scout" in marine, or rather naval, phraseology, may not be altogether clear to those readers whose acquaintance with such matters is only slight in character, although very little knowledge of the subject of shipbuilding is necessary to make it clear that a vessel built for scouting duties must surely be intended for the work of reconnoitring, with a view to ascertaining the strength and disposition of an enemy's fleet. As torpedo boat destroyers may be looked upon as a natural development of the torpedo-boat itself, so the scout class of vessel may be considered as marking a further stage in the evolution of such craft, designed for the purpose of destroying hostile destroyers and for acting to some extent as a "parent" ship to the torpedo boat division of the home fleet. The accompanying illustrations, for which the writer is indebted to Messrs. Sir W. G. Armstrong, Whitworth & Co., Ltd., of Newcastle-on-Tyne, who built the boat, show a vessel of the scout class, viz., H.M.S. *Adventure*, which has recently completed her official trials of coal consumption, full speed, armament arrangements, and steering and circling evolutions, the most successful results having been met with in respect of each.

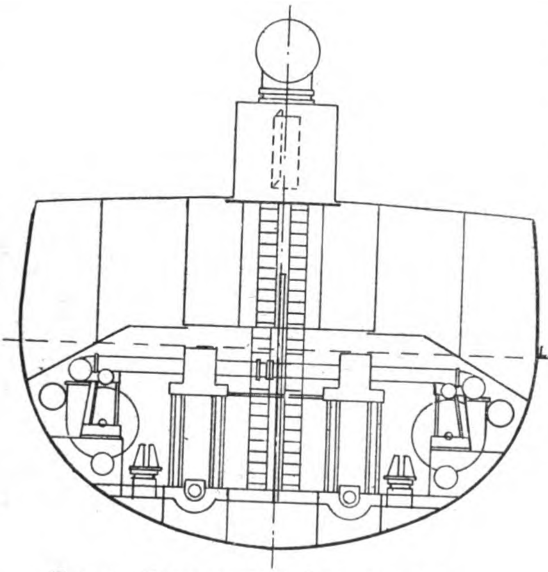


Fig. 2.—Cross-section Looking Aft.

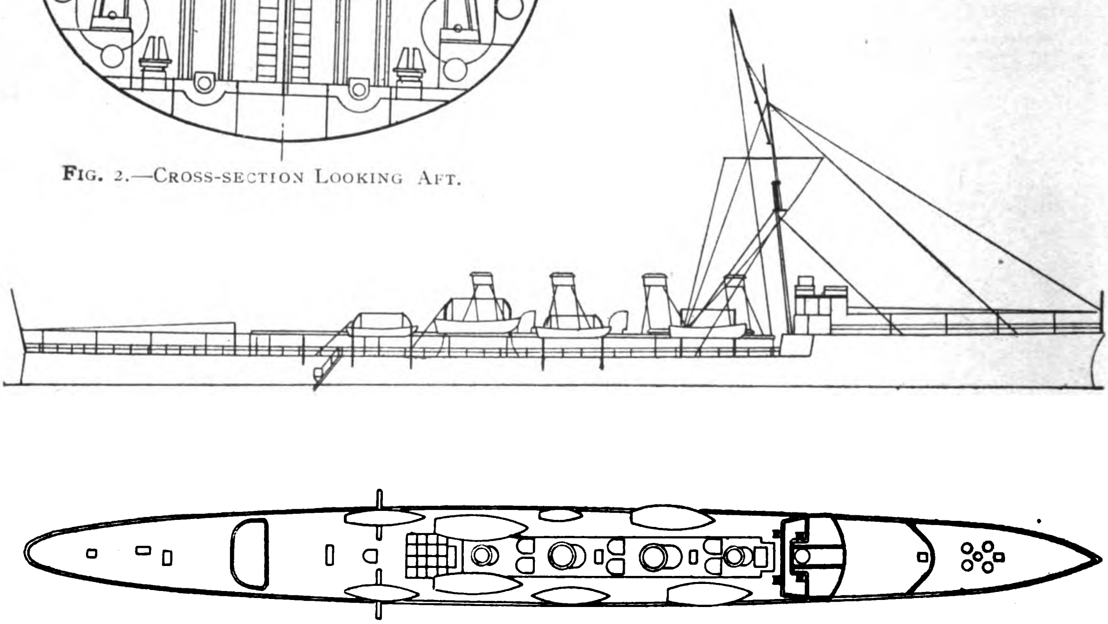


Fig. 1.—Elevation and Plan of H.M. Scout "Adventure."

The vessel is 374 ft. long, 38 ft. 3 ins. beam, 23 ft. 3 ins. depth moulded and 12 ft. 6 ins. draught. The displacement is 2,620 tons, and comfortable accommodation has been provided for 286 men and officers inclusive. The engine room staff comprises 160 persons of all grades, and the propelling machinery, which has been constructed by Messrs.

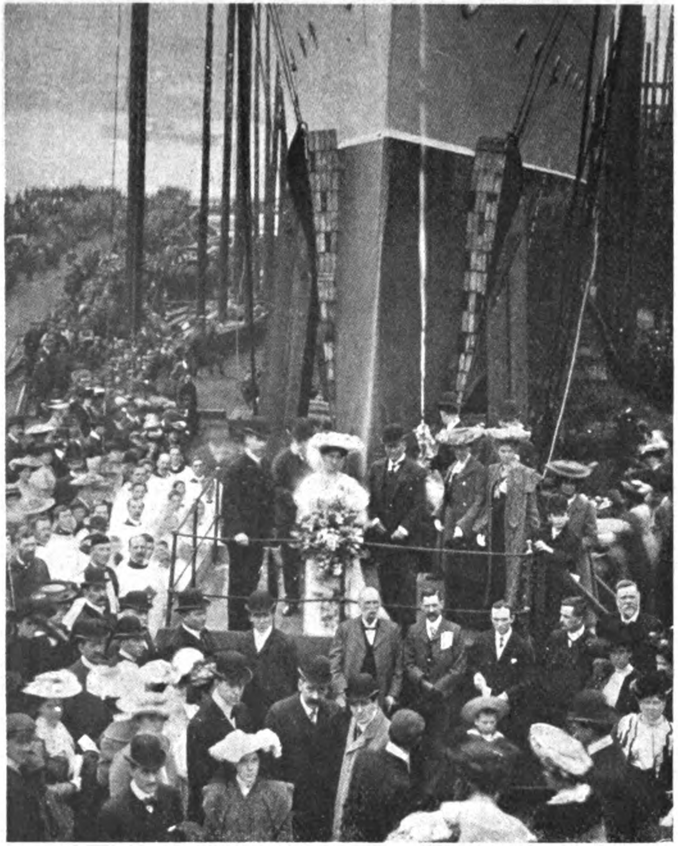


FIG. 3.—BEFORE THE CEREMONY.

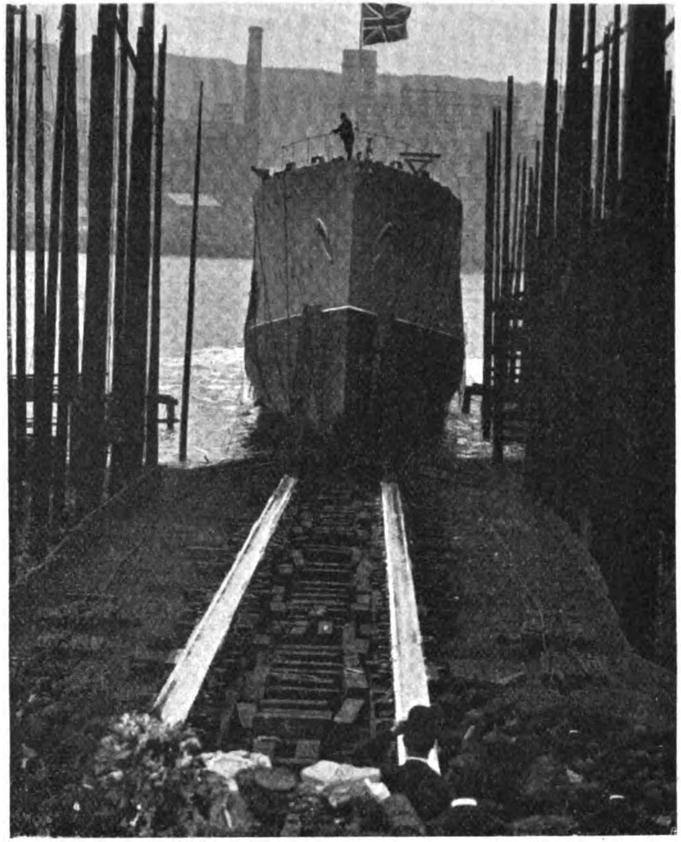


FIG. 4.—ENTERING THE WATER.

THE LAUNCHING OF H.M. SCOUT "ADVENTURE" AT NEWCASTLE-ON-TYNE.

This vessel was built by Messrs. Sir Wm. Armstrong, Whitworth & Co., Ltd.

For description] [*see pages* 206-208.

Hawthorn, Leslie & Co., consists of Marshall-Allen patent six-cylinder type engines, designed for 16,000 h.-p. at 250 revolutions.

In these engines, which have small cylinders and comparatively short-strokes, the weight and height are decreased, the strains due to moving weights being also decreased, thereby giving equable torque; all this being accomplished without increasing the piston speed.

The boilers are of the latest Yarrow type, all the feed-water being caused to traverse the outer rows of tubes before coming in contact with the boiling water. The total heating surface is 42,686 sq. ft., and the total grate area 784 sq. ft.

Each engine has one surface condenser with 10 ft. tubes arranged for allowing of a double flow of circulating water, entering at the after ends of the lower tubes. Each condenser provides 6,800 sq. ft. of cooling surface. The main engines have very ample bearing surfaces, there being eight long and two short bearings for each crankshaft, and the pins of the connecting-rods are shrunk in place and secured. Combination metallic packing is used for the piston-rods, the high-pressure rods being entirely without soft packing; but the remainder have the closed type of rings with soft packing outside them. The engines are fitted with the Surtees and Thews isolating valve, which automatically shuts off steam from the chests in the event of sudden fracture. Each boiler has an automatic feed regulator patented by Messrs. J. & G. Weir, who also supplied the main and auxiliary feed pumps. High pressure feed water filters and evaporators are fitted, the latter capable of 65 tons per day, single effect. The electric lighting machinery is by Messrs. Belliss & Morcom, and Brotherhood air compressors are employed.

The launching of the *Adventure* took place on the 8th September, 1904, by Miss Barry, daughter of Captain H. D. Barry, the director of naval ordnance and torpedoes. At the trials the vessel attained a maximum speed of 25·955 knots, and an average speed of 25·422 knots was maintained for 6½ hours; revolutions, 251·6 per minute; piston speed for 6½ hours in feet per minute, 1,069, and indicated horse-power, 15,850. Sufficient heating surface has been provided for 20,000 h.-p. with the boilers at full pressure, but at the trials nothing was done to force the vessel to its maximum capacity.

The bunker capacity of the scouts is sufficient for 4,500 knots at not less than 10 knots per hour.

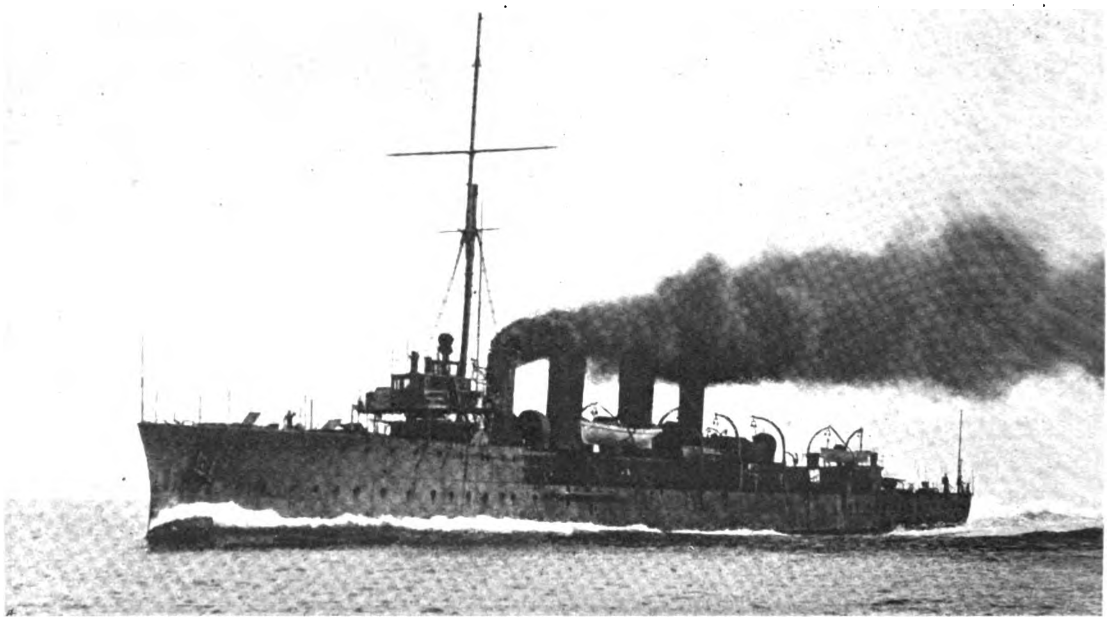


Fig. 5.—H.M. Scout "Adventure" on her Trials.

The armament consists of ten 12-pounders and eight 3-pounders, with two 18-in. Whitehead torpedo tubes above water. Large magazines are provided, having a capacity of about 220 rounds per gun. There is a sloping protective deck, 1½ ins. thick, and a circular conning tower 3 ins. thick. Space for one month's baggage and stores for each of the crew, taken at about 5½ cwts. per man, is provided.

The diameter of the twin propellers is 11 ft. 6 ins., and the pitch 12 ft. The blade surface in each propeller is 55 sq. ft., the pitch ratio being 1·093 sq. ft., and the disc ratio 1·888 sq. ft. A similar vessel to the *Adventure*, viz., the *Attentive*, will shortly be ready to commence a set of trials such as those to which the vessel forming the subject of this article has recently been through.

How to Soften Ivory.—Into 1 qrt. of vinegar slice ½ lb. of mandrake. In this immerse the ivory and let it stand forty-eight hours in a warm place. At the end of that time it will be possible to bend the ivory into any form desired.

The Silver Medal "M.E." Locomotive.

By T. P. Longworth.

THE model locomotive, "Lizzie," illustrated herewith will be recognised by many readers as being built from the coloured plate design which was given in the *M.E.* for January 7th, 1904, Vol. X. With the exception of the taps and boiler fittings, smokebox door casting, and spirit tank screw cap, lining and lettering, the model was built entirely by myself, and was awarded the silver medal at the test which was held early in this year.

The side-plates were taken in hand first of all, and made of hoop iron to the sizes given in the drawings. Two plates were riveted together and then one carefully marked out (the error in dimensioning the smokebox part being found), and then small holes, about ⅛ in. diameter, drilled round the marks, afterwards cutting with a cold chisel and then filing (a very laborious job).

Having got the sides and turned spindle, I thought the crankshaft would be best to try next, as I was not sure whether I could make it, as the only lathes I had access to were 8-in. and 10-in. centres. The crankshaft is made from a solid piece of 2-in. round mild steel, and had to be very carefully marked out at ends for centres, and then turned a little smaller in diameter, between each set of centres alternately, until reduced to size. The first attempt was not successful, as when complete I found it had sprung, and was not properly true. The second attempt is the one now in the engine. The cylinders were then bored in the 10-in. centre lathe from an angle bracket, then cylinder ends faced and valve face, etc., filed. The connecting-rods are of sheet steel, and all bolts for joints in this and eccentric lever motion I turned from ⅜-in.

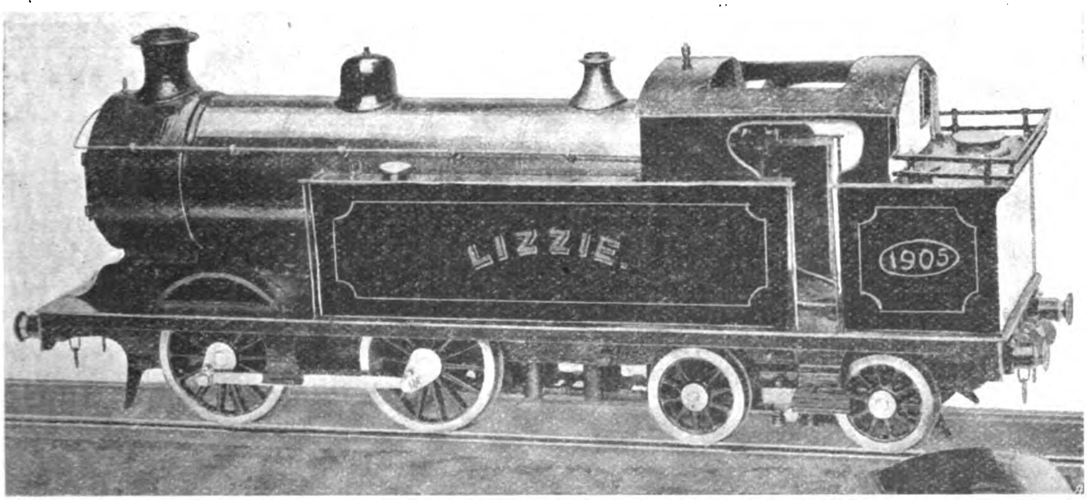


FIG. 1.—SIDE VIEW OF MR. T. P. LONGWORTH'S "M.E." LOCOMOTIVE.

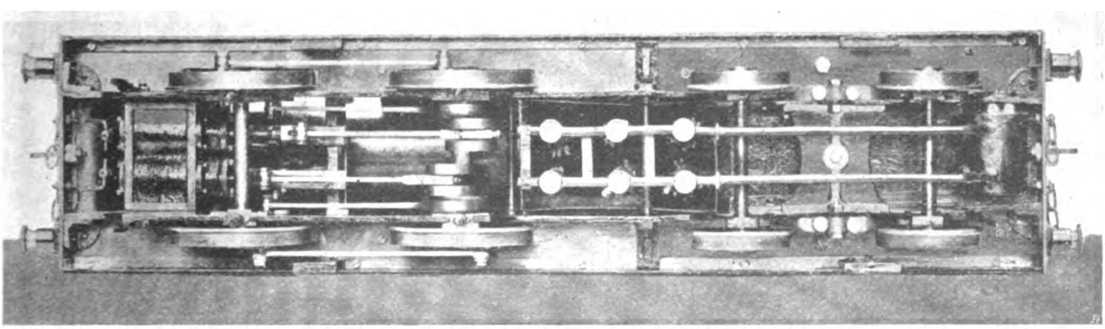


FIG. 2.—UNDERSIDE VIEW OF THE ENGINE.

round steel or iron in a chuck I made, as shown in Fig. 4. The wheels are made from patterns of white metal, and took a long time.

After completing the engine and driving wheels, I made the bogie and bogie wheels, the axles being made of cast tool steel.

The boiler is made of a solid-drawn copper tube, with copper tubes and gunmetal downcomer and ends, and is brazed. After brazing, and before any holes were put in the ends for mountings, etc., it was tested by water to 100 lbs. per sq. in. I had a difficulty in making the regulator valve watertight, so altered the design somewhat to get better results, as shown in section (Fig. 5). Tne

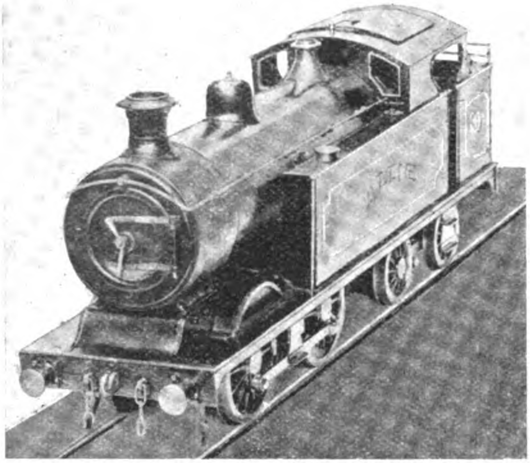


FIG. 3.—FRONT VIEW OF MR. T. P. LONGWORTH'S MODEL LOCOMOTIVE.

side-tanks, cab, and spirit tanks gave me a good deal of trouble to make, and I had the engine running under its own steam on February 24th last, and so entered the model for competition, although previous to this I had no intention of doing so.

After working the engine two or three hours, and coupling the side rods, I ran it on a short track made of square section iron, to see if I could get the drawbar pull by means of a spring balance. I got various results, from 2 lbs. to 3½ lbs., but not having had any experience in this line, I would rather it was tested by an expert.

After satisfying myself that the engine and boiler

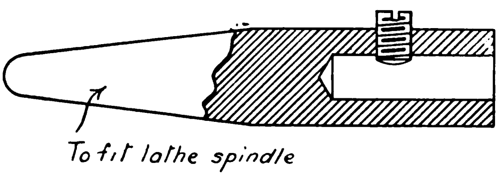


FIG. 4.—CHUCK FOR TURNING SMALL BOLTS, &c.

were all right, I painted it with enamel and stove varnish, and then asked a friend to line and letter the engine.

The whole of the patterns have been made by me, and all the small turned brass pieces are made from small brass castings, ⅜-in. round and about

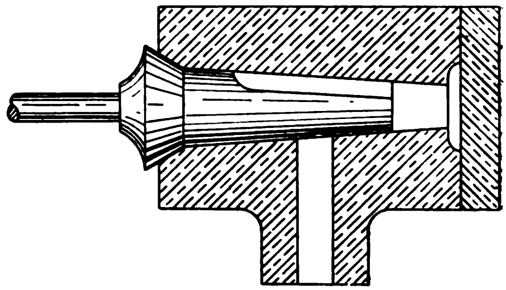


FIG. 5.—SECTION THROUGH REGULATOR VALVE.

7½ ins. long, cast to fit the chuck mentioned, and turned by hand in an 8-in. centre lathe.

All the turning, except the crankshaft and axles, has been done by hand tools.

Small twist drills have been used for drilling all holes, and a set of circular dies and taps from 1-16th in. to 5-32nds in. Whitworth for all the screws.

The "Holiday" Competition.

DURING the present holiday season, we have decided to award every reader who sends us a description and original photographs of anything of engineering or model-making interest he may encounter during his vacation, which shall be sufficiently good to warrant insertion in our journal. The prizes vary in value from 5s. to 10s. 6d., according to merit. All winning competitors will receive a notice of the value of the prize awarded, when they can choose the tools or other articles they may wish sent to them. All entries should be accompanied by a separate letter, marked on the envelope "*M.E.* HOLIDAY COMPETITION." This letter should include the title of the article and any other information not necessary for publication. The article should be written *on one side of the paper only*, with the name and address of the sender on the back. The photographs and separate sketches enclosed with the contribution should similarly bear the name and address of the sender, otherwise delay may arise in the awarding of the prizes. It is essential that the copyright of the photographs must be the property of the senders, and the covering letter should contain a declaration to this effect. The competition will close on October 16th.

ROUND THE WORLD IN SEVEN SECONDS.—Mr. Morton, secretary of the American Navy, opened a telegraph switch in the grounds of the Railway Appliances Exhibition at Washington, which started a time-signal round the world. The signal encircled the world in 7 secs., and a map measuring 21 ft. by 42 ft. showed the progress of the signal by means of electric bulbs.

Practical Letters from our Readers.

[The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a nom-de-plume *if desired, but the full name and address of the sender* MUST *invariably be attached, though not necessarily intended for publication.]*

Armature Reaction and Distortion of Field.

To THE EDITOR OF *The Model Engineer*.

DEAR SIR,—Thinking that the following experiment might interest some of your readers, I have enclosed some particulars.

Every electrician knows that as a dynamo or motor is loaded the current in the armature produces a magnetic field, the strength of which depends on the load on the machine. Thus, in a two-pole machine (see Figs. 1 and 2) the resultant field—which was horizontal at no load—becomes inclined, and the brushes have to be shifted so that the line joining them is at right angles to the resultant field, to ensure sparkless commutation. In Figs. 1 and 2, A is field due to field-magnets; B, armature field; R, resultant field; P P, position of brushes for sparkless running. Supposing in the case of a

DYNAMO.

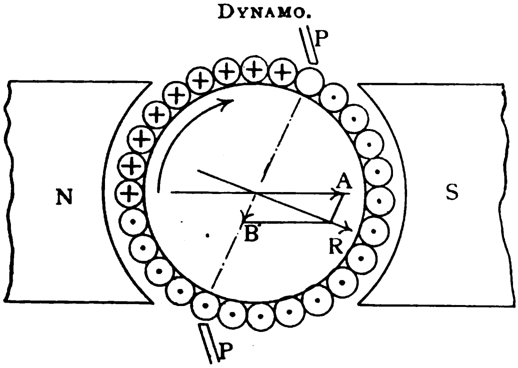


FIG. 1.

MOTOR.

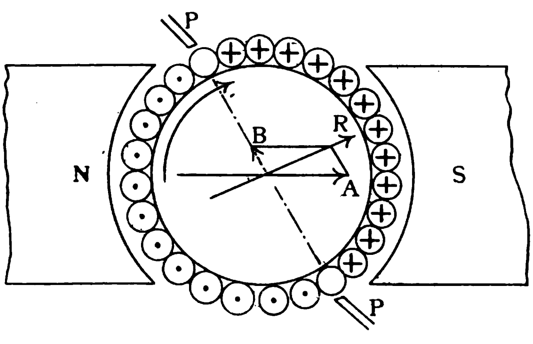


FIG. 2.

motor the fields are unexcited and a small current is passed through the armature while the brushes are in a position similar to that shown in Fig. 2, a magnetic field should be produced in the direction of the straight line joining the brushes, but owing to the presence of the massive iron pole-pieces this field will be distorted, and may be supposed to take up a direction similar to C (Fig. 3).

Now, C may be resolved into two components, D and E, the former being on the straight line joining the brushes, and the latter at right angles to D. D produces no torque on the armature, but E, it will be noticed, is acting in exactly the opposite

MOTOR.

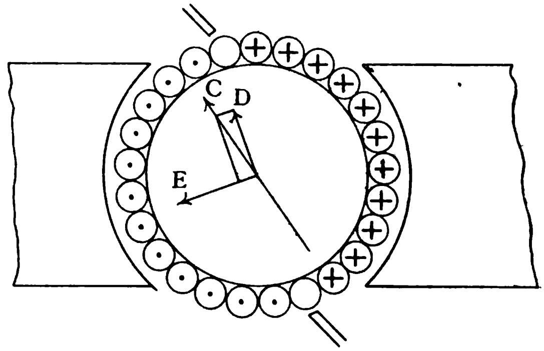


FIG. 3.

MOTOR.

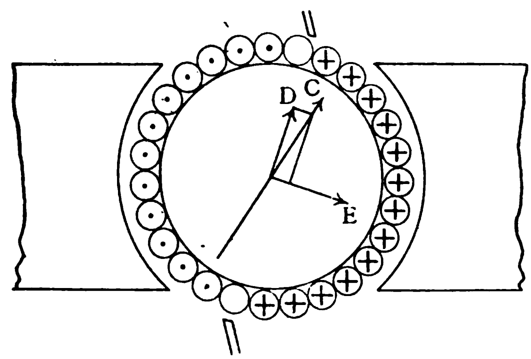


FIG. 4.

direction to R in Fig. 2, and, therefore, will produce a torque tending to turn the motor against its brushes. If, however, the brushes are given a forward lead (see Fig. 4), E will, relatively, be acting in exactly the opposite direction, and the motor should turn in its usual direction.

This experiment was tried by myself on an 8 h.-p. Goolden motor, taking 110 volts normally.

It was first "started up" in the usual manner (fields excited) from a battery of large accumulators, and the following particulars noted at no load:—

Volts across brushes = 120.
Armature current = 2·6 amps.
Field current = 3·5 amps.
Speed = 1,550 revs. per minute.

This gives an absorption of 312 watts in the armature, and over-all watts 732.

The machine was then shut down, the fields disconnected, and the brushes advanced two commutator bars (about 13 degs.) from the vertical position. A current of about 46 amps. was then passed through the armature. This at first produced no effect, but on giving the motor a "start" it commenced to crawl up in speed, taking about two minutes to acquire a velocity of 1,000 revs. per minute.

At about 1,400 r.p.m. the brushes began to spark, and small movements of the brush-rocker would not stop the sparking. After about five minutes from starting the following readings were taken :—

Volts across brushes = 11·9.
Armature current = 46 amps.
Speed = 1,800 revs. per minute (still very slowly accelerating).
Watts = 547.

Operations then had to be stopped owing to the excessive sparking on the commutator and the violent boiling of the water starting resistance.

After the resistance had sufficiently cooled down, a second set of readings were taken, the current being considerably lower. They are as follows :—

Volts across brushes = 7·8.
Armature current = 30 amps.
Speed, 1,400 r.p.m. (fairly constant).

This gives the absorption of power as 234 watts. The normal speed of machine is about 1,450 r.p.m. when excited off 110-volt mains. Will it ever be possible to build a motor without fields ?—Yours truly,
A. G. WARREN.
Abbey Wood.

A Model Omnibus.

TO THE EDITOR OF *The Model Engineer*.

DEAR SIR,—In one of your issues some time since I saw instructions for making a model 'bus. Being fond of modelling in my younger days, I thought it a splendid idea of trying my hand at one, but the particulars given by your contribut r were so vague, I had to abandon his particulars altogether and go on my own lines, for on counting the spokes of several 'buses, I find instead of nine in the front wheels there are twelve, and the hind wheels contain fourteen. In no case that has come under my notice have I found a wheel to contain an odd number, and then again I was at a loss about the fore carriage or that part on which the 'bus revolves. There was no mention, as far as I recollect, so I went about it in my own old-fashioned way, got measurements, reduced them to ⅞ scale, and went to work. I have not quite finished it yet, but if your contributor or any of your staff interested in modelling would like to see it, I shall be pleased to show it as far as it is done. It is one of T. Tilling's, Ltd., Deptford and Poplar 'buses, which run through the Blackwall Tunnel.—Yours truly,
224, Church Street, Deptford, S.E.
R. W. PETERS,

SUBMARINES.—Dr. Varin, of Roumania, has proposed liquid carbonic acid gas as a source of power for the surface running of submarines. He would employ initial pressure of 1,000 lbs. per sq. in., and with a cut-off at one-third stroke a 15 h.-p. motor is said to use only 3·75 ozs. per h.-p. hour, and as low as 2·45 ozs. at a cut-off of 0·1. By means of a heater the initial temperature is made 780° F. for an exhaust of 250° ; but ordinarily an initial temperature of 250° is found sufficient, the final temperature being 100°. But the higher temperature is more economical. To heat 33 lbs. of the gas per hour to 480° F. requires 9½ ozs. of petrol to be burned in the superheater.

Queries and Replies.

[Attention is especially directed to the first condition given below and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-hand corner of the envelope "Query Department." No other matters but those relating to the Queries should be enclosed in the same envelope.

Queries on subjects within the scope of this journal are replied to by post under the following conditions :—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied, wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed. (4) Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of Replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor,* THE MODEL ENGINEER, *26—29, Poppin's Court, Fleet Street, London, E.C.]*

The following are selected from the Queries which have been replied to recently:—

[14,433] **Tesla Coil for Small Wireless Telegraphic Apparatus.** H. H. (Harrow) writes: I want to construct a compact Tesla coil to be worked by a small ½-in. spark coil, connecting it to the condenser and spark-gap in the usual way. Will you kindly give me a rough sketch, and state about how much wire is required for primary and secondary, and about what gauge? My reason for making one so small is that I want to find out how much advantage over an ordinary induction coil (if any) there is in using a Tesla for wireless telegraphy purposes, and not having more space than about half a mile, I wanted to carry out my experiments on a very small scale. I have been through several large books on electricity, but have found nothing of any practical use, except perhaps Mr. Bottone's "Electric Apparatus and How to Make It," which devotes about one and a half pages to the subject.

We have not any data to hand with regard to the construction of Tesla coils of such small dimensions as you speak of, and we should not recommend you to attempt the experiment. Mr. J. Pike in his article in THE MODEL ENGINEER describes a small Tesla coil to work with a 2-in. or 3-in. spark coil, and this might, perhaps, be some guide to you. We can confidently assure you that, setting aside the difficulty of making a satisfactory Tesla coil which will improve the results of a ½-in. spark induction coil, you will gain absolutely nothing by the addition of such apparatus for the purpose of wireless telegraphy. Tesla coils are not used in wireless telegraphy, except in very large stations where a large power is available, and even then their use is a questionable gain, and they introduce certain difficulties in small amateur stations which, even were there any gain of other kinds, would put them quite out of court. For instance, they are worse than useless, unless the oscillation frequency of the condenser and the Tesla coil primary are synchronised or tuned to the natural period of the aerial wire.

[12,591] **Model Steamer Machinery.** G. H. M. (London) writes: (1) Would the boiler described on page 40 of "Model Boiler Making," give enough steam (for about an hour) to two pairs of double oscillating cyliders, each ½-in. bore by 1-in. stroke, so as to get the maximum work from them? (2) What is the best way of supplying air to the fire of a model boiler? I find an ordinary ventilating shaft does not give enough. Would a pump or fan of some sort be of use? (3) Would two pairs of double oscillating cylinders, each ½-in. bore by 1-in. stroke, drive a boat 5 ft. long, 10-in. beam, 6 ins. depth, at a good rate, both pairs of cylinders acting on the same propeller shaft, and what size ought the propeller to be? (4) It is my intention of making a launch boiler described in "Model Boiler Making," page 40. What is the best fuel for this boiler? Could zinc be used to make it?

(1) Yes; although for the purpose you intend the boiler is not an ideal one. We would prefer the design on the next page, the boiler being made a little longer. The one on page 40 in the size given is rather difficult to fire. Solid fuel would be the best to use, but the firebox is small. The boiler is rather heavy for its power. (2) By induced draught of the exhaust steam in the chimney; use a blower when the engine is standing, and before steam is raised employ an auxiliary blower (see issue of February 12th, 1903). For further information see "Model Locomotive," by H. Greenly, price 6s. 4d. post free. Do not think of pumps or fans. (3) You will get more power out of two single cylinder engines with ⅝-in. by 1 in. cylinders. We suppose you intend to go in for twin screws; therefore use a 3-in. propeller on each shaft. (4) See first paragraph as regards fuel. Zinc on no account should be used; you might as well employ sheet lead or brown paper.

[14,411] **Stationary Petrol Motor Trouble.** A. B. (Hammersmith) writes: I should be grateful if you could enlighten me as to the trouble I have got into with a petrol motor. It is an air-cooled bike engine, fitted with an air fan, which works successfully in cooling cylinder, etc. Bore is about $2\frac{3}{8}$ ins., and stroke $2\frac{3}{4}$ ins. Carburettor is a sort of float-feed spray type; contact-breaker is a simple "wipe," used in conjunction with a trembler coil. Petrol tank is situated about 9 ins. or 1 ft. above carburettor, which is close to engine combustion head to keep carburettor warm. There is a peculiar "blowing-back" action from the engine inlet-valve when it is working fast. If I only let the valve open about 1-16th in., this blowing back ceases. The real trouble is this—the engine was sold to me as a $1\frac{1}{4}$ h.-p. motor, but I have a 50-volt 10-amp. dynamo, and when I get the motor at full speed—which is only about 700–800 r.p.m.—and slip the belt on, the motor, after a brief struggle, pulls up. The dynamo has no load on, and I have tried adjusting the air inlet and petrol supply to carburettor, but with no result—otherwise as above. I have recently fitted a heavy 9-in. outside flywheel in the place of the original motor cycle pulley, which was only $3\frac{1}{2}$ ins. diameter, and not large enough to give a speed enough for the dynamo, which requires 2,500 r.p.m. As the motor has two flywheels inside the crank-case, do you think I have "overflywheeled" the motor? Would you think that if I put a 6-in. wood pulley in place of the large one, that I should get better results? If I only allow inlet valve to open 1-16th in., I fancy that the full charge of gas does not get to the cylinder.

It appears as though your exhaust was not clear, and that too much back pressure is the result when running at even normal speed. Is your spark advanced far enough, and are the valve settings correct? Remember, that for high-speed motors the overlap of the settings is greater than for slow-speed spirit or gas engines. The extra flywheels would not account for loss of power—at least, to this extent. Have you tested engine with a break? and worked out the h.-p.? How does she run with no load—*i.e.*, quite light? How many times does she take gas (or spirit)? Observe this, and you will get a good idea of what power she takes to drive simply herself. Write us again if you still have difficulties. Have you got our new handbook," Gas and Oil Engines," by W. C. Runciman, price 7d. (post free)?

[13,951] **Electric Bell Wiring.** W. L. (Blaina) writes: Being an old reader of THE MODEL ENGINEER, I should like, if you would enlighten me on this subject. I want to know how to put a second bell on a length of wire without using a second battery. I have one bell on the one end, but I want to work another on the other end with the same battery. I find that it forms a cross to put it on by connecting the two wires, and I have tried the plan given in the book on bells (MODEL ENGINEER Series) by using one wire, and making a good earth (Fig. 44), but which I cannot get to work. The distance between the bell now and where I want to put the other is 1,100 yds. The battery I have for working the length is 15 Leclanché cells, connected in series.

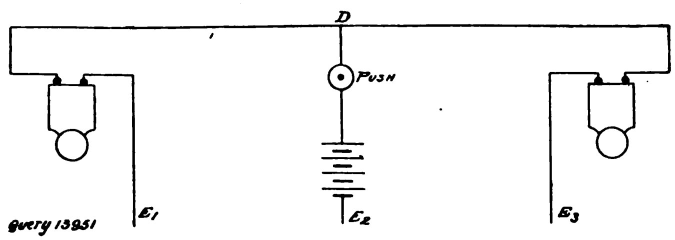


DIAGRAM OF ELECTRIC BELL WIRING.

Will the above sketch suit you? The points E1, E2, and E3 are all joined to either earth or return wire. The points D and E2 should be midway between the cells. If this does not suit, send us a sketch of your present circuit. Regarding your failure to use an earth return, perhaps you did not make good enough earth connection. This should consist of a copper plate about 24 ins. square buried in crushed coke about 5 or 6 ft. deep, in a damp place. It is essential to obtain a wet contact. Water-pipes make very good earth connections when available.

[14,347] **Marine Engineering.** F. R. (South Wales) writes: I intend going in for marine engineering. I am now 18, and have served two years in a fitting shop. (1) Would it be advisable to go to some marine engineering works? If so, what period of time should I require to remain there before going to sea? (2) How long would I have to remain on sea afterwards before I could sit for second engineer? (3) Is it necessary to serve five years before going to sea, or could I serve part on land and the remainder at sea? (4) Could you give me the names of a few marine engineering firms who take improvers, and what wages I would be likely to have? (5) Which would be the better to get on—a merchant or a passenger vessel?

(1) Yes. Four years at least must have been served in a shop either building or repairing steam engines and boilers and also one year at sea in a foreign-going vessel before you can sit for your second class Board of Trade certificate. Or, instead of the above-mentioned apprenticeship, you can serve four years at sea as engineer on regular watch of a foreign-going steamer of not less than 66 nominal h.-p., or six years in a home trade steamer. You could go away to sea at once if you can get a steamer. But the more experience you have had ashore previous to sailing the better. (2) See above. (3) In the case of serving part on land and part at sea, you would have to refer your case to the Board of Trade. Provided such experience were deemed useful, it would be allowed to count as qualifying service. (4) Most engineering firms take improvers. Messrs. Doxfords, of Pallion, Sunderland; the North-Eastern Engine Works, Sunderland; Palmers, on the Tyne, etc., and many others. Look out a few firms in some of the trade papers and write to them; or, better still, make personal application. Wages would run from 16s. to 20s. per week. (5) Immaterial. We are preparing an article on this subject which will be published shortly.

[13,812] **Electric Railway Car.** F. W. S. (Parel) writes: I am building a model electric car, 1-in. scale, the total finished length being 5 ft. 6 ins. I desire to run it on the third rail system, similar to the new cars on the Metropolitan Railway, and as the weight will be about 50 lbs. I should be glad if you will kindly let me know—(1) The size and strength of motor and dynamo? (2) What type of engine would be best to drive the dynamo, and the horse-power of same? (3) Where can I get the seven or eight small electric lamps with which the car will be lighted?

(1) We would advise a small 50-watt motor or two motors like those of our coloured plate of January 5th, 1905, but with drum armatures. Use a 75 or 100-watt dynamo to make up for the lamps. (2) A 2-in. by $1\frac{1}{4}$-in. Stuart Turner's high-speed engine and a boiler with about 400 sq. ins. of heating surface. (3) The Universal Electric Supply Co., 60, Brook Street, Manchester, will supply you with the lamps.

[14,509] **Electrical Engineering as a Profession.** R. E. K. C. (Cardiff) writes: Will you kindly advise as to the best method of starting a boy of 16 on the way to become a fully-qualified electrical engineer? Also say whether, under the present crowded state of the profession, referred to in recent MODEL ENGINEER, you would consider the future prospects sufficient to justify the expense of a college theoretical course in addition to doing practical work to enable him to get degrees if sufficiently proficient. Would you consider it advisable to attempt to pass his London Matriculation Examination before leaving school? To do so would delay him twelve months, and so make him 17 years old to start with. The question is whether to send him to college (Cardiff University) for a course of theoretical training, which extends over three years, first, and then go as improver to the practical part; or *vice versa*. The benefit of your advice will be esteemed a favour.

A general outline of the advisable course to take in such a matter is given in the article which appeared in our issues for July 1st and 15th, and August 1st, 1902. Since then the profession has become more crowded, though, of course, electricity being now so universally applied in connection with trades, arts, and industries, it is a question whether the supply exceeds the demand in a greater proportion or not. The ideal training is to sandwich the practical with the theoretical year and year about; but this cannot always be done. The next best thing is a college course first, with as much practical work as can be had at the college workshops, which most technical institutes are provided with nowadays. A practical knowledge first, enables the student to appreciate more fully the theory afterwards, besides making it a pleasure instead of a drudgery. We do not think you can do better than take the course you suggest, provided the prospective student "means business."

[14,365] **Horse-power of Engine; Flash' Boiler.** W. R. J. (Regent's Park) writes: I should be obliged if you would answer the following questions:—(1) What horse-power would a horizontal steam engine with two cylinders, 2-in. bore by 2-in. stroke, develop at 100 lbs. to the sq. in. at 600 revolutions per minute? (2) Would the small power flash steam generator, described on page 278 of Vol. XII of THE MODEL ENGINEER, supply the steam for the above engine? (3) Would a No. 6 "Primus" burner be suitable for the steam generator?

$$\frac{P \times L \times A \times N}{33{,}000} = \text{i.h.-p.};$$

therefore,

$$\frac{75 \times 22 \times 2 \times 1{,}200}{7 \times 12 \times 33{,}000} = 1\tfrac{1}{2} \text{ i.h.-p.}$$

for each cylinder, so that as regards size the boiler will be quite suitable. The use of "Primus" burners is out of the question.

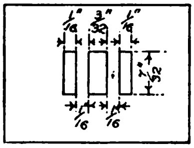
[14,514] **Electrical Training.** "KEMPTON" writes: Being a reader of your paper and seeing various kinds of queries asked, I should be most obliged if you could tell me if it would be possible

to obtain a situation as electrician with only a knowledge obtained by correspondence from an Institute (of electric light and power), and if it would be wise to go in for a course and obtain a situation as labourer or something of that kind, and work my way up?

You must have some—the more the better—practical knowledge before you can take a position in charge of machines. If you refer to only wiremen's duties, we advise you to get into some electrical works or shop and work your way up. Correspondence training is no use *alone*. It is very useful to a mechanic or electrician who has practical knowledge but no theory. See "How to Become an Electrical Engineer," in July 1st and 15th, and August 1st, 1902, issues.

[14,179] **Steam Port Proportions.** M. H. K. (Liverpool) writes: I should be much obliged if you would answer the following queries: What should be (1) the travel of valve, (2) lap, (3) lead, (4) advance of eccentric for an engine 1-in. bore by $\frac{3}{4}$-in. stroke, with ports arranged as below? Also, what should be the dimensions of exhaust cavity of valve? The ports are not exactly as shown in sketch, but are—steam ports, 3 1-16th-in. holes;

STEAM PORT PROPORTIONS.



exhaust port, 2 3-32nd-in. holes. But the holes are within the boundaries of the line on the sketch. Would you also kindly give me details of link-motion reversing gear for same?

The whole of the information you seek is to be found in "The Model Locomotive," by H. Greenly, price 6s. net, 6s. 4d. post free from this office; see chapter on valve gearing and motion work. We would advise 1-32nd-in. lap of valve; 3-16ths-in. valve travel; no lead; no inside lap. The cavity of the valve should be 7-32nds × (1-16th + 3-32nds + 1-16th) = 7-32nds in. square. The design of link motion depends largely on the surroundings; see the above-named book.

[14,449] **Boiler for Driving Electrical Plant.** S. W. K. (Manchester) writes: Would you kindly tell me the dimensions of a vertical boiler and engine that would drive an 8 candle-power dynamo, and oblige?

An 8 candle-power lamp will require somewhere about 32 watts. Allowing for losses in the dynamo belt and in the engine, the i.h.-p. will have to be at least double this equivalent of this output—say, 75 watts, which, of course, is 75-746ths, equalling 1-10th h.-p.

The plant being very small, 1-10th h.-p. will require $\frac{2,200}{10} = 220$ sq. ins. of heating surface, under the best conditions. The boiler should be 7 ins. diameter by 14 ins., and should be multitubular, having about ten tubes, $\frac{1}{2}$ in. outside diameter.

[14,469] **Model "Lady of Lake" Locomotive.** W. B. (Manchester) writes: I am about to build a $\frac{1}{2}$-in. scale model of the "Lady of the Lake" (L. & N.W.R.), and I would be much obliged if you would forward me a sketch with the chief measurements marked, including the size of cylinders and driving wheels.

You will find a scale drawing in the issue for November 17th, 1904. The cylinders for a $\frac{1}{2}$-in. scale model may be $\frac{1}{2}$ by 1 in. bore, and the driving wheels $3\frac{1}{2}$ ins. diameter on tread. Valuable information on the subject will be found in our new book "The Model Locomotive: Its Design and Construction," price 6s. 4d. net, which book we would advise you to purchase before commencing your model.

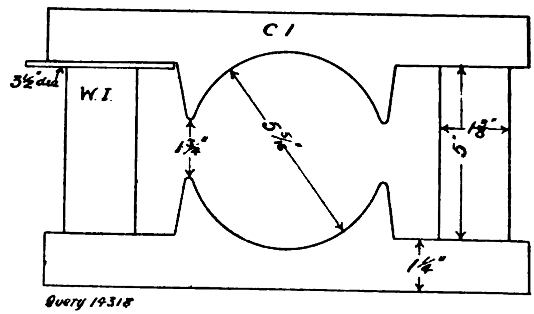
[14,493] **Small Gas Engine Trouble.** F. W. R. (Luton) writes: I recently bought one of Madison's $\frac{1}{4}$ h.-p. gas engines (Otto cycle), but cannot get it to work, owing, as I feel sure, to not getting ignition tube hot enough. The compression is good, and valves act perfectly; but as I have not had one explosion yet, I want to ask your advice as to how to get the tube hotter. I have your handbook on gas engines, but do not seem to find the information, except that the flame must be regulated, etc. I manage to get it *red* hot, but that is all. Is this sufficient to fire mixture? The burner is only just pushed into the casting. (1) Is the length of flame enough? As you see, it is only about $\frac{1}{2}$ in. between end of Bunsen burner and ignition tube. Looking downward, I cannot distinguish the blue cone, as it all seems a golden colour. I have regulated the gas by tap, etc. (2) Is it necessary to have a good space between bottom of casting and engine body (say $\frac{1}{2}$ in., or more, as I can regulate same) for further supply of air? If you think my first supposition is correct, should I fit in a tube, or something, so that the end of the burner is $1\frac{1}{2}$ ins. from the tube itself? (3) Am I correct that that should be about the distance? If so, what would you suggest?

Provided your gas pressure is fairly good, you should have no difficulty in getting your burner adjusted properly, so as to make tube bright red-hot. We really cannot explain the methods of adjustment more thoroughly or explicitly than Mr. Runciman has done in our handbook, "Gas and Oil Engines." (1) If the flame is a good clear blue, and about 3 ins. long, you should find that quite sufficient. It is preferable to enter the burner in a sloping direction; but this is not essential. You will not see the blue cone unless you take the burner out of the chimney, as the asbestos and tube will tend to colour the flame yellowish. (2) If it is this space which regulates the air supply to engine, you will have to find which is the most suitable space by trial. Cannot you fit an air check (made of a piece of sheet tin, with a hole in it about $\frac{1}{4}$ in. diameter) to the air supply, so as to regulate it to a nicety? (3) You should vary the distance until you get best results; no definite distance can be stated. If you are still unsuccessful, try fitting two burners, one each side of chimney, so that flames play steadily all round the tube.

[12,826] **Corrected Telephone Connections.** G. E. G. (Newcastle-on-Tyne) writes: In January 19th issue you have furnished a diagram and particulars referring to telephone intercommunication (Query No. 12,826), which are not, from my views, correct. It is indicated—"With the switch in the position shown B can ring A up by means of bell B_1 and C signal with bell B2." If you examine the switch connections as shown, you will find, I think, that the lines of station B are joined to bell B2. Further, the ringing current from C would have to pass through the battery and telephone at A before the bell B_1 could be actuated, otherwise the bell would not ring with the connections as shown. Then, if so, the bell at the distant station (C) would ring continuously along with bell B_1 from the battery current provided at A.

With regard to your criticism of switch given in reply to Query 12,826 (January 19th issue), we may say that we are perfectly aware that stations B and C cannot intercommunicate, as such condition was not asked for in our correspondent's letter (not reproduced in full). The arrangement for effecting this is a perfectly obvious one, but would have complicated the switch; and in the event of our correspondent not being able to work out the diagram shown would have involved two sketches. The transposition of the letters B_1 B2 is obviously an error, which is not likely to confuse anyone who has studied the diagram as you have. The internal connections of the telephone set were not given by our correspondent.

[14,318] **Windings for 240-watt Manchester Dynamo.** J. A. H. (Huddersfield) writes: I am about to build a dynamo (Manchester type), and should be glad if you could give me some particulars *re* same. I have 2 ins. in width of stampings, as per sample enclosed. Will you please give windings for both armature and field coils? I have 4 lbs. of wire (No. 18 D.C.C.), which I want to use for the field coils. I should like the voltage to be 30, and as many amps. as possible. Of course, I could get some more



MANCHESTER DYNAMO FIELD-MAGNETS.

18 gauge wire if I have not enough. Also please fill in the dimensions on sketch. I should be glad of an early reply, as I cannot do much until I get the particulars. I may add that I have your handbook on small dynamos.

Wind armature with No. 18 gauge D.C.C. copper; get on as much as you can—about 2 lbs. will be required. Wind field coils with about $3\frac{1}{2}$ lbs. No. 21 gauge S.C.C. copper wire on each core, both coils joined in series with each other, and in shunt to the brushes. Speed about 1,800 revolutions per minute; output, 30 volts and about 8 amps. No. 18 gauge wire is too thick for the field-magnet winding.

[13,546] **Boiler Queries.** C. C. A. (Marlborough) writes: I should be very much obliged to you if you could tell me of suitable type of boiler for a launch engine $\frac{3}{4}$ by $\frac{3}{4}$. I want it as small and as light as possible, and a very quick steamer, to work at about 20 to 25 lbs. per sq. in. Also, how many sq. ins. of heating surface would be required for an engine $1\frac{1}{4}$ by $2\frac{1}{4}$, pressure 50–60?

You do not say whether the boiler is to go in a boat or not, and therefore it is difficult to give you definite advice. A small return tube boiler, with a $3\frac{1}{2}$-in. or 4-in. outer shell, 6 to 7 ins. long, and with furnace tube $1\frac{1}{2}$ diameter, should work very well in a boat.

The return flues should be ⅜ in. outside diameter. The firing should be a methylated spirit vaporising blow lamp, or a benzoline lamp. The latter will give the least trouble, but is more difficult to make. Of course, a blower should be used, and the exhaust steam (nozzle, 3-32nds diameter) should be used to induce a draught. An auxiliary blower will be necessary during steam raising. For stationary boiler, a simple vertical boiler, without firebox, will be the lightest; or you may use a 9-16ths-in. scale water-tube loco boiler; inner tube, 2½ ins. diameter, outer shell 3 ins. diameter. The fuel may be a simple methylated spirit lamp in each case. With reference to the heating surface required for a 1½-in. by 2½-in. engine, it depends upon whether the exhaust steam is used to create a draught. The average would be (for 300 r.p.m.):

$$\frac{100 \times 1 \times 5}{2 \times 300} = 500 \text{ sq. ins.}$$

For other speeds in proportion, allowing a slightly smaller amount of heating surface for higher speeds, and a greater amount for lower speeds to make up for the differences arising from radiation and condensation losses. The rule is—

$$100 \times \frac{\text{area piston} \times \text{stroke} \times \text{speed} \times 2}{\text{V.P.}} = \text{H.S. in sq. ins.}$$

The speed should be multiplied by two only where the engine is double-acting. V.P. depends upon the pressure: it is the ratio of the volume of steam evolved from a given volume of water (see issue of January 1st, 1902, page 22).

[14,245] **Model Locomotives.** S. C. F. (Walthamstow) writes: (1) I bought a cheap model (L. & Y.R.) locomotive some three years ago (2-in. gauge), and at that time she went fairly well. The boiler is 1½ ins. diameter, 6¼ long, externally fired, and drives a pair of oscillating cylinders ⅜ in. by ⅞ in. She has been going gradually bad for some time, but now she can only just pull herself for about 6 yds. at a very slow pace, and she was working at 35 lbs. pressure. Several times I have tried a series of experiments of different pressures, and I also coupled the wheels together, making it 4-coupled, with no better results. But when I lift her off the rails and let her run lightly (using my fingers as a brake) she goes at a tremendous speed. (2) I have a model railway (2-in. gauge) running around my garden, and I have a great deal of rolling-stock of the same gauge, and I wish to build a model locomotive for this railway. Do you think an engine built something like the one illustrated in the Queries and Replies column for December 1st, 1901, or do you think a tank engine would be better? (3) What motion would you employ for reversing the engine?

(1) The pistons in the cylinders are worn out. The only thing that we can suggest is that you remove them and turn a groove in them, and pack this groove with cotton (from lamp wick). If you cannot do this, perhaps you can get new cylinders fitted to it. (2) It does not matter much. A tank engine has some advantages—especially a 4-wheeled vehicle—considering the sharp curves on your railway. (3) Use slip eccentric gear. See "The Model Locomotive," price 6s. net, 6s. 4d. post free from this office.

[14,523] **Model Marine Boiler.** C. H. B. (Saffron Walden) writes: Would the boiler, as described in Fig. 14, page 40, of "Model Boiler Making," be suitable for a 3 ft. 6 ins. launch and driving a pair of D.A. oscillating cylinders ⅝-in. bore by 1-in. stroke. Will charcoal work well, as fuel, and, if so, should there not be a fire-grate for the draught from under or back of firebox?

The boiler is rather heavy. We would advise you to go in for a rather elongated form of marine return tube boiler. Barrel may be about 4½ or 5 ins. diameter, and 8 or 9 ins. in length. Furnace tube should be 2½ ins. diameter and return tubes ⅜ in. diameter. Use a benzoline "blow-in" burner. With the design given, of course, a grate should be fitted, also a "brick" arch.

[12,502] **Boiler for Launch.** M. B. (Newcastle) writes: I will be much obliged it you will answer me the following:—(1) I am making a water-tube boiler twice the size of Fig. 17 in "Model Boiler Making." Will the same supply steam to a single launch engine having cylinder 3 ins. by 4½ ins? (2) Will the above engine drive heavy boat, 16 ft. long by 5 ft. beam? (3) What size pump ought I to fit size of propeller? (4) Approximate speed of boat? (5) Best position of engine in boat?

(1) The boiler should be at least 4½ times the size, and will have to be constructed in a different manner entirely. (2) Yes, the engine is quite big enough for the boat. (3) Use about 11-in. diameter propeller. (4) Four miles per hour. (5) The disposition of the engine in the boat will be determined by a number of circumstances. The boiler should be made of steel throughout, and should have a large steam drum as well as a superheater. We should only make the boiler as described if it is to be fired by methylated spirit.

[14,499] **Chemistry.** F. S. Y. (Cliftonville) writes: Thank you very much for answering my query No. 14,219 on July 6th. Will you kindly inform me on the following:—(1) If I take up any of the chemical professions which you enumerated, would Latin be required, as this subject I have greatly neglected? (2) Is there more chance of getting on in these and more pay than in electrical work? (3) Are any special examinations needed for them? (4) If I went in for chemical work, must I study physics, etc.? (5) What is the average pay of an analyst?

(1) Latin would be required if you wish to obtain your degree, but a slight knowledge would suffice for all ordinary work. (2) It depends entirely upon circumstances. A chemical engineer—*i.e.*, the man who has a good knowledge of both chemistry and engineering, can usually get plenty of good employment. (3) For analytical work you need to pass the examination of the Institute of Chemistry. (4) Yes. (5) Anything from 30s. to £4 a week—that is, of course, an assistant's post. A man "on his own" might make more or less.

[14,506] **Liquid Ammonia.** W. G. K. (Hungerford) writes: Will you kindly tell me if I can procure ammonia gas in a liquid form, so that I can evaporate it the same as liquid air, as I want to experiment with it?

We think you will obtain what you require from John Orchard and Co., 27, Hereford Road, W.

[14,500] **Pattern Making.** H. C. (Didsbury) writes: I wish to make a pattern for a cast-iron engine bed for a small undertype engine and boiler. I have a pattern maker's steel rule divided off on one side for single, and on the other side for double contraction for iron. What I want to know is, which scale must I work to? The thickness of metal I intend to leave is ⅜ in.

Work from the single contraction side of the rule. We take it that your final casting will be made direct from the wooden pattern, and not from a casting from the wooden pattern.

[14,402] **Field-magnets for 1¼ in. by 1¼ in. Ring Armature.** K. R. K. (Troyeville, Johannesburg) writes: I should be greatly obliged if you would kindly answer me the following query. I have a small 8-segment ring armature 1¼ ins. long by 1¼ ins. diameter, wound with 8 ozs. No. 22 D.C.C. wire. What size field-magnets would be suitable for it, and how much wire would it require, and what size? What will be the output in volts and amps.?

We advise you to adopt the Manchester pattern, as Fig. 12 in our Handbook No. 10. Take the 20-watt size scale, as given on page 23, and adopt the 10-volt winding for the field-magnet, as given on page 50. The weight of wire which you state is on the armature seems very large for the size. Have you not made some mistake in your figures? We doubt if the machine will be successful as a dynamo with the present armature winding, but it should run very well as a motor from three or four bichromate, or similar, cells in series. Field-magnet winding should be joined in shunt to the brushes. If machine does not excite as a dynamo, try rewinding the armature with No. 24 gauge double-silk-covered wire, so as to get on more turns. To test if machine will work as a dynamo, use an 8-volt 1 c.p. lamp. Speed to be about 3,000 revolutions per minute.

The News of the Trade.

[*The Editor will be pleased to receive for review under this heading samples and particulars of new tools, apparatus, and material for amateur use. It must be understood that these reviews are free expressions of Editorial opinion, no payment of any kind being required or accepted. The Editor reserves the right to criticise or commend according to the merits of the goods submitted, or to abstain from inserting a review in any case where the goods are not of sufficient interest to his readers.*]

* *Reviews distinguished by the asterisk have been based on actual Editorial inspection of the goods noticed.*

*An Inexpensive Chuck.

Those readers in want of a cheap and useful lathe chuck will find the tool advertised in a recent issue by The Liverpool Castings and Tool Supply Co. well suited to their usual requirements and pocket. We have recently received one of these for our inspection, and find that the quality and finish are good. The chuck has four independent, reversible steel jaws, each operated by a separate screw, the ends of which are recessed, and adjusted by a box key; and will hold work even larger in diameter than the body of the chuck, and of various shapes, such as round, square or irregular. The chuck is made to attach to the faceplate of the lathe by means of four screws. Further particulars and prices may be had on application to Cathedral Works, Church Lane, Liverpool.

New Catalogues and Lists.

The General Electric Co., Ltd., 71, Queen Victoria Street, London, E.C. We have received an illustrated catalogue of the "Whitton" single and polyphase induction motors, giving prices and specifications; also a number of pamphlets descriptive of bells, lamps, switches, cables, wires, also electricians' and wiremen's tools and accessories.

The Editor's Page.

THCSE of our readers who are owners of model railways will, we think, find a subject of special interest in the article by Mr. E W. Twining which commences in our current issue. Although we know of a number of cases of model railways in which the question of pictorial effect has been carefully considered, we are convinced of the truth of Mr. Twining's remarks that there are many model railway engineers who do not sufficiently study this side of their hobby. The charming illustrations which our contributor has provided show better than any verbal description what the picturesque possibilities of a well-planned model railway are, and we hope his drawings and suggestions will be found of much assistance by those who wish to improve the appearance of their railways. It may be worth while emphasising the importance of accurate scale in proportioning the architectural and constructional features of a track, as this is a vital essential to a realistic result. It would be helpful to have photographs of work of this kind which has already been accomplished by other readers, and we shall be very pleased to receive correspondence from those who are interested.

* * *

We continue to receive picture post-cards from our readers in various parts of the world, and for these interesting evidences of our widespread circulation we extend our best thanks. We may add that our offer to send exchange views of London is still open, and we shall be glad to hear from those who have not already written us.

* * *

We are occasionally asked to purchase goods by readers abroad, who send us a remittance accompanied by instructions of a general character, the amount enclosed being considerably less than the amount required to properly fill our correspondent's requirements. It appears to be assumed by such correspondents that a certain article, such as a lathe or a launch motor, can be obtained for a certain sum, and without troubling to ascertain whether or no their estimate of the cost is a reasonable one, they send off the money and ask us to send out something to suit. In several instances it has happened that for the sum sent it has been impossible to obtain anything at all suitable, and the correspondent has had to wait at least twice as long for the goods as he need have done, in order that we could notify him of the difficulty and receive his further remittance. We hope that those whom this may concern will remember that it is better to first ascertain the probable cost of what they require, or if this is not practicable, to remit an ample amount, of which any excess can be readily refunded by us.

Answers to Correspondents.

F. C. B. (Nottingham).—Thanks for letter. See Editorial Notes in last issue.

F. W. S. (Parel).—We have perused your letter with much interest. We will endeavour to do what you request, but we too often must admit that, in the matter of the length of and the amount of detailed information contained in the article, we are entirely in the hands of the individual contributor who is describing the construction and design of his model. We seldom, if ever, object to information that can in any way be considered of practical value to the reader.

J. C. (Workington).—Your query is not quite clear. Try A. G. Thornton, King Street West, Manchester.

O'D. (Co. Cork).—Thank you for your letter. If your plate is an original from the Berlin foundry, it might be worth from 10s. 6d. to £1 1s.; but it is always difficult to put an exact value on anything in which there is not a regular market. See Editorial notes in last issue.

J. P. (Hull).—Messrs. Whitney's, 117, City Road, E.C. could supply you.

Notices.

The Editor invites correspondence and original contributions on all amateur mechanical and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected or not, and all MSS. should be accompanied by a stamped addressed envelope for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

This journal will be sent post free to any address for 13s. per annum, payable in advance. Remittances should be made by Postal Order.

Advertisement rates may be had on application to the Advertisement Manager.

HOW TO ADDRESS LETTERS.

All correspondence relating to the literary portion of the paper, and all new apparatus and price lists, &c., for review, to be addressed to THE EDITOR, "The Model Engineer," 26—29, Poppin's Court, Fleet Street, London, E.C.

All correspondence relating to advertisements and deposits to be addressed to THE ADVERTISEMENT MANAGER, "The Model Engineer, 26—29, Poppin's Court, Fleet Street, London, E C.

All subscriptions and correspondence relating to sales of the paper and books to be addressed to Percival Marshall & Co., 26—29, Poppin's Court, Fleet Street, London, E.C.

Sole Agents for United States, Canada, and Mexico: Spon and Chamberlain, 123, Liberty Street, New York, U.S.A., to whom all subscriptions from these countries should be addressed.

Contents.

[The asterisk (*) denotes that the subject is illustrated.]

THE

Model Engineer

And Electrician.

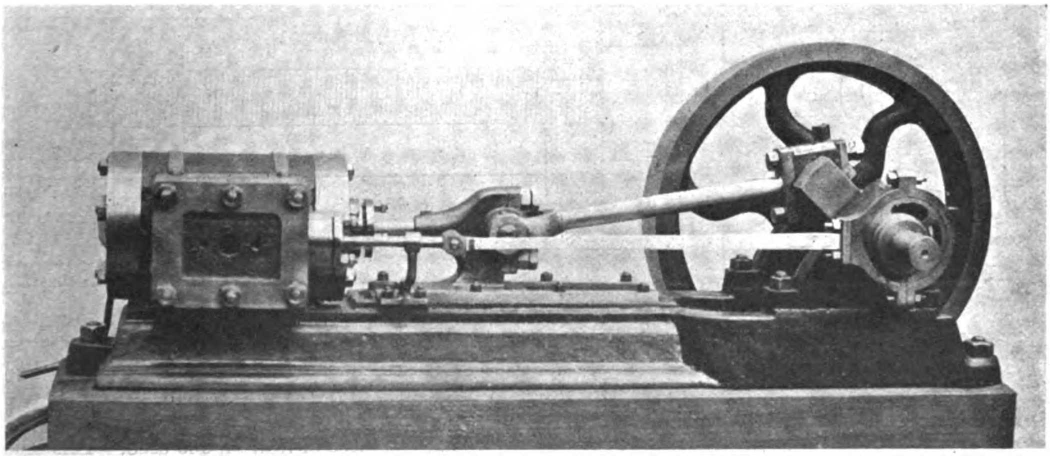
A JOURNAL OF PRACTICAL MECHANICS AND ELECTRICITY.

EDITED BY PERCIVAL MARSHALL, A.I.Mech.E.

Vol. XIII. No. 228. SEPTEMBER 7, 1905. PUBLISHED WEEKLY.

A Model Horizontal Steam Engine.

By A. E. Nute.



Mr. A. E. Nute's Model Horizontal Engine.

The accompanying photograph is of an engine I made some two or three years ago. Getting out the drawings, making the patterns, and then the engine, occupied my spare time for nearly two years, taking it comfortably and putting a finish on the work. The cylinder is $1\frac{1}{2}$-in. bore and 3-in. stroke, is lagged with teak between the cylinder, and the wood is a layer of asbestos board. The lagging is held in position with two brass bands. The cylinder is fixed by four $\frac{1}{4}$-in. screws running up through the bedplate into the four lugs or feet cast upon it. The piston is of gunmetal, fitted with two hard brass rings, and 5-16ths in. steel piston-rod.

The slide-valve rod is 7-32nds in., where it works in the guide; the remainder of its length is turned down to 3-16ths in., and the part running through the valve is screwed with a fine pitch and fitted with four bronze nuts for the adjustment of the slide-valve, which is of gunmetal. The steel guide is bushed with a piece of brass tube.

The two drain cocks are screwed into the cylinder feet on the far side of the engine; the levers being connected with a light steel rod; both cocks are opened or closed together.

The slipper plate and all the receiving or machining pieces cast upon the bedplate are on the same bevel plane, making it much more convenient to level off. At each end of the slipper plate a hollow is cast to retain any surplus oil.

The slipper is of gunmetal, and has a good area of sliding surface, the two sides of which are bevelled to suit the steel strips bolted each side of the plate, forming a dovetailed guide. The crankshaft is $\frac{5}{8}$ in. diameter, and forged from well-hammered iron, the centre being forged solid and sawn out. The forked end of the connecting-rod was also forged solid and sawn out after it had been turned. The flywheel is 8 ins. diameter and 1 5-16ths ins. face. Several that have seen this model have been so much taken up with it that they are now making one each for themselves.

Workshop Notes and Notions.

[Readers are invited to contribute short practical items for this column, based on their own workshop experience. Accepted contributions will be paid for on publication, if desired, according to merit. All matter intended for this column should be marked "Workshop" on the envelope.]

A Cheap Parallel Vice.

By "Darius."

The drawings and description herewith are of a cheap parallel vice, which since being made has quite repaid the labour and time. The patterns were first made and castings obtained from them at a local foundry. The holes for guides were first of all drilled—two in the front jaw, two in the sliding jaw, and two in the angle piece at the back end of baseplate. The holes for the screw were then drilled, the one in the front jaw being a full ½ in. to allow the screw to turn easily in it, and the one in the sliding jaw was tapped ½ in. (Whitworth), to take the tightening screw, which was turned from steel rod and screwed to fit the jaw, and then case-hardened in the usual way. The screw has a hole drilled through the head, and a handle of steel turned down to ¼ in. to tighten the vice by. The guides, as will be seen, are two ordinary ⅜-in. bolts, 5½ ins. long, on which the sliding jaw slides to hold the work. The whole is fastened to the bench by four large screws passing through the base, which is 3 ins. by 6 ins. and ½ in. thick. On each of the jaws is fastened a piece of roughened steel, which was previously hardened to aid the grip and stop the work from slipping while being operated upon. The jaws in this case are 3 ins. wide, and admit about 2½ ins. between them. Such a vice should prove useful to anyone who needs one, and of course the dimensions may be altered to suit the requirements of the maker.

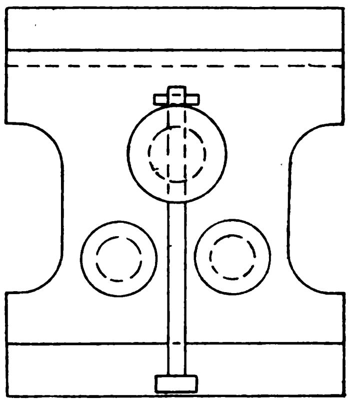


Fig. 1.—Front Elevation.

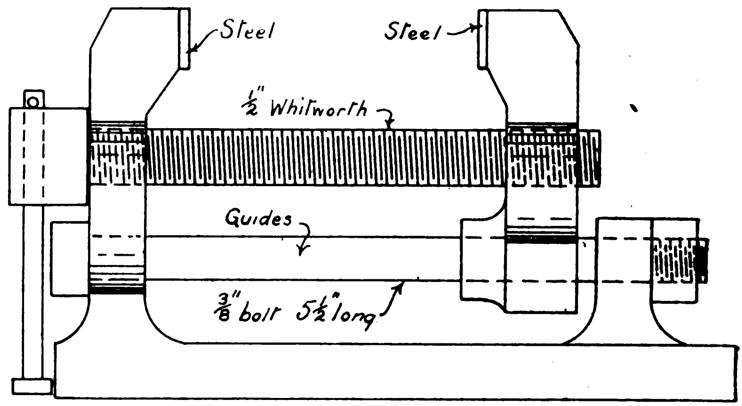


Fig. 2.—Side Elevation.

A CHEAP PARALLEL VICE.

A Simple Speaking Tube.

By J. W. A.

Finding it necessary to have some cheap, and therefore, simple means of communication between two workshops in our house, one being situated at the top and the other on the ground floor—the distance from window to window being 23 ft.—it was decided to fix a speaking tube. However, as the cost of lead piping stood in the way, it was arranged to use the ordinary bamboo poles. Six of these were obtained, about 6 ft. long by ½ in. diameter, and a short length of lead piping. The following particulars will interest those who may be thinking of fixing a similar arrangement.

The bamboo poles must be cleared of the internal partitions which exist at every knot; this, of course, can be done by burning with a red-hot iron-rod. A quantity of square pieces of tin will be required, according to the number of joints to be made. Tin canisters or biscuit boxes will do. These, if bent round the end of the bamboo and soldered in the ordinary way, will make excellent sockets; then if a couple of indentations are made with a punch or French nail, they will hold firmly on to the pole. If the tube is to be fixed to a wall, as in our case, hooked nails can be obtained, which are just the things.

Where a bend is required at each end of the tube for passing through the window frame into the room, the piece of lead pipe is used. This must be inserted into the end of the bamboo; if necessary, scrape a little from the exterior of the lead pipe to make a good fit, and before inserting give the interior of the bamboo a coat of seccotine. At each protruding end of lead pipe, slip over a short length of rubber tube, say about 2 ft. long. Obtain two penny tin funnels, paint them black, and connect to the end of rubber tubing. When two penny whistles are obtained and inserted in the funnels, the speaking tube is complete, the entire cost being as follows:—Six bamboos, 1s. 6d.; rubber tube, 6d.; two whistles, 2d.; two funnels, 2d.; lead pipe, 2d. Total cost, 2s. 6d.

A Useful Scribing Block.

By R. J. Mitchell.

The sketches illustrate the principle of a novel and very handy scribing block. It will be found accurate; that is, it does not vary its set when being finally tightened up, as most scribing blocks do; easily set, and capable of minute adjustment.

The scriber rod is made from drawn brass tube, plugged up at one end with brass rod, where it is also split into four, and externally screwed ; a lock ring A tightening up the renewable points. Care should be taken that the hole in this end is very precise, to ensure a "fit" when the points are inserted. The other end of scriber is cupped out, and contains a small phosphor-bronze spherical

FIG. 2.—ENLARGED SECTION OF E.

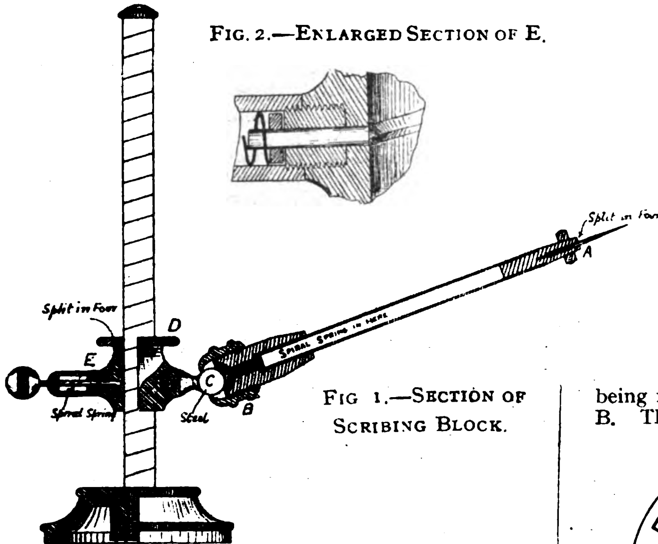


FIG 1.—SECTION OF SCRIBING BLOCK.

bearing, which is held up to its work by a spiral spring ; this is to prevent the scriber falling down, and thus breaking the point ; the externally knurled ring B holds the bearing up to the steel ball C, which can be very firmly tightened up by B. The central pillar has a thread of coarse pitch, and wide angle (about 90 degs.) cut thereon, and the pin in E being pressed into this groove, a small vertical raising or depression is obtained by turning the whole casting round a small amount. When setting the tool proceed as follows :—Unslack D, and pull pin at E out, slide whole block to nearest convenient height until pin at E engages in slot. Adjust point at A roughly, and then by finer adjustment tighten round ring at D, and that at B, this before making finer adjustment. The writer can confidently advocate the use of a ball joint here ; for if well-made and the bearings are not of the same metal as the ball, a most surprising grip is obtained by a moderate tightening up of the locking ring B. Otherwise the sketch will, it is thought, be explanatory, and sizes are left to the prospective maker's convenience. One hint, however—make the ball fairly large, say, ½ in. diameter, and the thread at B of fine pitch.

A Washer Cutter.

By G. W. BURLEY.

In making electrical apparatus, doubtless, many readers of THE MODEL ENGINEER have had occasion to make small round washers out of ebonite or vulcanised fibre sheet. The writer has had, when making different kinds of such apparatus, to make ebonite and fibre washers, for insulating purposes generally, of several sizes, and in the course of such work he has had to make recourse to several kinds of washer-cutters. Some of these have been distinctly bad in design, others have been indifferent, whilst the remainder—the minority, however—may be classed as good. The best one that the writer has yet come across is the subject of this article. By its means washers of various sizes, the range depending upon the size of the tool, can be cut, and that with a minimum of expense and of labour. Also, the cutter can be made by the amateur, if he possesses a lathe and a vice, together with the ordinary attachments and tools.

The accompanying figures show two elevations of the tool. The stock A is made out of wrought iron, of dimensions suitable for the work to be done. B is also made of wrought iron, and this is screwed on to A, which is turned up telescopically, with the middle portion screwed and the smallest portion shaped like a diamond-pointed drill. It is on the middle portion that B is screwed. In B a large number of square holes are cut, there being two holes for each diameter of washer, the two being diametrically opposite. Into these holes two cutters fit, being fastened rigidly to B by nuts at the back of B. The two cutters are made of steel, and hardened

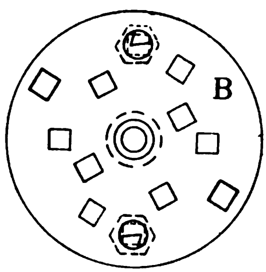


FIG. 1.—END ELEVATION.

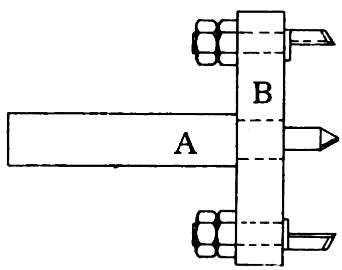


FIG. 2.—SIDE ELEVATION.

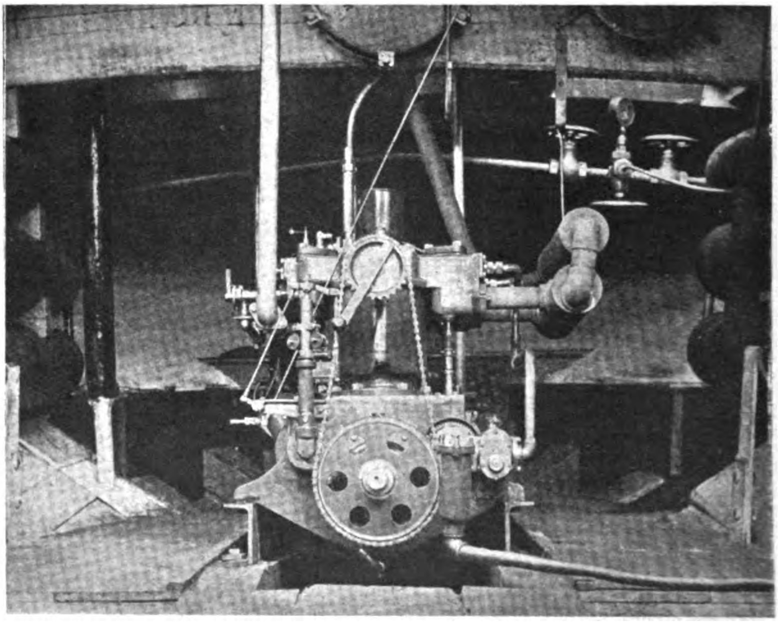
A WASHER CUTTER.

to a high degree. They are of identical form and size, and should be capable of being interchanged. They should also be at the same distance from the centre of rotation, and, for this reason, great care must be taken in setting out the square holes in the plate, and also in making the cutters. The point of each cutter should be in the centre line of the hole in which it is fastened. The stock is placed in a self-centreing chuck, the speed being moderately high for ebonite.

A FEW tenths per cent. of vanadium raises the elastic limit of a mild structural steel one-half without impairing its ductility.

The Latest in Engineering.

Gas-propelled Canal Boats.—On the Bridgwater Canal there was a successful trial recently of a new method of propelling barges. It is a very simple system, and if it realises the hopes of its promoters it will work a great change in the traffic on canals. Colonel R. Wilson Thom, of Southport, has devised a plan by which compressed coal gas may be used as the motive force, and the chief recommendation of his invention is a reduction of the cost of propulsion by at least one-half. As an example of what he proposes to do, he has, with the sanction of the Manchester Ship Canal Company, who control the Bridgwater Navigation, fitted up a 60-ton barge with a small gas engine, an illustration of which is given herewith. This engine, with fittings, takes up very little space—only 6½ ft.—at the stern of the vessel. Gas is supplied at the high pressure of 200 lbs. per sq. in., and it may be as high as 600 lbs. The gas is stored in twelve steel tubes, six on each side of the boat. Each tube is 15 ft. in length, the diameter of the bore being 10 ins. Colonel Thom estimates that only 200 cubic ft. of gas will be needed to drive a barge of 60 tons for one hour at a speed of 4½ miles an hour. The initial cost of the gas will be trifling. Another gain is as regards labour. Fewer hands will be required on board. Then there is the advantage of cleanliness and the absence of unpleasant smells, such as accompany oil engines. A further gain is in the matter of weight, for 14 cwt. represents the total weight of engine and machinery. A single charge of gas will suffice to work a loaded boat for twelve hours and to propel it fifty miles, with two other barges in its train. It is intended to form a company to bring the new method of propulsion into use on our canals, and in connection therewith to set up the necessary gas-producing plant at various centres. The by-products of gas are expected to yield a considerable sum. If the new method succeeds on canals, as it seems likely to do, one may look for its use in other directions.



A Gas Engine for Propelling a Canal Boat.

Electricity for Sea-Sounding.—For ascertaining the depth of the sea without the use of the sounding lead and similar devices, the Norwegian engineer Berggraf sends sound waves perpendicularly into the water, and measures the time they require to return to the surface after having been reflected from the bottom of the sea. The speed of the sound in water being known, the length of the space passed through is immediately determined; one-half of it is the depth of the water. A period of four seconds, for instance, between the departure and return of the sound corresponds to a depth of 2,400 metres (7,874 ft.). The device consists of a transmitter, a receiver, and a timepiece. The electro-magnetic transmitter sends to the bottom of the sea a series of deep sounds, which upon their return are taken up by the microphone, and reproduced by a listening device or receiver. Naturally the sound is exceedingly weak upon its return, so that it is hardly perceptible, but it is rendered distinctly audible by the vibration of the receiver or ear-piece being reinforced by a sounding tube.

The Gülder Gas Engine.—This engine is a new introduction of German design, and it seems to realise a considerably improved efficiency. The motor is of the vertical type, with crankshaft below, where the familiar double-beam A-shaped frame, derived from steam engine construction, has been used to advantage. In the upper end of one of the two beams is located the governing shaft, driven from the crank axle by means of a vertical intermediate shaft. Its cams, by means of vertical steel-tube rods, actuate the inlet and outlet valves, which are located in the cylinder casing. The working cylinder, owing to this ingenious arrangement of the governor and valve, is a smooth tube, free from any projections that would interfere with a symmetrical heat expansion in the cross-section of the bore; and, similarly, the internal compression chamber is purely cylindrical and free from any channels and pockets. Between the valves, and surrounded like these by a water-jacket, is the electric ignition device, the ignition current being applied by a Bosch magneto machine mounted above the governor shaft, and moved by it, so that the moment of ignition is readily adjusted by hand without stopping. The regulation of speed is effected by throttling the cylinder contents, the composition of the charge being adjusted simultaneously with the quantity, so as to maintain a safe ignition mixture with any load. Complete combustion is secured by the efficient position of the igniter on the axis of the cylinder. The design of the combustion chamber as a regular cylinder with smooth walls greatly facilitates a thorough expulsion of the exhaust gases, while avoiding a dispersion of the fresh mixture, which is so prejudicial to complete ignition. As the combustion is started in the centre of the compressed charge, whence it may spread to all sides by the shortest possible paths through the whole charge of the cylinder, a high heat efficiency is obtained. Six tests made with ordinary coal gas, and on loads varying from half to full, showed a remarkable regularity of speed, varying only between 210·7 and 214·5 revolutions per minute. With the best tests, a heat efficiency of 42·7 per cent. was recorded.

The Lebaudy Airship. — A record trial has been performed by the Lebaudy airship, keeping longer in the air than ever before — 3 hours and 11 minutes in all—and circling to and fro between Moisson and Freneuse, and repeatedly rounding the clock tower of the latter place, and returning to its starting place again a number of times. These evolutions were carried out with the wind blowing 8 miles an hour, and the great airship obtained a velocity of 26 miles an hour with the wind, and 11 miles against it—that is to say, her average speed through the air was approximately 19 miles an hour. That an airship of this type succeeded regularly in accomplishing a speed of 11 miles an hour against an 8-mile wind is regarded as such a practical triumph that it has been determined, as soon as the weather is favourable, to take the airship on a protracted tour through France, visiting the camp of Chalons to take part in the military manœuvres, and bring her back again to her home at Moisson.

The synthesis of water, by the influence of radium emanation, has been recently accomplished.

A Good Record.—Guard Mechin, who recently retired from the G.W.R. after over forty years' service, estimates that he has travelled 3,000,000 miles without any serious accident. He was guard of the last broad gauge train from Paddington to Wolverhampton, and of the first Great Western narrow gauge train to Plymouth. For thirty-seven years he carried the same Great Western watch (No. 400), except when, periodically, it was being cleaned.

A New Submarine Boat.—From Germany it is reported that an Italian engineer has invented a submarine boat, not intended for war purposes, but for picking up articles from the bottom of the sea. To this end it is provided with strong grappling hooks, which are moved by electrical power. It was recently tested at Genoa. The greatest depth yet reached by the boat was 348 ft., and the crew did not experience any difficulty in breathing at this depth.

Coil Winding Calculations.

By L. L.

Readers of this Journal are often confronted with the problem as to how to calculate the size, diameter, length, etc., of wire required to fill a bobbin. In this article it is proposed to deal with the two forms of winding, *i.e.*, rectangular winding and conical winding.

Rectangular Winding.—The rectangular winding is such that one layer lies exactly on the other layer, and does not lie in the hollows of the superimposed layer, and so forms a rectangle.

Fig. 1 represents a bobbin which is to be filled with wire so as to form a *rectangular winding.*

Let D_1 = external diameter of bobbin (inches).
,, D_2 = internal ,, ,, ,,
,, l = length of bobbin inside cheeks (inches).
,, b = thickness of coil in inches.
,, d = diameter of insulated wire in inches.

Now the number of turns per layer = $\frac{\text{length of bobbin}}{\text{diameter of wire}} = \frac{l}{d} = n$ and number of layers = $\frac{\text{thickness of coil}}{\text{diameter of wire}} = \frac{b}{d} = n_1$.

$\therefore$ Total number of turns = number of turns per

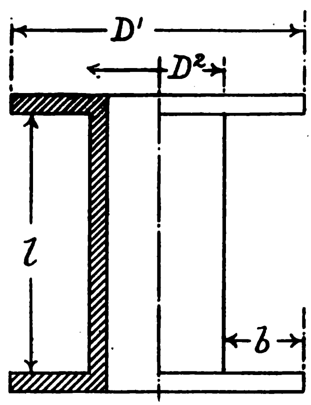


Fig. 1.

layer $\times$ number of layers $= n \times n_1 = \frac{l}{d} \times \frac{b}{d} = \frac{l \times b}{d^2} = S$.

$\therefore d = \sqrt{\frac{lb}{S}}$ = diameter of wire required to fill a bobbin of ***given dimensions***, with S turns of wire.

The method for calculating the total length of wire of a given diameter required to fill the bobbin is as follows:—

The mean length of one turn = mean circumference of bobbin.

The mean diameter of bobbin $= \frac{1}{2}(D_1 + D_2) = D_3$.

$\therefore$ Mean circumference of bobbin $= \pi D_3 = \frac{\pi}{2}(D_1 + D_2) = l\,m$; and since there are S turns of wire in the coil, the total length of the wire = mean length of one turn $\times$ number of turns $= l\,m \times S = Z$.

But $S = n \times n_1$ and $l\,m = \frac{\overline{\Delta}}{2}(D_1 + D_2)$.

$\therefore Z = n \times n_1 \times \frac{\overline{\Delta}}{2}(D_1 + D_2)$, but $n \times n_1 = \frac{l\,b}{d_2}$

$\therefore Z = \frac{\overline{\Delta}\,l\,b\,(D_1 + D_2)}{2\,d^2}$ inches;

b is also equal to $\frac{1}{2}(D_1 - D_2)$.

$$\therefore Z = \frac{\overline{\Delta}\,l\,(D_1 - D_2)\,(D_1 + D_2)}{4\,d^2} = \frac{\overline{\Delta}\,l\,(D_1^2 - D_2^2)}{4\,d^2}$$

Conical Winding.—Conical winding is such that the wires of one layer lie in the grooves made by the lower layer. Fig. 2 represents a portion of a conical winding. It can be seen from the figure that the number of turns in each layer differs from the other by one.

Let n_1 = number of layers.

,, a = ,, of turns in bottom layer;

then the total number of turns

$$S = a + (a - 1) + (a - 2) + \ldots + [a - (n_1 - 1)]$$
$$= n_1\,a + \frac{n_1\,(n_1 - 1)}{2}.$$

In order to find the distance between each layer,

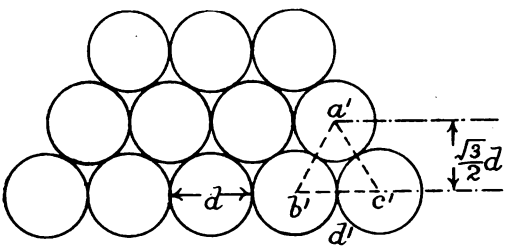


FIG. 2.

join the centres of three adjacent turns at the points $a_1\,b_1\,c_1$

The distance between the centres of two adjacent layers = $a_1\,d_1$

From Fig. 2 it can be seen that

$(a_1\,b_1)^2 = (a_1\,d_1)^2 + (b_1\,d_1)^2$ (I. 47 Euclid);

but $a_1\,b_1$ = diameter of wire = d

and $b_1\,d_1$ = radius of wire = $\frac{1}{2}d$.

$$\therefore d^2 = (a_1 d_1)^2 + (\tfrac{1}{2}d)^2$$

$$\therefore (a_1 d_1)^2 = d^2 - (\tfrac{1}{2}d)^2 = d^2 - \frac{d^2}{4} = \tfrac{3}{4}d^2.$$

$$\therefore a_1\,d_1 = \sqrt{\tfrac{3}{4}}\,d = \frac{\sqrt{3}}{2}\,d = \cdot 866\,d$$

$\therefore$ Distance between each layer = ·866 × diameter of wire.

It follows if n_1 = number of layers,

$$\text{the thickness of coil } b = \frac{\sqrt{3}}{2}\,d\,(n_1 - 1) + d$$
$$= d\left\{\frac{\sqrt{3}}{2}(n_1 - 1) + 1\right\}.$$

NEW JAPANESE FLOATING DOCK.—A large steel floating dock was recently launched at the Mitsu Bishi Dockyards, in Japan. It is 387½ ft. long by 85 ft. wide by 41 ft. 7 ins. deep. The largest of the Japanese merchant vessels can be accommodated in it.

A Cardboard Model G.N R. Locomotive.

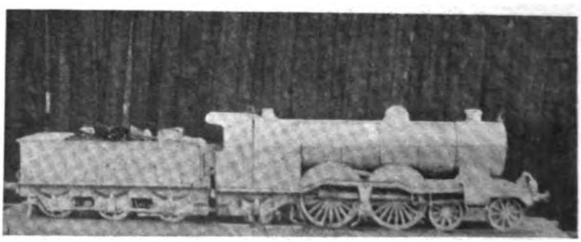
By F. HAMBLING.

THE following is a brief description of a cardboard model of the G.N.R. "Atlantic" type locomotive No. 251, which I have made to the scale of 1-in. to the foot. The model is made entirely of very simple materials. The main frames are made out of cardboard, about ⅛ in. thick, and were cut out with a fretsaw. Then I made the stays and buffer planks, which are pinned and glued to the frames. The cylinders were made from an empty gas mantle box, being about the right diameter; and the pistons are made of thick pieces of cardboard glued together and pressed, and then sandpapered round. Tin bent into shape constitutes the slide-valves, and I used wood for the valve spindles and slide-bars: after finishing the cylinders, I fixed them into the frames with ordinary pins. The wheels are made from thick pieces of cardboard, the spokes cut out with a mount-cutter's knife, and then glued together with a larger circle of cardboard for the flange. They were then fastened on to wooden axles, pinned and glued, and allowed to set well.

The axles are fixed into extra thick pieces of cardboard for the bearings. Connecting-rods are made of wood, and the springs are pieces of cardboard glued together. After this, I proceeded with the boiler, using a large sheet of thin wood pulp board; by damping, it was easily bent into shape; fixing the front tube plate and rings all along the boiler to keep it in shape.

The top frame or footplating is made of thin cardboard, pinned on the top of main frame.

The cab and splashers were next made and fixed. The chimney and dome are of cardboard tube, built up with glue. The safety valves and whistle



MR. F. HAMBLING'S CARDBOARD MODEL G.N.R. LOCOMOTIVE.

are partly of wood and cardboard, and the handrails are wire. The brakes are wood, the brake cylinders being cardboard; and the buffers are also of cardboard tubes. For the vacuum pipes rolled paper is used. The cab is complete with pressure gauge, vacuum gauge, steam sanding gear, and vacuum brake handle, pipes, etc. The reversing lever is tin, and lifts the link motion when moved. The water cocks and damper also work. The tender is complete with water tank, working hand brakes, and tool box, etc.

A LARGE SEARCHLIGHT.—The greatest searchlight in the world has just been built at Berlin for the Russian Government. It is said to be of 316,000,000 candle-power.

Slide and Micrometer Calipers.

By A. W. M.

THE slide caliper of which the Columbus gauge is a good example (see Fig. 1) is now extensively used by mechanics, and though in its simple form scarcely needs explanation, yet a recent letter from a reader of THE MODEL ENGINEER, who has received one of these gauges, shows that some amateurs at least do not understand slide calipers of the most elementary type.

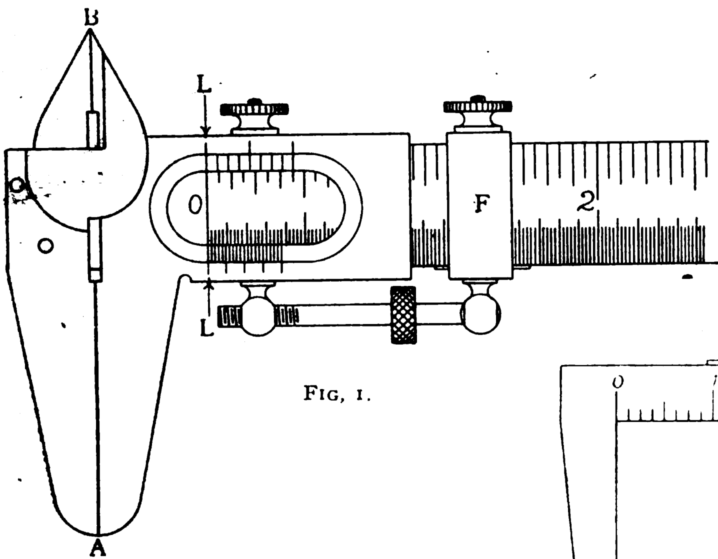


FIG. 1.

It has been said that an eminent and successful engineer, when asked what was the secret of his success, replied that he was never ashamed to ask for information from those who could instruct him. Following this sound principle, the reader referred to has had the courage to ask for an explanation of the use of the parts of his Columbus gauge, and THE MODEL ENGINEER herewith replies to him in the form of an article, which may also be of assistance to others requiring information of a similar nature.

The most simple form of slide caliper is that shown in Fig. 2. The object to be measured is placed between the jaws, the sliding one being moved along the bar until it touches the object; on this jaw is either a line or a thin edge which moves over the graduated lines marked on the bar. The size of the object between the jaws is known by reading the line on the bar which is opposite to the mark or edge on the sliding jaw. Fig. 3 shows a caliper reading 2 ins. between the jaws, the size being indicated by the fine edge on the movable jaw. Fig. 4 shows a similar caliper, also reading 2 ins. between the jaws, the size being indicated by the outside mark on the movable jaw; this caliper is also arranged to measure the diameter of holes: its jaws are therefore provided with projections (P P) to go inside the hole to be measured. As these projections must have a certain thickness, it will be seen that the mark on the movable jaw to indicate the size of the hole cannot be in the same position as the mark which indicates the size of objects placed between the jaws; a second mark is therefore provided, which will be opposite the mark on the bar corresponding to the width of the projections P P when the jaws are completely closed. It does not matter at what part of the bar the graduated lines commence, as this will depend upon the position of the edge or line on the movable bar which is used for reading off the size indicated by the caliper. In Fig. 3 this edge happens to be in a straight line with the measuring part of the movable jaw, and the lines upon the bar will commence from a point in line with the measuring part of the fixed jaw; but in Fig. 4 the bar will be marked at a point (C) which is at such a distance from the measuring part of the fixed jaw that it will be opposite to the outside mark 1 upon the movable jaw when the caliper is completely closed; the inside mark 2 will then be opposite a line which gives the width of the projections P, P. If the smallest hole into which they could enter is ¼ in. diam., then the mark 2 will be opposite to the ¼ in. line on the bar

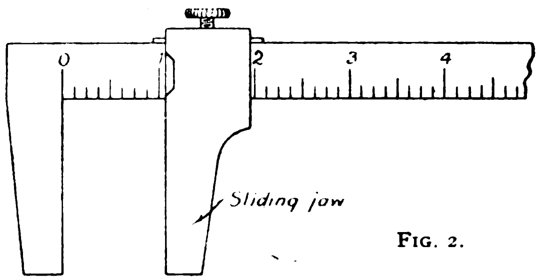


FIG. 2.

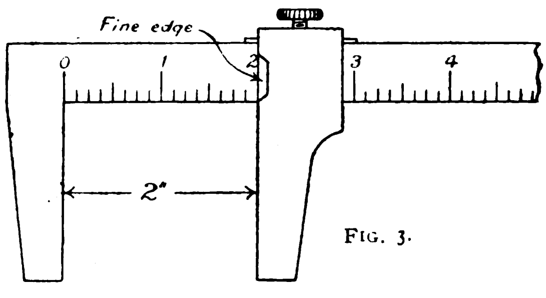


FIG. 3.

(see Fig. 5). The first thing to do with an unfamiliar caliper is to close the jaws completely, and then examine the movable one to find out the mark or edge which is opposite to the zero line on the bar. Note that the line on the bar at which this mark points indicates the extent to which the jaws are open, and therefore the size of the object between them. Or if the calipers are to measure inside dimensions, also as in Figs. 4 and 5, the second mark should be noted as the one to be used when inside measurements are made. To become familiar with the caliper, set the marks to various dimensions, and then test the jaws by applying a rule to them. It should be noticed that caliper jaws are sometimes relieved near the bar, so as to confine the measuring edge to the outer part (see Fig. 6). When this is the case, measurements must be made with the parts of the jaws marked M, and not between the parts marked R, as the latter are not intended to be used, and would give a false indication on the bar.

When the Columbus gauge (Fig. 1) is completely closed, the zero line L on the bar is opposite to the end line of each of the two small scales engraved

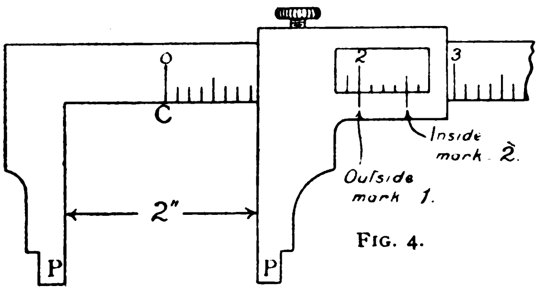


FIG. 4.

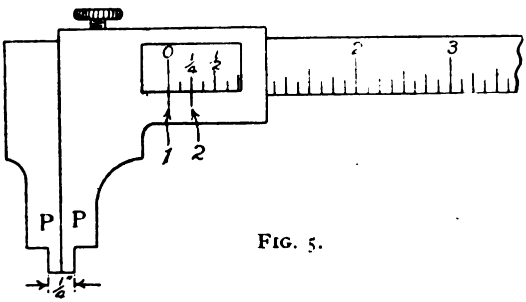


FIG. 5.

upon the movable jaw; these particular lines are, therefore, the marks to be used when reading the measurements of the gauge, both for inside or outside; because in this caliper the jaws provided for the two kinds of measurement are in line. If the jaws are opened to the extent of 1 in., it will be found that the lines L on the movable jaw are exactly opposite to the 1-in. mark on the bar; and if a rule is applied to the extensions A and B of the jaws, the distance will be 1 in. in each case. The true reading is thus not the part of the scale on the bar at which the line A B of the jaws is situated, but that part of the scale to which the lines L are pointing.

To facilitate the adjustment of the movable jaw, a clamp F is provided in the more expensive calipers; it has a screw attached to it by means of which the movable jaw can be slowly advanced or receded, and its movement easily observed and controlled. The depth gauge fitted to the Columbus caliper is also read to the same marks (L) upon the movable jaw. When these marks are opposite the 2-in. line on the bar, the depth gauge will (if measured by means of a rule) be found to protrude exactly 2 ins. from the end of the bar.

The Vernier Scale.—It will be noticed that the movable jaw of the Columbus gauge is marked with two small scales, the end line L of each forming, as already stated, the mark to which the scale on the bar is read. The use and method of reading these has puzzled many possessors of slide gauges; they are called Vernier scales, after the name of the inventor, and have been so largely adopted for making accurate adjustments in scientific instruments that an acquaintance with such a scale is useful. The principle is that of subdividing a scale division by comparing it with a division on a second scale, which division is smaller than the first by a definite and known amount.

Supposing a bar caliper (Fig. 7) is divided into divisions of 1 in. each, and it is desired to be able to measure to smaller amounts than 1 in.—say, quantities of $\frac{1}{2}$ in.—then by marking a division (C, D) on the movable jaw, its lines being exactly $\frac{1}{2}$ in. apart, the measurement could be effected, because C, D being a certain fraction of the divisions on the bar, the movement of the jaw by an amount equal to the width of this division indicates that this fraction is added to the opening A whenever the mark D is exactly opposite a mark on the bar, the mark C being the indicating point for the whole numbers. When the jaws are closed, C is opposite to the zero mark on the bar. If now, the jaws are opened until D is opposite the 1-in. mark the caliper reading is $\frac{1}{2}$ in., because C has not yet reached a point at which it would commence to indicate, and we know by the proportion between the divisions on the jaw and the bar that it takes a movement of $\frac{1}{2}$ in. to bring D opposite to any mark on the bar. If now the jaws are opened wider until C is opposite the 1-in. mark, we know that they are open to the extent of 1 in., because C indicates units, and not fractions. Opening the jaws yet more, until D is opposite the 2-in. mark, we know that the reading of measurement is now $1\frac{1}{2}$ ins., because, as already stated, it takes a movement of $\frac{1}{2}$ in. always to bring D opposite to a mark on the bar: the rule would, therefore, be to take

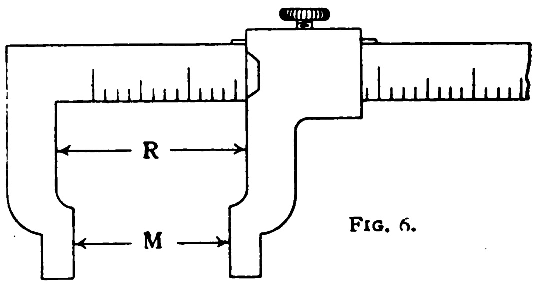


FIG. 6.

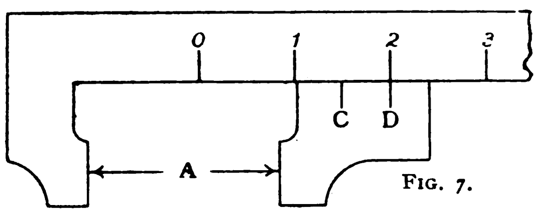


FIG. 7.

the number nearest to the left hand of C as the unit, and the distance from D to C as the fraction, D being exactly opposite to a mark on the bar. The sketches in Fig. 8 show these successive stages.

To carry the idea a step onwards, make the division on the movable jaw equal to $\frac{3}{4}$ in., and divide it into four divisions of $\frac{1}{4}$ in. each (Fig. 9). If the inch divisions on the bar are subdivided into $\frac{1}{4}$-in. divisions, we shall be able to measure amounts of 1-16th in. by comparing the movement of the marks on the movable jaw C D with the marks on the bar. As before, the mark C points to the units and the fractions are counted from D to C, the counting commencing from the mark on the movable jaw which is opposite to a mark on the bar. By taking three of the divisions on the bar for the distance C D, and dividing this distance into four parts, we produce four divisions, each of which is

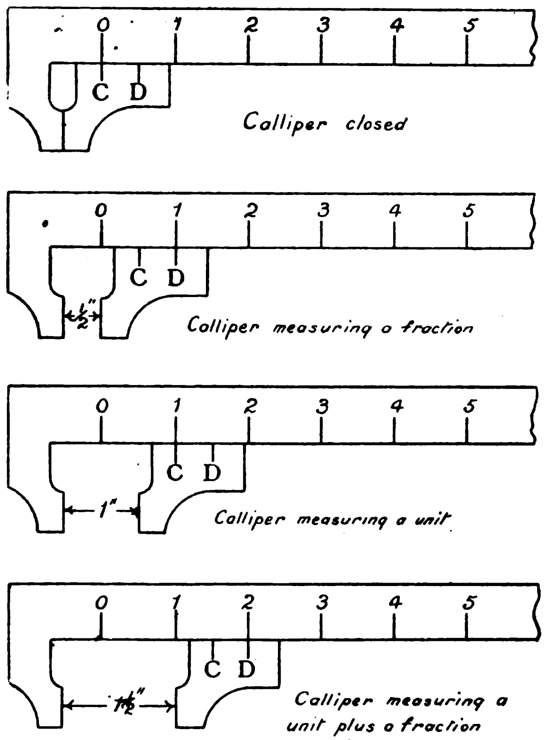


FIG. 8.

three-fourths of one of the bar divisions. If, therefore, the mark C is exactly opposite to one of the lines on the bar—say, the 2-in. line—the distance between the jaws will be 2 ins., and mark No. 3 on the jaw will be just one-fourth of a bar division short of mark A. If, however, the object between the jaws has opened them, so that mark No. 3 is opposite to A, the measurement will be 2 and 1-16th ins., instead of 2 ins., because the divisions on the jaw being only three-fourths of those on the bar, it would require a movement equal to a quarter of a bar division to bring 3 up to A. It will be seen that a further movement of an equal amount will move mark 2 as far as line B, and the measurement would be 2 and 2-16ths ins.; a third movement of an equal amount would bring mark 1 as far as line E, and the measurement would be 2 3-16ths ins.; and so on. The observer would first note the unit division on the bar which was nearest to the mark C; next he would look on the vernier scale for the mark which was opposite one of the small divisions on the bar; then he would count the vernier divisions towards and up to C. This would give him the value of the fraction by which the measurement exceeded the unit. In this example it would be 3-16ths in. over 2 ins.

The object of the vernier scale is, therefore, to enable a measurement to be indicated to some fraction of the smallest division on the bar. It is easy to read a division of 1-16th in., or even of 1-32nd in., on the bar, and no vernier is required; but it is more difficult to read 1-64th in. or 1-100th in.; whilst to read a measurement to the thousandth part of an inch would be very difficult, if not impossible, as the lines would be so close together; and yet by means of the vernier scale a thousandth part of an inch can be read if the divisions on the bar are not finer than the fiftieth part of an inch,

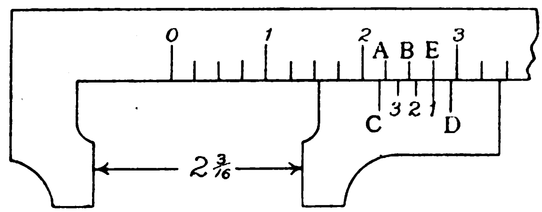


FIG. 9.

by comparing with them a vernier scale, the divisions of which are only slightly smaller than the 1-50th-in. bar divisions.

The Columbus gauge has two vernier scales and two sets of bar divisions; one set—that nearest the adjustment screw—enables measurements to be made to one-thousandth part of an inch, and the other to the 1-128th part of an inch—that is, to half of 1-64th in.

The 1-1000th in. vernier is constructed and used as follows. The bar is marked with divisions of 50 to the inch as its smallest divisions. Now, it is easy to set the mark L (Figs. 1 and 10) on the jaw to these lines, and so make measurements to the one fiftieth part of an inch, or even to guess fairly near to half a division, which would be the 1-100th part of an inch. But it would be hopeless to try

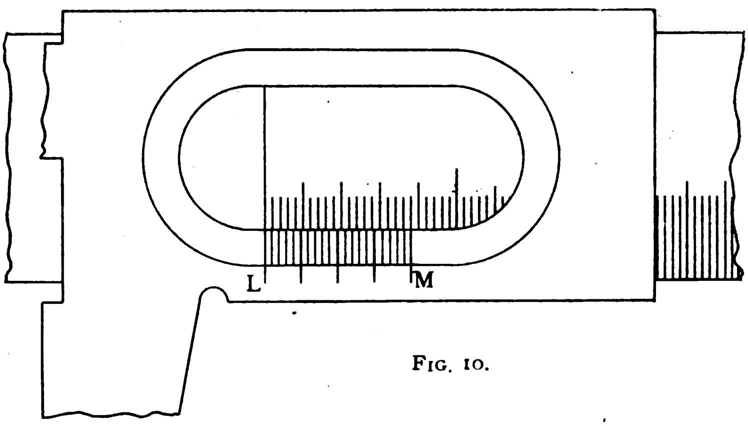


FIG. 10.

and set it to the 1-20th part of a division, which would be necessary to measure the one thousandth part of an inch; so the vernier scale is provided to enable this to be done.

A distance (L, M) is always taken to nineteen of the smallest of the bar divisions, and this distance is divided into twenty equal parts: each of these parts is thus smaller than a bar division of 1-50th in. by 1-20th of such a division; but the 1-20th part of 1-50th in. is the 1-1000th part of an inch. So it follows that each vernier scale division is the thousandth part of an inch smaller than a bar division; and that if you start at L, and count along the vernier scale to M, you will count 1-1000th of an inch short for every division, until you come to M, when you will have completed twenty, which make up the one bar division by which the vernier scale is shorter than twenty bar divisions.

(*To be continued.*)

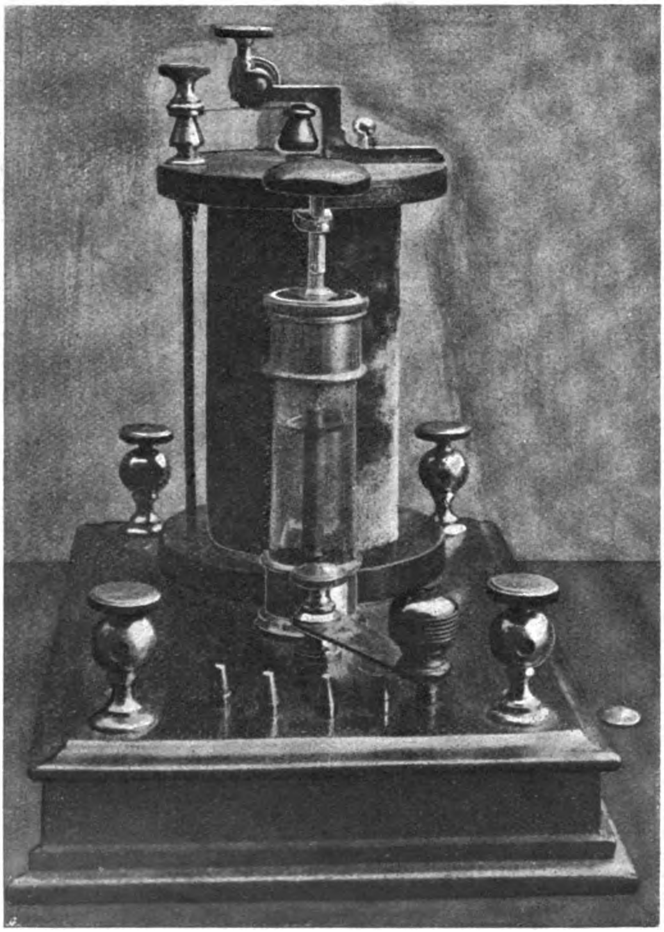
A Belt Preservative.—Castor oil is an excellent preservative for leather belts, and rats will never touch belts treated with it. Apply the oil warm.

A Bazaar Shocking Coil.

By L. R. Tanner.

The coil herewith illustrated is of the upright or vertical type, and is the property of a friend of mine, Mr. Amos Paskin, to whom I am indebted for the following particulars:—

The core consists of soft iron wire 6 ins. long and ¾ in. in diameter, to which is fitted the circular coil ends, which are 3¾ ins. diameter and ⅜ in. thick. Two layers of No. 16 D.C.C. copper wire, wound in the space between the coil ends, viz., 4¾ ins., form the primary winding. The secondary winding consists of 1⅛ lbs. of No. 36 D.C.C. copper wire, which fills up the space between the primary winding and the green velvet covering shown in the photograph. The coil is screwed down to a base 6¼ ins. by 9¼ ins., under which all connections are made. Two methods of regulating the shock are provided, viz., a water resistance and a four-way switch (photograph shows switch handle partly on the fourth and fifth studs). The water resistance glass is 4½ ins. high and 1 in. in diameter, and contains water to a height of 2½ ins. The four-way switch works as follows: Before winding the secondary wire it was divided into four equal parts. When the first quarter was wound a loop was left long enough to connect to the switch. Each quarter was treated in the same manner, so that when the winding was completed two ends and three loops remained. One of the two ends was connected to the first stud of the switch; the three loops were then in turn connected to the next three studs, and the remaining ends to the last stud. The first stud was then connected to one of the secondary terminals, and the switch handle to the other.



A Vertical Type Bazaar Shocking Coil.

The woodwork is mahogany stained, and the brasswork lacquered. The coil is worked by two half-pint bottle bichromate batteries, and the shock is extremely powerful when the switch handle is on the third stud, which means that only half the effect of the coil is being used.

Regulation of Gas Engines.—In order to regulate the supply of mixture to a gas engine so as to enable the relative proportions of gas and air to be varied in proportion to the varying calorific value of the combustible gas, an arrangement has been devised by which a flame of the gas is caused to heat a metal rod, more or less according to the intensity of the flame, the expansion of the rod effecting the regulation of the gas and air butterfly valves by means of a lazy-tongs and multiplying lever arrangement. There is an alternative method by which the flame is made to affect the electrical resistance of a wire, the change of resistance accomplishing the same purpose by electrical means.

Traction Notes on Road and Rail.

By Chas. S. Lake.

The New Rolling Stock of the District Railway.

Although July 1st was the date appointed for the inauguration of the electric services on the District Railway, it is only quite recently that anything like a complete organisation of traffic on that basis has been effected. The scheme is a comprehensive one, inasmuch as it provides for a service of electrically-propelled trains connecting Ealing on the West with East Ham on the Eastern side of London, passing over the City portion of the line *en route*; whilst provision is also made for gaining access to the Uxbridge Station of the Metropolitan Railway, *viâ* South Harrow.

The type of car employed, and the appearance of a complete train of cars used on these services is shown in the accompanying photographic reproduction, for the original of which the writer is indebted to the builders. Messrs. The Brush Electrical Engineering Company, Ltd., of Loughborough and London. Each train consists of seven cars, three of which are equipped with motors, the remaining four being trailers. The motors are each of 200 h.-p., so that an aggregate of 1,200 h.-p. per train is provided. The cars are 49 ft. 6½ ins. long over the buffers, 12 ft. 3¼ ins. high from rail level, and 8 ft. 10½ ins. wide over the outside eaves' mouldings. As is usual in vehicles of this description, the seats are mostly arranged longitudinally along the sides of the car, leaving ample flooring space between them. A few transverse seats are provided, and drop seats are fixed at the central doors, so that they can be used on the side opposite to the platform, and dropped out of the way on the platform side itself. The trailer cars and the middle motor car accommodate fifty-two passengers, and the end motor cars seat forty-eight passengers each, giving a total capacity per train of 356 persons, not including attendants. The doors slide on ball-bearing rollers, and are worked by compressed air, under the control of the guard of each car, by means of a three-way valve communicating with the supply of compressed air for operating the brakes. The doors are moved by pistons working in small pneumatic cylinders. The whole of the wood used for internal fittings, mouldings, etc., has been rendered non-inflammable by the Brush Company's patent process. The cars are sheathed on the outside in aluminium, finished with royal scarlet colour painting. From thirty to thirty-five electric glow-lamps, of 16 candle-power each, are employed in each car for lighting, and the upholstering is mostly in non-inflammable rattan. In winter the trains will be heated by means of "Gold" electric heaters.

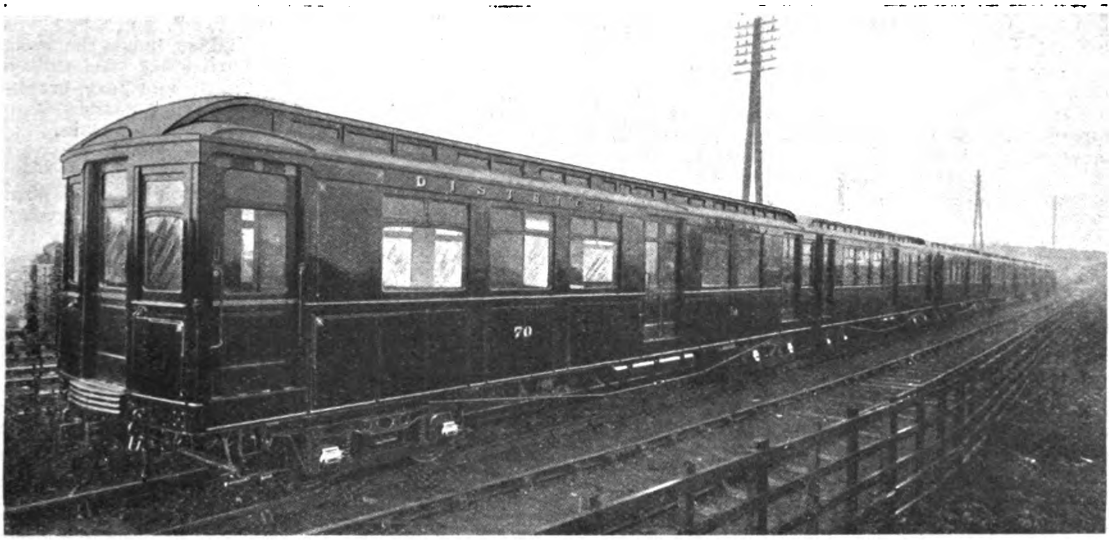


Fig. 1.—An Electric Train on the District Railway.
Built by The Brush Electrical Engineering Co., Ltd.

Additional Motor Buses for London.

An additional motor omnibus service is, at the time of writing, about to be inaugurated in Western London, and by the time these Notes are in print the service will probably have been commenced. The vehicles will run between Kilburn and Victoria Station, *viâ* Maida Vale, Edgware Road, and the Marble Arch. They are of the double-deck type, and of particularly substantial design. The seating accommodation is fo· thirty-four passengers, and the engine has two horizontal cylinders, 6-in. bore by 7-in. stroke;

the maximum number of revolutions per minute is 600, and the horse-power developed is 20. The four speeds and reverse are worked by a hand-lever, which is moved over a quadrant on the steering column. The drive from the engine is conveyed to the gear box shaft by means of a Renold silent chain. The 'buses are provided with electric bells both inside and out, and lighting is effected by means of acetylene lamps. Two windows on either side are made to open. The vehicles, which are owned by the Victoria Omnibus Company, Ltd., are painted a bright red. They have been built by Messrs. Moss & Wood.

ELECTRIC TROLLEY CARS, MIDDLESEX COUNTY COUNCIL.

The writer has received from Messrs. The Brush Electrical Engineering Co., Ltd., of Loughborough and London, particulars, with photograph, of one of the electric trolley cars supplied by them to the Middlesex County Council.

These cars, which run as far afield as Edgware, on one route, are of the double-deck type, and have a total over-all length of 34 ft. 6 ins. Seating accommodation for thirty passengers inside and thirty-nine on the upper deck is provided, the staircase being of the London United pattern with intermediate landing.

The interior of the car is handsomely fitted with rattan seats and stuffed cushions of old gold material, the windows being provided with curtains of a similar colour, while the ceilings are of three-ply maple veneer relieved by walnut mouldings.

Ventilation is effected by perforated panels above the side windows, arranged in such a manner that air is forced into the car in whatever direction it may be travelling; but, if desired, the amount of ventilation can be governed by the pivoted sash frames inside the car, which are arranged to be opened or closed at will.

The bodies are mounted on maximum traction trucks of the Brush Company's standard pattern, with the pony wheels leading, the electrical equipments being of the British Thomson Houston Co.'s manufacture.

Life-guards of the Willson-Bennett pattern are fitted, and folding steps of the Brush standard pattern are provided, to come in line with the Board of Trade requirements.

THE TANTALUM LAMP.—A life test of tantalum lamps, which has now progressed about 550 hours, has given results that bear out quite fully the statements concerning the lamp made by two engineers on the staff of the Siemens & Halske Company. Two lamps with clear globes have been burning about 550 hours, and they have not fallen off in candle-power as yet by 10 per cent. The efficiency is about 1·8 watts per c.-p. for the clear globe lamp and 2 watts for the frosted globe lamp. The filaments get beady in appearance after about 50 hours, but change very slowly subsequently. Burned in a nearly horizontal position they sag considerably during the first period of their life, and then begin to tighten up again. The light has almost exactly the same hue as that of the Nernst lamp. In this test the tantalum lamps have held up better in candle-power than an Edison lamp burned and tested with them for a check.—*Elec. World.*

Notes on the Treatment of Tool Steel.

By J. M. T.

BEFORE going on to speak of its treatment, I must commence by giving a very short description of tool steel.

Cast or tool steel is composed of iron and carbon, and I think I need not go back any further in its manufacture than to say that it is generally made by blowing air through molten cast iron, and so burning out all the carbon contained in the cast iron. Then definite quantities of carbon are introduced in some form, and, when thoroughly mixed, it is run into suitable moulds. It is then taken to the rolls and reduced in diameter, and is ready for the market.

The amount of carbon in cast steel is sometimes as high as 2 per cent. and sometimes only 1 per cent., generally about 1½ per cent., and it should occur as a chemical combination, and not as a mechanical mixture. If too much carbon is introduced, the iron will not combine with it all, and some will remain free, as graphite, and so make the steel very brittle. In fact, the particles of steel will be surrounded with the very brittle substance, graphite, making it very weak. If this is carried to an extreme, it will become brittle cast iron again.

We will next consider the most important point in treatment of steel, and that is

HARDENING.—When steel is rapidly cooled from a red heat (or any high temperature) to a low one, it becomes hard. The more rapid the cooling, the harder the steel becomes. If the cooling is too slow, or if the steel was not hot enough, it will not harden. It should be brought to the right heat and cooled only sufficiently fast to get the desired result. Steel is very sensible to heat. A high temperature causes steel to assume a very coarse and open grain, and if steel is hardened at a high temperature it will retain this coarse open grain, and consequently will not be able to resist strain nearly so well as if the grain was close and compact.

There is a best temperature from which to harden all steel, and that is the recallescence point of that particular brand. The temperature is about 1,200° F., and it seems that steel in cooling from this point is less strained than from a higher temperature. The grain is found, when a piece is broken, to be very close and fine, and so the steel is in its strongest state, much stronger than if heated to a higher temperature, with its consequent open grain. If the fracture of a broken piece of steel that has been hardened at the proper temperature—that is, the recallescence point—is examined under the microscope, it will look like (as an example) fine sifted sugar; but if a piece that has been overheated or burnt is examined, it will look like coarse Demerara sugar, and it will easily be seen that there is no comparison between the two in taking a fine edge or resisting strain. It may be that steel hardened from a very high temperature is harder than if hardened from the recallescence point, but it is not nearly so tough; in fact, it is brittle—too much like glass, hard, but exceedingly brittle.

A really good razor probably illustrates the most perfect hardening and tempering and grinding of a very high grade of tool steel; but its edge, if

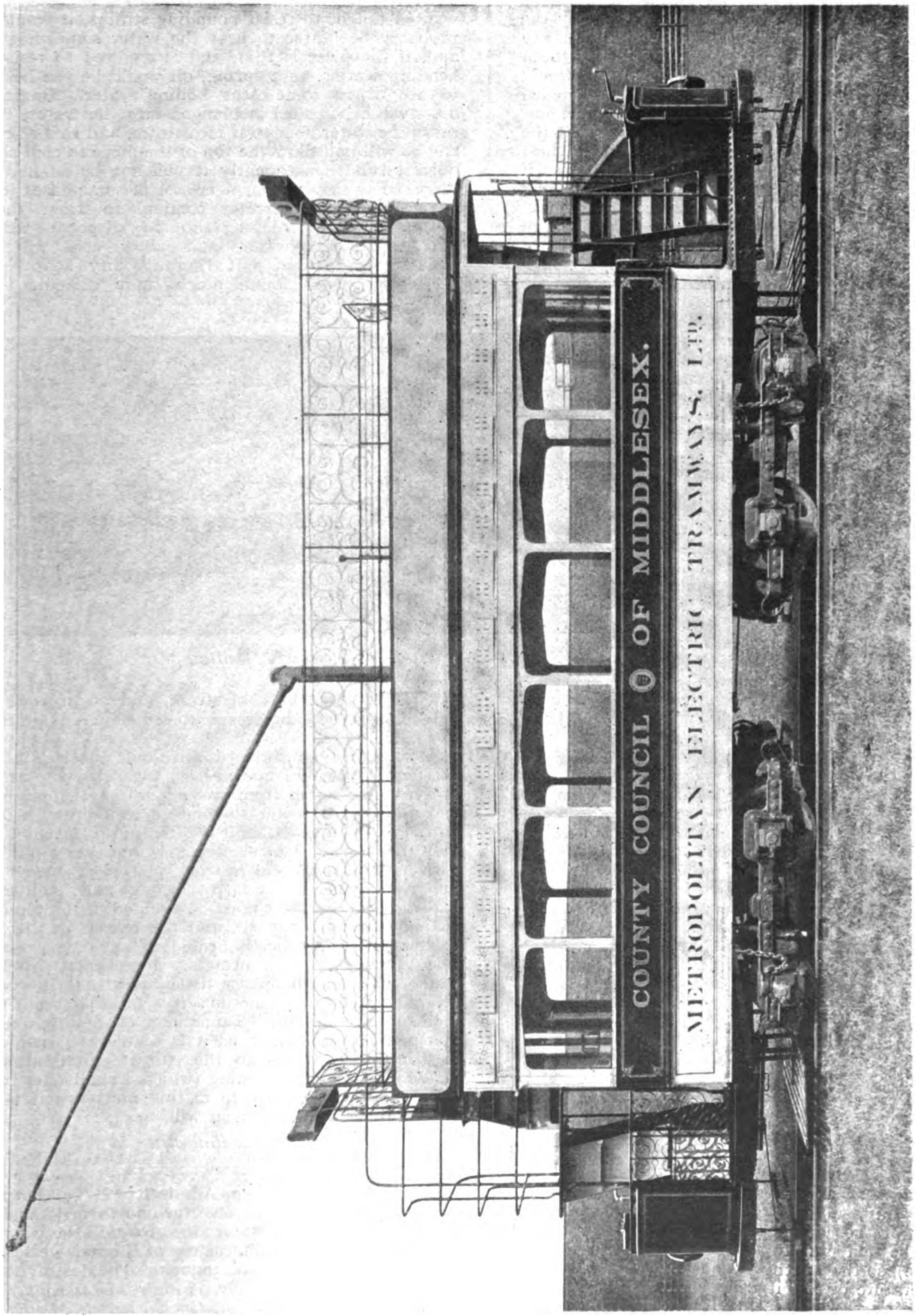


FIG. 2.—AN ELECTRIC TROLLEY CAR FOR THE MIDDLESEX COUNTY COUNCIL.
Built by The Brush Electrical Engineering Co., Ltd

examined under a microscope, would look like a poorly sharpened saw; but if another razor by the same maker and same steel had been allowed to get too hot in hardening, even if it had been finished exactly like the first one, the edge would look under the microscope like a badly ploughed field. This point of temperature is a most important one, and it must be remembered that the grain of the steel is always fixed by the highest temperature to which the steel was heated, even if it cools down to the recallescence point before being plunged into the cooling bath. If the steel should be accidentally overheated, it must be allowed to cool down and reheated to the proper temperature—the recallescence point, or, as it is often called, the refining point. To come nearer the beginning, this recallescence point is a most interesting one. If a short bar of steel is heated to a bright red, and then taken from the fire and placed in a dark place, it will, of course, cool down, and so lose its bright red colour.

When it is a medium red, it will gradually grow brighter, beginning at the ends and travelling each way to the centre. It remains this bright red for some seconds, and then grows dull, and finally black, as it cools.

The temperature at which the steel recallesces is the best point at which to harden. The temperature varies with different qualities of steel, sometimes being as low as 1,100° F., and sometimes as high as 1,300° F. If steel is heated, and the temperature taken by means of a thermometer or pyrometer, as the heat increases, the thermometer will steadily rise until the recallescence point is reached. It will then remain stationary for a few seconds, and then steadily rise. Then if the heat is stopped, or the piece is taken from the furnace, the temperature will steadily fall until the recallescence point is reached, when it will once more stand still for some seconds, or even rise, and then begin to fall again. If the readings are compared, it will be noticed that the stationary point is not the same in both cases. I don't know why this is, and I don't know that it is of any very great importance, because steel should always be hardened on a rising and not a falling heat, if a fine grain is wanted. It is stated that there is practically no expansion or contraction in the steel if hardened from this point, and also that the steel is much stronger or tougher. The toughness is probably due to the steel being hardened at a low heat. If it is true that it does not alter in size, I cannot say why it is.

Cooling Mediums.—We next have to consider the cooling mediums, or hardening baths. The most common are water and oil, though there are plenty of other substances used, as mercury, to produce extreme hardness; sealing-wax and soap for toughness, and to combine hardening and tempering in one process; tallow for the same object; and many others. As I said before, the rapidity of the cooling affects the hardness (supposing the temperature of the heated pieces to be the same), so that, if the piece is cooled in water at a temperature of 60°, it will be much harder than if cooled in water at 100°. An advantage can be taken of this very often, for if a piece is wanted extremely hard, cold water would be used; but, if wanted tough, to resist pounding strains, it would probably be better to heat the water somewhat; and, if the piece is thin, and is required to resist bending strains, as a spring, oil would be the best to use, or, in some cases, boiling water. Immediately the hot steel is plunged into the water, it turns the water next to it into steam, and this rises and so will not allow the top of the piece to cool so quickly, and consequently it will not be so hard there. For this reason, it is best in some cases to have a supply of water coming up from the bottom of the hardening tub to disperse this hot steam and water, and allow cold water to reach the piece. If there is any soap in the water, it is found much more difficult to get rid of this cloak of steam, and so if water is used, it is very important to see that it is quite clean.

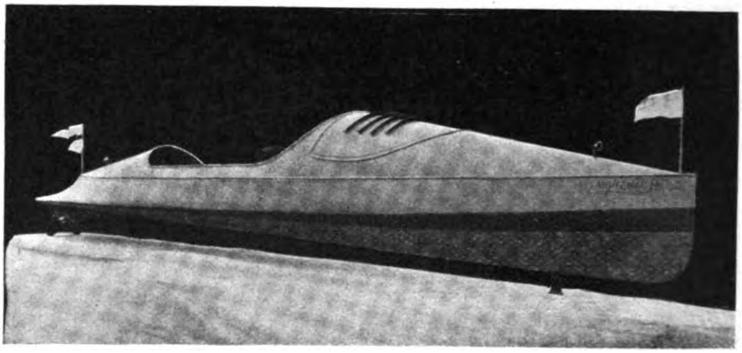


Fig. 1.—Mr. G. A. W. Roberts' Model Motor Boat.

A saturated solution of salt and water is an excellent hardening mixture, as the salt seems to prevent any steam from staying round the piece, and allows cold water to come in contact with it all the while; in fact, as it is often put, it seems to bite the steel. The steel comes out very hard with a small degree of heating, in consequence of the rapid cooling. Sharp corners and sudden variations in diameter must be avoided, if the piece is to be safely hardened, and the reason is this: when a piece of steel is heated, it expands; and when cooling, it contracts. Sometimes after hardening it remains just a little larger than it was before heating; but sometimes it is actually smaller than the original size. Tapmakers, especially, find this point troublesome, as it is scarcely possible to grind the threads to the correct pitch after hardening. Pack hardening (which I shall refer to later) is supposed to help in this matter, and no doubt proper heat treatment will, too.

(To be continued.)

New T.-B. D's.—The Admiralty have given orders for a flotilla of twelve turbine torpedo-boat destroyers to be built for the Royal Navy for coast service. The displacement of the new vessels will vary from 220 tons to 230 tons. The destroyers will be named *Dragonfly*, *Firefly*, *Grasshopper*, *Greenfly*, *Gadfly*, *Glowworm*, *Gnat*, *Cricket*, *Mayfly*, *Moth*, *Sandfly*, and *Spider*.

My Model Racing Motor Boat.

By G. A. W. Roberts.

THE following is a description of my model racing motor boat, *Nauteuse*. The length over-all is 6 ft. 10 ins., 10-in. beam, and 2-in. mean draught. The hull is carved out of a log of mahogany, this being the easiest method with this design of boat. I first of all shaped the outside, and then dug out the inside with bits and chisels. This I found not to be a very difficult task with the proper tools, a draw knife taking off all the rough outside, and for finishing off inside and out I made a double curved smoothing plane. Fig. 4 shows the method of fixing the hood to the hull, a plate the width of the hull being cut to the shape, and a wire put in the edge, the hood afterwards being soldered to the plate. The whole of the hood and cover, with louvres, being made of stout tin.

The engine is placed just under the forward hood, and it and the carburettor are quite accessible when the cover is removed. The engine is a 2-in. by 2-in. 4-stroke outside flywheel petrol motor, as usually fitted to low-powered motor bicycles, and is air-cooled by a fan placed behind the cylinder, which draws air through the louvres in the cover, and keeps the engine quite cool. The carburettor is a small spray type. To start the engine a stout cord is wound round the shaft and a smart pull given to it. Petrol is stored in two tanks, situated under the forward and stern hoods; both feed the carburettor by a common pipe, and this preserves the trim of the boat. The cowles lift out and form filling holes for the tanks. The tail shaft is driven from the engine by an ordinary leather-faced clutch, which enables the engine to be started without starting the boat.

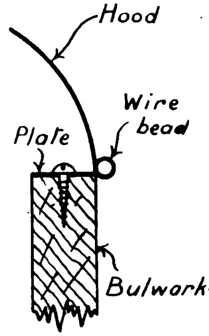
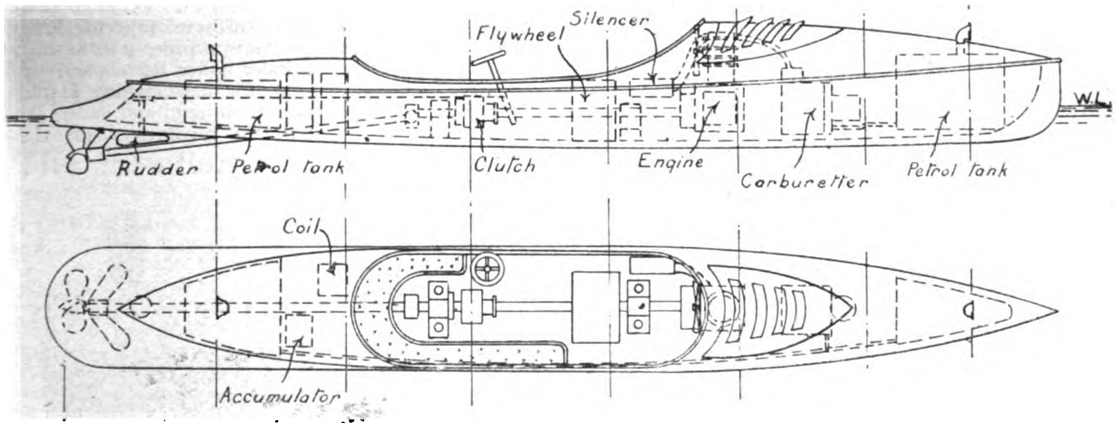


Fig. 4.—Method of Fixing the Hood to Hull.

Steering is effected by a balanced rudder worked from the steering wheel. The coil and accumulator for ignition is placed under the after hood. The propeller is a three-bladed one built up on a boss with 3-10 in. brass plates sweated together and filed to shape; it is 5 ins. diameter, 7-in. pitch. I have not yet timed the boat for speed, the engine not yet being "turned up"; but I will take some tests and send them to you as soon as possible. I anticipate from the fine lines of the hull and the power of the engine that the boat will have a remarkable speed.

The photograph will give a good idea of the lines of the hull, and the drawings will also help to give a better idea of the whole arrangement than any written description. Any further particulars I shall be pleased to send to anyone requiring them, on applying through the editor.

Fig 2.—Elevation and Plan.



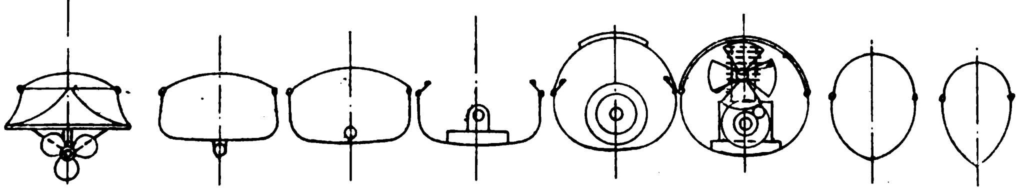


Fig. 3.—Cross-sections.

A MODEL RACING MOTOR BOAT.

A Single Cylinder Undertype Semi-portable Engine.

By P. W. Wilson.

THE accompanying photograph represents an engine that I have built entirely to my own designs and ideas. The cylinder, as will be noticed from the photograph, is placed at the firebox end, leaving open and free access to the crank, eccentrics and bearings, while the piston can easily be withdrawn by removing front cover and guide, the latter being sufficiently strong to need no bracket at the extreme end.

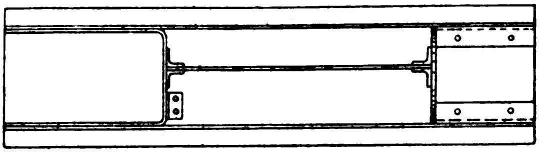


Fig. 1.—Plan of Bedplate.

The whole of the bedplate is built up out of 1-16th-in. Muntz metal plate, and secured by suitable angle brass and riveted, the whole forming a very strong and yet light frame, both the cylinder and bearings being amply supported. The former is secured by two 1/8-in. studs and nuts, also two 1-16th-in. "steady" pins driven in a fit, so that no alteration can be made in the setting of the cylinder in case of subsequent overhauling.

The valve (ordinary D) is worked from a rocking shaft, which latter is supported by two turned and polished stanchions, which are secured to the motion plate by nuts. This rocking shaft has three arms, one connected to eccentric, one to the valve gear, and one to the pump (not shown in photograph). The crankshaft is made of steel (one forging), and presents ample bearing surface, being designed for high speeds, the width of the bearings and crank-pin brasses being 3/4 in. and 1/2 in. respectively.

The connecting-rod is made out of an old broken shifting spanner, and is bushed with brass at the crosshead end, the big end being cut out to take split brasses in the usual manner, and secured by collar, which is in turn secured by check nuts on underside.

The boiler is of copper, riveted and tinned inside, with the usual internal firebox (loco type), and has one tube or flue; and notwithstanding the comparatively small heating surface, I have had fairly good results on the trials.

The fittings to this small engine include the regular Board of Trade water gauge, two test cocks, steam pressure gauge, two safety valves, one feed check valve, one blow-off cock, one steam whistle, one hand feed-pump for emergency, and connected to the steam pipe I have an automatic lubricator duplicated by an ordinary one-cock ditto, which affords ample lubrication to the steam (which I find is needed, more especially in the use of brass cylinders). The steam pipe (not shown) leads from top of firebox shell to cylinder by neatly-bent pipe, fitting close to boiler.

In conclusion, I may say that this engine has been designed and constructed during my spare time on long sea voyages, and it may be interesting to other readers of The Model Engineer to know that this little machine has been more than half-way round the world. The nameplate, which reads: "P. Wilson, Globe Works, Sunderland, 1905," was made for me (to my own pattern) in Calcutta by a native Indian.

The crankshaft bearings I picked up in Hamburg; the cylinder, shaft and countershaft, and bearers, together with boiler mountings, were made to my special order by Messrs. Bassett-Lowke and Co., of Northampton; and I have much pleasure in stating that the entire satisfaction I have had in the actual steaming of this small engine I attribute to the good and workmanlike design of the cylinder ports, and minimum allowance of clearance at each end of the stroke, which has been made apparent to me, having tried the same boiler with different engines, duly noting circumstances.

I append dimensions of the engine and boiler:—

Diameter of cylinder, 7/8 in.; stroke, 1 1/4 ins.; diameter of flywheel, 4 3/8 ins.; diameter of crankshaft, 5-16ths in.; piston-rod, 1/8 in.; width of connecting-rod, 3-32nds. in. by 3-16ths in., tapering down to 5-16ths in. at big-end; steam pipe, 3-16ths in.; exhaust, 1/4 in. (passing under boiler barrel, and up chimney, curtailed to 1/8 in. for blast, which I find very effective). All feeds, both hand and main, are 3-16ths in. fittings, and the revolutions of the

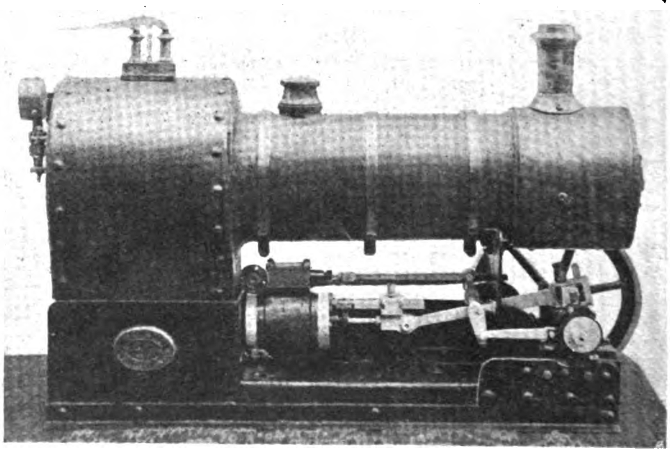


Fig. 2.—Mr. P. W. Wilson's Undertype Steam Engine.

engine with 22 lbs. steam running light mount up into the thousands.

Total length of engine and boiler combined, 15 ins.; total height (without any additional chimney), 9 1/2 ins.; boiler, 3 1/2 ins. diameter by 13 ins. long by 2-in. smokebox; firebox shell: outside, 4 1/2 ins. by 3 1/4 ins.; inside, 3 3/4 ins. by 2 1/4 ins. by 4 ins. high; flue, 7/8 in. diameter, fired by No. 1 Primus petrol burner, or gas Bunsen ditto, with asbestos nuts on fire bars (both of which give ample heat), the steam being on the ascendancy with engine opened out full, feed going in hot.

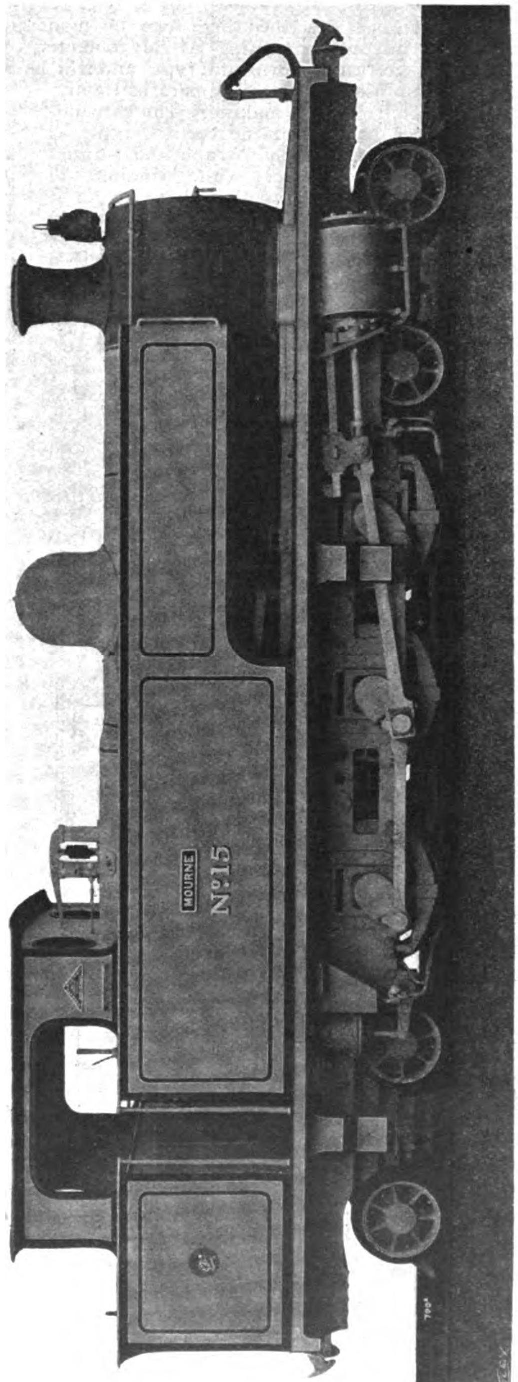
New Tank Locomotives for the Donegal Railway.

By the courtesy of Col. W. Hamilton, J.P., whose contributions on the subject of model railways are well known to our readers, we are able to reproduce a photograph of one of the latest tank engines on the Donegal Railway. The engines are of the 4—6—4 type, with the frames of the coupled wheels outside. The cylinders are 15 ins. diameter by 21 ins. stroke; the barrel of the boiler is 9 ft. 9 ins. long and 4 ft. diameter. The driving wheels are 3 ft. 9 ins. diameter on tread, and the weight of the engine in working order is 45 tons. The standard automatic vacuum brake apparatus is fitted, and works in conjunction with Gresham & Craven's steam brake on the engine. The locomotives were built by Messrs. Nasmyth, Wilson & Co., Patricroft, Manchester, the design being selected by a committee of the directorate, of which Col. Hamilton is a member. They are painted the company's standard green, with a black band, edged on each side with a narrow white line, the cylinders, buffer planks, cranks, and underframing being finished vermilion colour. Altogether the engines are fine examples of narrow gauge practice, and form an interesting addition to the excellent locomotive stock of the Donegal Railway.

The "Holiday" Competition.

During the present holiday season, we have decided to award every reader who sends us a description and original photographs of anything of engineering or model-making interest he may encounter during his vacation, which shall be sufficiently good to warrant insertion in our journal. The prizes vary in value from 5s. to 10s. 6d., according to merit. All winning competitors will receive a notice of the value of the prize awarded, when they can choose the tools or other articles they may wish sent to them. All entries should be accompanied by a separate letter, marked on the envelope "*M.E.* Holiday Competition." This letter should include the title of the article and any other information not necessary for publication. The article should be written *on one side of the paper only*, with the name and address of the sender on the back. The photographs and separate sketches enclosed with the contribution should similarly bear the name and address of the sender, otherwise delay may arise in the awarding of the prizes. It is essential that the copyright of the photographs must be the property of the senders, and the covering letter should contain a declaration to this effect. The competition will close on October 16th.

New Zealand Exhibition.—The Government of New Zealand has decided to hold during the summer of 1906-7 (that is in December) an International Exhibition at Christchurch, Canterbury, New Zealand, in which all the nations of the world have been invited to participate. The object of the exhibition is educational.



One of the New Narrow-Gauge Tank Locomotives for the Donegal Railway, Ireland.

A Galvanometer Testing Set.

By S. Eden Green.

THE set described here can be made up by anyone possessing a galvanometer, either vertical or horizontal type, and will be found a most useful piece of apparatus to anyone electric model making. The galvanometer I have is of the vertical type, as will be seen from photograph, and I found it a great nuisance, while winding the sections of a large coil, to have to rig it up with battery, etc., every time I wanted to test a section for continuity, so I placed the galvanometer in a box with a battery of six small dry cells, and connected the lot up as shown in the diagram (Fig. 1). The cost for complete set (not including galvanometer) was under 10s. The cells are 1½ ins. square, and placed three abreast in the box. The switches were made from some scrap brass; 1 in. brass round head wood screws did very well for switch studs, with four ¾-in. brass nails for stops. The number of studs, of course, depends on the number of cells in battery.

From the diagram it will be seen that when the line switch is on the "off" position—*i.e.*, in the middle of G and C studs, the galvanometer is in series with cells for testing the continuity of circuits, or for tracing the internal connections of, say, a telephone, and by manipulating the battery switch any number of cells from one to six may be used, according to length of circuit, or amount of resistance to be overcome. When line switch is on G stud, it will be seen that the battery is cut out, and the galvanometer may be used alone, for testing E.M.F. of other batteries, locating short circuits, leaks, etc., or, in short, anything a galvanometer may be wanted for. When line switch is on C stud, the galvanometer is cut out, and a battery of from one to six cells is at hand for anything it may be required. A pair of flexible wire leads, with small brass or copper lugs soldered on to ends, completes a most useful and portable set of electrical apparatus.

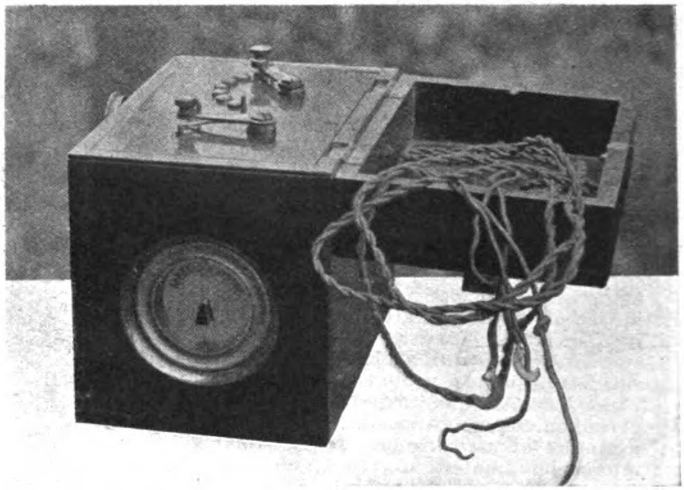


Fig. 1.—Mr. S. Eden Green's Galvanometer Testing Set.

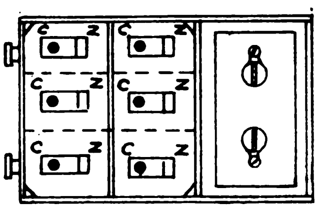


Fig. 3.—Plan.

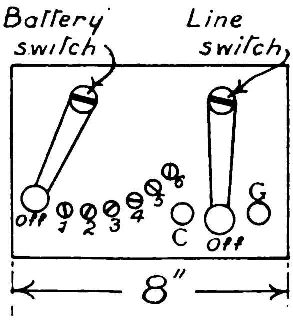


Fig. 4.—Switches.

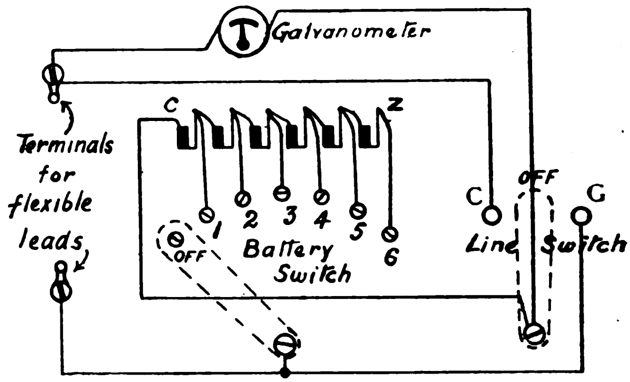


Fig. 5.—Diagram of Connections.

A Compound Petrol Engine.—The Pollard engine has a single low-pressure cylinder between the two high-pressure cylinders, and is of the same bore as these latter. All the exhaust from the high-pressure cylinders is not used, a portion only of the gases being allowed to escape from ports uncovered by the high-pressure pistons during the last portion of their explosion strokes and the first portion of their exhaust strokes, such gases expanding further in the central cylinder. Additional power, it is stated, is obtained by the use of the third cylinder

For the Bookshelf.

[Any book reviewed under this heading may be obtained from THE MODEL ENGINEER *Book Department, 26–29, Poppin's Court, Fleet Street, London, E.C., by remitting the published price and the cost of postage.]*

TRANSACTIONS OF THE G.W.R. JUNIOR ENGINEERING SOCIETY, SWINDON. Pamphlets Nos. 44 and 55. Edited by E. G. Ireland. Price 5s. net; postage 4d.

This volume contains some excellent papers by

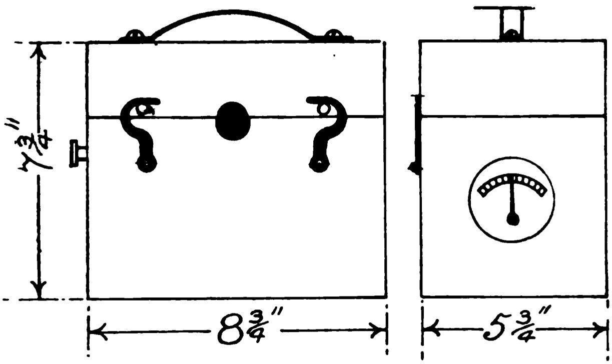


FIG. 2.—FRONT AND END ELEVATIONS OF THE GALVANOMETER TESTING SET.

the members of the above society, the subjects of which include railway carriage and wagon stock, modern automobile construction, G.W.R. express locomotives, valves and valve diagrams, metallurgy of copper, and sewerage and sewage disposal. The text is illustrated by some thirty-five plates and smaller diagrams.

WIRELESS TELEGRAPHY AND HERTZIAN WAVES. By S. R. Bottone. London: Whittaker & Co. Third edition. Price 3s.; postage 3d.

That this little handbook should have reached a third edition says much for the interest taken by the scientific amateur in wireless telegraphy, and for his appreciation of Mr. Bottone's lucid treatment of the subject. The author not only gives an excellent summary of the underlying principles and the historical considerations of this attractive branch of electrical work, but he also describes in detail the construction of suitable experimental apparatus, and in an appendix refers to the latest developments. The book is one which may be cordially commended to electrical amateurs and students.

B. F. STURTEVANT CO., of Boston, U.S.A., and Queen Victoria Street, London, the well-known firm of ventilating engineers, have lately published an interesting and useful treatise on the principles and application of ventilation and heating. The book is excellently illustrated, containing many invaluable tables and diagrams, and can be heartily recommended to all those who at any time are likely to be confronted with the difficulties of providing a building with an efficient system of ventilation and heating.

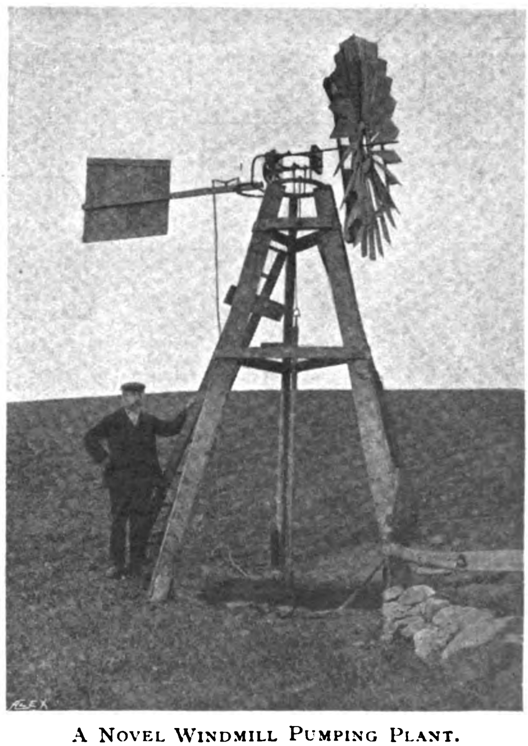
A Novel Windmill.

By G. T. WEST.

THE accompanying photograph illustrates a novel windmill pumping plant erected by the farmer seen in the photograph and a blacksmith residing near. The construction of it occupied their spare time for about three months, and the inclusive cost did not exceed £1.

Second-hand materials were principally used in its construction, altered to suit the requirements, and it has now run for seven months with only one small stoppage, which is a very creditable performance, considering the price. The only stoppage was caused by the plunger leather leaking, and as it was originally an old leather washer, no fault can be found with the design of the windmill. Another piece of leather put it into good running order again, and it now continues to run quite satisfactorily. The simplicity of the machine is apparent, and, for the benefit of those wishing to make a cheap, reliable, and easily constructed windmill, the following particulars will give the principles on which to work.

The wheel is 6 ft. in diameter, and has twenty-four blades 6 ins. broad at the circumference and tapering towards the centre. These blades are held by means of two squares of wood, the outside one being 5 ft. 6 ins. square by 2 ins. by ¾ in.; the



A NOVEL WINDMILL PUMPING PLANT.

inner one being 1 ft. square. Small blocks of wood are nailed to the squares, having sloping sides on which the blades are fixed and kept at a proper angle to the wind. Two pieces of wood, 3 ins. by 2½ ins., forming a cross, the ends of which are fastened to the corners of the outside square, are fixed by screws to the squares, and a hole is bored in the centre to receive the spindle.

The spindle is of ½-in. steel, with a 12-toothed gear wheel keyed on to the end of it, while a 24-toothed wheel engages in this and reduces the speed to half. The spindle to which the large wheel is keyed is cranked, and a connecting-rod of ⅜-in. iron rod, which is continued down by a piece of square wood to one foot from the pump, where it is fixed to another piece of iron rod, produces the reciprocating motion. Where the wood and iron are joined at the top is a simple hinge, and at the lower joint, a swivel. The bearings are of beech, each block holding one end of both spindles. The frame consists of three legs, each 6 ins. by 2½ ins. by 15 ft. long, which are sunk for 3 ft. into the ground. These legs are kept rigid by six pieces of wood, as seen in the illustration, while a piece of wood 4 ins. broad by ¾ in. thick, and nailed to the lower stays, acts as a guide to the plunger rod, which passes through a hole in the centre of it. The tailpiece is 3 ft. long by 2½ ft. by 2 ft., and the rod for tailpiece is 6 ft. long by 1½ ins. square.

The apparatus for turning was constructed out of three iron rings, the two outer being fixed at such a distance from one another that the middle ring moves round easily without unnecessary play-room. The middle ring is fixed to the two beech bushes by means of four upright iron rods. A small ladder is placed at one side for handiness in oiling, adjusting, etc. The pump is also home-made, and into its construction comes two horse-shoes, part of a gas lamp, and a piece of cycle tubing. It is 3 ins. stroke, 2¼ ins. in bore, with a ½-in. delivery pipe.

Practical Letters from our Readers.

[The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a nom-de-plume *if desired, but the full name and address of the sender* MUST *invariably be attached, though not necessarily intended for publication.]*

Making Small Wing Valves.

To THE EDITOR OF *The Model Engineer*.

DEAR SIR,—With reference to Mr. Bradford's notes on the making of small wing valves in THE MODEL ENGINEER of August 24th, Mr. Bradford advises filing the stem up, if any difficulty is experienced with the slide-rest or hand-tool. If the former is used, there should be no difficulty whatever; while a hand-tool is not suitable for turning work of this nature. These small brass goods, such as valves, gland nuts, unions, etc., etc., should not be filed in any way, but be left from the cutting tool. The following method of making valves is employed by the writer, and those readers who have the necessary apparatus will find it will give every satisfaction:—

At Fig. 1 is shown a valve finished complete, except cutting the wings and parting off. On the right is shown a small end and side mill held in a drill chuck which fits into a live spindle (not shown) driven from the overhead gear. Note that the height of the drill spindle and the lathe centres must be the same. The depth of cut having been adjusted by means of the cross-slide, the index peg is put in a hole in the 60 circle on the division plate, and a cut taken up to the neck under the valve seat, when the cutter is run back, and the operation repeated on the other two sides. Fig. 2 is an enlarged view of the finished article, and the

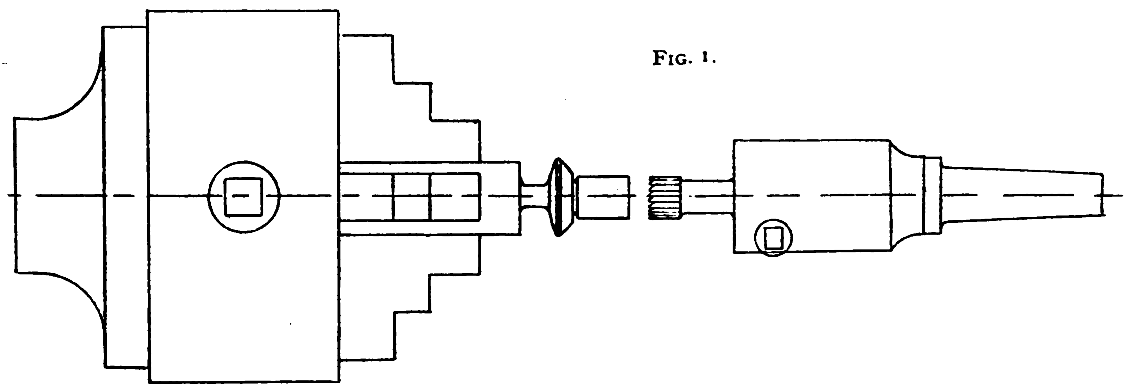


FIG. 1.

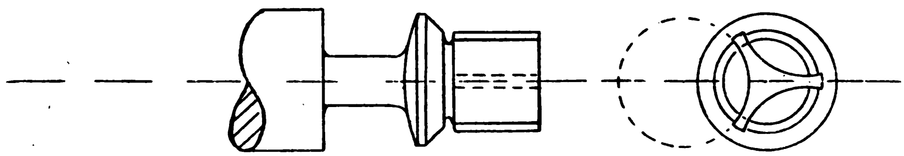


FIG. 2.

A METHOD OF MAKING SMALL WING VALVES.

dotted circle in the end view shows the path of the cutter. I should like, in conclusion, to advise any reader who is making any kind of live or cutter spindle for his lathe to make it so that the chucks for it and the lathe are interchangeable. The beauty of such an arrangement only requires seeing to be at once appreciated.—Yours truly,

Clapham, S.W. E. W. FRASER.

Bicycle-Driven Dynamos.

To THE EDITOR OF *The Model Engineer*.

DEAR SIR,—With reference to "Auphsyde Crank's" suggestion as to driving small dynamo by a "push bike," and Mr. H. P. Taylor's by a motor cycle, the first-named gentleman will require something more than the ordinary cycle stand to hold his machine. A friend and myself just recently adapted a bicycle to get the necessary speed up to start a petrol motor, and it was not until I had made a most rigid stand of wood and iron, and nailed the same to the floor, that the machine would stand still at all.

Then there is the gear to keep speed near constant, which introduces fresh complications; then size and type of dynamo. "A. C." will find that a very small one will do, if he is going to push it round for long. "Auphsyde Crank" is wrong in thinking that a prize offered in connection with the idea would be a "prize for originality." The idea is not new, for a friend of mine has often told me of a machine he saw rigged up as "A. C." suggests at a shop where they taught cycle riding. The novice was invited to get on and learn to pedal, and was told that a little varying resistance would be put on as he progressed. It was, for a thin round leather belt went from the back wheel (minus tyre), through a partition, and into a back workshop, where a small boy was busy polishing up small plated goods at a very light "bobbing head," driven by the aspiring (and perspiring) novice.

Mr. Taylor may do better with a motor cycle, if he can only keep the speed constant and his engine cool. The latter must be done at all cost, or he will ruin his machine. Of course, he will take a belt direct from engine pulley to dynamo. It is to be feared that, in any case, he will do his machine but little good, as these things are not so solidly built as the small stationary steam or gas engines.—Yours truly,

Clapham, S.W. E. W. FRASER.

The Society of Model Engineers.

[*Reports of meetings should be sent to the offices of* THE MODEL ENGINEER *without delay, and will be inserted in any particular issue if received a clear nine days before its usual date of publication.*]

London.

THE first indoor meeting of the winter session will be held on Thursday, September 28th, at the Holborn Town Hall, at 7 p.m. It has been decided to make this a special track and general exhibit night, and all members are particularly requested to bring some exhibit, either models (finished or unfinished), tools (home-made or otherwise), whether the articles have or have not been exhibited before. To encourage members to bring exhibits, a first prize of 15s., and a second one of 7s. 6d., both in cash, will be awarded during the evening for such model, or part, tool, etc., as shall be deemed by a general vote of the members present to be the most interesting exhibits. Each member present will be entitled to vote for one exhibit other than his own, the exhibit obtaining the highest number of votes taking the first prize, and the next in order the second. It is earnestly requested that those members possessing locomotives will bring and run them at the meeting; two straight tracks will be fitted up side by side, so that races may be run. The locomotives are, of course, included in the above prize scheme.—HERBERT G. RIDDLE, Hon. Sec, 37, Minard Road, Hither Green, S.E.

Queries and Replies.

[*Attention is especially directed to the first condition given below and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-hand corner of the envelope "Query Department." No other matters but those relating to the Queries should be enclosed in the same envelope.*

Queries on subjects within the scope of this journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied, wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed. (4) Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of Replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor,* THE MODEL ENGINEER, *26—29, Poppin's Court, Fleet Street, London, E.C.*]

The following are selected from the Queries which have been replied to recently:—

[14,400] **Winding 10-watt Simplex Dynamo for Plating Purposes.** S. R. writes: (1) Could a 10-watt Simplex dynamo be wound for 2 volts 5 amps. for electroplating? If so, what with? (2) Could a four-part drum armature be used? (3) What size bichromate battery would it need to run as a motor? (4) What power could be obtained from a small gas engine, working on the same principle as the Mitcham launch motor in your issue of January 19th, 1905 (cylinder 1¼ in. bore, 2-in. stroke; electric ignition)? (5) Would it drive a 10-watt dynamo?

(1) It is very difficult to get small drum armature machines to excite when wound for very low volts, and we doubt if you would get a 10-watt machine to work with a 2-volt winding. (2) If you decide to try, we should recommend six coils as the least number to wind with. Try the design described in Chapter 6 of our Handbook No. 10, and use the winding given. So long as the armature does not get overheated, you can take more current than 2 amps., if you can get the machine to give it. Work at 5 volts, and use a resistance in series with the plating bath to regulate the current. The voltage does not matter if the right amount of current is passing through the bath; electroplaters usually work in this way. Two amperes would be strong enough for 20 to 100 sq. ins. of surface, depending upon circumstances and the kind of metal to be deposited. (3) A battery of 3-quart size bichromate cells in series would run this machine well as a motor. You could use smaller cells, but they would then run down more quickly. (4) About ¼ h.-p. (5) Yes, easily.

[14,391] **Interrupter.** W. B. A. S. (Dublin) writes: (1) Could I increase efficiency of a good 1½- or 1-in. coil by fitting an interrupter, or would it be likely to damage the insulation if such were not specially designed for such an instrument? (2) Has the Wehnelt interrupter maintained its first fame during practical trial and use (continued)? (3) You speak in your handbook of different lengths and areas of contact platinums. Do you increase the area of the platinum for higher E.M.F. or currents, or the reverse? (4) About what distance should platinum point be from the lead plate for best result with above coil? If another opposing platinum point were set in the lead, could the interrupter work equally well with an alternating source of current supply?

(1) The damage is more likely to occur in the vacuum tubes than in the coil. The condenser should be cut out of action, as it is not required. We should not fear damage to a well-made coil, if not allowed to heat. (2) It is not used for every kind of work. It gives very brilliant effects for *x*-ray screens, and is useful for short exposures in radiography. Some form of mercury interrupter is

more generally used, and we think you would do better by using one of these, unless you particularly wish to experiment with an electrolytic interrupter. (3) The area of platinum should be increased for heavier currents, but, as a matter of fact, the larger the area, the better and easier will the coil be in working. The length is merely a question of allowance for wear; platinum is very expensive, therefore the tendency to keep the size small. (4) Read the note on the Wehnelt break in THE MODEL ENGINEER for February 5th, 1903, page 140. Doubtful, as the contrast between point and large surface is necessary.

[14,408] **Working Small Coil from Magneto Machine.** W. B. A. S. (Dublin) writes: I wish to work a 1-in.–1½-in. spark coil from a small electro-magneto machine. Current is ample, but I wish to intensify secondary spark. Can I use a Campbell-Swinton liquid interrupter? These work well with alternating currents; or would such a form of interrupter set up induced currents of too high an E.M.F. in the armature of magneto machine as to break down the insulation? Or must I wind a special armature?

What do you mean by small electro-magneto machine? An electrolytic interrupter is usually considered to require at least 50 volts; but we believe it is possible to get it to work with as low as 12 volts. An induction coil is liable to damage the insulation of a dynamo used to work it; but it is generally not a very great matter to re-wind the armature if it should be damaged. As the coil is only a 1½-in. spark size, we should certainly risk the experiment. Why not use a mercury interrupter, such as that described in Chapter 6 of our Handbook No. 11? This would probably give better results with low voltage.

[14,401] **Electric Wiring for House.** L. W. (Belvedere) writes: (1) Will you please send me a drawing of a switchboard for 50-volt 10-amp. dynamo for lighting house and charging accumulators, and how to fit it up? Also, size of wire required for lighting same from dynamo and accumulators? (2) Also size of glass jars, and size and number of plates for making accumulators? I believe I shall require about 27 accumulators. Also how many amp. hours they will have to be? (3) Also state size of wire required for wiring house. (4) Also horse-power required to drive dynamo, which is of the Kapp type. (5) Also, will a motor cycle engine do to drive same if it is water-cooled? (6) Also number of 16 c.p. lamps dynamo will light. (7) Will ebonite do for a switchboard instead of slate?

(1, 2, 3) See our shilling handbook on "Private House Electric Lighting," and our sixpenny handbook on small accumulators. (4) About 1½ b.h.-p. It would be advisable to have an engine of rather more than less than this figure. It is assumed that the dynamo is of good efficiency. (5) Yes, if it is worked at steady load. (6) About eight 16 c.p. lamps of average efficiency. (7) Ebonite is very expensive. Hard wood, such as teak or mahogany, can be used for 50 volts. Slate is easily procurable, however, from slate merchants, and is very cheap, even if enamelled; but a plain slab rubbed smooth on face and edges would do very well.

[14,399] **Armature for Undertype Field-magnets.** H. H. writes: I have lately purchased a small set of undertype dynamo castings, consisting of two F.M. castings, bearings and brush-rocker in gunmetal, dimensions of F.M. being as follows:—Height, 4½ ins.; thickness of cores, ½ in.; diameter of armature tunnel, 1 9-16ths in.; length of tunnel, 1½ ins., these dimensions being as when castings were received. The iron seems to be rather hard. Will this make any difference to the successful working of the dynamo? (1) What size of eight-slot drum armature will be needed? (2) How far beyond the ends of the tunnel should the armature project? (3) What quantity and gauge of wire will be needed for F.M. and armature, which is to be wound in four sections? (4) What should the output be about, and at how many r.p.m.? (5) If run as a motor, what current will it take, and about what would the power be? I have your book on "Small Dynamos and Motors," but do not see this type described. I should be much obliged if you would kindly supply me with the above information, as this is my first attempt at model dynamo making.

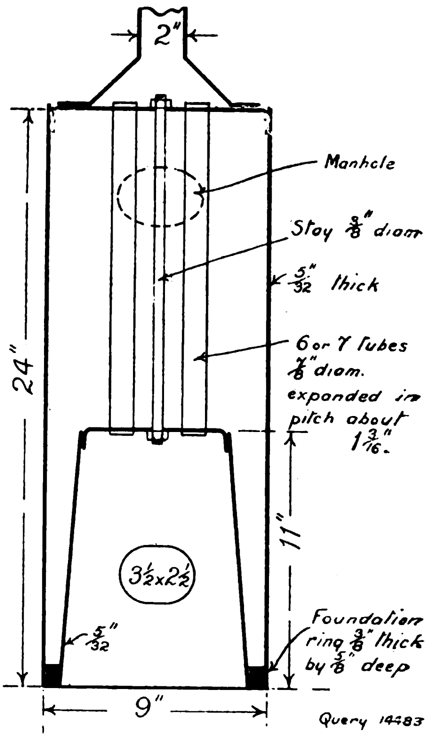
(1) Diameter of armature stampings, 1½ ins. (2) The core should be flush with the magnet tunnel at the ends; there is no gain in allowing it to project; the end windings will, of course, project. (3) Armature to be wound with No. 25 gauge single silk-covered copper wire; get on as much as possible—about 3 ozs. will be required. Wind field-magnet to a depth of ¼ in. with No. 24 gauge s.c.c. copper wire; about 4 ozs. will probably be the weight on each core. Join both coils in series with each other, and in shunt to the brushes. (4) Output about 8 volts 1½ to 2 amps. at 3,000 to 3,500 r.p.m. approximate. Test the machine with an 8-volt 1 c.p. lamp. (5) As a motor would take 6 or 8 volts and 3 to 4 amps. at full load, the current will vary with the load; power perhaps 1-50th h.-p. The iron being hard need not prevent the machine from working; soft iron would give a better output.

[14,407] **Nickel Plating.** R. C. (Sowerby Bridge) writes: With reference to the article on nickel-plating (Mitressey Process) in your issue of the 6th, I have carefully perused same, but cannot understand the nickelling bath. Could you oblige me by stating the quantity of water required for this bath, all the items being either powder or crystals? Could you also explain the meaning of the words "red stuff"?

We have no other particulars than those given in THE MODEL ENGINEER. The nickel bath would presumably contain enough water to entirely dissolve the various chemicals. We suggest that, having a certain amount of water to start with, the chemicals are put in, and more water added until they are all dissolved. Red stuff probably means rouge polishing powder, or any polishing material.

[14,483] **Model Vertical Boiler.** H. S. (Birmingham) writes: I have a boiler 24 ins. by 10 ins.; it is a plane drum made out of a piece of steel tube, with one end welded in. I want to make it into a vertical boiler, and inside firebox to supply steam at 45 lbs. per sq. in. to an engine with a cylinder 1¼-in. bore and 4-in. stroke. Would you please give me the size of the firebox? I have several ⅞-in. tubes by me. The shell is provided with a manhole as shown.

We would advise a firebox 11 ins. high, other dimensions being as shown on the accompanying sketch. You do not give the thick-



SECTION OF A MODEL VERTICAL BOILER.

ness of the barrel, but we would prefer not less than ¼ in. where steel is the material employed. As the top end is welded in we would advise a central stay to prevent the joint being strained. The tubes should number six or seven, and be placed around the centre stay. The pitch of the tubes should not be less than 1 3-16ths ins.. The smokebox may be made as shown. The exhaust should be used to create a draught.

[14,378A] **To Distinguish Positive and Negative Terminals.** W. H. H. (Chandlers Ford) writes: Many thanks for the previous reply. In addition, could you give me the correct reading of the enclosed battery diagram (not reproduced)? I have always understood the short thick line to represent the carbon and the long thin line the zinc.

In the ordinary diagram for a battery in which it is represented by alternate thick and thin lines, the latter being long and the former short, it is usual to take the long thin lines as representing carbon, and the short thick lines as representing zinc. A careful writer, however, would add the positive and negative signs, so that there should be no doubt. When these signs are omitted, it should mean that the diagram merely represents a battery, but that it does not matter in which way it is to be connected.

[14,412] **Charging Secondary from Primary Batteries.** J. J. M. (Thurles) writes: I enquired from Messrs. Dawbarn & Ward, and I enclose their letter, *re* the time it would take to charge a 4-volt 10 amp.-hour motor bicycle accumulator from a four-cell quart-size Bunsen battery, as described in your series (No. 1) on

small accumulators. I would feel much obliged if you would kindly inform me in this matter, and send me the proper formula for working out the charging of different accumulators from this battery.

The time required to charge any accumulator depends upon its condition and the charging rate of current, as stated by the makers. If this is not known, then for small pasted type cells you can take the figure given in our handbook on page 35, namely, 4 amps. per sq. ft. of *positive* surface of plates in one cell, reckoning in both sides of the plates. You can charge at a lower rate and spread the operation over a longer time, or charge at the maximum rate, and make the duration of the charging as short as possible. If the accumulator has not been charged at all—that is, if the plates have been merely made—the first charge must be continued until the liquid gases or boils in appearance; perhaps 12 to 24 hours may be required. But after this first charging, the accumulator will, if discharged to about the lowest permissible limit, require about seven to eight hours' charging at the maximum rate to bring it to a fully charged condition. If only in a partially discharged condition, the time would be less, according to the amount of the charge remaining in the accumulator. You should never entirely run out the charge in an accumulator—1·8 volts is the lowest value at which the voltage should be allowed to drop to per each cell in the accumulator. A voltage of 2½ volts, or slightly more, is required for each cell in the accumulator. A 4-volt accumulator would require 5 volts at least to charge it; and so on. Three Bunsen cells in series would be ample for a 4-volt accumulator. An amperemeter should be inserted in the circuit to indicate the amount of current flowing, and, if necessary, some resistance put in series with the cells to cut down the current to the proper value. About 2 yds. of No. 22 gauge German silver wire would probably be sufficient to use as a regulating resistance, more or less wire being inserted according to requirements of the moment. The boiling or gassing state of the liquid is an indication that the accumulator is charged; but it does no harm to continue the charging.

[14,396] **Marine Engineering.** R. J. L. (The Hyde) writes: Would you be so kind as to give me some information as to where to apply? I am an engineer. It has been my wish for a long time to get on board boats, such as L.C.C. steamers, or those that run out of Parkeston Quay to France and Holland, as artificer. Age 26, height 5 ft. 6 ins. If you could furnish me with information as to where to apply, I should be extremely obliged.

Provided you have served your time in some engineering work for a period of about four years, or have had an experience in engineering matters extending over that period, you would have to put in one year at sea before you could sit for the Board of Trade examination and obtain the certificate which marine engineers in charge must hold. We cannot say what qualifications are necessary to gain a berth in the L.C.C. service, but suggest you write for particulars to the secretary to the L.C.C. Steamboat Department, Spring Gardens, London. We have an article in preparation on the subject of marine engineering, which will be published in an early issue.

[14,456A] **Tyres for Model Motor Cars.** A. C. B. (Bungay) writes: Would you kindly tell me if it is possible for me to obtain model rubber-tyred wheels for motor cars, about 2 ins. in diameter? If obtainable, could you give me the address of the firm who stocks them?

We would recommend the use of the rubber rings, as employed on the spool winder of a household sewing machine. These are made in several sizes, and are of white rubber. Apply at the local "Singer's" depot.

[14,466] **Spirit Lamp; Model Steamer Displacement.** J. G. B. (Poplar) writes: Would you kindly oblige by letting me know what an alcohol lamp burns? The description of lamp was given in your number of March 26th, 1903 (Vol. VIII, No. 100). And could you also tell me what would be the draught of a torpedo destroyer measuring 4 ft. 6 ins. by 5 ins. deep by 5½ ins. beam, and weighing 15½ lbs.

The lamp burns methylated spirit, which is almost pure alcohol. The boat will draw about 2 to 2½ ins. of water, according to the lines of the hull. You can work it out from the drawings, remembering that 1 cubic ft. of water weighs 62½ lbs.

[14,487] **Model Locomotives.** J. F. (Coventry) writes: Will you please oblige me by answering the following? I have a pair of ⅞-in. by 1-in., and also a pair of ¾-in. by 1½-in., slide-valve cylinders. Which would you advise me to use with a brass loco boiler with fire and smokebox, size 2¾ ins. by 9 ins., length over-all 10½ ins., and tested to 35 lbs. What dimensions would you say for frames? I wish to have cylinders inside frames. What size driving wheels would you advise? I should like to make the model a 2—4—2 type. The depth of firebox is 2½ from centre of boiler.

We would advise you to employ the ⅞ by 1-in. cylinders. The ¾-in. bore cylinders would prove much too big. The valve chests will have to be arranged either above or below the cylinders, if placed inside the frames; but we do not see any advantage in the 2—4—2 type if the cylinders are so arranged. With outside cylinders, the driving wheels may be from 2½ ins. to 3 ins. diameter, and be placed about 3¼ to 3½ ins. apart. We cannot help you much in the matter of design, as you do not send sufficient particulars.

[14,420] **Boring Armature Tunnel too High.** H. N. H. (Brighouse) writes: I have just finished a 500-watt Avery-Lahmeyer dynamo from dimensions in "A B C of Dynamo Design," but cannot get it to excite. The armature tunnel has been bored a little too high, thus making the distance a little greater at the top of the pole tips and less between the bottom ones. I have filed the corners off the pole tips. How will the above affect the brushes, etc.? The armature, a laminated 24-cogged drum, slots ¼ in. by 5-16ths in. deep, 4 ins. diameter, is wound with 18 S.W.G., twenty-four coils each of eight turns; two coils in each slot and tested at 230 volts for leakage, etc. The wire does not quite fill the slots to the top (nearly 1-16th in. left); will this alter it at all? There are three binding wires, each about ¼ in. wide, consisting of 24 gauge tinned *iron* wire, and soldered. The laminations are not insulated in any way from the shaft; is it necessary? The tunnel is bored ⅛ in. larger, viz., 4⅛ ins. The commutator, a 24-bar, built-up copper one, is 2¼ ins. diameter, and tests all right. The brushes are of *carbon*, the carbons making good contact with the holders and bedded on to commutator. The size of carbons is ⅝ in. wide by ⅜ in. thick, covering one-and-a-half sections at a time. The field coils consist of 15 lbs. No. 20 S.W.G. in series with one another. The dynamo refuses to excite itself, although when the fields are excited from another small dynamo (giving about 15 volts), I can get some current, but only about 10 volts. The brushes are set diametrically opposite. I have changed brush connections all ways and tried field coils in parallel, etc. The pole-pieces are of the right polarity, viz., N. and S. respectively, but immediately the current from the small dynamo stops, so does the current in the armature. The speed is about 1,900—2,000 revs. per min. Could you in any way enlighten me on anything I may not have tried? The ring oilers have brass bushes and rings.

This machine should excite, though the pole area is small for the size of armature. The unequal position of the armature would only affect the working of the machine as regards sparking at the brushes; it would tend to produce this. Try copper gauze brushes. Raise the speed to about 2,500 revs. per min.; try the brushes in various positions, and again try crossing over the brush leads. It is not necessary to insulate armature stampings from the shaft; the fact that armature slots are not quite filled with wire will not make much difference. As the machine gives current when separately excited, it shows that there is nothing much wrong with the windings; we expect that a higher speed and gauze brushes will get over the difficulty.

[14,388] **Estimating Power required for Driving Small Tools.** A. W. (London, W.C.) writes: I have a number of small tools for light metal work which would be very convenient to drive by an electro-motor for short periods on occasions, for which purpose I am proposing a small Manchester motor, eight-cogged, shunt-wound, as your diagram No. 12 in "Small Dynamos and Motors"; but I cannot rely on my estimate of the power required, so will be thankful for your advice. What I require is sufficient power to take a cut (in the lathe) off hard brass 1 in. diameter, about 1-64th in. deep and wide at 100 r.p.m.; or to drill hard brass up to ½ in. as a maximum. You may take it that the tools are all in perfect condition—smooth working, and cutters used at the correct angle. My idea is that a 30-watt motor would do it (with or without a transmission pulley to gear down. I shall be obliged if you will advise:—(1) If a 30-watt motor would be sufficient? If not, what would be required? (2) What is the most suitable proportion of the voltage to the amperage for the purpose? (3) Taking the accumulator cells to be in series to produce the voltage, what should be the total area (not considering the two sides) of the positive plates per cell to produce the amperage suitable for running for half an hour at a time, without over-taxing the cell? (4) (*a*) Can you recommend a London firm for lead for plates? (*b*) I have some commercial red lead, bought from a general chemist, not specifically for the purpose—would it be safe to use this in forming the plates?

(1) It is very difficult to predetermine the power required to drive a machine. The energy lost by friction in driving belts, mandrel, friction of centres, &c., cannot be determined, and is variable. We should prefer to use a motor of about ⅛ b.h.-p., series-wound, permitting it to run at about 2000 r.p.m., and gearing down by light belt. The 150-watt scale for Fig. 12 would be suitable for such a motor; probably the machine would be working in an under-loaded condition, but it would then run much easier and smoother than if worked constantly at full load, and would have a reserve of power. If this size is too large for you to undertake, you could take the 100-watt size; but we do not advise anything smaller. (2) Does not matter; but a medium course is more convenient; high volts mean a large number of cells; very low volts mean large cells and very heavy winding on the motor; 24 volts would be a good figure to adopt. The amperes will vary according to the load. (3) We recommend two accumulators of the size described in Chapter 3 of our Handbook No. 1 on Small Accumulators, connected in series to give 24 volts. You will also find general information on the subject in this book. (4) (*a*) Try Messrs. Farmiloe & Sons, Ltd., 34, St. John Street, Clerkenwell; or Messrs. Stanton, Shoe Lane, Holborn Circus, E.C. (*b*) Good quality commercial red lead for the positives, and litharge for the negatives, should prove satisfactory. Mix with 1 part commercial sulphuric acid to 2 parts water in each case; add more acid if the red lead does not turn a dark brown colour. Paste should be stiff,

The Editor's Page.

THOSE of our readers who are attracted by the historical side of engineering will find an article of considerable interest in the *Connoisseur* for August, under the title of "Motor Prints." The article is illustrated by a number of reproductions of old prints of motor-cars of a century or so ago, from the collection of Sir David Salomons, Bart. Some of the reproductions are in colours, and all are of much interest, as showing the remarkable ability which was brought to bear upon the problem of road traction in those early days of engineering science. Another article of great interest, illustrating some very early forms of atmospheric steam engines, appeared in the *Engineer* for August 11th. The prints from which these illustrations are made were recently unearthed in the British Museum by our contemporary, and are well worth the careful attention of engineering students.

* * *

"A. M. H. S." (London) writes :—"In reference to single eccentric reversing gear illustrated on page 187 in your issue of August 24th, this device, which your correspondent mentions he saw in a publication dated 1878, is, to all intents and purposes, Dodd's expansion gear, which was invented about 1845, and is described in D. K. Clarke's 'Railway Machinery.' This gear was introduced shortly after link motion was invented, and was comprised of a sheave with two pairs of wedges in one piece with it. The sheave was movable along the axle. The wedges acted upon corresponding slopes in the eccentrics. It would be very interesting if your correspondent were to make a model gear on the lines he suggests, and bring it to one of the forthcoming meetings of the Society of Model Engineers. If he would do this, I am sure it would be greatly appreciated."

* * *

On the same subject, "R. M. B." (Bearsden) writes :—"Referring to 'J. C. T.'s' letter in August 24th issue, a few months ago my father showed me a sketch of a single eccentric reversing gear which he had invented some years ago, and had it fitted to a steam crane, which he said was still working at Port Dundas, Glasgow. Since then my father has died, and I am therefore unable to get more information about it. I did not preserve the sketch, but, as far as I can remember, it was identical to that published in above issue."

Answers to Correspondents.

A. B. (Partick).—We have written to the firm referred to, and trust the matter will be satisfactorily settled.

W. D. M. (Chester-le-Street).—We cannot express any opinion on your invention without knowing fuller details. The hydraulic ram is a well-known device for achieving a similar purpose.

C. E. B. (Rondebosch, S.A.).—Thank you for your kind offer to send occasional photos. We shall always be pleased to receive these.

H. L. H. (Whitby).—Thanks for your letter and enclosure. The latter is a curious effusion, the writer's ideas of business being amusing, to say the least. We are glad you enjoy the *M.E.* so much.

J. L. P. (Derby).—(1) We know of no paper of this name. (2) We believe there is an American journal of this name, but we have no particulars. (3) The address of Thermit, Ltd., is 27, Martin's Lane, London, E.C.

Notices.

The Editor invites correspondence and original contributions on all amateur mechanical and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected or not, and all MSS. should be accompanied by a stamped addressed envelope for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

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Contents.

[*The asterisk* (*) *denotes that the subject is illustrated.*]

THE
Model Engineer
And Electrician.
A JOURNAL OF PRACTICAL MECHANICS AND ELECTRICITY.

EDITED BY PERCIVAL MARSHALL, A.I.MECH.E.

VOL. XIII. No. 229. SEPTEMBER 14, 1905. PUBLISHED WEEKLY.

An Electrically Propelled Model Yacht.

By A. C. WATKINS.

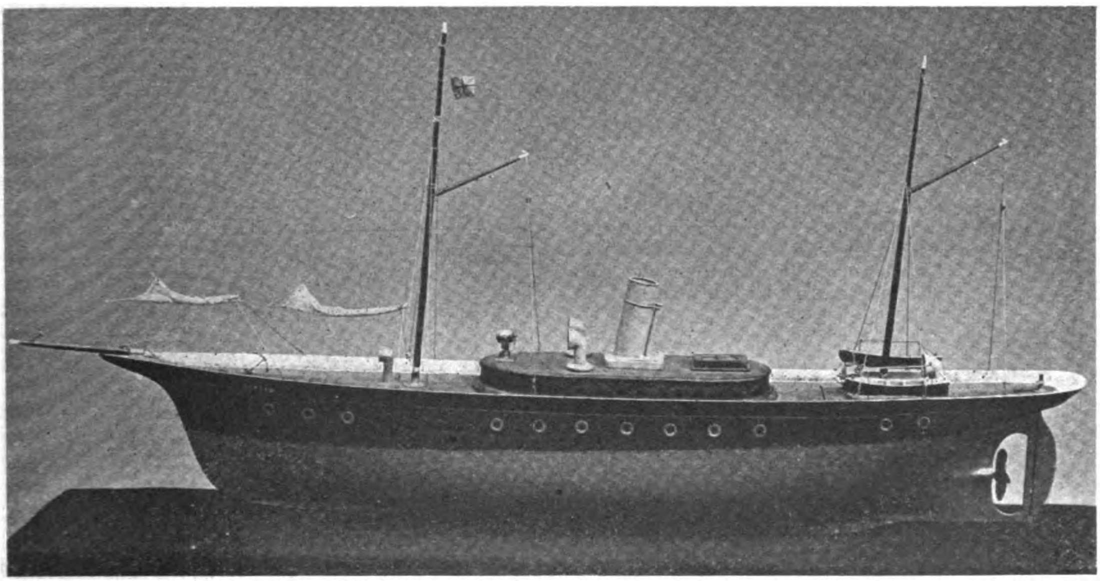


FIG. 1.—AN ELECTRICALLY PROPELLED MODEL YACHT.

THE illustration (Fig. 1) shows a model of a steam yacht, which, with the exception of the hull, is my own work. The fittings include two small boats cut from pine, and four ventilators made from scrap material, the rounded portions are filled in with putty, which gives them perfect form, afterwards being painted, together with the funnel, a buff colour. The boat is driven by electricity, the motor being one of Whitney's "Twencent," geared on to shafting. The reversing switch is one I made from a design given in THE MODEL ENGINEER handbook, and works well. The decks are made in three pieces of white holly. The hull has four coats of salmon paint, each coat being well rubbed down with fine sandpaper; above waterline it has one coat of black shellac varnish. The port-holes are round circles of brass, taken from rivets of registered packets, and screwed on; they give the boat a fine finish, I being a lover of appearance rather than speed. I may state the yacht has been greatly admired when sailing. I have only one 4-volt accumulator, which enables her to maintain a moderate speed.

The model locomotive shown in Fig. 2 is one I made four years ago, and, as can be seen, is of American type; but I am very sorry to state she is no more, having come into a violent collision: it fell to the ground, and was in a moment a huddled and confused wreck. It was built entirely of wood, with a few exceptions. All the wheels were cut from solid pieces of wood, and after cutting out spokes, I flanged them with a penknife.

I may add that my stock of tools is very limited.

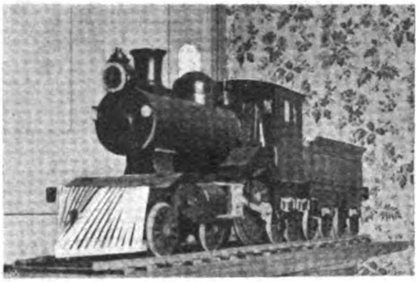


FIG. 2.—A MODEL AMERICAN TYPE LOCOMOTIVE.

I have no lathe, the greater part of my work being done with fretsaw only.

Workshop Notes and Notions.

[Readers are invited to contribute short practical items for this column, based on their own workshop experience. Accepted contributions will be paid for on publication, if desired, according to merit. All matter intended for this column should be marked "WORKSHOP" on the envelope.]

Carbon Terminals.

By J. A. B.

The following will be found a thoroughly reliable method of fixing terminals to battery carbons, much superior to casting on lead caps, as it is impossible for the salts to creep up and destroy the connection; also it can be fixed to any carbon up

FIG. 1.

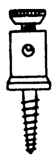


FIG. 2.

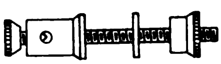


FIG. 3.

CARBON TERMINALS.

to ¾ in. thick:—Obtain two terminals, as Figs. 1 and 2 (usually sold at 1½d. or 2d. each); unscrew the wood screw from Fig. 2, and screw one end of Fig. 1 in its place; put on a washer and the milled nut, when it will appear as Fig. 3. To make the hole in the carbon, file up the end of a piece of iron or steel the same size as the screw of Fig. 3 to a pyramid point; fix in a handle, mark the place on the carbon ⅜ in. from the top, and work the tool backwards and forwards. When the hole is through, thoroughly soak about 1 in. of the top of the carbon in melted paraffin wax.

How to Make a Box Spanner.

By A. G.

Take a piece of round mild steel and drill out the centre as in Fig. 1, taking care to keep the drill central, and to have the steel large enough, so that when drilled the thickness of the remaining walls is from 1-16th in. to ⅛ in., according to the size of the spanner being made. The steel to be drilled must be accurately centred, and this is best done in a lathe. Care must be taken to keep the drill well lubricated (with soda water, the soda preventing the water from rusting the steel), or else the steel will get hot, bind, and break. The size "A" of the drill is determined by the size of the tool to be made. Suppose the spanner is to fit the nut in Fig. 2, then the drill to be used should be as near as possible to the size of the mean of the distances *a* and *b*. The method of converting the drilled steel into a hexagon is simple. Take another piece of

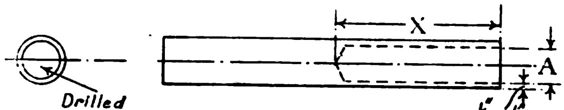


FIG. 1.

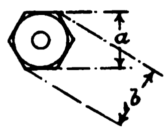


FIG. 2.

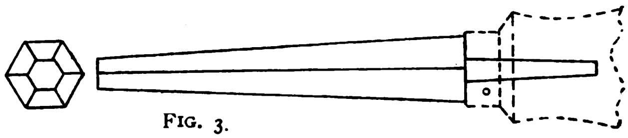


FIG. 3.

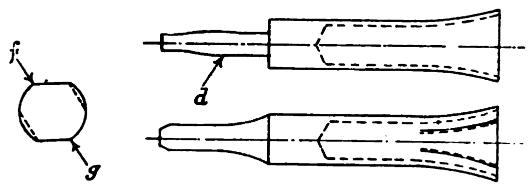


FIG. 4.

DETAILS OF A BOX SPANNER.

round mild steel, place it in the vice, and file six sides on to it, as in Fig. 3. The easiest way to get the sides equal is to commence by filing on two opposite sides, taking care to make them parallel. Then grip the steel by the two edges *f* and *g*, in Fig. 4, and file away to the dotted lines. The remaining two sides should be easy, but be sure all the sides *are* equal. Now we return to the drilled steel. Place the tapering hexagon (Fig. 3) inside it, and hammer the round drilled steel to make it take the shape of the hexagon. If the hexagon thus made is not large enough to fit the nut for which it is intended, drive the solid hexagon further into the drilled steel, so as to spread it out, and then hammer the sides again. The hexagon is made tapering, so that it may also serve for nuts of different sizes. The size X in Fig. 1 is determined by two things—first, by the length of screw which will protrude when the nut is screwed up in position; and, secondly, by the distance which the tapering hexagon will have to be driven into the drilled steel to make it fit.

A handle may be fitted to the spanner, as shown in Fig. 3. The tongue going into the wood is cut out of the solid round with a hacksaw, and finished with a fairly smooth file, a slight boss being made at *d*, so as to obtain a grip on the wood.

A Useful Zinc Alloy.

A composition of 88 lbs. zinc, 10 lbs. copper, and 2 lbs. aluminium makes a useful zinc alloy. By omitting the aluminium and using 12 lbs. of copper, the alloy becomes harder. Melt the copper and add enough cold zinc to kill it and to prevent it spitting when added to the bulk of the zinc. Separately melt the zinc, pour in the copper, and well stir till thoroughly fluid; then add the aluminium, and, after well stirring, pour into flat plates about 1 in. thick. These plates, when cold, are broken up, re-melted under small charcoal, and then poured into horizontal covered sand moulds to form 1-in. bars. The alloy has a surface resembling oxidised silver, and is filed and polished perfectly smooth, with a cut to the file like grey iron. It tools well, and does not get so knocked about as do white metals in which the lead is the base.

A Case-Hardening Preparation.

Yellow prussiate of potash, by weight, 7 parts; bi-chromate of potash, 1 part; common salt, 8 parts. Pulverise the crystals and mix thoroughly. Heat the piece to be hardened to a dark red, and dip into the preparation, or sprinkle it on the piece. Return to the fire and let it soak, then repeat several times according to the depth of hardened surface wanted. Finally plunge into water or oil. This may be used on tool steel, soft steel, or iron.

Improved Form of Tool-Holder for Lathe Slide-Rests.

By Percy M. Fowler.

No doubt a great many lathe workers have experienced the annoyance of packing ordinary lathe tools up to the right height, as they become worn through sharpening, and the difficulty of finding just the right thickness of packing to bring them into the correct position. This led the writer to scheme out a tool-holder which would overcome this difficulty, and, at the same time, provide a ready means of setting the tools accurately at any desired angle without the use of gauges, which at their best are only a makeshift when used in this connection.

One of the main objects kept in view when designing this tool-holder was that it could be readily machined on the same lathe for which it was intended. In the present case the lathe in question was a $3\frac{1}{2}$-in. centre screw-cutting lathe, with a gap-bed, and no difficulties were encountered in machining the forgings to an accurate fit, and making a thoroughly reliable job.

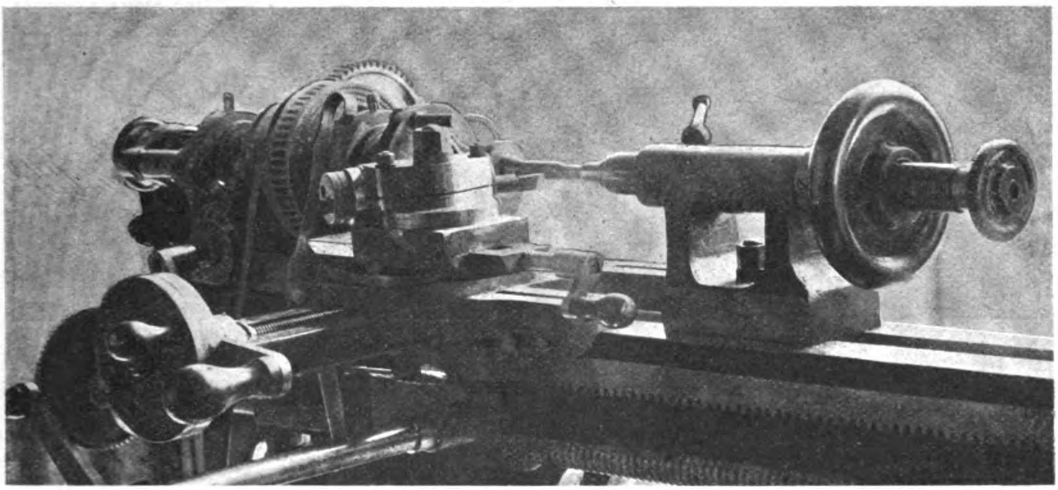


Fig. 1.—The Tool-Holder in Position.

Of course, this type of holder requires round tools. The writer considers that round tools will be found to possess such distinct advantages over the square tools, that, when once used, they will be so thoroughly appreciated that square or rectangular section tools would not be used again, except in some special case. It will be found, also, with this type of tool-holder that it is quite easy to sharpen the tools in the lathe simply by mounting an emery wheel on the lathe spindle, and setting the tools in the holder to the desired angle by means of the graduations on the base. Tools sharpened in this manner produce much better work and give very much greater satisfaction than those sharpened in the ordinary way by hand on a grinding stone or emery wheel.

Turning now to the photographs illustrating this article, the first, Fig. 1, shows the tool-holder in position on the lathe, carrying a tool ready for cutting the screw threads on the end of a spindle. This photograph also shows the lathe on which the tool-holder was made.

Fig. 2 is a photograph of the separate parts of the tool-holder—*i.e.*, the "quill" or block, and the holder, together with some of the tools used in the holder. The drawings reproduced show the general arrangement and dimensions of the tool-holder as made for the 3½-in. centre lathe. Of course, these dimensions would be varied to suit when applied to a larger or a smaller lathe.

With this introduction, we will turn at once to its constructional details.

In making this apparatus to suit any particular lathe, the first item to be determined is the distance from the centre of the lathe to the top slide in the rest, as this governs the diameter of bore through the quill carrying the holder. It is necessary that the horizontal centre of the bore through the quill should coincide with the centre of the lathe spindles in height. Having determined this distance, a drawing should be made, proportioning the other parts accordingly; and from this drawing a wood pattern should be constructed as a guide for the smith in making the forgings of the quill. This pattern should be made about 1-16th in. larger than the finished size, so as to allow for cleaning up and finishing bright all over. The forging for the quill should be of the best quality of mild steel, and before getting it from the works it would be advisable to have the large hole (1¼ ins. diameter) bored through, say, about ⅛ in. less in diameter than the intended finished size, and also the vertical hole (⅝ in. diameter), to take the stud on the tool box.

This should be about 1-16th in. smaller than the required finished size. Having these two holes drilled at the works will assist very much, as the remaining work to be done is light, comparatively speaking, and the machining to the right dimensions can readily be done on a small lathe without any great expenditure of energy (see Figs. 3, 4 and 5).

The tool-holder itself (Fig. 6) should be made out of a piece of best mild steel of a suitable diameter, the boring of which should be done after the quill is finished.

First mount the quill on the faceplate of the lathe, and bore out the hole (⅝ in. diameter) to accurately fit the stud on the top slide of rest, and also recess the top to take a spherical washer, as shown on the drawing and photograph (Fig. 2).

In the writer's case a groove had been turned in the top slide, and a corresponding projection (2¼ ins. diameter) was therefore turned on the quill to fit this; but this is an exception to find the top slide so fitted, unless it be specially ordered at the time of purchase, and most will have to rely on the top slide stud to form the fulcrum on which to revolve this holder, so that it will be necessary to bore the hole to a nice fit.

The next operation will be to turn up a mandrel to fit the bore of this hole (⅝ in. diameter); then mount the quill between the centres of the lathe. Now turn up the base where it fits on the top slide, and also the spigot (2¼ ins. diameter), if it is decided to adopt this to fit corresponding recess. This spigot (2¼ ins. diameter) should be of ample size, and accurately machined, as the adjustment and steadiness will depend to a great extent on its being nicely fitted.

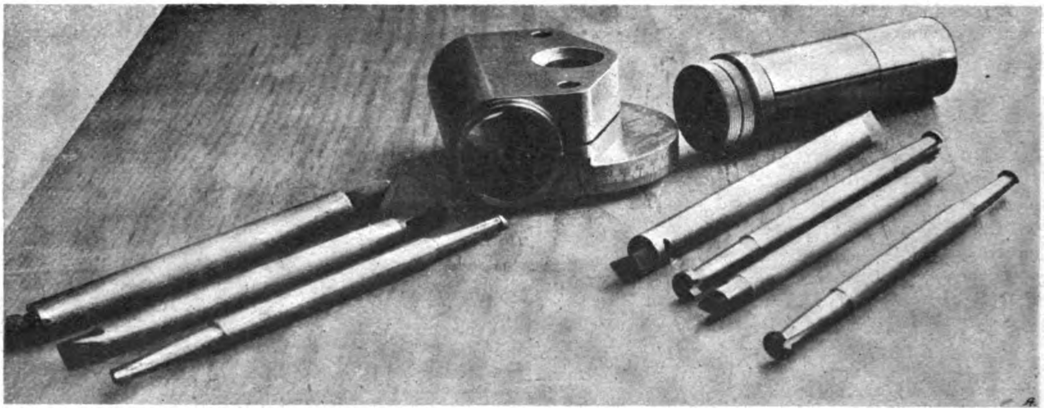


FIG. 2.—THE QUILL, HOLDER, AND SOME OF THE TOOLS.

The next operation will be to mill up the edge of quill base (1½ ins. radius) to the correct size and to a true circle, and polish same ready to receive the divisions. If a milling attachment is not possessed, the circle should be scribed off whilst still between the centres, and afterwards filed up to the line so marked. The divisions will start from the centre at right angles to the bore of the quill, and should be graduated from 0° at the centre to 90° on either side. These divisions can be etched in with acid, or cut with a V-shaped tool, the latter being recommended on account of giving finer divisions and more even spacing. The numbers of the divisions can be put on with steel stamps.

Now mark off the top slide by means of straight lines running at right angles to each other, one being parallel with the other at right angles to the lathe centres, their point of intersection being in the centre of the top rest stud. Scribe the lines distinctly, as these will form the marks for setting the divisions on the quill base.

Now mount the quill in its proper place on the top slide, setting the 0° on quill base against the line marked on the top slide drawn at right angles with the line of the lathe centres; bolt it down solid, and run the rest in until the centre line of the hole ($1\frac{1}{4}$ ins. diameter) through the quill coincides approximately with the centre line through the lathe centres.

Now mount a boring bar between the centres, and bore out the quill to the desired size. This will ensure that when the quill is set at zero on the cross centre line, its bore will be parallel with, and also that the centre line through bore accurately coincides in height with the lathe centres. Of course, it is understood that the boring out of the quill is effected by feeding either with the leading screw or the top slide screw, taking care not to feed too quickly, and be careful to obtain an even and true surface in boring. Having got this correct, now take the tool-holder itself in hand, and turn up the body ($1\frac{1}{4}$ ins. diameter) for a sufficient length to accurately fit the bore of the quill. The middle portion can be relieved slightly so as to give a good bearing at the ends when clamped in the quill (see drawing); also turn up the collar (1 7-16ths ins. diameter by $\frac{1}{4}$ in. wide), and polish ready for receiving the divisions. Cut these as before explained, either with a V tool or by acid, and number them. (In the writer's case this circumference was divided into 100 parts, arranged in groups of 5.) Knurl the outside edges (1 7-16ths ins. diameter by $\frac{1}{8}$ in. wide) so as to form a grip for the fingers in turning and adjusting.

Now file up the quill to the finished dimensions, and with a hacksaw cut a slot about 1-32nd in. wide right through the front part on the horizontal line, as shown by Figs. 3 and 5 and photograph. This now forms a grip for fastening the tool-holder in position. Put the tool-holder in place, and pass a temporary bolt through the stud hole, and draw up tightly with a nut; this will clamp the quill firmly on to the tool-holder, so that it can be placed again in the lathe on the same centres on which the tool-holder was turned, and the ends of the quill for a distance of $\frac{1}{4}$ in. can now be turned up to form collars of the same diameter (1 7-16ths ins.) as the divided collar on the holder.

Now mark off on the collars just turned on the quill the horizontal and vertical lines, taking care that the point of intersection is precisely in the centre of the bore carrying the holder; scribe these lines in deeply, as these will form the marks for setting the holder at any division corresponding to the required height. Now mark off the holes ($\frac{1}{2}$ in. and $\frac{3}{8}$ in. diameter) to be bored through the tool-holder to take the tools. Mount the quill with the tool-holder in place on the top slide in the correct posi-

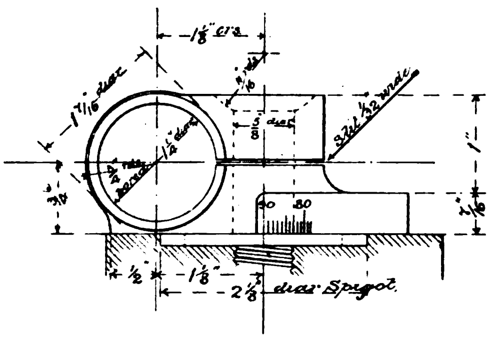


Fig. 3.—End Elevation of Quill.

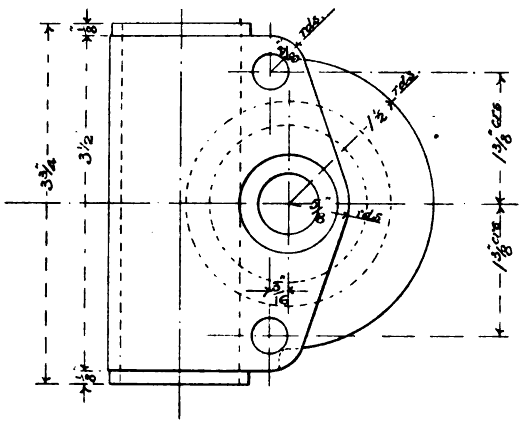


Fig. 4.—Plan of Quill.

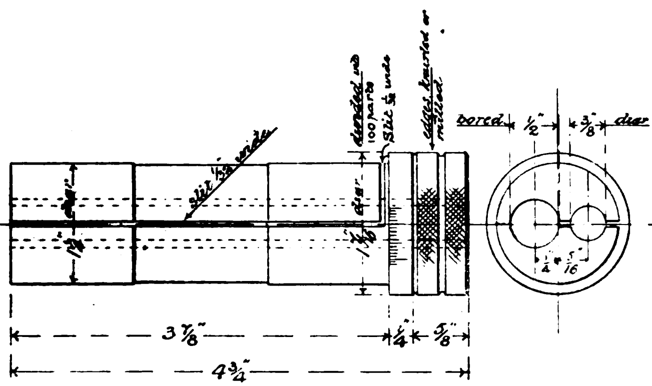


Fig. 6.—The Tool-holder.

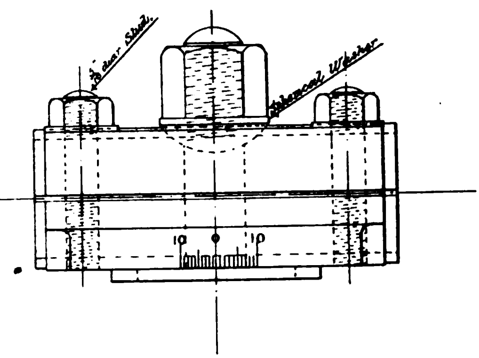


Fig. 5.—Front Elevation of Quill.

Details of Mr. Percy M. Fowler's Improved Form of Tool-holder. (*Scale: Half full size.*)

tion, setting the 0° division on base to the cross line on top slide, and also setting the 0° division on the tool-holder collar against the top line scribed on the quill. Bore these two holes right through the tool-holder from end to end, being careful that they are true and straight. If desired, these holes might be first bored a little smaller than the finished size, and afterwards bored out to correct diameter with a boring bar in the same manner as the large bore of quill. This will ensure their being accurate and true. It will be seen that this operation must necessitate the holes being on the true horizontal centre line, and also of the same height as the lathe centres, as they are bored with the various divisions set and clamped; accuracy is thus obtained.

Now clamp the tool-holder on top slide, and with a circular saw of suitable diameter mounted in the lathe, cut the slot (1-32nd in. wide) on the longitudinal centre line, running it down as close as possible to the collar. Now cut the cross slot in a similar manner quite close to the collar and down to the horizontal centre line; this will form a clamp for the tools in the same manner as the tool-holder

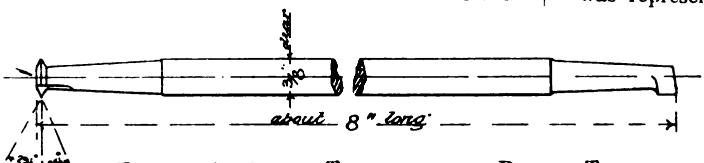


Fig. 7.—An Inside Threading and Boring Tool.

is clamped in the quill. Finish the remaining portion that the circular saw did not reach by means of a broken hacksaw used in a handle, as you use a file, and when complete it will be found that the tool-holder, when clamped in the quill, will also hold the tools firmly in the holes that have been drilled for them. Care, however, must be taken that the tools are not too slack a fit when the clamping screw is released. The two different sizes of tools, viz., ½ in. and ⅜ in. diameter, will be found convenient for large and small work respectively; two tools can also be used at one time—one for roughing, and one for finishing. The object of the two small studs (5-16ths in. diameter) shown at either end of the quill is to clamp the holder a little more firmly at the outer end when taking very heavy cuts. The writer has found, however, in practice, that these are seldom required, as the tools are held very rigidly with such a long length of support in this holder, that the heaviest cuts can be taken without any springing or chattering of the tools.

If the foregoing directions have been carefully followed, the maker of this tool will have something which is entirely satisfactory, and well worth the labour expended. The one made by the writer has been in use for over twelve months, with the most gratifying results, and never yet has a lathe job cropped up but that the boring or turning could be carried out in the most accurate and expeditious manner—due to the ready adjustments provided.

It is not possible in this article to deal with the tools used in this holder, but possibly this may form the subject of another article. Fig. 7, however, shows a tool, one end of which is for cutting inside screw threads, and the other end for boring. It will be noticed that this tool has been turned up and finished between the lathe centres, and that it possesses some novel features of construction.

The Latest in Engineering.

A High Speed Belgian Turbine.—The turbine steamer *Princesse Elizabeth*, built by the Société Anonyme, John Cockerill, of Seraing and Hoboken, Belgium, for the Belgian Government, has very successfully completed her trials on the Clyde. Constructed for the mail service between Ostend and Dover, the *Princesse Elizabeth* has a length of 344 ft., a beam of 40 ft., and a mean draft of 7 ft. 9 ins. She has three propellers, each driven by a Parsons turbine, and she was built for a guaranteed speed of 22½ knots. Her official trials were run between the Cloch and the Cumbrae Lights on Wednesday, when she attained an average speed of 84 knots on four runs. The vessel was also required to do 13 knots astern, and when tried on the measured mile she averaged no less than 16 knots on two runs. She is thus one of the fastest, if not indeed the fastest passenger turbine steamer in the world. The Belgian Government was represented at the trials by M. Berbrugghe, President of the Commission of Reception, and M. Pierrard, Director of the Belgian Marine. The *Princesse Elizabeth* will be completed for commission at her builders' yard at Hoboken.

A 10,000 h.-p. Parsons Turbine.—Two steam turbine sets of 10,000 h.-p. each, which are being installed at the Rhenanian Westphalian Electricity Works, are the largest turbine sets, and, in fact, the largest stationary engines in all Europe. Each of these gigantic engines comprises a turbine running at 1,000 r.p.m., which is direct-connected to a rotary current generator of 5,000 k.w., 5,000 volts, and 50 periods per second, as well as to a direct current generator of 1,500 k.w. and 600 volts, and to a central condensing plant. The whole set is 20m. in length, and weighs 190 tons, of which 9·4m. and 107 tons correspond to the turbine. The maximum height of the turbine above the floor is 2·6m., and the maximum breadth likewise 2·6m. The turbine is of the single-cylinder type, and has only two bearings, one of which serves at the same time as bearing to the alternator. The governor is made to compensate to within 1 per cent. for any oscillations in the angular speed with variations in the load as high as 20 per cent., while the maximum variation in the number of revolutions between running at no load and at full load is not to exceed 5 per cent. Another unit of the same size is shortly to be installed at the power station in a Westphalian Mining Company.

A 10,000 h.-p. Reversing Rolling Mill Engine.—This is now being exhibited at Liege and has been built by the Cockerill Company to drive a rail and girder mill. It is kept in motion for exhibition purposes by an electric motor. The engine is really made up of three tandem compound engines on one shaft, with cranks at 120 degs. Each low-pressure cylinder is 53 ins. in diameter, and the high-pressure cylinders are nearly 36 ins., the stroke being 52 ins., and the pressure of steam about 114 lbs per sq. in.; or, say, eight atmospheres. It is not intended to use superheat in this engine, but the cylinders are jacketed.

Slide and Micrometer Calipers.

By A. W. M.

(*Continued from page 226.*)

To use the vernier scale, close the jaws until they touch the object to be measured; then note the division which is nearest to the left hand of the mark L; this gives the unit figure—say, 1 in., as Fig. 11. Then note the vernier division, which happens to come exactly opposite to a bar division, and commence to count towards L; when you reach L, the number of vernier divisions which you have counted indicates the number of 1-1000ths in. by which the object between the jaws exceeds 1 in. in size. In Fig. 11 the vernier division P is the one to commence counting from as the zero mark. As there are twelve of these divisions between P and L, the measurement is therefore 1 in. + 12-1000ths in.—that is, 1 012 ins.

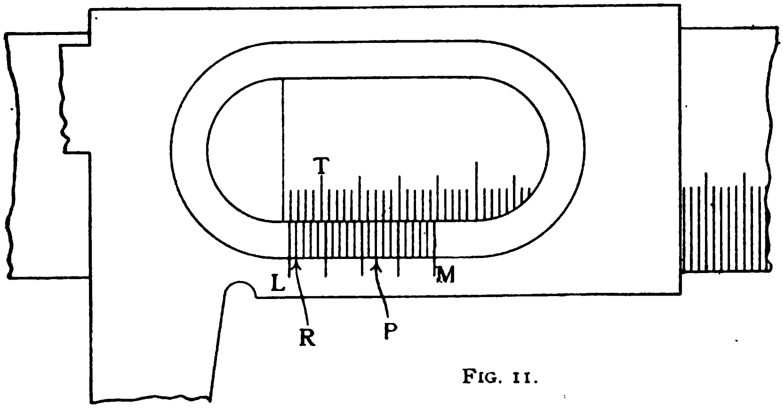


FIG. 11.

If the mark L had been near one of the larger sub-divisions on the bar—say, T (Fig. 11), the first after the 1-in. mark—then you would, of course, commence to add the 1-1000th measurements on to this, so that the measurement would have been 1 in. + 1-10th in. + 12-1000ths; or 1·112 in. You should always proceed in this way, determining first the unit, and then the fraction to be added, each division on this particular vernier scale counting as 1-1000th in., and the counting to commence from the vernier mark, which happens to be opposite to a mark on the bar, always in the direction from M to L; though it would come to the same result if you commenced counting at the vernier mark L and continued until you reached a mark opposite to a bar division; this would only be another way of counting. You can use the method which seems the more convenient.

Supposing that the mark L was in excess of the 1-in. mark on the bar by a very small amount, and that the mark R was the vernier scale mark which was exactly opposite to a mark on the bar, it would then show that the size between the jaws was one 1-1000th in. more than 1 in., because you would count only one scale division on the vernier; and as by the principle of the vernier you know that the difference between a division on the bar and a division on the scale being 1-1000th in., a movement of the jaw of exactly this amount has been required to bring mark R opposite to a bar division, just as explained in Fig. 7, when, for the sake of illustration, a difference and movement of half an inch was used.

When measuring sizes from 0 to 1 in., of course there will be no unit figure, as only fractions will be involved; but the method remains the same. You take the largest bar divisions to the left of L, and then add to it the amount in excess—say, 1-10th in. + 1-50th + 3-1000ths would give ·123 in. This would mean that the mark L was beyond the first large sub-division on the bar by one of the smallest divisions, plus an amount which is calculated by counting vernier divisions.

The second vernier scale on the Columbus gauge is made and used in a precisely similar manner; but in this case the smallest divisions on the bar are 1-16th in.; so that measurements are not made to decimal fractions, but to the usual subdivisions of 1-16th in.; that is, to 1-64th; and the half of this, viz., 1-128th in., or half sixty-fourths, as one would usually call it when reading from an ordinary rule.

An examination of the Columbus gauge will show that this vernier scale has a length equal to seven of the smallest bar divisions; that is, 7-16ths in., and is itself divided into eight parts. Each vernier division is therefore 7-8ths of one of the smallest of the bar divisions; as these are 1-16th in., it follows that the difference between the two is half 1-64th in.; that is, 1-128th in., as there are four 1-64ths in

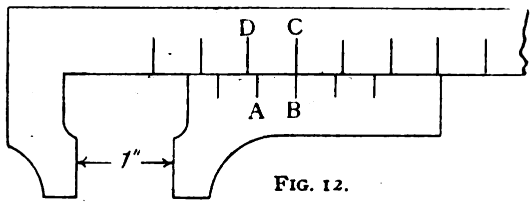


FIG. 12.

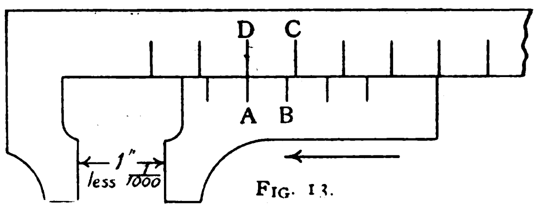


FIG. 13.

in one 1-16th-in. division. This vernier enables comparisons to be made to small differences in 1-16th in. measure, and is thus useful for the less exact class of workshop measurements; whilst the other vernier can be used for measurements to an accuracy of 1-1000th in.; though it is quite easy to reckon 1-100th in., as the vernier will count ten divisions exactly whenever the amount is 1-100th in. Inside measurements and depths are indicated by the same lines which caliper objects between the jaws.

Some discretion is required occasionally, as no one of the vernier divisions may appear to be exactly opposite to a bar division. When this occurs, you should select the one which seems to be the nearest to a bar division as the zero to commencing counting; and remember that the starting vernier mark is reckoned as 0, and not 1. It is necessary to use a magnifying glass to properly read small vernier scales, such as those on the Columbus gauge.

As well as its use in determining the size of a finished object, the vernier scale serves as an accurate means of gauging pieces made to given larger or smaller dimensions than another piece. For instance, suppose a spindle is a tight fit in a hole, and you desire to reduce its diameter by a very small amount to make it an easy fit, you would set the jaws to 1-1000th in. smaller than the diameter of the spindle, and then turn it down until it fits the smaller opening of the jaws. First set the caliper to the exact size of the spindle, and then examine the vernier to find one of its lines (B, Fig. 12), which was exactly opposite to a line C on the bar; the movable jaw is then closed, until the adjacent line A to the left-hand of B is exactly opposite to the next line D on the bar (Fig. 13). The opening between the jaws will now be smaller than before by an amount equal to the difference between the vernier and bar scale divisions. In the case of the 1-50th in. bar scale on the Columbus gauge this difference would be 1-1000th in; but if the 1-16th-in. bar scale and vernier had been used, the difference would be 1-128th in.; that is, half 1-64th in. By moving the jaw to the right, the distance to be measured would be made greater by the same amounts. It is also as easy to measure to greater amounts of difference by counting more than one division to right or left. For instance, two divisions would equal 1-64th in., four divisions equal 1-32nd in., and so on; the adjustment being made by moving the jaw until the last division reckoned to right or left has been moved to a position opposite to the next bar division.

In Figs. 12 and 13 a few large divisions only are shown, the scales not being complete or intended as reproductions of the Columbus scales, but only to explain the method of adjustment.

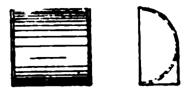
(*To be continued.*)

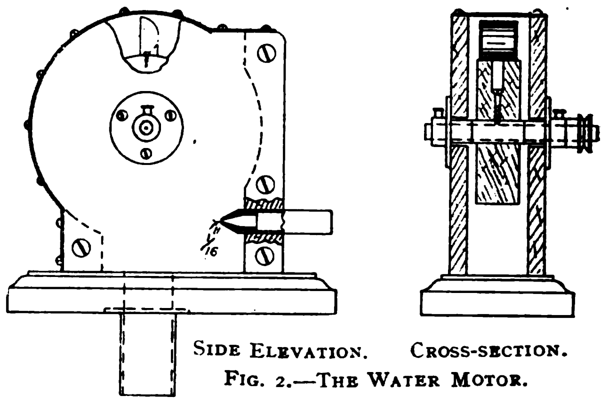
A Small Water Motor and Dynamo.

By W. P.

THE small water motor and dynamo illustrated below are easy models for a beginner to construct. The water motor is one I designed and made over six years ago. Although mostly made of wood, it has a very good appearance. The spindle is a piece of silver steel rod with a brass bush sweated on to prevent end play, the bearings projecting inwards as well as outwards from the flange. The wheel for the buckets is made of teak, with a wood screw to secure it to brass bush. The buckets were made out of a piece of $\frac{7}{8}$-in. brass tube cut into seven pieces, $\frac{3}{4}$ in. long; these pieces were then cut lengthwise in halves, giving fourteen buckets. Pieces of thin sheet brass were cut roughly for the ends, and sweated on (Fig. 3). An easy method of

FIG. 3.—BUCKETS.

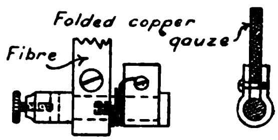




SIDE ELEVATION. CROSS-SECTION.

FIG. 2.—THE WATER MOTOR.

FIG. 4.—DYNAMO BRUSHES.



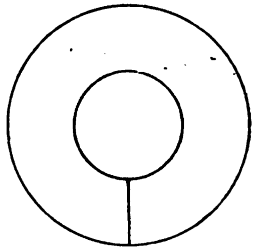


FIG. 5.—FLANGES FOR FIELD COIL.

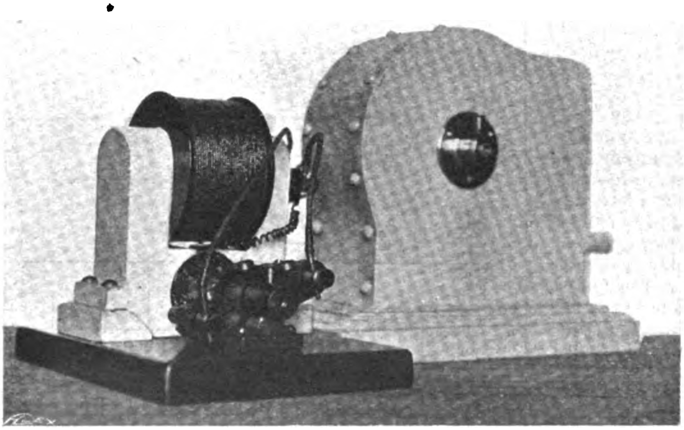


FIG. 1.—A SMALL WATER MOTOR AND DYNAMO.

soldering is to hold the buckets and ends together with a small cramp; apply spirits and a small cutting of solder inside, then heat over a Bunsen burner, the solder running round the joint, making a strong and neat job. The buckets are screwed on with brass round-headed wood screws (see Fig. 2). The case is made of teak, consisting of two sides, with a dividing piece at one end and a small block at other end, and baseboard is screwed together with brass screws. A strip of sheet zinc is screwed on as shown. The particulars for constructing the dynamo are taken from "Small Dynamos and Motors," with slight alterations. The flanges for the field-coil were turned from sheet ebonite, then cut half through, as shown in Fig. 5; they can then be sprung on to the field-magnet and glued in position with "iron glue," keeping joint in centre of magnet. The brushes were made as shown in the drawing (Fig. 4); the springs can be adjusted by turning the terminal round. The water motor is capable of driving a much bigger dynamo if required to do so.

STEEL TEST.—It is stated in the *Engineering and Mining Journal* that a steel containing 4·99 per cent. vanadium and 1·084 per cent. carbon only failed under test with a pull of 140,596 lbs. per sq. in.

Picturesqueness in Model Railways.

By E. W. TWINING.

(*Continued from page 204.*)

IT may not be out of place at this point to mention a few of the terms used by engineers and architects when referring to the various parts of masonry bridges, tunnels, and other arched structures, such as are dealt with in miniature in this article. Commencing at the lowest point, the "foundations" are, of course, the parts which carry the whole work. Upon these rest, in the case of bridges, the "piers." The top course of stones forming the pier is called the "quoins"; from these the arch rises, the actual point of the commencement of the curve being called the "springing." The stones forming the rings of the arch are called the "voussoirs," and the underneath face of the arch has been termed the "soffit." Rising from the top of the rings are walls called "spandrils"; these walls run longitudinally, the external or visible walls being called the "main" or "outer spandrils." On the inner spandrils the ballast, sleepers, and rails are carried. The lighter walls rising from the outer spandrils above the level of the track are called "parapets." The

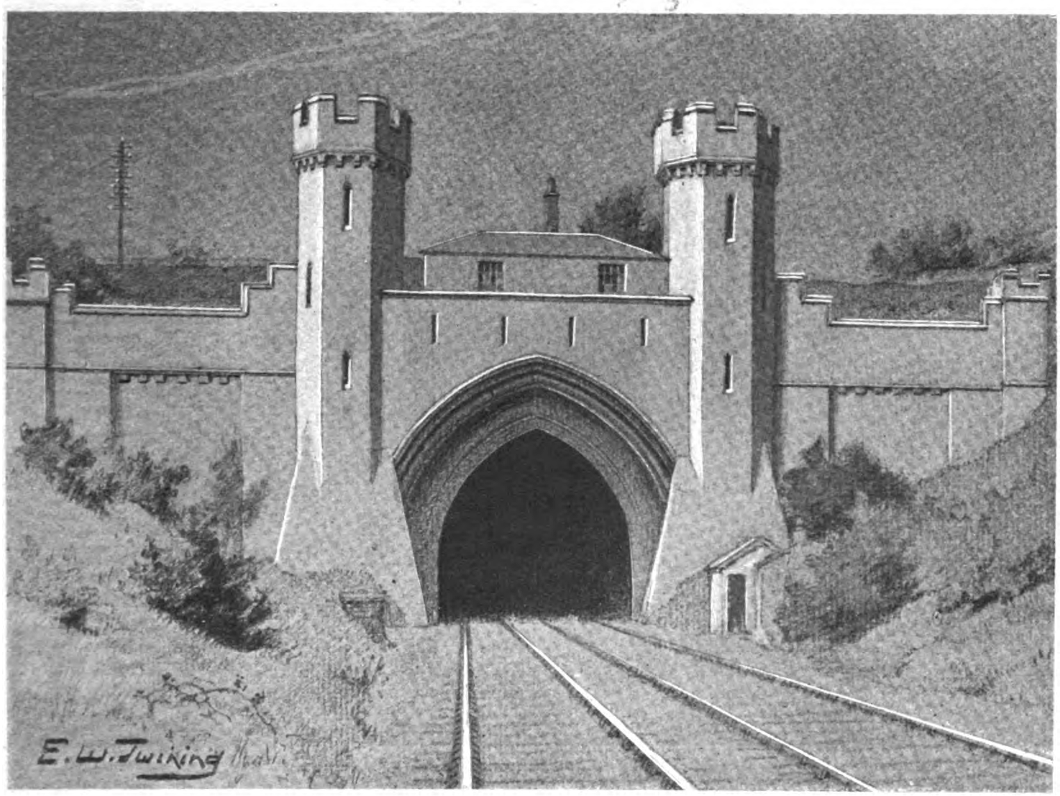


FIG. 7.—CLAYTON TUNNEL, L.B. & S.C.R.

centre of the arch—*i.e.*, its highest point, is called the "crown." Between the rings of voussoirs forming two arches at the point where they meet on the pier, masonry in the form of an inverted arch is inserted to assist in carrying a portion of the thrust of one arch on to the two adjoining it; this has been given the name of "backing." It usually extends for about one-sixth of the spans on each arch to a point known as the "haunch." The "rise" of an arch is the clear vertical height from the springing to the crown, and the "span" the clear distance between the piers at the springing. The "abutments" are the piers forming the tunnels, as well as the bridge (Fig. 10), are intended to be made of timber.

It would be well before cutting any wood to make full-sized drawings of each of the pointed openings; the dimensions and centres can then be copied more accurately on to the wood. The openings are all of the four centred form known as the Tudor arch, with the exception of the small arches of the bridge, which are two-centred only; the length of the radius in each is different as shown. For the main walls white pine boards may be used, 1 in. thick planed on face: these boards should be clamped edge to edge, and in the case of A and B (Figs. 6

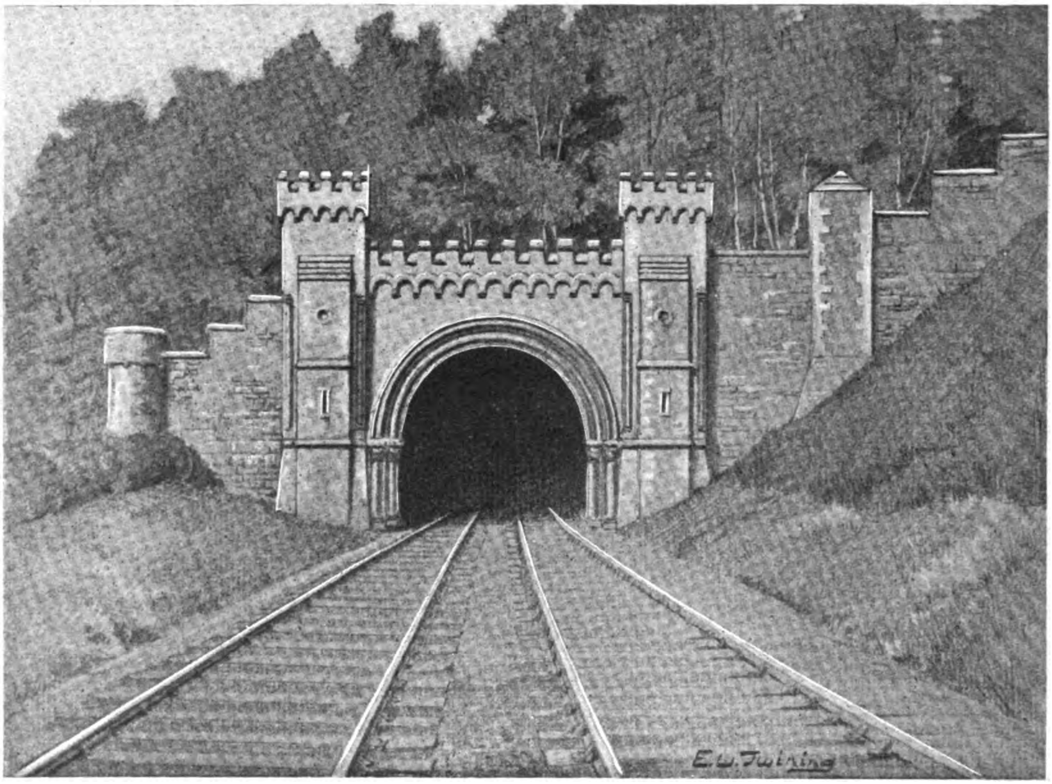


FIG. 8.—ENTRANCE TO SHUGBOROUGH TUNNEL, NEAR STAFFORD, LONDON AND NORTH-WESTERN RAILWAY.

ends of the bridge projecting from the earthworks. In Gothic architecture certain courses of stone, which run horizontally and are moulded on their outer face, are called "string-courses." "Dripstones" are those similarly moulded stones which are used to carry rain-water clear of openings, such as windows, doors or arches; these stones are carried down on either side of the opening to about the level of the springing.

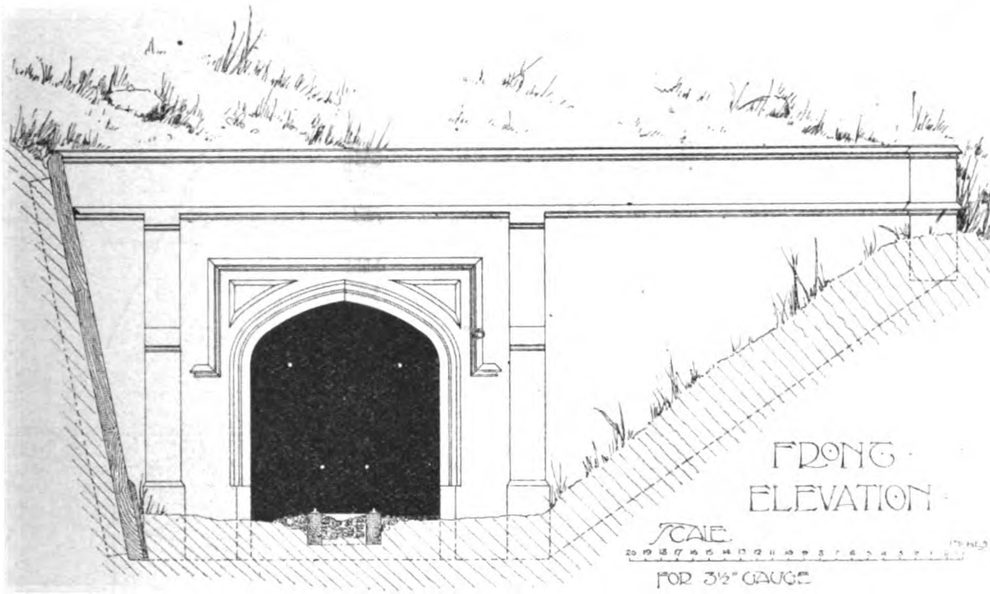
The Clayton tunnel on the L.B. & S.C. Railway is a fine specimen of Gothic entrance, the northern end of which is illustrated by Fig. 7, whilst the Shugborough Tunnel near Stafford on the L. and N.W. Railway (Fig. 8) is good, being in the Norman style with round-headed arch.

Another design for Gothic tunnel entrance without embattled towers is given in Fig. 9. These and 9) placed vertically with stout battens screwed to the back. For the retaining walls and the spandrils of the bridge, it will be found more convenient to place the boards with the grain horizontal. It will be noticed that the opening in A, Fig. 6, is struck from two centres only, that in B alone being struck from four. B will be bevelled as shown. In Fig. 9 four centres are struck on both A and B. Care should be taken after cutting to get these openings placed concentrically, when the two can be screwed together.

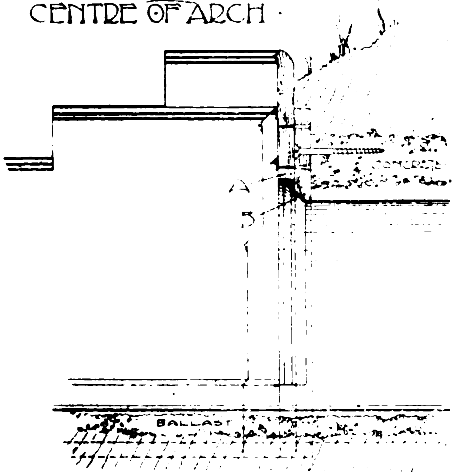
It has been assumed that the railway at the point where the tunnel is to be placed is running parallel with and close to the garden wall. This is the reason why retaining walls have been shown at one side of the tunnel entrances, the retaining walls having been placed at opposite sides to allow the designs to be used for the two ends of the same tunnel. If there is room between the line and the garden wall, both sides of the tunnel entrance may be made alike. Examples of both arrangements in actual practice may be seen in Figs. 1 and 3, and 2 and 7.

The octagonal towers in a small tunnel, say, not larger than ½-in. scale, can be cut from square quartering, the corners being chamfered and the embattled tops cut from the solid; but for anything larger the method shown should be followed.

(*To be continued.*)



SECTION THROUGH CENTRE OF ARCH



A DESIGN FOR A GOTHIC TUNNEL ENTRANCE BY E. W. TWINING

FIGURE 9

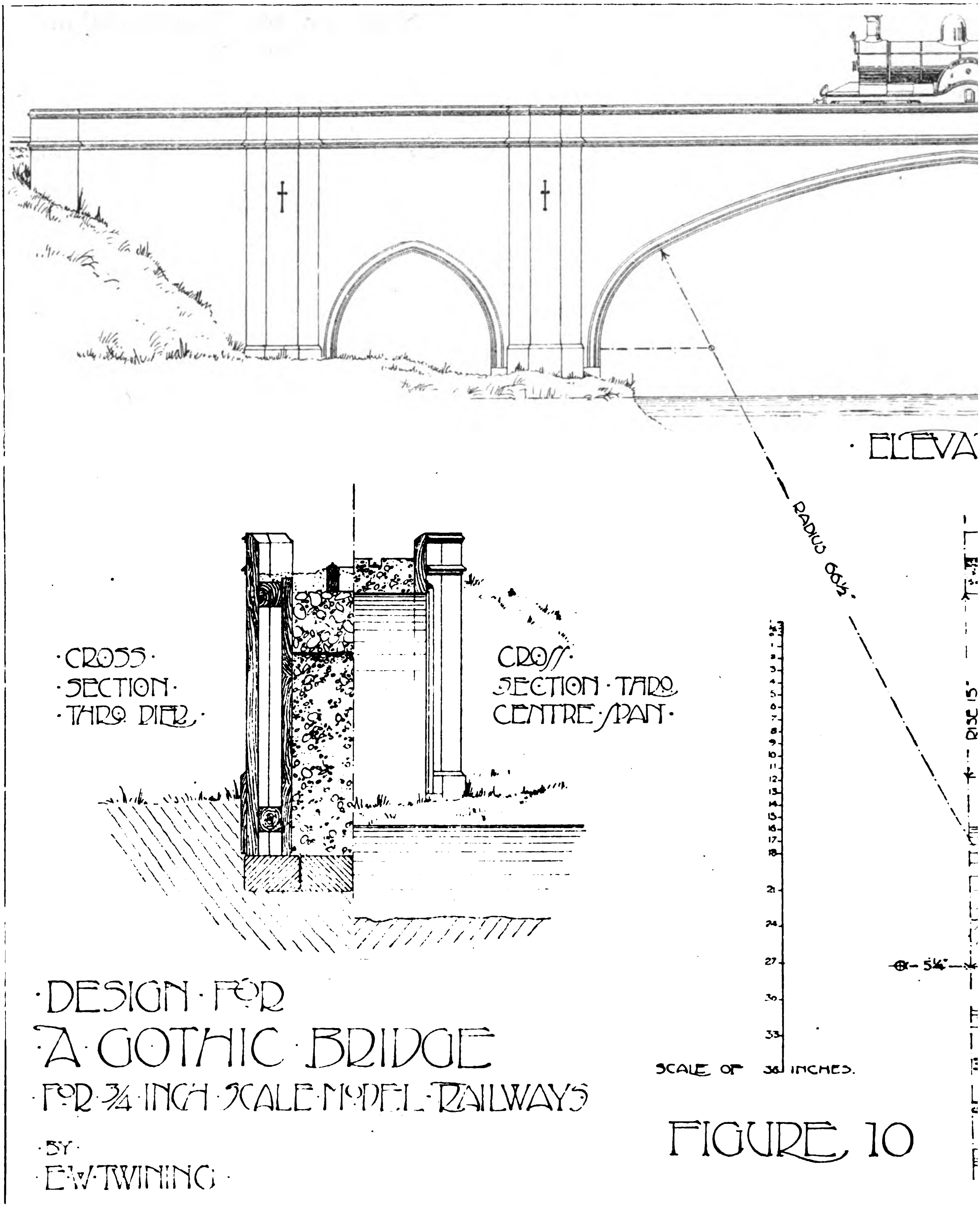
Notes on the Treatment of Tool Steel.

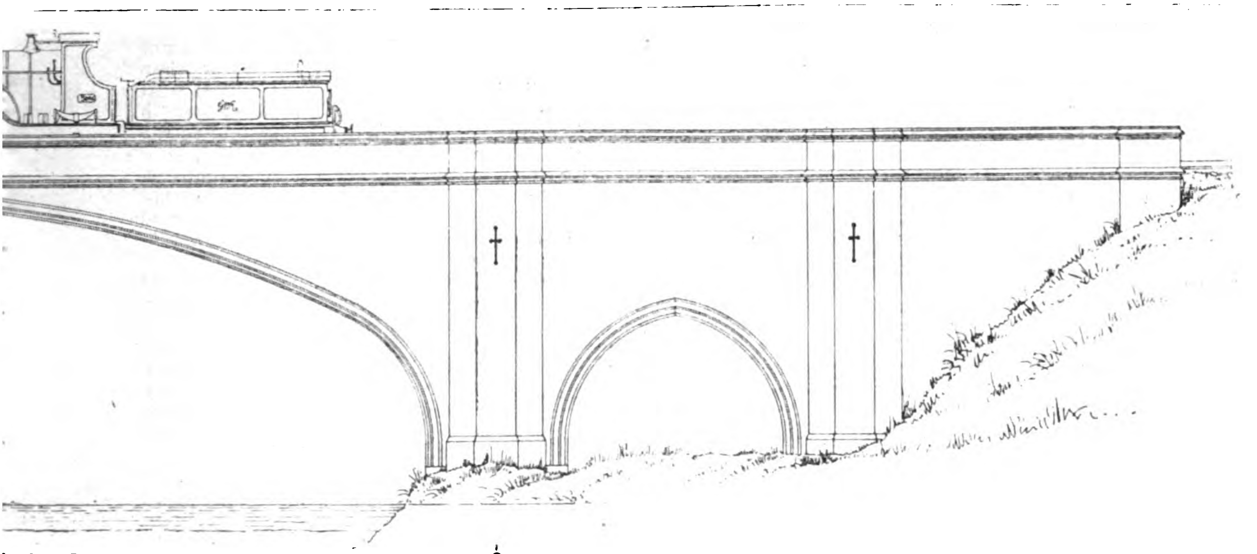
By J. M. T.

(*Continued from page* 230.)

NOW, the outside naturally cools down before the inside, and in cooling, shrinks, and exerts enormous pressure upon the inside, and the pressure is turned into heat, and so actually keeps the inside hotter than it otherwise would be. Then as the inside gradually cools, it shrinks also, and pulls with enormous force upon the outside hard portion, so that there are very great strains in any piece of hardened steel, and if these strains are excessive, the piece cracks. This is exactly what is happening to the earth now, and has been since it was flung off

IT has been shown that small crystals, having the lustre, hardness, gravity, and index of refraction of diamond, can be obtained by heating in the electric arc pulverised carbon on a spiral of iron wire, the heating taking place in hydrogen, and under great pressure—3,100 atmospheres.


ELEVA
RADIUS 66½
RISE 15
5¼
CROSS SECTION THRO PIER
CROSS SECTION THRO CENTRE SPAN
SCALE OF 36 INCHES.
DESIGN FOR
A GOTHIC BRIDGE
FOR ¾ INCH SCALE MODEL RAILWAYS
BY
E.W. TWINING
FIGURE 10



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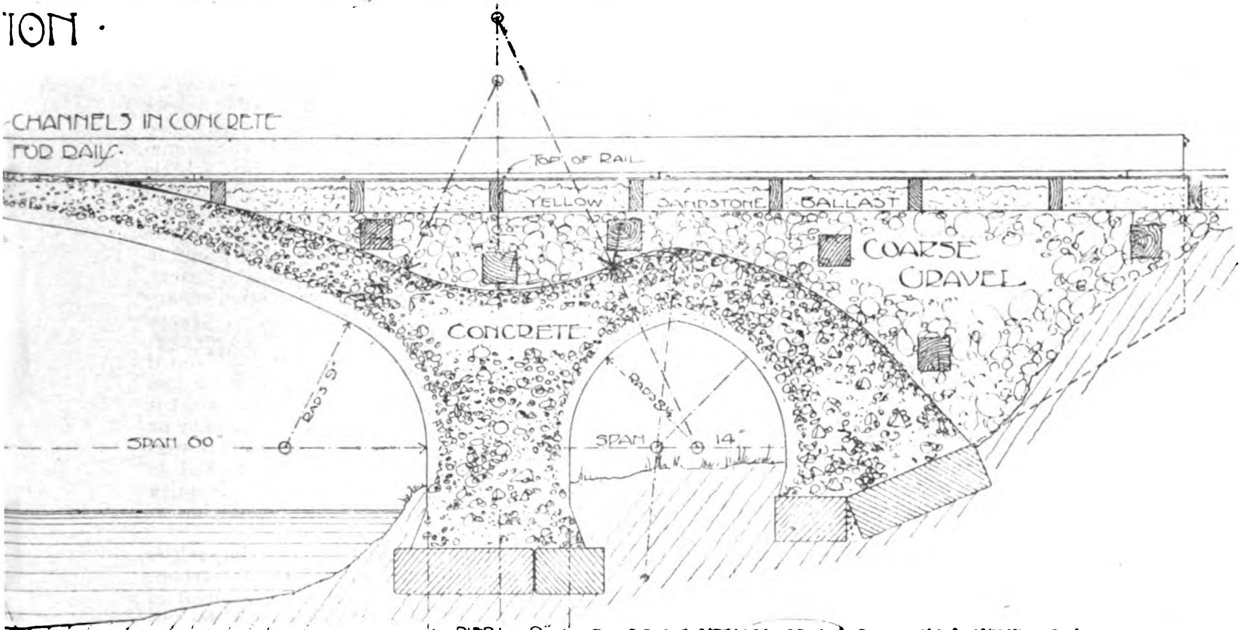
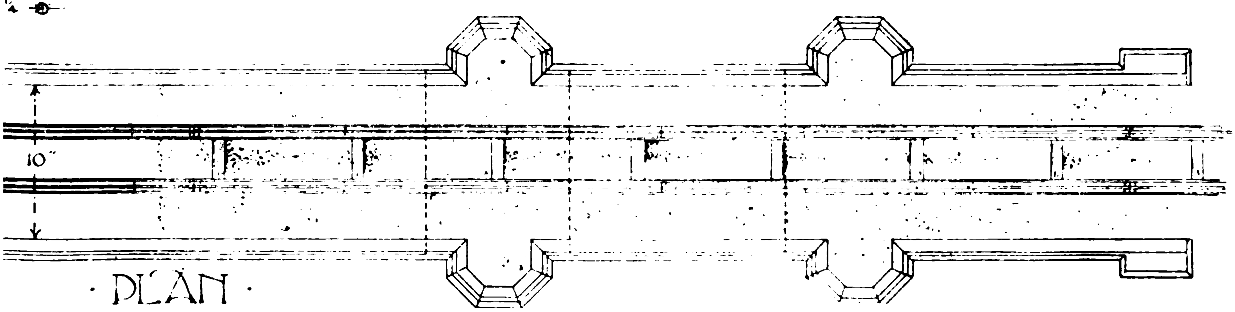


· LONGITUDINAL · SECTION ·

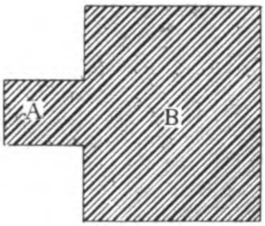


· PLAN ·

from the sun. The earth was thrown off from the sun in a molten condition into cold space, and straightway started to cool down. A hard crust was formed first, and as the interior kept on shrinking away from this, it pulled with enormous force until the strain was too much for the solid rocks in the crust to stand and they broke, forming what geologists term a fault. Sometimes the fault is only for a few inches deep, but sometimes it was for thousands of feet.

If the rocks are soft and yielding we get the phenomena of land rising or falling, at the seashore for instance, very slowly. Steel will behave exactly in this way, but in its hardened state it is so brittle that it will not bend very readily, and as the cooling is much more rapid in proportion to the cooling of the earth, we get sharply defined cracks, sometimes going right to the centre of the piece, or even beyond. The immense strain in a piece of hardened

A Steel Section requiring Careful Hardening.



steel can be readily understood by putting slow steady pressure on a short hardened piece and noting the pressure required to break it.

Simultaneous cooling of the entire piece is what is wanted for successful hardening, but this cannot be accomplished if the piece has sharp corners or great or sudden differences in diameter. A piece as shown in the diagram above, hardened carelessly, would be almost sure to crack in two where A joins B, because A would cool and become hard long before B was cold, and as B shrank there would be too much strain at the junction for the steel to stand. It could be overcome largely if the root were well rounded, and B plunged into the bath first; then the hot water and steam rising would keep A hot much longer, and as there would be no sharp dividing line, the strain would be divided over a larger area. If the corner must be sharp, then fill it up with fireclay, or a loosely-fitting iron ring, and dip B in first.

I have just mentioned fireclay. It is a most useful material to have at hand when preparing a piece for hardening. It is bought as a powder, and is mixed with water to the consistency of dough, and is used to fill up sharp corners or holes, so keeping the steel from losing its heat too rapidly. But it wants careful using, because if too much is used or the hole is long, the steel may come out soft where the fireclay was by preventing the steel cooling quickly enough. Sometimes this is very useful, and I will touch on this point later on.

If a piece of steel that is to be hardened has a hole in it near the edge, it should be filled up either with a loosely-fitting piece of iron wire, or fireclay, because when it is cooled suddenly in the bath, the thin piece will set hard long before the thicker portion, and as the thick portion cools and contracts, it will pull with sufficient force to crack the thin piece.

Another method—and a very good one—to prevent cracking is to have a layer of oil on the surface of the hardening bath. As oil is lighter than water, it will always rise to the surface, and float there. The oil should be, to a certain extent, in proportion to the piece to be hardened, and to the degree of hardness required. The oil, being a poor conductor of heat, allows the steel to cool comparatively slowly at first, and then the water finishes the cooling process. By this slow cooling the steel is not strained to anything like the extent it would have been if dipped in cold water at first, and yet is much harder than if cooled off entirely in a bath of oil, and tougher than if cooled off entirely in water. A method used to get the surface extremely hard, and yet not to strain the piece unduly, is to exactly reverse the above process. For this it is necessary to have a bath of water and another of oil; dip the hot steel first into the water, and keep it there long enough to harden the outside of the piece only, and then instantly plunge it in the oil bath, and the centre will cool down gradually. If the piece is a fair size—say, a 1-in. tap—this can be done quite successfully; but it requires a great deal of experience and good judgment to know just when to take it out of the water so that the outside may be quite hard and the middle soft. Still, it is a commercial process, and is most useful when the piece has to stand twisting strains, as in a tap.

Expansion of Steel in Heating.—When a piece of steel is heated it expands, and when it is cooled it contracts. Sometimes to its original size, sometimes smaller, but generally it remains just a little larger. I cannot definitely say how much high carbon steel expands in hardening, as it is very difficult to get consistent results, because of the difficulty of having all the conditions the same in all the pieces experimented upon, and, of course, different percentages of carbon affect the expansion; but a very rough estimate might be perhaps 2-1000ths in. to 3-1000ths in. for every inch in length. To repeat, steel expands when heated, and if heated unevenly, or too rapidly, it may expand so fast that it cracks; and probably as much steel is cracked by improper heating as by too sudden or unequal cooling. One can tell if a piece of steel has cracked in heating, or whether it cracked in hardening, by observing the fracture. If it is quite clean and bright, it is a hardening crack; but if discoloured, it cracked in heating.

Again, steel very rapidly absorbs impurities when it is hot and, also, it rapidly loses its carbon. For this reason it is bad practice to heat steel in an open flame or in coke, as it will absorb the sulphur from the coke and become brittle, and the gas and air will cause the surface to oxydise and scale, and so it becomes brittle and rotten, and quite unfit for use as a cutting tool. If it is necessary to heat steel in this way, it should not remain in the fire any longer than is absolutely necessary to get the required temperature, and the surface should be ground away to a considerable depth to get right down to the unaffected steel. Small pieces of steel, such as lathe tools, drills, cutters, etc., may be kept away from these impurities while heating by putting a piece of gas barrel (closed at one end) in a furnace or fire, and raising it to a sufficiently high temperature, and holding the pieces inside the pipe until they are hot enough to harden. The pieces must not touch any part of the pipe, or they will be heated there too rapidly. The tube should be evenly heated all round, if possible, but if the heat comes chiefly from one side, it will be best to slowly revolve the piece so that it may be heated evenly.

PACK-HARDENING.—The best way to harden small pieces of steel is what is called pack-hardening. This is packing the pieces in an iron box, usually cast iron, with some carbonising agent between them, such as charred bone or leather. The pieces must on no account come within about ½ in. of the sides or bottom or top of the box, and they should be separated from each other by not less than ¼ in. If they come near the sides of the box, the iron will extract some of the carbon from the steel, and make it of inferior quality; and this may go on to such an extent that the steel will be, after quenching, quite soft on the surface where it was close to the iron box.

The cast-iron box filled with the steel pieces, and the carbonising mixture, is placed in a muffle furnace, and gradually heated until it is red hot entirely through. It is kept at this heat for a time—perhaps about half an hour—and then taken from the furnace, and the contents are either tipped wholesale into the hardening bath, or are quenched separately, according to the nature of the pieces. To tell when the box is red-hot right through, a few holes are drilled through the lid, near the centre, and iron rods are put through these right down to the bottom of the box. When the box is thought to be hot enough, a rod is withdrawn, and if it does not show the right heat, the box is allowed to remain in the furnace until another is withdrawn which shows the desired colour. The furnace is once more closed for twenty or thirty minutes, and at the end of this time the contents ought to be ready to be hardened.

(To be continued.)

Notes on Locomotive Practice.

By CHAS. S. LAKE.

(Continued from page 159.)

COMPOUND LOCOMOTIVES FOR THE N.E.RLY.

IT is reported that the North-Eastern Railway have in hand, at the present time, at their Gateshead Works, some four-cylinder compound express passenger locomotives, which are to be the largest engines employed on any British railway. It is understood that they will be of the Atlantic (4—4—2) type, with high-pressure cylinders 14¼ ins. diameter, and low-pressure cylinders 22½ ins. diameter. The inside valve gear will be of the Stephenson type, whilst that for the outside cylinders will be of the Walschaerts' pattern in a modified form. The boiler will have maximum proportions, and will be fitted with a Belpaire firebox. Patterns for a locomotive of this description were completed at Gateshead Works as long ago as the middle of last year, but it is, of course, impossible to say whether these will be used in connection with the new series of engines, or whether a fresh set have been prepared to altered dimensions. There can be no doubt, however, that the movement in favour of four-cylinder compound locomotives having the 4—4—2 wheel arrangement is a growing one in this country.

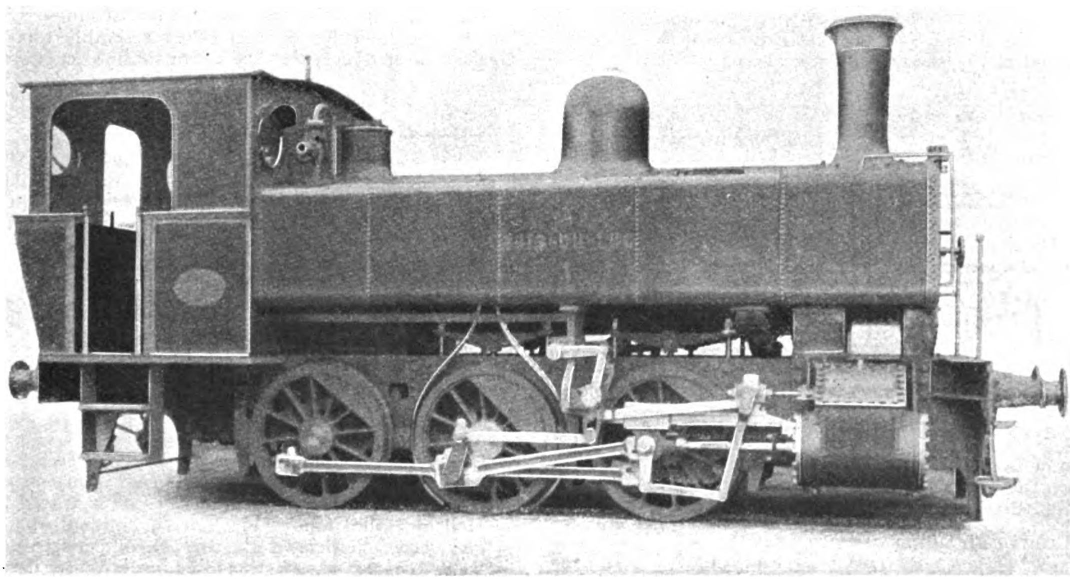


FIG. 26.—BELGIAN LOCOMOTIVE FOR SHUNTING WORK AND BRANCH LINE TRAFFIC.

A STANDARD BELGIAN SHUNTING AND LOCAL TRAFFIC LOCOMOTIVE.

The accompanying illustration shows one of a number of six-wheels-coupled shunting engines recently completed by the Société Anonyme des Forges, Usines et Fonderies, of Haine-Saint-Pierre, Belgium. The engines are of a handy type, and are possessed of greater power than their appearance—judged by the photograph—might lead one to believe. The cylinders are outside the frames, with the steam-chests above them; the valves are of the flat type, actuated by means of the Walschaerts' valve motion. The boiler has the standard mountings of the Belgian State Railways, and side tanks are fitted extending on each side from the cab to the front end of the smokebox. These tanks are connected by an equalising pipe passing below, and encircling the boiler barrel at the forward end. The cab is of a comfortable description, with windows of circular pattern, fitted with shields at the top in front and back. These engines, which are used for working branch passenger and goods traffic, as well as for shunting work, have the following dimensions:—Cylinders, 16⅞ ins. diameter by 24-in. stroke; wheels, 3 ft. 11⅜ ins. diameter; total heating surface, 1,044 sq. ft.; grate area, 12·25 sq. ft.; working pressure, 170 lbs. per sq. in.; tractive effort (65 per cent. of boiler pressure), 6·870 kil.

ATLANTIC TYPE LOCOMOTIVES FOR THE CALEDONIAN AND MIDLAND RAILWAYS.

It is stated that both of these railways have in hand at the present time, at their respective works, new Atlantic type passenger locomotives. Those on the Midland Railway will be compounded on the Smith three-cylinder system.

COMPOUND DUPLEX GOODS LOCOMOTIVE, NORTHERN RAILWAY OF FRANCE.

Among the locomotive exhibits at Liége Exhibition is a huge "duplex" goods locomotive, designed by Mons. du Bosquet, Chief Locomotive Engineer of the Northern Railway of France, for service on the Lens to Hirson section of the line. The cylinders are four in number, and compounded, the high-pressure cylinders driving one group of six-coupled wheels, and the low-pressure driving the other group. The actual wheel arrangement is 0—6—2, 2—6—0, and the coupled wheels are arranged in the form of two bogies with frames complete, capable of independent movement the one set from the other. The boiler side tanks, etc., are mounted on a central box section frame resting upon the bogie frames, and the front bogie pin takes the form of a spherical bearing of large diameter, whilst that at the rear is a flat bearing. The smokebox end of the boiler receives direct support from the leading bogie frame, and circular bearing brackets at the rear of the firebox are attached to the trailing bogie, with additional supports under the cab doorways. A similar engine to that exhibited is now in service, engaged in hauling coal trains weighing 1,000 tons up gradients of 1 in 200 at Lens. The principal dimensions are:—Cylinders—H.-P., 15¾ ins. by 26¾ ins.; L.P., 24⅜ ins. by 26¾ ins.; coupled wheels, 4 ft. 9¼ ins. diameter; centres of bogie pivots, 26 ft. 10 ins.; total wheelbase, 38 ft. 3⅜ ins. The boiler, which is pitched with its centre line 9 ft. 2¼ ins. above rail level, contains 130 Serve tubes 15 ft. 10½ ins. long by 2¾ ins. diameter. The total heating surface is 2503·30 sq. ft.; grate area, 32·29 sq. ft.; and working steam pressure, 214·7 lbs. per sq. in. The water capacity of the rear tanks is 836 gallons, and that of the forward tanks 1,980 gallons; whilst a bunker capacity for 5 tons of coal is provided. The engine weighs loaded (maximum) 102 tons; empty, 78 tons.

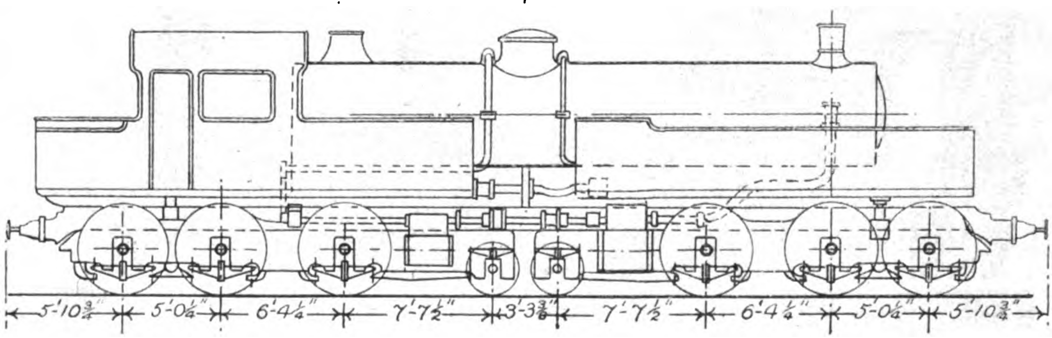


FIG. 27.—HEAVY DUPLEX COMPOUND LOCOMOTIVE: NORTHERN RAILWAY OF FRANCE.

"CRITICISING" NORTH-EASTERN LOCOMOTIVES.

An amusing, but at the same time very foolish, article recently appeared in a Yorkshire contemporary, in which it was stated that "The monster six-coupled express engines on the N.E.R., with their mammoth boilers and squat chimneys, burn a tremendous lot of coal—they resemble torpedo-boat destroyers for their consuming capacity—whilst it is stated that two of the smaller types of engines between them burn less coal on a run than does one of the huge locomotives. It is stated that Neilsons, the famous locomotive builders of Glasgow, have challenged the N.E.R. officials to allow them to take one of the old familiar 7-ft. driving wheel locomotives to reconstruct it, and that they will hand over the sum of £100 to any charity the company like to mention if it does not work as well as one of the monsters of the new class." Such a statement as the foregoing can only be described as malicious nonsense, written by one who obviously has no knowledge, worth the name, of locomotive construction. It is stated on the authority of Mr. Wilson Worsdell, Chief Mechanical Engineer of the N.E.R., that there is no truth in the allegation that "Neilsons" (*i.e.*, the N.B. Loco. Co.) have offered to reconstruct any North-Eastern passenger locomotive. As a matter of fact, ten new 4—6—0 type express engines with 5 ft. 6 in. boilers are about to be built at Gateshead Works.

(*To be continued.*)

A CORRECTION.—In our issue for August 24th, page 172, referring to the New de Glehn Compound Locomotive, total wheelbase should read total heating surface.

Accident on the Groudle Glen Miniature Railway.

An accident, fortunately unattended with any very serious consequences, occurred recently at the Groudle Glen Miniature Railway. The Glen is a pleasure resort near Douglas, I. of Man, and the railway, which is about a mile in length, is used for conveying passengers to an enclosed creek of the sea, in which sea lions and Polar bears disport themselves. The gauge is 24 ins., and the locomotives used are six-wheeled tank engines, sufficiently large to enable the man to stand upright in the cab, built by Bagnall's, while the coaches are on the char-à-banc principle.

About noon a train fairly well filled with passengers was proceeding along the line, when the driver of the locomotive fainted, with the result that the train, which was travelling at considerable speed, rushed along until its career was arrested by the stop-block at the terminus, and the locomotive and coaches were partially wrecked.

Eleven of the passengers were injured, but for the most part they only suffered from shock. Steps were at once taken to assist the injured people, and medical aid was quickly on the spot. It is fortunate that the stop-block withstood the shock, otherwise the train would have been precipitated over a high cliff. The line was speedily cleared, and during the remainder of the day trains were running as usual, and conveyed hundreds of sightseers to the scene of the accident.

The "Holiday" Competition.

During the present holiday season, we have decided to award every reader who sends us a description and original photographs of anything of engineering or model-making interest he may encounter during his vacation, which shall be sufficiently good to warrant insertion in our journal. The prizes vary in value from 5s. to 10s. 6d., according to merit. All winning competitors will receive a notice of the value of the prize awarded, when they can choose the tools or other articles they may wish sent to them. All entries should be accompanied by a separate letter, marked on the envelope "*M.E.* Holiday Competition." This letter should include the title of the article and any other information not necessary for publication. The article should be written *on one side of the paper only*, with the name and address of the sender on the back. The photographs and separate sketches enclosed with the contribution should similarly bear the name and address of the sender, otherwise delay may arise in the awarding of the prizes. It is essential that the copyright of the photographs must be the property of the senders, and the covering letter should contain a declaration to this effect. The competition will close on October 16th.

Electro-Peat Fuel.—The first plant for the manufacture of electro-peat fuel has now been erected at Kiberry Bog, near Athy, co. Kildare, upon the estate of the Duke of Leinster.

A Shocking Coil and Electric Alarm.

By Wm. Pringle.

The shocking coil illustrated is similar, with the exception of a few improvements, to the one described in The Model Engineer handbook, "Induction Coils." The baseboard was made from an old piece of yellow pine, which was veneered with mahogany, the edges being stained black. The guides are screwed on from underneath. I find that the iron wire core, after being annealed, is not easily sweated together. A better plan is after binding it together, to soak it in thick

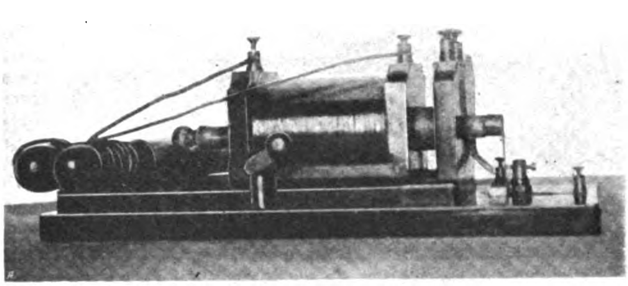


Fig. 1.—Mr. Wm. Pringle's Shocking Coil.

shellac varnish, and bake in an oven, giving it an occasional coat. After it gets hard, the binding wire can be removed. As will be seen by a glance

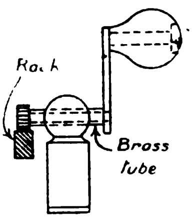


Fig. 2.—End View of Rack and Pinion.

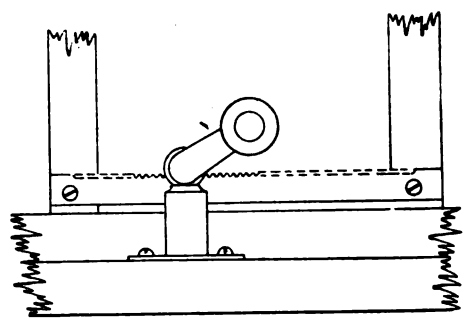


Fig. 3.—Rack and Pinion for Shocking Coil.

at Figs. 2 and 3, a rack and pinion is fitted. A small pillar was turned, and the sheet brass base sweated on and bored for two screws. A piece of brass tube was procured to fit the spindle of pinion, and a hole was bored in pillar in to which the tube was sweated in. A crank was sweated on end of spindle, and a pin, on which the wooden handle revolves, riveted on to the crank. I have found that a good kind of paper to use for insulating the secondary coil is foreign notepaper, being very thin and close grained.

The electric alarm, of which a photograph is

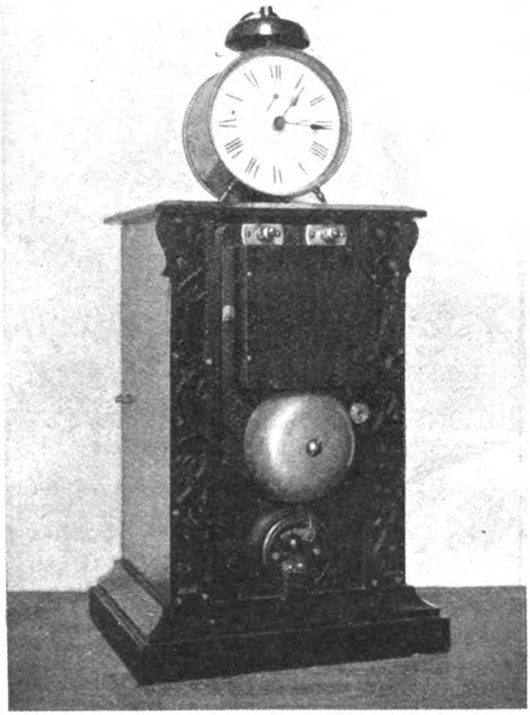


FIG. 4.—MR. WM. PRINGLE'S ELECTRIC ALARM.

herewith reproduced (Fig. 4), is after the style of the one described in THE MODEL ENGINEER of July, 1900, so that further description here is quite unnecessary.

ELECTRO-DEPOSITION OF NICKEL ON SHEET ZINC.—According to the *Industrie Electro-Chimique*, zinc plates, on which it is desired to deposit a film of nickel, should first be cleaned with a mixture of chalk and oil, then well polished, and thoroughly washed. They are next fastened back to back, and given a coating of copper by being immersed for two minutes in an ordinary electrolytic bath. All the copper salts are then most thoroughly washed off, and the plates, separated from one another by means of rubber bands, or coated on their backs with paraffin wax, are brought into the nickel bath. The latter is best made up from 600 grammes of nickel ammonium sulphate, 250 grammes of boric acid, and 10 litres of distilled water. The current density must be 1·2 ampere per square decimetre. After the nickel is deposited, the plates should be well polished.

The Society of Model Engineers.

[Reports of meetings should be sent to the offices of THE MODEL ENGINEER *without delay, and will be inserted in any particular issue if received a clear nine days before its usual date of publication.]*

London.

THE first indoor meeting of the winter session will be held on Thursday, September 28th, at the Holborn Town Hall, at 7 p.m. It has been decided to make this a special track and general exhibit night, and all members are particularly requested to bring some exhibit, either models (finished or unfinished), tools (home-made or otherwise), whether the articles have or have not been exhibited before. To encourage members to bring exhibits, a first prize of 15s., and a second one of 7s. 6d., both in cash, will be awarded during the evening to such model, or part, tool, etc., as shall be deemed by a general vote of the members present to be the most interesting exhibits. Each member present will be entitled to vote for one exhibit other than his own, the exhibit obtaining the highest number of votes taking the first prize, and the next in order the second. It is earnestly requested that those members possessing locomotives will bring and run them at the meeting; two straight tracks will be fitted up side by side, so that races may be run. The locomotives are, of course, included in the above prize scheme.—HERBERT G. RIDDLE, Hon. Sec., 37, Minard Road, Hither Green, S.E.

TRADE OPPORTUNITIES IN EAST AFRICA.—Mr. Arthur P. Jolly, who has lived in British East Africa, Somaliland, and the countries which the Juba River surrounds, for the last nine years, in his report on the trade of those countries to the Manufacturers' Association of Great Britain, Orchard House, Westminster, emphasises the point that immense openings for trade exist in foods, clothing, iron, copper, brass-ware, hardware, glass-ware, building material, furniture, agricultural implements, etc., etc., and urges that British manufacturers should set about capturing these markets in a more systematic manner. The exports consist of ivory, indiarubber, copal, and aribica, hides, skins, horns, grain, shells, mangrove, bark, copre, potatoes, beans, fibre, and wax. The country is also capable of exporting large quantities of timber, which is spread along the banks of the river Juba for hundreds of miles. In these forests may be found oak, walnut, ebony, mahogany, and iron red wood suitable for all purposes. These valuable natural productions not only offer return cargoes for shipping lines, but afford opportunity for the investment of British capital and enterprise with prospect of profitable returns. There are some 30,000 camels employed yearly in transporting immense quantities of merchandise from the coast towns to the interior. The greater part of the business is at present in the hands of America and Germany, who work the countries direct with their own representatives. There is at present a splendid opening here for agricultural implements and machinery, and good prices may be obtained. Transport service is being established on the river Juba to supersede the present caravan transport, which is very slow and expensive. The new river service will carry goods four times as quickly, and at less than half the present camel transport rates

Practical Letters from our Readers.

[*The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a* nom-de-plume *if desired, but the full name and address of the sender* MUST *invariably be attached, though not necessarily intended for publication.*]

A Single Eccentric Reversing Gear.

To the Editor of *The Model Engineer.*

Sir,—Being somewhat interested in the description of arrangement for reversing with one eccentric contributed by "J. C. T." in the last issue of The Model Engineer, I venture to send you an arrangement which once attracted my attention, being somewhat novel in its appearance while at work, and simple in its action.

Fig. 1 is a front elevation of sheave and crankshaft; B is a disc, or cam, bored and turned diagonally as shown, and is keyed on shaft A, the

Fig. 1.

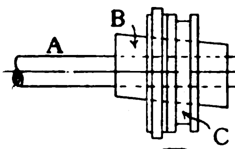
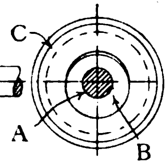


Fig. 2.



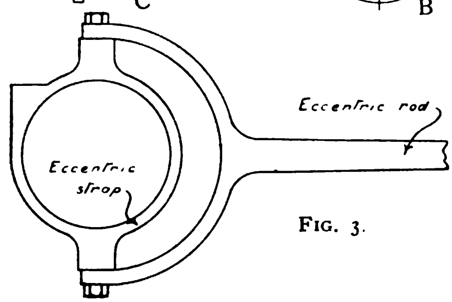


Fig. 3.

A Simple Eccentric Reversing Gear.

throw at either end being equal to the travel of valve. C is a loose sheave and lever-clutch, which works on a feather-key let in B, and is operated by a forked lever, which is fitted with a pawl, and works in a quadrant placed horizontally, so that when moving the lever from right to left, or *vice versa*, it would operate the sheave and clutch, and thus reverse the valve from full forward to full backward or cut-off at any point of the stroke by simply notching up, as in link-motion.

Fig. 2 is an end view of shaft and sheave, and Fig. 3 s ows the eccentric strap with forked rod, in order to accommodate itself when thrown out of centre line with valve spindle.

The above attachment was fitted to a portable engine used for winding purposes at a small colliery. —Yours truly,

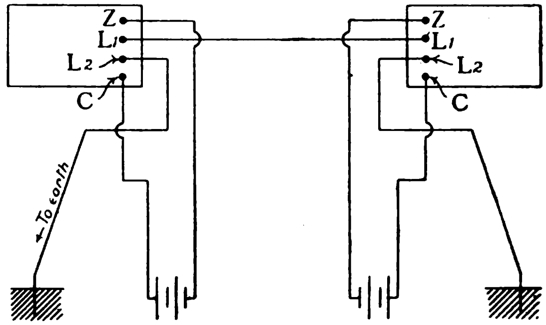
Horsehay. R. A. Peake.

Electric Telegraph Connections.

To the Editor of *The Model Engineer.*

Dear Sir,—In your interesting little book No. 8, "Simple Electrical Working Models," Chapter 1, "How to Make an Electric Telegraph," the diagram showing how to connect the two instruments shows that two wires must be placed between the two instruments, viz., L′ and L².

This need not be so. I work my telegraph over



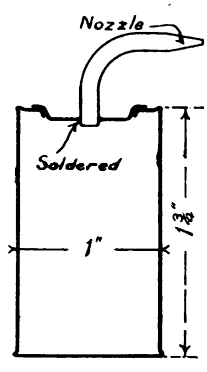
Electric Telegraph Connections.

a quarter mile of space with only one wire; the method of doing this is very simple, viz.:—Connect the wire L′ to L′ on the other instrument, and run the wires L² of both instruments to the earth, and the earth will take the place of the other wire, thus saving a considerable quantity of this material.—Yours faithfully, A Student.

The Generation of Acetylene Gas.

To the Editor of *The Model Engineer.*

Dear Sir,—I regret that when I wrote to you describing my experiments in acetylene production (published in your issue of August 24th, page 187) I omitted a marginal sketch which I referred to in



Apparatus for Generation of Acetylene Gas.

the text, and also the dimensions of the cocoa tin; these are as here shown.

You will see by this sectional sketch that the apparatus was by no means large, yet it worked, and showed the feasibility of the production of gas by the use of an efflorescent salt. Subsequent experiments in the same direction have shown that the soda used must be freshly pulverised from the crystals, as I have found that soda pulverised in the morning would generate no gas in the afternoon.

Re the article on bicycle-driven dynamos, in the same issue, may I add that a friend of mine uses his bicycle for driving his lathe during the winter months. He turns his machine upside down, so that it rests on the handle-bar and saddle. The back tyre being removed, a cord is passed round the rim and round the lathe pulley. The front wheel having been removed bodily, the driver sits in the fork, thus formed, and drives the pedals with his hands, while the turner manipulates his tools. The same arrangement worked very well in connection with a small emery wheel used for tool grinding, the necessary speed being obtained with very little labour.—Yours truly,

Kincardine-on-Forth. NATHAN SHARPE.

A Model Working Loom.

TO THE EDITOR OF *The Model Engineer*.

DEAR SIR,—In reply to Mr. Bradshaw's letter, which appeared in August 3rd issue, concerning my model working loom, I must admit that the mistake is mine. The scale I worked to was ¼ in. to the inch (quarter full size), so that he is quite right in what he says.—Yours truly,

J. FINNINGHAM.

ELECTRIC LAMPS AND COLLIERY EXPLOSIONS.—The opinion is very prevalent that incandescent lamps give off very little heat, and can be used in collieries with perfect safety. That this view is erroneous has been convincingly proved by practical experience. In a paper read before the North of England Institute of Mining and Mechanical Engineers, Mr. Holliday stated that after a fire in his colliery, he made experiments which confirmed his suspicion that electric lamps were the originating cause. The experiments of Mr. Holliday were afterwards repeated by Mr. Hall, one of H.M. Inspectors of Mines. It was then found that when a 16 c.p. lamp rested upon coal dust, heat was generated with great rapidity. In one case, with a slight covering of dust, the temperature rose to 370° F. in three minutes, and to 450° in four minutes, when the lamp exploded. In other experiments temperatures as high as 650° F. were reached, and in some cases the coal dust in which lamps had been placed was found to be red-hot for some time after the original source of heat had been removed. These investigations are sufficient to suggest that great care must be displayed in the use of electric lights underground, and a fatal explosion of firedamp, which took place recently in the Gendebien Colliery, near Charleroi, owing to the bursting of an incandescent lamp, shows that the danger is one that cannot be overlooked.

COST OF LIGHTING BIG BEN.—It is stated that the cost of lighting the dials of Big Ben electrically, amounts to £242 for the year. The green light is incidental to the lamp used experimentally, and the cost of the current, if it were adopted permanently, would be reduced some 35 per cent. A red colour is impracticable.

THE PEDRAIL.—The Local Government Board have just issued an order enabling pedrails (the invention of Mr. B. J. Diplock) to be used in England and Wales. Previous to issuing the order a number of engineers of the Board attended trials of a locomotive mounted on pedrails, and were thoroughly satisfied with the demonstration.

Queries and Replies.

[Attention is especially directed to the first condition given below and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-hand corner of the envelope "Query Department." No other matters but those relating to the Queries should be enclosed in the same envelope.

Queries on subjects within the scope of this journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied, wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed. (4) Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of Replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor,* THE MODEL ENGINEER, *26—29, Poppin's Court, Fleet Street, London, E.C.]*

The following are selected from the Queries which have been replied to recently:—

[14,209] **Switchboard for Accumulator Charging.** G. H. (Bridport) writes: Will you please answer me the following questions? I have a dynamo which gives 9 amps. at 25 volts at 1,000 r.p.m., and I want to charge accumulators with it. (1) I want to charge one 4-volt accumulator by itself sometimes. How can I reduce the 25 volts to the 5 volts necessary to charge one accumulator? (2) Does a resistance coil reduce the volts, or only increase the amperes? If it is not asking too much, please send a rough sketch of a charging board, with connections for ampere and volt meter and switches and resistances. (3) Should the voltmeter be always working, or should there be a switch to cut it out?

(1) You can reduce the volts by means of a resistance. If the accumulator takes a very small amount of current, use a lamp in series with it as a resistance. The lamp being one which takes the same amount of current as the accumulator requires to charge it, the lamp may be one of the 25-volt lamps you generally use with your dynamo, or may be a 20-volt lamp. If one lamp does not pass sufficient current, then you can put two or more lamps in parallel, so that enough current passes; it amounts to putting the accumulator in the return wire from the lamps; such an arrange-

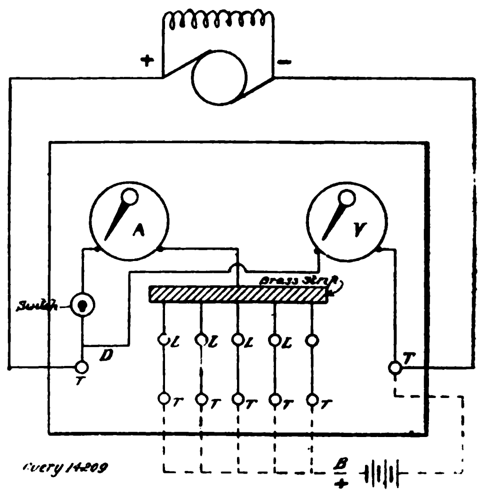


DIAGRAM OF SWITCHBOARD CONNECTIONS FOR ACCUMULATOR CHARGING.

ment has the advantage that the accumulator cannot discharge back if the dynamo should stop or drop its volts—that is, it cannot send back any appreciable current. (2) A resistance coil absorbs so many volts, according to the amount of current flowing. You will find an explanation in THE MODEL ENGINEER for March 5th, 1903, issue, page 237. Also see our Handbook No. 1. (3) Depends upon the construction of the voltmeter. These instruments are generally made now, so that they can be always on. You would be quite safe in trying it so; if it becomes warm, and the pointer begins to drop, then it would be better to have a switch, so as to put on the instrument when required. This method of using lamps as a resistance would do for accumulators of 2, 4, 6, and 8 volts, or so. L is lamp for resistance; T, terminals. The lamps are put into the sockets according to the amount of current wanted. The voltmeter will show the dynamo volts. If you want to know the volts on the accumulator, it should be joined to B, and not to D.

[41,441] **Magnetism in Fields of a 4-pole Machine.** F. C. (Tibshelf) writes: Will you kindly enlighten me on the following:—Are the poles of a four-pole compound motor wound so as to give polarity, as Fig. 1, and also how do the magnets, which are not wound, receive their magnetism? And has the polarity of the magnets anything to do with the position of the brushes, or is it the winding of the armature? Will you please explain how to find

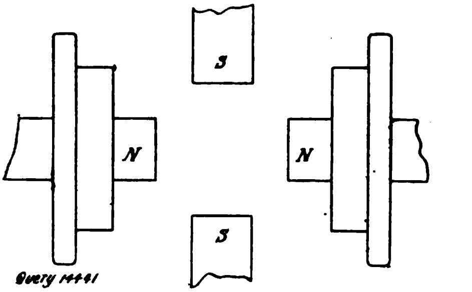


FIG. 1.

the horse-power of a motor, and a dynamo, and where could I get a good book on that subject (a good practical book), and also one on the flow of a current in a dynamo armature and a motor armature? Will you please give me a rough sketch of a closed circuit armature and an open circuit armature, and how to find the segments of the commutator where the brushes have to touch.

Yes; the poles should be alternate N. and S.; the poles which are not wound are magnetised by the coils on the other poles, the magnetism following the dotted lines in Fig. 2 herewith. The magnetism produced by the coils follows a path through the iron of the field-magnet and armature; coils placed upon the unwound poles would increase the effect. The position of the brushes must be such that they collect the current from points in the armature winding which are approximately mid-way between the corners of each pair of poles. The method of connecting up the winding to the commutator will, however, determine the actual position

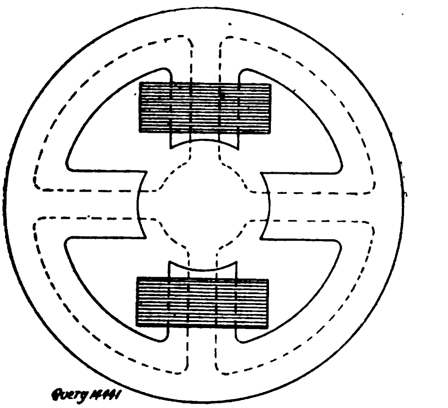


FIG. 2.

in which the brushes are set (see THE MODEL ENGINEER for August 11th, 1904, page 126). The polarity of the magnet does not affect the position of the brushes. The b.h.-p. of a motor can only be accurately determined by using some form of dynamometer; it can be approximately reckoned by ascertaining how many watts are absorbed when the machine is running light, and then adding the calculated ohmic losses which would occur with the current taken for any given load; this would give the losses to be deducted from the watts absorbed. An approximate rule is to reckon that the motor gives out 1 b.h.-p. for every 1,000 watts absorbed; for motors of 10 h.-p. and over, 900 watts would be nearer figures, as the efficiency is then higher. For a dynamo you can take the out put in watts and add to it the ohmic losses for any given output, plus the friction losses in the machine, which can be approximately determined by running it as a motor without load. The horse-power absorbed can also be ascertained by using some form of transmission dynamometer—746 watts equals 1 h.-p. A very good book is "Dynamo Electric Machinery," by S. P. Thompson, 2 vols., price 12s. each; or, "The Dynamo," by Hawkins & Wallis, price 15s. Closed circuit armatures have windings which form a completely closed circuit through the windings, and are tapped at intervals by wires which connect to the commutator bars (see diagrams on pages 34, 35, and 36 of our handbook No. 10). Open circuit windings have the ends of each coil connected to separate commutator bars, as in the diagram on page 25 of our handbook No. 10. They are not used for large machines now, except special machines for arc lighting. The remarks given apply to continuous current motors only.

[14,541] **Dry Cells; Small Incandescent Lamps.** R. H. R. (Sheffield) writes: (1) Would you kindly inform me how to recharge those sixpenny refills for flash lamps? I should also be very pleased if you would give me full instructions for making a cheap and reliable dry battery for lighting a 4-volt ordinary electric lamp for about an hour at a time, if possible, and how to recharge it.

(2 What would be the best gauge (S.W.G.) for ½ in. of platinum wire to get the best possible light with a 4-volt battery, and without fusing it?

(1) Use the dry cell described in our handbook, "Electric Batteries," 7d. post free. About three in series would be needed for a 4-volt lamp. The lamp would have to be a very efficient one, as these cells will not give a heavy discharge. (2) Use No. 46 S.W.G. platinum wire.

[14,339] **Model Electric Railways.** R. M. F. (Cambridge) writes: (1) I wish to electrify my line from the mains, which are 220 volts. Would it do if I wired as sketch (not reproduced)? (2) Would it be best to break the line, which is about 80 ft. long, and has about four short branches, into sections? If so, how?

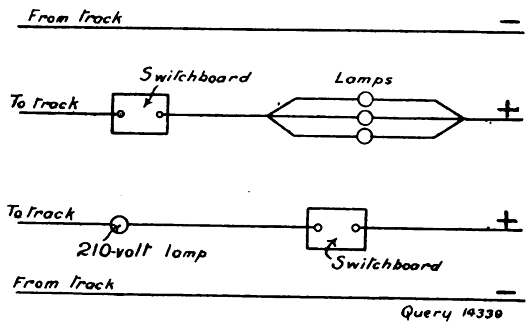


DIAGRAM OF MODEL ELECTRIC RAILWAY CONNECTIONS.

(1) Yes, you may take the supply from the mains, but you would have to use several lamps in parallel to get enough current. The track must be well insulated from the earth: supports of paraffined or shellaced wood may be used. As the Cambridge supply is alternating, the motor must be suitable. (2) You could make a trial in any case. For other information see the issues of July 15th and August 15th, 1902.

[14,565] **Ports for Producer Plant Gas Engine.** W. B. R. (Birmingham) writes: I have a gas engine, four years old, that is to say, the latest type, *re* compression, etc.; it is worked by town gas. I want to drive it with a suction plant. Can you tell me the proportion the gas inlet wants to be compared with the air inlet? Should the air inlet be reduced and the gas enlarged, or should the alteration be made by enlarging the gas inlet only? It does not give this information in your book on "Gas Producers."

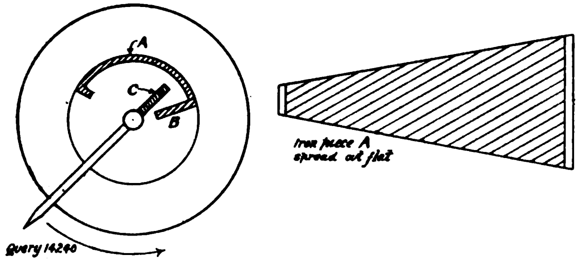
Enlarge the gas ports and valve to nearly the size of the air—in fact, as large as possible. You can then check the air by means of a plate to any required amount, when adjusting matters whilst engine is running.

[14,568] **Tube Ignition Trouble with Gas Engine.** P. B. (Cleckheaton) writes: I am in charge of an electric plant for lighting a public building with an Otto gas engine, 20 h.-p., and accumulators. I keep having trouble with the double-ended tube ignition, the porcelain tube breaking at the most awkward time, when I have the whole building lit up. As the accumulators will only discharge for about half-an-hour with the maximum load on, the lights go very poor before I get a new tube back. Would electric ignition be more reliable?

If you refer to our book on "Gas and Oil Engines," by W. C. Runciman, you will find some useful information on the subject of tube ignition, and an explanation of why these tubes often burst. You could, no doubt, have electric ignition fitted, but we question if you could make the whole job a success yourself. We should advise you to get the makers to fit you up with magneto ignition. The above-mentioned handbook is 6d., or post free 7d.

[14,246] **Dry Cell Difficulties ; Voltmeter Construction.** tion. J. A. B. (Irthlingborough) writes: I have made a set of three dry batteries (2 ins. by ¾ in.) for a flash lamp from directions given on page 105 of No. 68 of THE MODEL ENGINEER. They were lined with three thicknesses of white blotting paper, and the carbon mixture (equal parts by measure) was made damp with a solution of ½ oz. N.H, Cl, 2 fluid ozs. water, one teaspoonful of glycerine, and rammed tight round the carbon. For two days the lamp was lighted *brilliantly*; then it began to fall off, and at the end of a week the lamp was only made red-hot. I then removed the sealing, and poured in a few drops of solution. The light was then a trifle better, but not as good as at first. I then carefully emptied one of the cells: it was quite damp inside, and the paper lining was perfect and soft, except next the zinc, where it appeared dry and was stuck, and was difficult to scrape off. This appears to me to be where the fault lies—please advise me how to correct it. All the cells were amalgamated, and the one I emptied was not black inside. Before I made this set of cells I made others, and used ½ oz. N.H. Cl, to the same quantity of water, etc.; but the light was not so good, and the cells ran down in about the same time. Please explain the method of construction and action of a voltmeter on the same principle as the ammeter illustrated on page 520, No. 188 THE MODEL ENGINEER. I have looked through all my back numbers from No. 22, but cannot find any information on the subject. I have made a voltmeter on the solenoid principle, wound with No. 36 copper wire, but I cannot get as much deflection as I should like. One battery will move the pointer ¼ in., two batteries in series 5-16ths in., three ditto ⅜ in., and so on—1-16th in. for each battery. Please say why the pointer does not move as much as that shown on the cover of No. 214, THE MODEL ENGINEER.

The fault is, as you say, most probably at the paper lining. Try a paper which is more porous. Perhaps the lamp takes too much current. The makers of good flashlight apparatus provide lamps of special make with their batteries, which take a very small current. Many of the small lamps on the market, especially the low priced ones, take a comparatively large current. *Re* voltmeter. This is made precisely the same as the ammeter, the only difference being in the winding. Instead of using thick wire, the bobbin is wound with very thin wire, the gauge depending upon the volts to be measured. The action is as follows: a piece of thin, soft sheet iron (A) is curved to fit inside the bobbin, an end B is bent radially inwards; the needle spindle carries a flat piece of thin, soft sheet iron (C), which lies parallel to B when the point of the needle is at zero; the coil magnetises B and C, so that they become two bar magnets having adjacent N. and S. poles; C is therefore



VOLTMETER CONSTRUCTION.

repelled from B with a force depending upon the amount of current flowing through the coil. This force is balanced by a spring, or a gravity weight. The shape of the soft iron piece A is similar to sketch herewith, being tapered off in direction in which B is to move from zero. Both A and B are made of very thin sheet, about 1-64th in. thick. *Re* solenoid voltmeter. Perhaps your solenoid is pulling against the weight of the needle, if this hangs vertically. When at zero you can readily see that the needle will resist the sucking action with a rapidly increasing force as it moves towards the horizontal; if this is so, you must counterbalance the weight of the needle by a suitable counterweight. We may be able to advise better if you can send a sketch of the instrument.

[14,437] **Apprenticeship Difficulties.** W. H. (Dublin) writes: I would be glad of your advice on the following matter:—I served three years and four months in a Glasgow locomotive shop, but not getting a good class of work, I obtained a shift to a small firm in Dublin. Being a general shop, I thought I would get a good all-round knowledge; but instead of putting me in their shops, I was sent to a brewery where the firm is putting up a lot of structural work—a rough class of work altogether. Well, I have been in the place seven months now, and have not had the slightest bit of fitting nor am I likely to. I have heard the shop is not much good, for they do not get a good class of work. You will see I stand a very poor chance of learning engine fitting, and yet I will have four years in out of five next month. My age is 20. Do you think there is any possible chance of my obtaining a shift to some marine shop in the South of England—some small place where I could get repair work as well as new? Having had such a poor chance so far, I should like to pick up all I can before my time is out. I think you will understand my position now, and would be very grateful if you could give me some advice on the matter.

We would suggest that you endeavour to see the foreman or manager of your works and ask to be given a turn at some of the better work. If this does no good, you can only look out for another shop in another district. Stipulate before commencing work that you have fitting, etc., and not rough work alone. We cannot advise any particular firm. You would have to write or call on one or two, and see if they are open to take on any fresh hands. The north-east coast is the best for marine engineering. Round about Newcastle and North Shields there are a good many small yards which should suit you.

[14,393] **Charging Small Secondary Cells.** W. C. (Norwich) writes: Having completed a small accumulator as described in your sixpenny handbook, I am now anxious to charge it, but as I have no batteries suitable for charging, and can get a connection with the light mains, I should esteem it a great favour if you will let me know if I have worked out the voltage and amperage

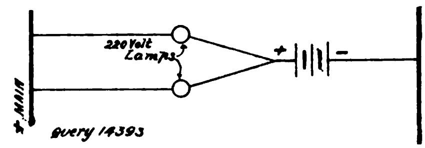


DIAGRAM FOR CHARGING SMALL SECONDARY CELL.

right. The voltage on our mains is 220; this I wish to reduce to 5 volts, and was thinking of doing so by placing a 200-volt, 16 c.p. lamp in series with the accumulator, and so reduce it to 20 volts; but, allowing 60 w. to the 16 c.p., a current of about ·33 amp. would only pass, and this is only half of what I require, so I wanted to place two in parallel, thus getting a current of 66 amp. at 20 volts. The remaining 15 volts I intended to reduce by inserting a resistance of about 22·72 ohms in series with the lamp. as 22·72 ohms by ·66 amp. would about equal 15 volts, thus leaving me a current of ·66 amp. at 5 volts, which is the right thing, I give a rough sketch (not reproduced) of my idea, and hope it is right; if not, kindly make it so.

You need not trouble about reducing the voltage by an exact amount, but just connect lamps of the same voltage as the supply mains in series with your accumulator, using one or more lamps in series to obtain the correct amount of current. Five volts is so small a proportion of 220, that the accumulator will practically make no difference, and the lamps will pass almost their full rate of current. Supposing your 16 c.p. lamps to take 60 watts, they will pass about ·3 amps., so that two of these in parallel will pass the amount of current required through your cells. Length of time required to charge depends upon the capacity of the accumulator. If the one described in chapter 2, it should take about 6 hours, as you never get out as much as you put in. It depends again upon how much the cell has been discharged. The first charging should be kept on until the liquid gases thoroughly, t may require 12 to 24 hours, do not discharge untill first charge is finished.

[14,572] **Motor for Small Launch.** C. D. writes: (1) I have a "Don" electric motor which requires rewinding. What gauge wires should I use to get the best results with a moderate current consumption? Armature is three-pole. (2) Will motor required to be geared to drive model cargo boat 2 ft. 9 ins. long by 4 ins. beam by 2½ ins. draught at a moderate speed? If so, will 7-1 or 35-1 be best? (3) What size 3-bladed propeller should I use, or would two small 2-bladed on same shaft give better results?

(1) You do not state size of motor. Winding given in our handbook, "Small Dynamos and Motors," should assist you; 7d. post free. (2) A 15-watt machine should do this easily. (3) About 1¼ ins. diameter.

[13,957] **Induction Coil Experiments.** A. E. T. (Alfreton) writes: It was my privilege, a short time since, to see some interesting experiments with the aid of an induction coil. It was at a music hall at Derby, and the manipulator styled himself Professor ——; and he claimed to be able to cure muscular paralysis, and certainly a demonstration he gave lent a great deal of colour to his claim. But the object of this letter is not to discuss the virtues of high tension currents as a remedy for paralysis, but rather to ascertain, if possible, a little information *re* his apparatus. This consisted of two tables: on the one was the in-

duction coil and a Wimshurst machine, and on the other what looked like an oblong box with two very heavy terminals on the top, these terminals serving as guides to very thick discharging electrodes, about, I should say, 1 in. thick. Fastened to the front of this box, and extending its whole length, was a bright copper coil of about No. 10 S.W.G. On a stand to itself was an iron cylinder, with a thick brass rod with curved head and brass ball situated in the centre of said cylinder. Having described, as nearly accurate as my distance from the stage would permit, I will proceed with the performance. On turning on the current, a very heavy blue, steady spark, quite an inch thick by 1½ ins. long, crossed the terminals already mentioned, with a fierce roaring, crackling sound. The "Professor" then seized two handles, and, judging by the contortions of his body, he seemed to be having a rough time. But the thought struck me that his antics were either counterfeit or he had a splendid nervous system. When he held the handles about 4 ins. apart, the space was immediately crossed by a thick spark. Is it possible for a man to stand such a high frequency current as this appeared to be, or was his apparatus arranged similar to an experiment described in the *M.E.* by Mr. Howgrave-Graham on oscillating discharges—I mean the prime discharge passing through two Leyden jars, and thence to a second set of electrodes (in which case it would be possible to handle the current with impunity)? The "Professor," after this startling demonstration, then, still holding one terminal in his hand, approached the other hand to the cylinder, and when within about 4 ins. off the knob, a wavy yellow spark bridged the space, causing his hand to jerk spasmodically; and it was some time before he could keep his hand continuously before the nob. The noise of the discharge was truly a fearful affair, and the presence of ozone was distinctly noticeable; and as the lights were out, the "Professor" assumed an appearance closely resembling Mephistopheles, and created unbounded awe among his audience. Now, on the data I have been able to supply, could you describe to me the procedure—whether it was a splendid scientific hoax, or was it really a genuine affair?

The exhibition you describe was probably a number of effects produced with the aid of high frequency currents. The exact details of the apparatus used cannot be given, either from direct knowledge or from your description. It is not likely that the exhibition showed anything which was not some modification or production on a larger scale of the experiments now in process of description by Mr. Howgrave-Graham in THE MODEL ENGINEER. Was not the name and title of the exhibitor "Dr. Bodie"? If so, the experiments were certainly with high frequency discharges. We believe Dr. Bodie's medical degree to have been taken in the United States, and we do not believe treatment by high frequency discharges to be efficacious for sudden cures on the stage, though they undoubtedly have good gradual effects by careful and regulated daily application in certain cases. No doubt the exhibitor took heavy oscillatory currents through his body. A current can be borne with ease which would kill at ordinary frequencies, or if continuous. By putting up with some degree of discomfort, a considerably larger current could be taken. We regret that we are unable to give further information, and would suggest that you should read Mr. Nikola Tesla's book on the subject.

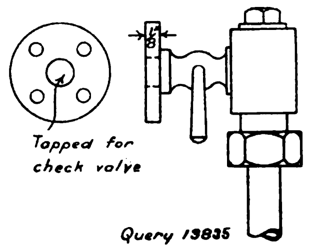
[14,484] **Dynamo Construction.** B. B. (Liverpool) writes: Please will you answer me the following questions? Enclosed is rough sketch of dynamo (not reproduced). What size of wire and quantity will I require on armature and field-magnets? Also, what thickness must wrought-iron cores be for field-magnets? What will be the output of the dynamo? Kindly give me a few particulars that will help me, as this is my first attempt at model-making.

Wind armature with No. 20 gauge D.C.C. copper wire. Get on as many turns as you can—about 1½ lbs. will be required. Field-magnet cores to be of wrought iron, circular section 1½ ins. diameter each, to be wound with about 3 lbs. No. 22 gauge S.C.C. copper wire on each core, both coils to be joined in series with each other, and in shunt to the brushes. Output about 30 volts 6 amps., at 2,800 revolutions per minute (approximate). The volts can be adjusted within limits by running at higher or lower speed. Test with a 30-volt 8 c.p. lamp. You will find a great deal of useful information in our Handbook No. 10.

[14,474] **Windings for Small Dynamo.** A. A. (Gillingham) writes: I have the castings of a small dynamo, and should like to wind to give an output of 10 amps. at 30 volts. The dimensions of the armature are as follows:—Length of drum is 2⅛; twelve slots ⅜ square, and also it is laminated with twelve segments on commutator. (1) How many turns will I want for each slot, and also the gauge? The sizes of the fields are—bobbins 1½ core, 2½ in. length; armature tunnel is turned 2⅞; the width, 2⅞; height, 6⅞. (2) How much wire will I want for each field, and what gauge will I require to get? I have made a rough sketch of fields, so that you will know what class of dynamo it is. About what speed will the dynamo have to run to give the above results?

(1 and 2) Wind armature with No. 22 gauge D.C.C. copper wire; get as many turns as you can in each slot—a quantity of about ½ lb. will be required; two coils to be wound into each slot. Field-magnet to be wound with about 3 lbs. No. 22 gauge S.C.C. copper wire on each core; both coils to be joined in series with each other, and in shunt to the brushes. You will not be able to get so large an output at a reasonable speed. At about 3,000 revolutions per minute, you may get, approximately, 30 volts and 5 amps. The voltage may be adjusted by running at a higher or lower speed. Armature should be made to run as close to the pole faces as practicable.

[13,835] **Boiler Fittings.** F. G. B. (Manchester) writes: I have been trying to fix a check valve in a steel boiler, 14 ins. by 7 ins. and ⅛ in. thick. The thread on the valve is B.A. and 5-16ths in. When I had tapped the hole I had drilled I found that the hole was a little too large. I can screw the valve in, but it is loose. I should be very much obliged if you could tell me how to remedy this.



METHOD OF FITTING CHECK VALVE TO A MODEL BOILER.

The best thing you can do is to screw a plate on to the check valve and to affix the plate, which should be faced to the barrel of the boiler, to the boiler shell with three or four small *brass* screws. Solder the check valve to the brass plate or pad in addition to the screwing.

[14,512] **Generating Station Attendant's Duties.** "ENQUIRER" writes: Will you kindly supply me with information concerning (1) the whole duties, or likely duties, of a dynamo attendant over a main generating plant installed with two Westinghouse-Parsons steam turbines, with a normal capacity of 3,000 h.-p., directly connected to a Westinghouse 3,000 h.-p. generator, which generates electric current at a pressure of 11,000 volts, three-phase, at 25 periods per second; with other accommodation for units 2,000 k.w., 3,500 kw., and 9,500 kw.; also two exciters in same room, which consist of a Westinghouse vertical compound engine, running at 290 revolutions per minute, coupled direct to a compound wound dynamo, generating direct current at 125 volts pressure? Secondly, the knowledge expected of a man who is to be in attendance? Thirdly, from what source, and by the aid of what books, can a man thoroughly equip himself in order to undertake and be master over any above like-mentioned plant? And, lastly, what extra duties, or likely duties, may crop up that he will be expected to undertake?

This is rather a question to address to the chief engineer responsible for the plant described, who would define the duties of such a position according to the circumstances of the case. You would probably be expected to have a knowledge of the various systems of winding dynamos and alternators, sufficient to trace out circuits and connections; also to know something about the theory of such machinery, the effects of alteration of brush position, variation in excitation, and so on, so that you could have some idea as to what was happening when troubles occurred. But your most valuable asset would be some experience in running electrical plant. As regards study, you should apply to a local technical college, or enquire of the Electrical Engineer Institute of Correspondence Instruction, 488, Norwich House, Southampton Street, Holborn, London; they may have a course which would be of advantage to you to follow.

[14,480] **Epicyclic Gear.** H. M. W. (Inverness) writes: I shall be glad if you could give me a description of an epicyclic gear reduction 4 to 1, suitable for a small lathe; something similar to that fitted on the Pittler lathe.

The principle of the working of epicyclic gearing is explained in "The Elements of Mechanism," by Goodeve; if you will study this book you may be able to work out the proportions of wheels, and then adapt a design to suit your lathe. A patent was taken out by A. G. Meeze in 1885 for an epicyclic internal gear for lathes; this might suit you, as the patent is now expired. You would be quite at liberty to make and use the mechanism. You can obtain the patent specification from the Patent Office, Southampton Buildings, London, W.C., price 8d. and postage (if still in print), by giving the number and year as follows:—Patent No. 5,912 of 1885. This contains a drawing of a lathe headstock, showing the gear, with a complete description of its construction. It is, of course, not a working drawing; but that you could make for yourself.

The Editor's Page.

WE would remind provincial readers visiting the Metropolis not to forget the Naval Exhibition at Earl's Court. This Exhibition should prove interesting to the model engineer by reason of the excellent collection of models on view in the several halls, those in the Prince's and Ducal Halls being especially fine. They comprise scale models of most of the best ships of the Cunard, Orient Pacific, Allan, P. & O., White Star, Donald Currie, and other well-known companies—the new turbine steamer for the Cunard, and the Allan turbine *Virginian*. Cargo and smaller passenger vessels are well represented and include several really instructive sectional models. Amongst the war craft are models of the latest British battleships and cruisers—the *Swiftsure*, *Terrible*, *Cape of Good Hope*, *Argyle*, and other modern types, together with scouts, torpedo boats, and torpedo boat destroyers. We also noticed models of the ill-fated *Viper* and the Hon. C. Parsons' first turbine boat, the famous *Turbinia*; and amongst the working models a very interesting one showing Messrs. Yarrow's ingenious system of hull construction for screw-propelled shallow-draft river steamers. Actual torpedoes and torpedo tubes, naval guns up to 12 inch bore made by Messrs. Vickers, Sons & Maxim, Ltd., are also on view.

* * *

Although during our visit we did not come across the model, we understand from our contributor that the model submarine *Nautilus*, which we illustrated and described in our issue of June 11th, 1903, is also to be seen at the Exhibition. As usual the Exhibition is provided with numerous side-shows, some of which are quite new. Messrs. West's cinematograph entertainment, "Our Navy," and the "*Entente cordiale*," which is given in a full-size model of Nelson's *Victory*, and "With the Fleet," in the Empress Hall, are well worthy of a visit.

* * *

To give an idea of the interest which many of our readers find in the perusal of the "blue covered sheet," as we have heard it affectionately termed, we quote from a letter received from Auckland, New Zealand. Our correspondent writes:—"I am one of your old English readers, though I have been out in the Colony for nearly twelve months. My back numbers of the good old *M.E.* have filled in many a lonely hour, and have been quite a boon to me. I have missed the last two volumes through having to keep moving about; but I am hoping to be more settled soon, when I shall get them sent out to me. I sincerely add my wishes to the many you have received for the welfare of your paper, and with this I close."

Answers to Correspondents.

M. J. M. C (Leeds).—We thank you for your kind letter, and will do our best to obtain from time to time such information as you request.

"STORAGE."—A 1½ b.h.-p. engine would do it comfortably. First cost about £16 to £19. Cost of running such an engine would be about ¾d. per hour.

J. E. H. (Coburg).—Shall be pleased to have your entry for our next "Gauge" Competition. Glad to hear from you, and to have post-cards.

R. G. B. (London, N.).—Thanks for yours, which we will bear in mind.

C. A. M. (Flen, Sweden).—You can get what you require from Messrs. Brown Bros., Ltd., Great Eastern Street, London, E.

W. J. P. (Erith) and J. J. B. (Ashton-under-Lyne).—See Editorial Notes in our issue of August 24th.

H. J. P. (Sutton).—We are arranging for some articles on this subject at an early date.

J. S. (Crosby).—A machine of 1,400 watts 50 volts, and giving 28 amps., would be required. See Perrin Maycock's "Electric Wiring, Fittings, Switches, and Lamps." 6s. 4d. post free. Read also recent query replies.

Notices.

The Editor invites correspondence and original contributions on all amateur mechanical and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected or not, and all MSS. should be accompanied by a stamped addressed envelope for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

This journal will be sent post free to any address for 13s. per annum, payable in advance. Remittances should be made by Postal Order.

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All correspondence relating to the literary portion of the paper, and all new apparatus and price lists, &c., for review, to be addressed to THE EDITOR, "The Model Engineer," 26—29, Poppin's Court, Fleet Street, London, E.C.

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Contents.

[*The asterisk (*) denotes that the subject is illustrated.*]

THE

Model Engineer

And Electrician.

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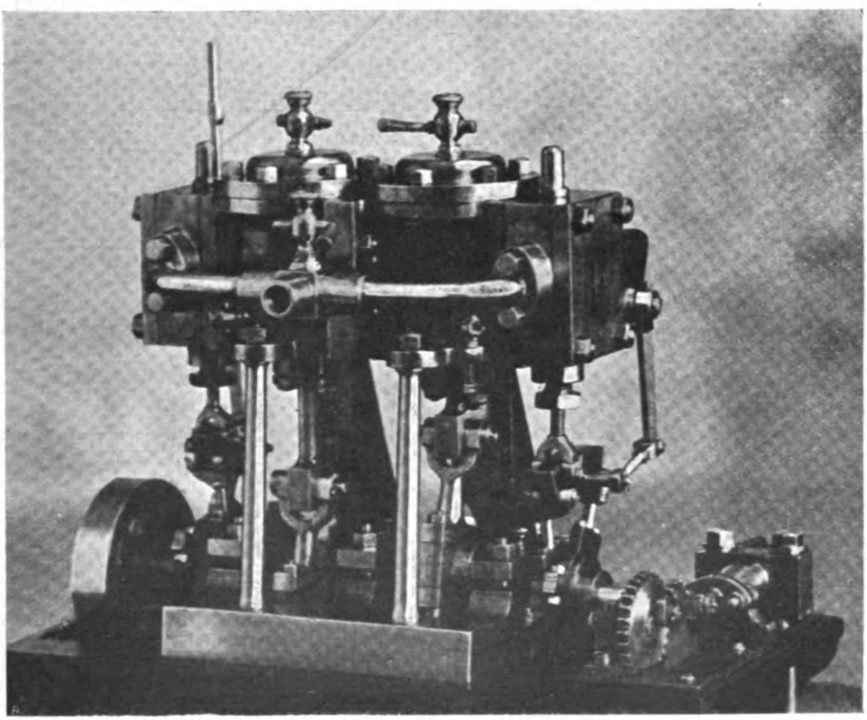
EDITED BY PERCIVAL MARSHALL, A.I.MECH.E.

VOL. XIII. No. 230. SEPTEMBER 21, 1905. PUBLISHED WEEKLY.

A Model Double-cylinder Marine Engine.

By DAVID CHARLESON.



MR. DAVID CHARLESON'S MODEL MARINE ENGINE.

THE illustration above shows a double-cylinder marine engine which I made last winter. Drawings for all the parts were made first, then the patterns. The description of the model is as follows :—

The cylinders are each 1¼-in. bore by 1¼-in. stroke. The bottoms are cast on the cylinders, saving extra trouble in making another joint with a bottom cover. The pistons have each two hard brass rings, turned ⅛ in. larger than the diameter of the cylinder, to give the necessary spring ; then an ⅛-in. piece cut out with a fretsaw. Crankshaft is made from a piece of mild steel, 1¼ ins. by ½ in. by 8 ins. long, cut out to shape, then brought to a white heat and twisted to right angles, centred at both ends, and turned to 13-32nds in. Then the sizes drawn on the shaft, and the metal that is not required between the webs drilled out, and the corners of the pins rounded with a file to save time in turning. Two discs were then made to turn the crank pin from a piece of cast iron 2 ins. diameter, ⅜ in. thick, drilled to fit on ends of shaft; then a small key driven in to keep discs in position. The centres of the pins were then marked on the discs by means of a surface gauge. The shaft was then ready for turning, which was a very slow job, as by taking a large cut it would bend and fly out of the centres. The pins were roughed out first, leaving a little for finishing. I found it necessary to jamb a piece of hardwood between one crank while working at the other, as it helped to keep the shaft steady in the centres of the lathe. After the pins were finished, the shaft was turned to ⅜ in. diameter. The feed-pump (5-16ths-in. bore, ½-in. stroke) is geared 2¼ from engine; the pump is fitted with phosphor-bronze valves. With an air pressure of 40 lbs. per sq. inch, the engine, running light, makes 2,000 revolutions per minute. In conclusion, I might add that most of the forgings were made in the kitchen fire, and the lubricators turned on a sewing machine. Other details may be gathered from the photograph reproduced on the front page.

Workshop Notes and Notions.

[Readers are invited to contribute short practical items for this column, based on their own workshop experience. Accepted contributions will be paid for on publication, if desired, according to merit. All matter intended for this column should be marked "Workshop" on the envelope.]

Bending Small Pipes.

By Eric Liddell.

The following method of producing a neat rounded bend in copper piping of about 3-16ths in. outside diameter occurred to the writer, and has been tried with great success.

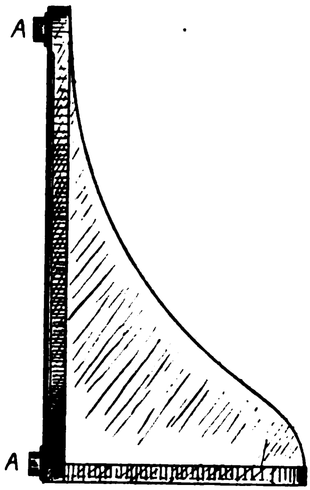
The tube to be bent has pushed into it a length of the metal spring part of an ordinary Bowden wire covering; the tube is then bent (a little more than the finished bend is required): the tube is then bent back to size of finished bend—this easing the spring inside—which can now be withdrawn by twisting and pulling simultaneously. The spring should be twisted so that its diameter is *reduced*, not in the opposite way.

The wire covering has also been used for springs—the whole of the springs in a motor bike clutch being replaced by pieces cut off a length of the covering and acting very successfully.

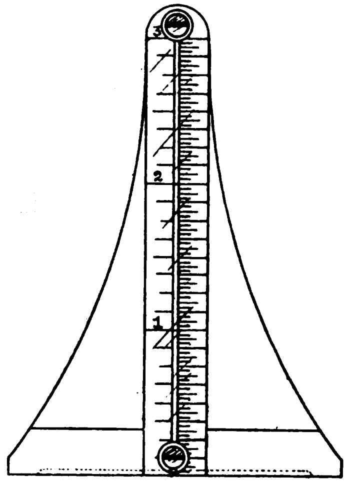
A Height Gauge.

By R. J. Mitchell.

When setting a scribing block for marking out, it is often needful to set its scribing point at some definite height. The tool shown in sketches well repays the trouble of making, and ensures more positive results than when a rule held against a square is used for this purpose. As will be seen, it is simply a rule, say, a Chesterman's 3-in., fastened vertically to the front of a casting whose base has been made flat; this is most easily done on a flat emery lap, and front side filed at right angles. The foregoing is elementary, and the only other point to be observed is to make the screw holes in the rule of a full clearing size, so as to allow of a slight initial adjustment.

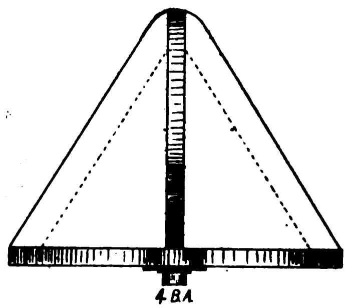


Side Elevation.



Front Elevation.

A Height Gauge.



Plan.

Hard Solder for Silver.

Equal parts of silver and brass make a good, hard solder for silver, which will fuse much easier, however, by the addition of 1-16th part of zinc. In soldering either silver or gold it is well to draw the solder into a wire, or to flatten between rollers and then cut into small bits, which may be used as required. To perform the work, first join the parts to be soldered together with fine, soft wire. Have ready some finely powdered borax, well moistened with water, into which dip a camel hair brush, and touch the joint to be soldered, placing a little solder on the joint. Apply a large piece of charcoal to the joint, and then with a blowpipe and lamp blow upon it through the flame until the solder melts.

Marking Steel Tools.

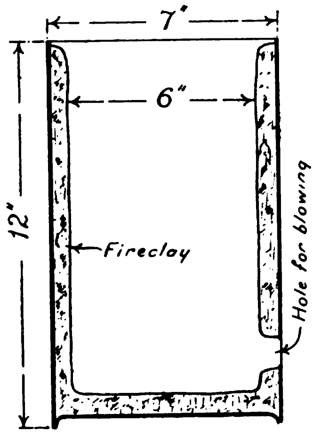
This is sometimes done in the trade by an etching rocess carried out as follows:—A rubber stamp, P aking white letters on a black ground, is required. m

Then an ink to use with this stamp is made with resin, ½ lb.; lard oil, 1 tablespoonful; lampblack, 2 tablespoonfuls; turpentine, 2 tablespoonfuls. Melt the resin, and stir in the other ingredients in the order given. When the ink is cold, it should look like ordinary printers' ink. Spread a little of this ink over the pad, ink the rubber stamp as usual, and press it on the clean steel—on a saw-blade, for instance. With a strip of soft putty, make a border round the stamped design, as close up to the lettering as possible, so that no portion of the steel inside the ring of putty is exposed except the lettering. Then pour into the putty ring the etching mixture, composed of 1 oz. of nitric acid, 1 oz. of muriatic acid, and 12 ozs. of water. Allow it to rest for only a minute, draw off the acid with a glass or rubber syringe, and soak up the last trace of acid with a moist sponge. Take off the putty, and wipe off the design with potash solution first, and then with turpentine.—*Work.*

A Small Brass Furnace.

By E. Scholfield.

The following is a description of a small brass furnace I have made and had in use for a long time. The furnace is 1 ft. high and 6 ins. inside diameter. To make it, a piece of stout sheet iron 23 ins. by 12 ins. is required; this is bent round, so that after riveting the seam it measures 7 ins. diameter. For the bottom a round piece of sheet iron must now be fitted in. A hole about the size of a shilling should be made in the side, about 2 ins. from the bottom,



A Small Brass Furnace.

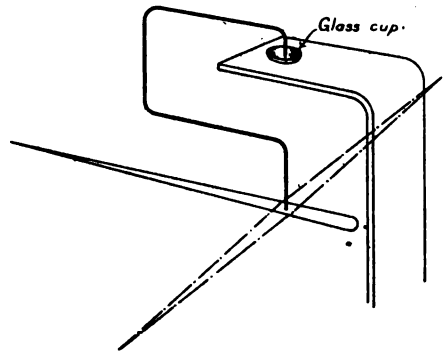
for the purpose of blowing. The furnace would then be ready for lining with fireclay, which must be done to a depth of ½ in. all round; also the bottom, no firebars being needed. Reference to the sketch will show how it is made. I use charcoal in mine, and for blowing I use an ordinary bellows, and get good results from it. For very small castings it is very satisfactory. I may mention here that a better blast is obtained by having the nozzle of the bellows about an inch from the hole, instead of quite close.

A Simple Galvanometer Needle Suspension.

By "Series Wound."

The following description of a galvanometer needle suspension, which for simplicity and sensitiveness should commend itself to all amateur instrument makers, should be of interest to readers of The Model Engineer.

The construction is clearly indicated in the accompanying sketch, and consists in fastening the needle to one end of a piece of stiff wire bent into the shape here shown, while the other end forms



Method of Suspending a Galvanometer Needle.

a pivot working in a small glass cup—such as might be formed by the sealed extremity of a small glass tube.

Much less mechanical skill is required to reach a given degree of sensitiveness by this means of suspension than by the forms of pivots usually described in this journal, while the mechanical advantages of this suspension over the more physical method of suspending by means of a thread of unspun silk need no pointing out. It should be mentioned that either type of needle may be employed, depending on form of instrument and scale.

The Latest in Engineering.

Improved Railway Points and Switches.—Of the details of the permanent way equipment of railways there is probably none which costs so much in attention and upkeep as the points and switches. The cost of oiling and cleaning of railway switches, the danger to the man engaged on the work, and the greater danger to the public if it is not done effectively, all enter directly or indirectly into the working expenses of the line; and the number of derailments when shunting, and the time and labour they involve, are almost all due to faulty operation or maintenance of the points. Messrs. W. J. Jenkins & Co., Ltd., of Retford, Notts, are now manufacturing an improved pattern of railway points, the chief feature of which is that there is no sliding motion whatever of the switch tongues over the chairs, and consequently no need of the perpetual oiling and cleaning necessary to keep the sliding surfaces in good order. The tongues are connected by the usual cross-ties, and are carried from one position to the other by the ends of a pair of small vertical levers set crosswise in the track between the rails. The weight of the tongues renders the combination only stable in its extreme positions, so that the points cannot remain in any intermediate position. The elimination of the slides renders operation very easy, and the more so as no balance weight is required on the operating lever. In fact, the latter can often be replaced with advantage by a simple pedal mechanism, so that a shunter may work it with his foot if his hands are encumbered with the usual lamp and coupling-pole. The ease and certainty of operation are very noticeable, and we understand that four sets of the points have been working day and night in a very busy yard for over two years without a drop of oil and without cleaning. One of these sets, installed where derailments due to flying shunting were particularly frequent, has entirely eliminated the trouble from that source. The mechanism is extremely simple, containing neither balance-weights, springs, nor sliding surfaces, and can be applied to any existing points, whether worked by hand, electric, pneumatic, or other power.—*Engineering.*

Trial of a New Channel Turbine Steamer.—The turbine steamer, *Princess Elizabeth*, built by the Société Anonyme John Cockerill, of Seraing and Hoboken, Belgium, for the Belgian Government, has very successfully completed her trials on the Clyde. Constructed for the mail service between Ostend and Dover, the *Princess Elizabeth* has a length of 344 ft., a beam of 40 ft., and a mean draught of 7 ft. 9 ins. She has three propellers, each driven by a Parsons turbine, and she was built for a guaranteed speed of 22½ knots. Her official trials were run between the Cloch and the Cumbrae Lights recently, when she attained an average speed of 24 knots on four runs. The vessel was also required to do 13 knots astern, and when tried on the measured mile she averaged no less than 16 knots on two runs.

The Mond Gas Plant Tests.—The official tests of the 1,000 h.-p. Mond gas plant erected for the Midland Railway at Heysham Harbour have now been completed, the actual results being 10 per cent. better than the guarantee. The heat units in the gas produced from 1 lb. of fuel amounted to 9,720 British thermal units; the quality of the gas varied in different tests from 185·6 down to 158·3 British thermal units per cubic foot. The plant consists of two producers and their accessories, and four gas engines rated at 250 b.h.-p. each. The fuel used was a bituminous coal, and the amount required amounted at full load to 1·28 lb. per b.h.-p. Two men suffice to look after the whole of the gas plant.

Automobile Speed Limit. — A prominent French automobile engineer recently stated that it would not be possible for a modern racing automobile to exceed the speed of 130 miles an hour while it is maintained at the present weight. M. Serpollet, the designer of the well-known steam car of that name, has therefore decided to approach this maximum as near as possible during this year. He is now constructing a steam car which he is confident will accomplish the kilometre in 18 secs., or at an average speed of 125 miles an hour. The motor will develop over 200 h.-p., and the weight of the engine without the steam generator or boiler will be only 150 kilogrammes (330 lbs.).

In South-Western Finland, deposits of zinc copper, and lead ore have recently been discovered. There have also been found traces of gold and silver.

Slide and Micrometer Calipers.

By A. W. M.

(*Continued from page* 248.)

Micrometer calipers, like the vernier calipers, are used to measure very small fractions, such as the 1-1000th in. Instead of a scale, however, the measurement is made by a means of a screw of accurate pitch. Suppose a screw is cut with a pitch of 1-10th of an inch—that is, the distance from the top of one turn of the screw to the next is 1-10th in., there would then be ten complete turns in 1 in. (see Fig. 14). If this screw was made to fit nicely into a nut, the following actions could be effected :—(1) If the nut was fixed so that it could

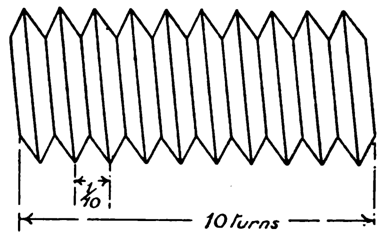


FIG. 14.

neither turn round or move and the screw was rotated, its end would advance, the point being flush with the face N of the nut (Fig. 15) at the commencement would move forward to P, a distance of exactly 1 in., when the screw had been rotated by exactly ten revolutions; with five revolutions it would move ½ in.; with one revolution 1-10th in.; and so on. (2) If the screw was fixed and the nut free to move, it would travel along the screw a distance of 1 in. (Fig. 16), when it was rotated through ten revolutions, or 1-10th in. for one revolution; and so on. (3) If the nut was only free to rotate but not to move sideways, and the screw was free to move but not to rotate, ten revolutions of the nut would cause the end of the screw to move exactly

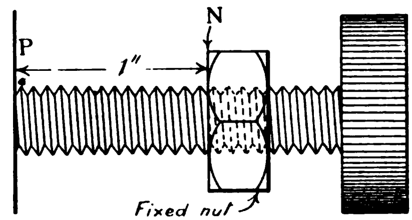


FIG. 15.

1 in. from N to P (Fig. 17); one revolution of the nut would cause it to move 1-10th in.; and so on. It will be seen from this that we have here a means of measuring the movement of a surface attached to a screw or a nut, provided we know how many turns the screw makes round its axis in a given distance, and that if the end of the screw formed the movable jaw of a caliper we could measure the amount of opening of the jaws by counting the number of revolutions of the screw or nut which had taken place to open the jaws to any amount.

To measure very small fractions we can count portions of a revolution. For instance, if only half a revolution had been given to the screw or nut, the amount of movement would be half 1-10th in., that is, 1-20th in.; if only the 1-10th of a revolution had been given, the movement would be only the tenth part of 1-10th in., that is, 1-100th part of an inch; and so on. To ensure that the correct amount of movement shall take place it is necessary to provide some kind of indicator to show when the screw or nut has been turned through a complete revolution or fraction of a revolution; it is also essential that the screw is made of accurate pitch, or else the measurement will not be correct. Though it is possible to compensate for inaccuracy, the screw is usually cut sufficiently good to render such precaution unnecessary.

The method adopted to show the amount of rotation which has been given to the screw, is to provide it with a plain circular head marked with a convenient number of equal divisions—ten, for instance; the lines dividing the circumference of the head exactly into ten parts (see Fig. 18). A complete or fraction of a revolution can then be accurately determined by adjusting the lines on the screw head so that they come exactly opposite to a fixed line on mark, such as the straightedge A (Fig. 18). The number of revolutions is determined by observing the position on the scale A of the edge B of the divided head: A is marked with divisions corresponding to the pitch of the screw, one complete revolution of B will cause the screw to advance one division along A. To ascertain the size of a shaft, for instance, you would place it between the end of the screw C and the face D; the screw is then rotated until the shaft is just touched by C and D. If it was exactly 1 in. in diameter, for example, the edge A would be opposite to the 1 in. mark on A and the 0 mark on B would be in line with the edge of A. If, however, the diameter of the shaft was slightly larger than 1 in., the 0

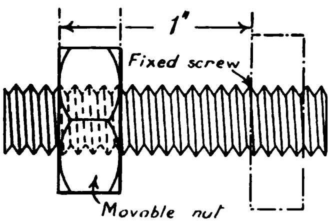


FIG. 16.

mark on B would not be in line with A but one of the other marks would be there, because B would have made a fraction of a revolution more than the exact number of revolutions necessary to move the end of the screw a distance of 1 in., and the number on B, which was in line with A, would indicate the value of this fraction. If the pitch of the screw was 1-10th in. and B was marked with ten divisions, the shaft would be 1 in. × 1-100th in. diameter if mark 1 was in line with A, or × 5-100ths in. if mark 5 was in line with A, and so on. By sub-dividing the ten divisions on B, the measurement can be made to a greater degree of accuracy: a sub-division to five parts would mean that the end of the screw would advance 1-500th part of an inch for each small division moved past the edge of A because B would now be divided into fifty parts, so that the 1-50th part of a revolution is indicated, and the pitch of the screw being 1-10th in. it is advanced 1-50th of its pitch, that is, 1-50th of 1-10th in. = 1-500th in. for each small division moved past the edge A. Such an instrument is called a micrometer caliper, and is an application of the principle illustrated in Fig. 15. The commercial form of this kind of caliper is an improvement upon the con struction, as shown in Fig. 18, the screw bein

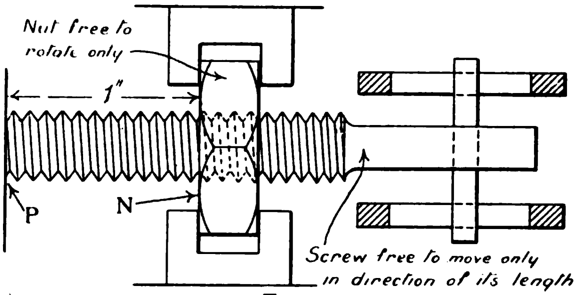


FIG. 17.

protected as much as possible and adjustments provided to compensate for wear and to lock the screw in position; but the principle is precisely the same as described.

The micrometer principle is also applied to slide calipers for making accurate measurements to small amounts instead of a vernier scale, removing the uncertainty of deciding at which line to commence the counting, as with the vernier.

A common form of micrometer slide caliper is shown in Fig. 19. In appearance it is very similar to the caliper described in Fig. 1, and the general remarks regarding the marking of the scale, method of determining the division to be taken when reading a measurement, and construction, are applicable to these calipers. The distinguishing feature is the use of a micrometer screw and nut instead of a vernier scale to indicate minute fractions of the divisions marked on the bar; it is an application of the arrangement explained in Fig. 17. The movable jaw B is provided with a screw S fixed so that it cannot rotate; upon this screw is threaded a nut M which can rotate upon the screw but cannot move along it, being held between the arms of the sliding clamp F. When this clamp is fixed to the bar by means of the setscrew N, the jaw B will be moved along the bar if the nut M is rotated, the amount of movement per revolution or part of one depending upon the pitch of the screw.

Suppose now that the bar is marked into divisions of $\frac{1}{4}$ in. each as its smallest divisions, and that the screw has a pitch of $\frac{1}{4}$ in. also, it is evident that B will move that amount for one revolution of the nut M; for half a revolution of M it will move half a quarter of an inch, that is, $\frac{1}{8}$ in.; or for a quarter of a revolution of M the movement of B will be a quarter of a bar division, that is, 1-16th in.; and so on. It will be seen, that provided we can accurately determine small fractions of a revolution of M, we can easily measure to very small fractions of a bar division. This is where the benefit of the micrometer screw principle appears, because we have only to mark the surface of the nut M into divisions corresponding to the smallest fraction of a revolution which we desire to indicate and to provide a fixed zero mark on one of the jaws of F to enable any fraction of a revolution of M to be determined ; and, further, by making the diameter of M large enough, we can ensure that the divisions marked upon it are so large that they can be read without the aid of a magnifying glass.

As very small fractions are more conveniently expressed as decimals of an inch, it is usual to arrange micrometer calipers to indicate to the 1-1000th part of an inch ; the actual size of the bar divisions would depend upon the pitch of the screw: a convenient division is the 1-40th part of an inch, the screw being of the same pitch. If the surface of the nut M is then marked into twenty-five divisions and it is turned through that part of a revolution, the jaw B will be moved an amount equal to the one-twenty-fifth of a bar division, which is equal to 1-1000th in., because 1-40th × 1-25th = 1-1000th.

To use such a caliper, the object—say, a round piece of steel—to be measured is placed between the jaws A and B, and they are closed until they just touch it; the position of the indicating mark L on the movable jaw is then noted: if it is exactly opposite to a bar division, the size can be at once noted ; but if the mark is slightly to one or the other side of one of the marks on the bar, you must use the micrometer to determine the fraction of a division by which the measurement is short of or beyond the mark on the bar. For instance, suppose the bar to be exactly 1 in. in diameter, then the mark L will be exactly opposite to the 1 in. mark on the bar ; but if L is slightly beyond the 1 in. mark it would show that the bar was larger than 1 in. in diameter by some small fraction of an inch. To determine this fraction, first clamp the jaw B by means of its setscrew D so that it cannot move, and remove the steel bar from between the jaws, leave N slack, then rotate the nut M until its 0 line is exactly opposite to the mark P ; now

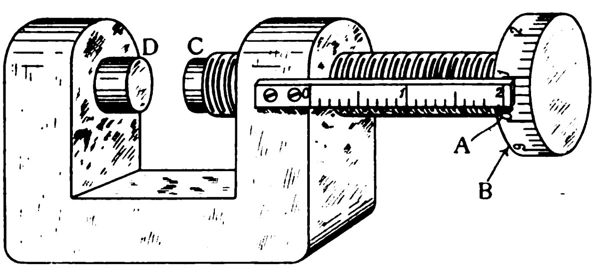


FIG. 18.

screw up N so that the clamp F cannot move along the bar; slacken D so that B is free to move. The nut M is now to be rotated until the mark L is exactly opposite the 1 in. mark on the bar ; the amount of rotation of M will indicate the distance which the jaws have required to be closed to bring L to the 1 in. mark, and, therefore, the exact size of the bar which is being measured. If the nut only required turning through an amount equal to one of its divisions, the jaw B would have only moved 1-1000th in. ; therefore, this would be the amount by which the diameter of the steel bar exceeded 1 in.—its size would therefore be 1·001 in. If the bar had been smaller than 1 in., the operations would have been precisely the same, except that the nut M would have been rotated in a direction to open the jaws until the mark L had reached the 1-in. line on the bar ; the reading would then show that the steel bar was ·001 in smaller than 1 in. in diameter.

You would proceed in exactly the same way if you wished to make one bar smaller or larger than another by a certain amount—say, 3-1000ths in. You would set the caliper so that it measured the diameter of the bar which was not to be altered ; then tighten up D, slacken N, set M so that its 0 line was opposite to P ; tighten N, slacken D, and rotate the nut M by as many divsions as required by the alteration in size : in this case, three divisions one way or the other would move the jaw B by 3-1000ths in. which is the difference required ; then finally tighten up D, and turn the new bar until it fits exactly between the jaws. If the jaws were fitted with projections (H, H) for measuring the diameters of holes, the same operations would be used to measure holes of different sizes, to alter a hole by a given amount, or to measure the sizes of spindles, etc., which were required to fit into a hole with a certain degree of fit.

Micrometer slide calipers are sometimes arranged with a movable screw (as in Fig. 18) fitted to the sliding jaw, instead of the arrangement of nut as Fig. 19. With these instruments the mark L is first set exactly opposite to a line on the bar which corresponds nearest to the size of the object to be measured ; the micrometer screw is then adjusted until the object to be measured is clipped between the jaws ; the difference in size is then read directly from the divisions marked on the micrometer screw-head.

The vernier caliper depends for its results largely upon the accurate marking of the scale ; the micrometer depends, as well, upon accuracy in the pitch of its screw. The backlash, or movement, which is always present between a screw and nut, is counteracted in the caliper shown in Fig. 19 by means of a spring which is coiled round the screw and, pressing outwards between the jaw B and clamp F, always keeps the nut M tightly against the thread of the screw. In micrometers such as shown in Fig. 18 the nut in which the screw works is usually split, and clamped by means of a screw, or screws, in such a manner that the backlash is eliminated.

It will probably occur to the reader that by combining the principles of the micrometer and vernier, exceedingly small measurements could be made ; this, as a matter of fact, is sometimes done in calipers to measure to the 1-10,000th part of an inch. If, for example, a circular vernier scale was engraved on the extension of F, in place of the single mark P, the marked surfaces of P and M meeting one another, a movement of 1-10th of a division on M could be easily read by the aid of a magnifying glass: this would indicate a movement of the jaw B of 1-10,000th in. Such calipers are only used for exceedingly accurate work. The usual workshop micrometer or vernier caliper reads to the 1-1000th part of an inch.

It is necessary to take some precautions when using slide calipers and micrometers, if reasonably reliable measurements are to be made. There may be some slight error in the divisions, or the opening between jaws may not exactly correspond to the indications of the mark which points to the divisions on the bar, as it is almost impossible to make such articles free from error. A new caliper should be examined, and if an inaccuracy in the reading is detected, the amount should be noted, so that it may be allowed for when measurements are made. Close the jaws and note if the indicating edge or line is exactly opposite to the zero mark on the bar; it may be slightly to one side or the other; if so, all your measurements should be made on the basis of this error. Be careful not to strain the caliper when closing the jaws, especially is this the case with micrometers and screw adjustments; the screw should only be moved with the lightest possible pressure, so that you can feel the contact between the measuring surfaces and the object to be measured. When comparing two articles, unless they are clipped between the jaws with exactly the same amount of force, the measurement as indicated by the caliper will not be correct. To guard against this fault, some micrometer screws are provided with a ratchet in the milled head, by which the screw is rotated; this ratchet slips as soon as the jaws grip the object with a certain pressure, thus ensuring that all objects are subjected to the same force, and, consequently, any difference indicated by the caliper must be due to size. It is quite easy, for instance, when measuring the diameter of copper wire, to flatten it to some extent when clipped between the jaws of a micrometer caliper, and thus obtain a false measurement. With all patterns of bar calipers it is important to tighten up the setscrews, such as D and N (Fig. 19), when the final measurement is made, except for temporary or approximate measurements, as the jaws may not be accurately square to the bar when the setscrews are loose.

To make a fine adjustment of the movable jaw by means of the screw S (Fig. 19), the clamp F should be fixed by means of its setscrew N, whilst the setscrew D is slackened so as to allow the jaw B to move along the bar. Always see that one of the screws—D or N—is slack before using the adjustment screw, as if the jaw and clamp should happen to be fixed tightly to the bar, there is risk of straining the screw and nut. These remarks also apply to the caliper shown in Fig. 1, as, though the screw here is not a micrometer screw, and therefore not used as a means of making measurements, yet it is better to avoid straining it.

Good bar calipers are usually fitted with flat springs between the points of the clamp screws and the bar, or the clamps and jaw are made to fit spring tight upon the bar, so that it is possible to

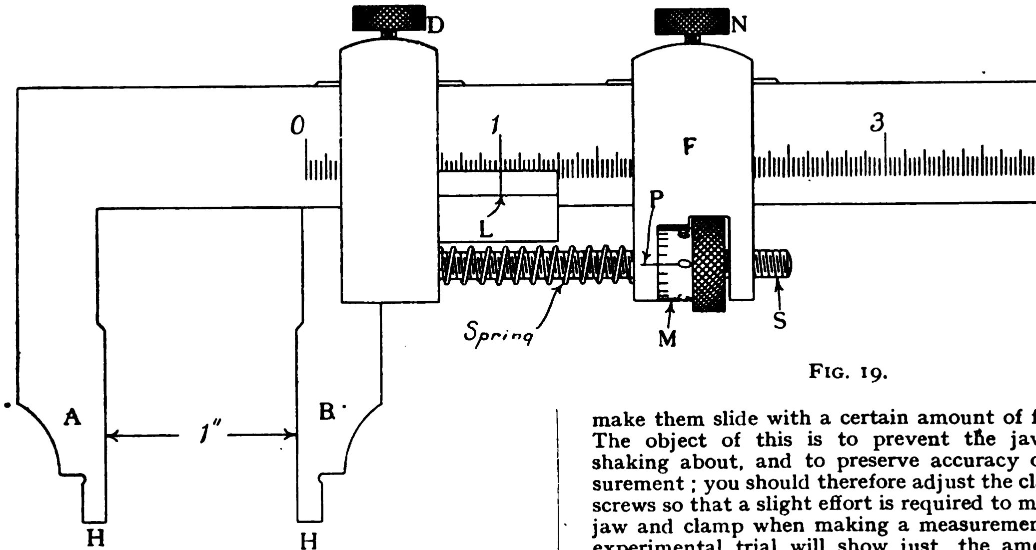


FIG. 19.

make them slide with a certain amount of friction. The object of this is to prevent the jaw from shaking about, and to preserve accuracy of measurement; you should therefore adjust the clamping screws so that a slight effort is required to move the jaw and clamp when making a measurement. An experimental trial will show just the amount of stiffness which gives good results. Remember that calipers which are to be used for measurements of 1-1000th in. should be carefully treated; if allowed to fall or be strained, they will not be reliable. The screws of micrometers should be kept in good preservation, as upon their condition accuracy of measurement depends.

NEW WIRELESS STATION IN CALIFORNIA.—A company is erecting a wireless telegraph station at Mount Tamalpais, California, whence they will communicate with Hawaii—a distance of 2,000 miles.

UTILISING BLACK SMOKE.—In many Belgian factories black smoke is utilised instead of being allowed to pass off into the open air. Fans drive the smoke into a porous receptacle, over which flows a stream of petroleum or other liquid, and the smoke is converted into gas. This gas gives a high heat, and is used for running gas engines.

UNIDIRECTIONAL WIRELESS TRANSMISSION.—An important improvement in space telegraphy is announced by Professor Braun, of Strassburg, Germany, the inventor of the system which bears his name. The Professor has succeeded, it is said, in sending wireless electrical waves in a single direction. Up to now it has been possible only to transmit waves in all directions. Much energy will be saved by the new invention, if it proves successful in practice.

Traction Notes on Road and Rail.

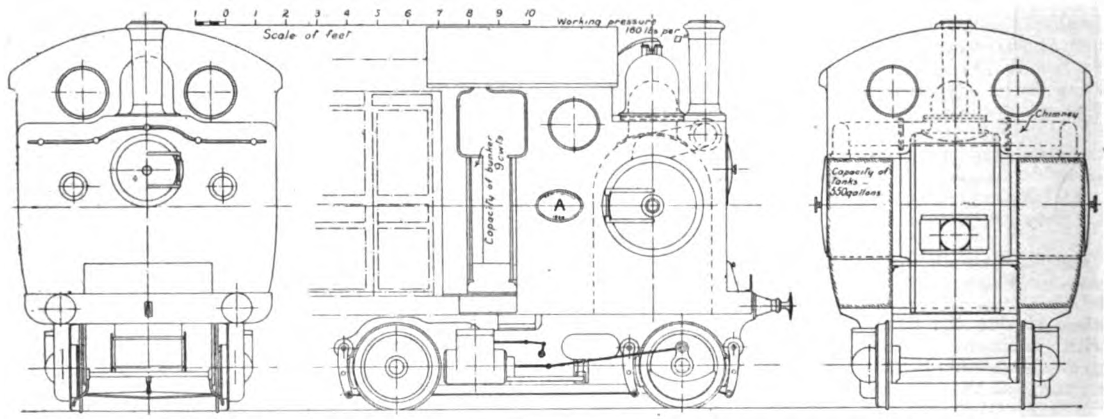
By Chas. S. Lake.

L. & N.W.R. Motor Developments.

This company has recently inaugurated a road motor service between Connahs Quay and Mold, connecting up the main Holyhead line with that from Mold to Denbigh, covering a distance of about eleven miles, through charming scenery, and passing through a number of villages—hitherto remote—during the journey.

The cars are painted the well-known L. & N.W. colours, viz., white and chocolate-brown, and they present a very attractive appearance. They accommodate thirty-four passengers, and carry a limited quantity of luggage. The need of such conveyances has long been felt in the district, and the vehicles are being especially well patronised.

The company have also put in service a steam goods lorry between Holywell Station and town, capable of taking a load of 5 tons, and also a trailer



Front Elevation. Side Elevation. Rear Elevation.

Fig. 1.—The Taff Vale Railway Steam Motor Car.

with a capacity of 2 tons. This is also proving of great benefit to those who have business with the railway.

The new steam motor coaches nearing completion at Wolverton for branch line traffic on the L. & N.W. Railway have two large passenger compartments, with a centre vestibule between them; also a luggage compartment and engine room. The centre vestibule is for the passengers to enter and leave the car by, and is controlled by the conductor, The seats in the compartments are arranged transversely along each side of the car, with a gangway down the centre. The engine is of the locomotive type, and, contrary to usual practice for these cars, the cylinders are carried inside the frames, as is also the valve gearing, so that all that is visible of the mechanism and parts are the coupling rods. This gives the design an especially neat and pleasing appearance, but it may be considered doubtful whether in an engine contained in such a small compass, and under the special conditions of working, it is not better practice to have the cylinders and gear outside. The appliances for controlling the car are duplicated, so that it can be operated from either end, according to the direction of running, and with equal facility. The car bodies are being built at Wolverton Works, from the designs of Mr. C. A. Park (Superintendent), while the engines are under construction at Crewe, these having been designed by Mr. Geo. Whale (Chief Mechanical Engineer). An illustration of one of these cars will shortly appear in these columns, together with dimensions.

Electric Locomotives on the District Railway.

Quite recently a trial trip was run for the purpose of testing two of the new electric locomotives for the District Railway. A standard L. & N.W. "Underground" train of ten coaches was hauled by the locomotives from Mill Hill Park to South Harrow and back, and a good speed was maintained, in spite of the gradients, for which, of course, the engines have not been designed. In ordinary working, the electric locomotives will replace the steam locomotives at Earl's Court for hauling the trains coming from Broad Street to the Mansion House. They have steel sides and frames, and are fireproof throughout. They are painted red, with gold lining, and resemble in shape an ordinary brake van.

Steam Rail Motor Cars, Taff Vale Railway.

The writer is indebted to Mr. Thos. Hurry-Riches, M.Inst.C.E., Locomotive Engineer of the Taff Vale Railway, for the accompanying illustrations of one of the steam motor coaches designed by him for working on that line. Each car is 58 ft. 9 ins. long over buffers, and runs upon two four-wheeled bogies, spaced with their centres 40 ft. $9\frac{1}{2}$ ins. apart, the total wheelbase being

49 ft. 3½ ins. Seats for twelve first- and forty third-class passengers are provided in some of the cars, but others have third-class accommodation only. Luggage space, measuring 3 ft. 11½ ins. by 8 ft., is included in the design.

There are two entrance gangways fitted with steps, which may be lowered and raised as desired. The car framing is constructed of steel channels and angles, stiffened by truss rods, and the body and frames are suspended to the bogie frame by eight spiral springs arranged to admit of passing round a five-chain curve.

The engine has two 9-in. by 14-in. cylinders placed outside the frames, the connecting-rods driving the end pair of wheels. Stephenson link motion is used for actuating the valves, which work above the cylinders by means of a rocking shaft.

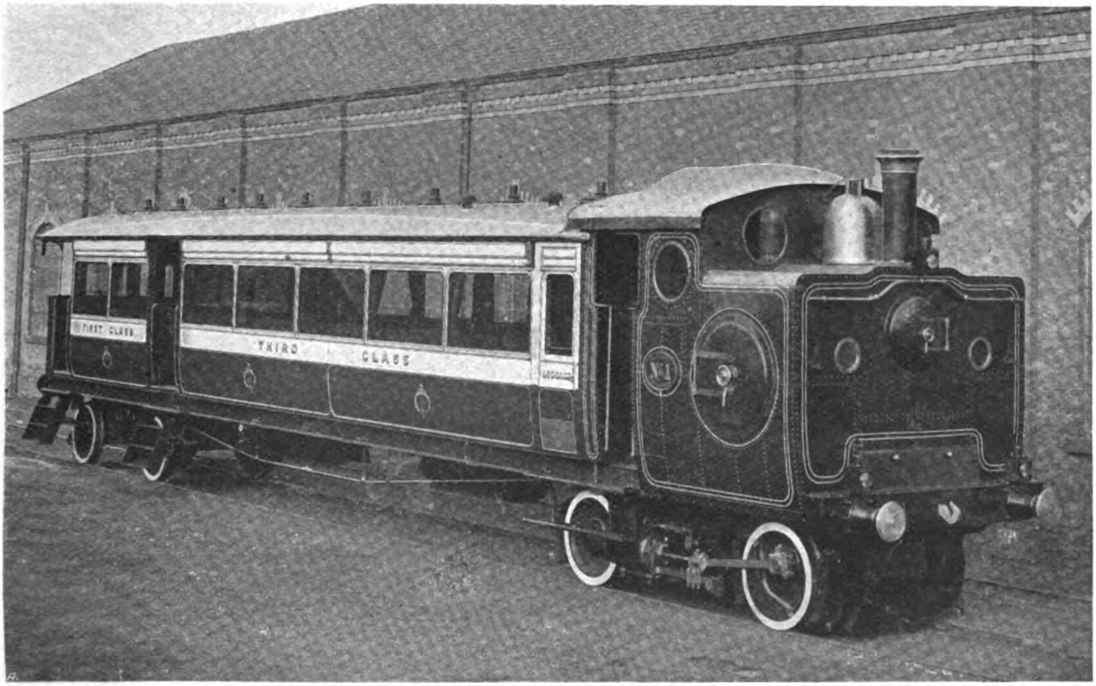


FIG. 2.—STEAM RAIL MOTOR COACH, TAFF VALE RAILWAY.

The boiler is of the multitubular type, constructed of steel plates, with a copper firebox. The barrel portion is placed tran versely, and the tubes are divided into two groups of 156 in each group. The total heating surface is 338·5 sq. ft., and the grate area 8 sq. ft.; and the working pressure 160 lbs. per sq. in. The engine bogie has 2 ft. 10 ins. diameter wheels, and a wheelbase of 9 ft. 6 ins. (in all the cars except No. 1, illustrated herewith, where it is 8 ft. 6 ins.) The water capacity of the tanks is 530 gallons, and the bunker holds 10 cwts. of coal. At 80 per cent. of the working pressure the tractive force is 4·263 lbs. The cars are proving successful in every way.

MOTOR OMNIBUSES IN LONDON.

The motor omnibus shown in the illustration on page 274 is one of several built by Messrs Straker & Squire, of Bush Lane, Cannon Street, E.C., for the London Road Car Company. The vehicle is of the "double-decker" type, and accommodates thirty-six passengers in all. The engine is petrol driven, and has four cylinders cast in pairs, with a water-jacket of specially large proportions, so arranged as to completely surround the explosion chambers of the cylinders and also the valve chambers. The water enters at the exhaust side of the cylinders, and passes out at the inlet side. The engine is securely bolted to the side members of the frame by means of lugs, or feet, cast in one with the bottom portion of the crank chamber, which is formed of two aluminium castings, jointed horizontally along the axis of the crankshaft, the latter being of forged nickel steel, and of very ample dimensions. The transmission of power is effected by clutch, through a change speed box immediately at the rear of the engine, and from thence to a second change speed box in front of the back axle. There are three changes of speed, and one reverse in the first speed box, and in the second speed box, which contains the countershaft and differential gear, there is a gear ratio change on the third motion shaft, which, in turn, drives by chains on the back axle. Two levers are employed for effecting change of speed; and by actuating the gear change in the second gear-box the three speeds contained in the first gear-box can be either doubled or halved. In this way six speeds can be obtained without the complication of a six-speed gear-box. The speed ratios are, approximately, 3, 9, and 14 miles per hour on high ratio; and 1½, 4½, and 7 m.p.h. on low ratio. This arrangement of six speeds gives a wide range for use under every possible condition of traffic, load, gradients, and weather.

The bore and stroke of the cylinders are 105 and 130 mm. respectively, and the horse-power developed is 24. The wheelbase of the vehicle is 13 ft. 6 ins., and total width over the hubs 6 ft. 5 ins. The normal engine speed is 950 revolutions per minute. The vehicles are fitted with "Royal Sirdar-Buffer" tyres, and are well and comfortably appointed in every way.

FRENCH SUBMARINES.—Three new French submarines, the *Opale*, the *Emeraude*, and the *Sapphire* will be the largest yet constructed. Their displacement is to be 422 tons, their length 146½ ft., and their beam 12¾ ft. They will each have two propellers, worked, when on the surface, by gas engines, and when submerged, by electric motors drawing their current from accumulators. The engines will develop 600 h.-p., with a corresponding speed of 12 knots per hour. Each boat will carry six torpedo tubes. They will be more habitable than boats of previous types, and they will have an increased radius of action.

A Large Pumping Plant.

THERE has just been completed, for the Tasmania Gold Mining Company, one of the largest pumping plants in the world. It is capable of dealing with 8,000,000 gallons of water per day from a depth of 2,000 ft. The plant is divided into three units. Each unit consists of a steam engine placed upon the surface, actuating four pairs of plunger pumps fixed in the shaft, raising the water 2,000 ft. in four stages, each of 500 ft. The engines are compound, differential condensing engines of unusually large size, and built for a steam pressure of 150 lbs. Each engine has a low pressure cylinder 108 ins. in diameter, with a stroke of 10 ft., and a high-pressure cylinder 50 ins. in diameter, also with a stroke of 10 ft. The quadrants, the arms of which are 15 ft. centre to centre, are built up of steel plates blocked with pitch pine. The main quadrant bearings are 18 ins. in diameter by 24 ins. long. The spear rods themselves are 22 ins. square, and in lengths of about 47 ft., the joints being made with steel spear plates and bolts in the ordinary way.

FIG. 3.—ONE OF THE "STRAKER" MOTOR OMNIBUSES FOR THE LONDON ROAD-CAR COMPANY.

A Small Electric Furnace and How to Construct It.

By H. Meyrick-Osborn.

The accompanying photograph (Fig. 1) shows a first-class working electric furnace, with which enormous heat can be attained quite easily. The method of constructing the furnace is as follows :—

First make a wooden core, the shape and size of the muffle required ; this is constructed with three strips of wood in the manner shown in Fig. 2. Two pieces (A and B), $\frac{1}{2}$ in. by $\frac{3}{4}$ in. by 4 ins., and one piece (C) tapered from $\frac{1}{8}$ in. by $\frac{3}{4}$ in. by 4 ins. to $\frac{1}{4}$ in. by $\frac{3}{4}$ in. by 4 ins. These three pieces are screwed together by means of two screws at one end, the tapered piece C being in the centre. Mark off 2 ins. at the unscrewed end, and carve this into

Fig. 1.—Mr. H. Meyrick-Osborn's Small Electric Furnace.

a ∩-shaped core 1 in. wide and $\frac{3}{4}$ in. high. The tapered piece should be left longer than the other two pieces to facilitate extraction later on.

When carved to proper shape and thoroughly smoothed, a piece of parchment paper is wrapped round the shaped end, a piece fixed at the end, and then secured with wax.

All now being ready for the building up of the muffle, take some finely powdered fire-clay cement (previously damped), and mix to a thick working consistency with silicate of soda (water-glass); spread a *very thin* layer all over the parchment paper, and place in a warm place to slowly dry.

The heat is to be obtained for the furnace by means of platinum wire. First of all, decide the voltage the furnace is to be worked with, then take a piece of platinum wire, and pull it down through a drawplate until about No. 24, or a little thinner; or I daresay the wire may be bought the required thickness to avoid any trouble and waste. Join up the length of wire in circuit with a lamp, using in the same manner as one would a resistance, and see how long a length is required to kill the light of the lamp; then cut out the lamp, and move one terminal down the length of platinum until it gets red-hot; then adjust until the greatest heat is obtained. Mark the length of wire, and cut off at this point. These experiments are best carried out on a sheet of asbestos board. In this particular furnace illustrated the current was obtained from a dynamo. The length of wire used was 14 ins., the voltage

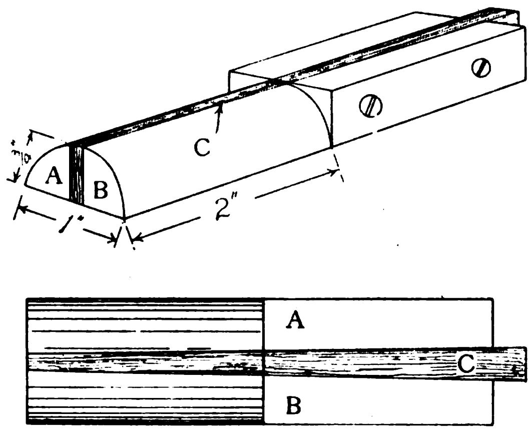


Fig. 2.—The Wooden Core.

required to obtain the greatest heat was about 30, amperes 5.

When the layer of fire-clay is fairly dry (not hard), wind on the length of platinum wire, leaving the two ends out to connect to terminals. The wire is best kept in position by means of binding with cotton, which will burn out when furnace is first used. Fig. 3 shows wire wound on. Now

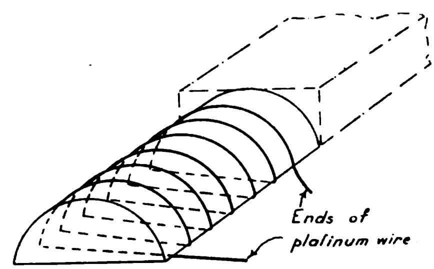


Fig. 3.—Method of Winding.

cover platinum wire with a fairly thick layer of fire-clay cement, and place in a warm place to harden.

Next make a box of thin sheet iron, a square (as at A) cut out of one side ; also one in front. To the front rivet a shelf (B) (see Fig. 4).

In the side A a piece of slate is riveted at D ; holes are drilled in slate E E, large enough to take two terminals, which are screwed in and fixed by nuts at the back. The holes F F are to bring the ends of wire through. When the fire-clay is nice and dry, have a long length of thin asbestos string; wind this round and round the fire-clay, then have plenty of asbestos waste, place a little at the bottom of box, place muffle in side, bringing ends of wire through the holes F F; pack more asbestos waste tightly all round until nearly full, then seal top with a mixture of 1 part plaster of Paris and 2 parts fine silver sand (powdered granite stone is better still); make into a thick consistency with water. When hard, cut off surplus, and leave level with front of case.

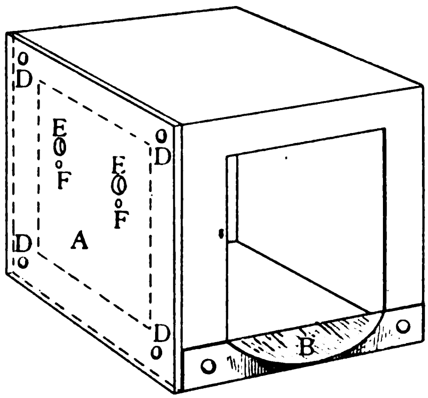
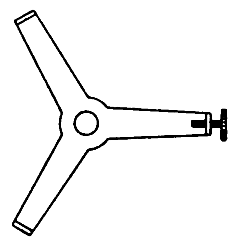


FIG. 4.—SHEET IRON BOX.

Now place the whole box in a warm oven for about six hours to dry gradually; take out, secure ends of platinum by clamping under bottom; screw nut of terminals, take out the binding screws in wooden plug, carefully withdraw centre tapered strip; then the other two pieces can be easily withdrawn, and the parchment peeled off without injury to the muffle. Now place it back into oven and thoroughly dry, gradually increasing the heat until the fire-clay is baked.

A very good and serviceable clamp for the box can be made by means of utilising a globe holder,

FIG. 5.—GAS BRACKET USED AS A CLAMP.



as found on gas brackets, provided it is of the proper shape; the two front teeth clip the front of the box, whilst the screw at the back tightens up the box. Any desired shape of stand can be turned up in the lathe, metal being the best material on account of the heat. When stand is ready, place furnace in position, connect up with dynamo through a resistance, and run the current through, care being taken to cut out the resistance and raise heat slowly the first time of using. After using once or twice, the furnace will be in perfect condition, the muffle hard as a brick, and enormous heat can be obtained; pure gold can be melted with ease. Very pretty jewellery can be made, such as now seen in the shops, by fusing together ordinary glass beads that have previously been crushed to a powder, and mixed with water to a thick paste.

Design for a Model Compound Horizontal Steam Engine.

By RICHARD W. ELTON.

FOR this design of a model compound horizontal engine I have assumed a pressure of 80 lbs. per sq. in. gauge, or 95 lbs. absolute at the valve chest of the H.-P. cylinder. It is required that the H.-P. cylinder of the compound engines shall use the same amount of steam as a simple cylinder engine, 1 in. diameter by 2 ins. stroke. The simple engine will use $\cdot 78 \times 1^2 \times 2 = 1\cdot 56$ cubic ins. per stroke. If we keep the stroke of the compound engine the same—viz., 2 ins. and cut-off at three-quarters of the stroke = 1·5 ins., the H.-P. cylinder of the compound will require to be $1\frac{1}{8}$ ins. diameter; this giving $1\cdot 12^2 \times \cdot 78 \times 1\cdot 5 = 1\cdot 48$ cubic ins. of steam per stroke; near enough for our purpose.

On drawing the theoretical indicator diagram for the H.-P. cylinder, cutting off at three-quarter stroke, we find a mean theoretical pressure of 77 lbs. per sq. in., and a terminal pressure of 57 lbs. per sq. in., both by gauge. Multiplying these values by a diagram factor of ·8, this being the relation of the probable to the theoretical diagrams, we find a probable mean pressure of 61·6 lbs. per sq. in.; and a terminal pressure of 45·6 lbs. per sq. in. Reducing these values still more to allow for back pressure, we obtain, say *55 lbs. per sq. in. average*, and *40 lbs. per sq. in. terminal* pressures by gauge.

Drop at receiver assumed as 5 lbs. per sq. in.

Pressure at L.-P. valve chest = 35 lbs. per sq. in. gauge, 50 absolute.

Proceeding as before, the theoretical diagram gives 33 lbs. per sq. in. average, and 22 lbs. per sq. in, terminal pressure, cutting off at three-quarter stroke. Mulitplying by diagram factor of ·8 reduces these to 26·4 average, 17·6 terminal pressure—both by gauge. Less back pressure, these become (say) 20 lbs. per sq. in. average, and 12 lbs. per sq. in. terminal pressure. Now, we wish to equalise the crank pin efforts as much as possible, for the engine to work smoothly, so we must obtain equal impulses in each cylinder. The mean total forward pressure in the H.-P. cylinder works out at $\cdot 78 \times 55$ (mean pressure per sq. in.) = 42·9 or, say, 43 lbs. The mean pressure in L.-P. cylinder being 20 lbs., we must have an area of piston

$$= \frac{43}{20} = 2\cdot 15 \text{ per sq. in.}$$

This gives an area of, say, 1 11-16ths ins. for the L.-P. cylinder. Thus, we start with these important points settled—H.-P. cylinder, $1\frac{1}{8}$ ins. diameter; L.-P. cylinder, 1 11-16ths ins. diameter, both 2-in. stroke, cutting off at three-quarter stroke.

Looking at the elevations and general plan of the engine (Figs. 1, 2 and 3), we see that it is of the coupled compound type, the high- and low-pressure cylinders being on either side of the flywheel. The H.-P. cylinder is governed, and on the opposite side of the bedplate is the pump. The engine being designed for a speed of 600 revolutions per minute,

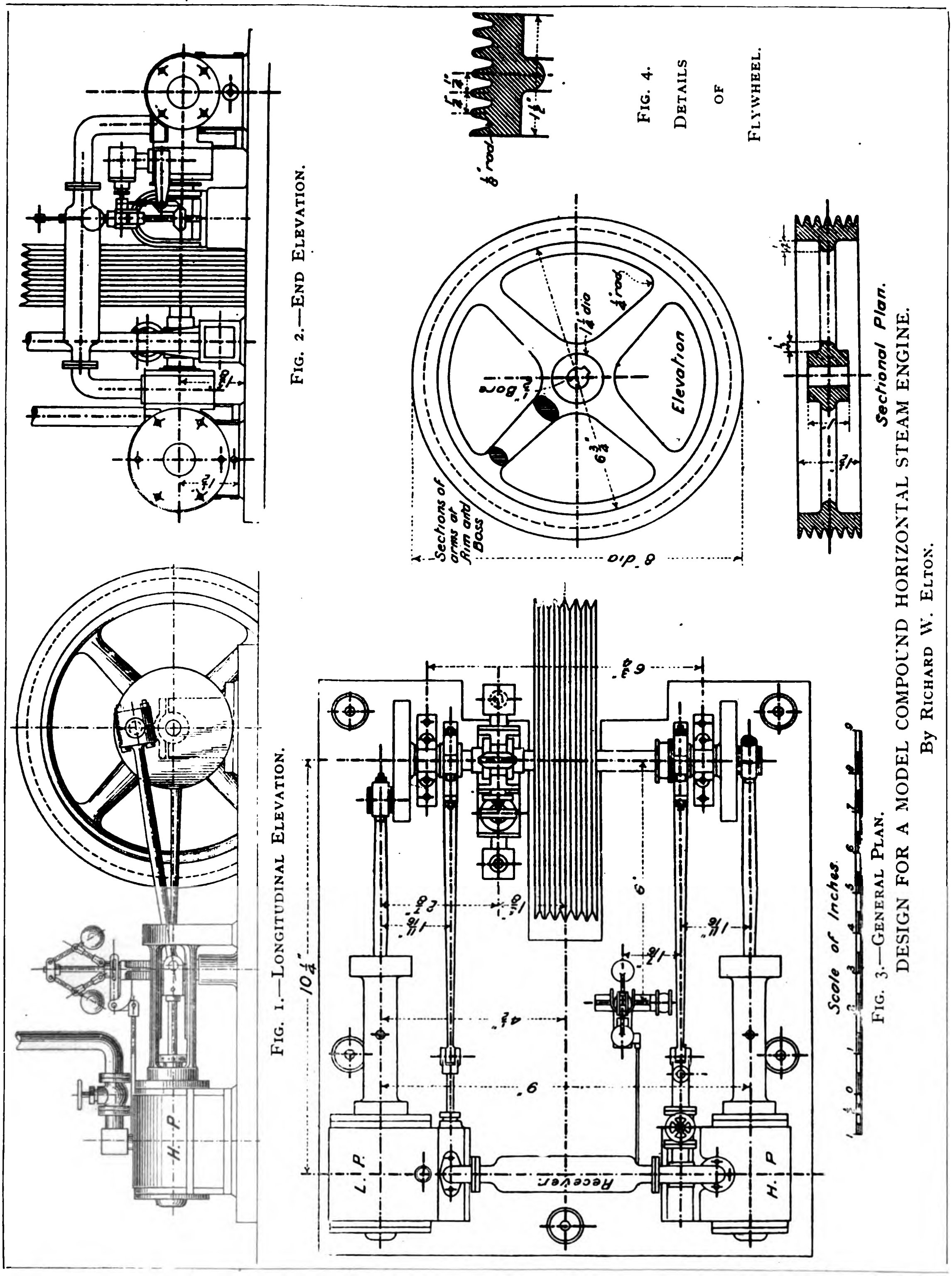


Fig. 1.—Longitudinal Elevation.

Fig. 2.—End Elevation.

Fig. 3.—General Plan.

Fig. 4. Details of Flywheel.

DESIGN FOR A MODEL COMPOUND HORIZONTAL STEAM ENGINE.

By Richard W. Elton.

a direct-driven pump would be inadmissible. The pump has, therefore, been arranged to be driven through the medium of worm gearing; the worm being double-threaded and the wheel having twenty teeth, gives a speed reduction of 10 to 1, or a speed for the pump of sixty strokes per minute with the engine at 600 revolutions per minute.

Between the stop valve and the H.-P. valve chest is a throttle valve, acted on direct by the governor through rods. Between the cylinders is the receiver.

make the casting too complicated, these might be cast in one with the cylinder, thus making a better job. The cylinders should be lagged with non-conducting material, and covered with sheet brass or steel, at the discretion of the maker. The sheeting can be screwed to the lugs shown, by 1-16th in. snap head screws. The method of fastening on the valve chest should be noted, as it enables the cover to be removed and the valve set by sight.

The back covers present no special features, the

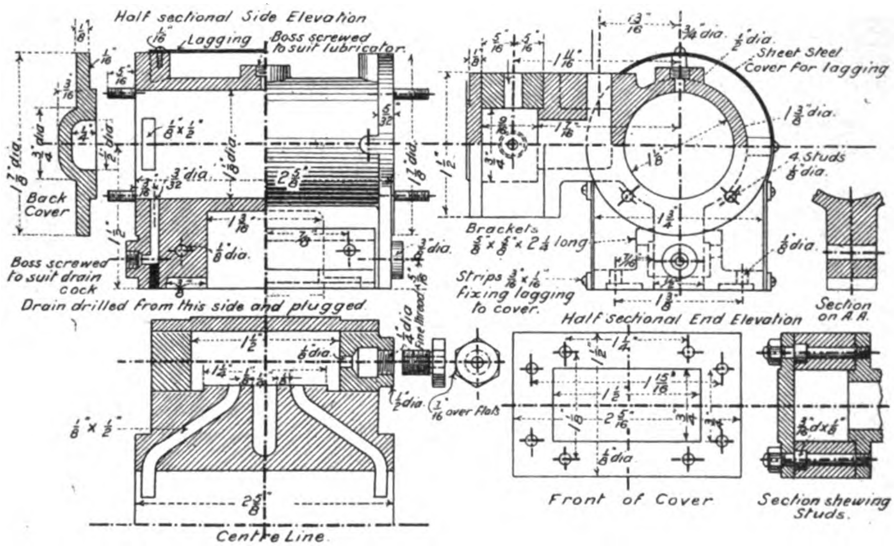


FIG. 5.—DETAILS OF H.-P. CYLINDER.

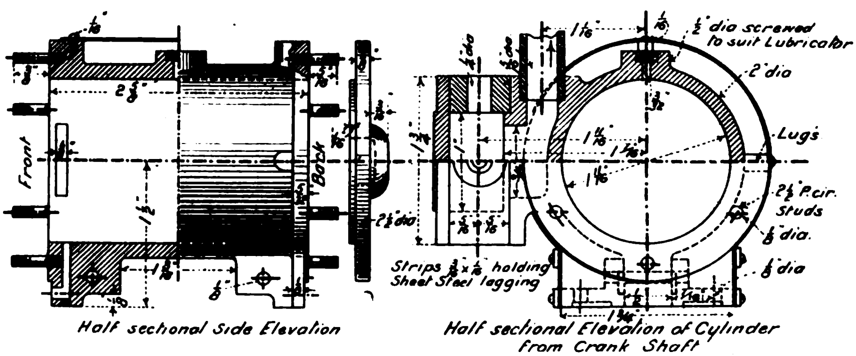


FIG. 6.—DETAILS OF L.-P. CYLINDER.

The cylinders, perhaps, rank first in importance. (Details are shown in Figs. 5, 6 and 7.) They may be cast in iron or gunmetal, as desired. The ports are cast in. It will be seen that the ports are ⅛ in. wide, and the eccentric only opens the valve 3-32nds in. This gives sufficient steam opening, and the full width of the port will be available for exhaust. The cylinders are drained at each end; the drains are better drilled from the bottom of the cylinder, and plugged as far up as necessary, as shown by black portion. The cylinders are fastened down to the bedplate by angle brackets, shown dotted on end elevations. If it would not usual central recess being for the piston-rod nut to pass into.

The bedplate should be of cast iron (see Fig. 8), but if considered better, a plain plate may be substituted without any alteration, except lengthening the governor casting.

(To be continued.)

NEW FRANCO-SPANISH RAILWAYS.—A convention has been concluded between France and Spain for the construction of three new railways through the Pyrenees—viz., from Aix-les-Thermes to Ripoli, from Oloron to Zuera, and from St. Giron to Sort.

Notes on Magnalium and other Light Alloys.

WE are indebted to Mr. R. E. Barnett, B.Sc., for permission to extract the following passages from a paper recently read by him before the Yorkshire Section of the Society of Chemical Industry :—

At the present time, three magnalium alloys are in regular use, denoted by the letters X, Y, and Z. The first of these is for forging or for castings in which strength is a primary consideration. Forging is done at about 330° C., special care being taken to avoid oxidation. The second, Y, is ordinarily used for casting. To secure good results, oxidation must be carefully guarded against, the melted metal must not be agitated or overheated, and after pouring the casting should be cooled as quickly as possible. The melting point is slightly above that of aluminium. The castings when properly made are clean and sharp. The third alloy, Z, is used for rolling and drawing. Rolling is done between 300° and 350° C. Frequent annealing is necessary, unless very hard sheet is required. Apart from the method pursued in rolling, it is stated that soft sheet can be made springy by heating to about 390° C. and slow cooling. Rapid quenching makes it soft. Similar considerations apply to drawing into rod, wire or tube. Frosting is done, as with aluminium itself, by alkaline liquors.

It will be noticed that except for its greater tendency to oxidation when hot, the treatment of magnalium by the foregoing processes is very similar to that required for aluminium. Magnalium has, however, two advantages at least over pure aluminium. Its tensile strength is decidedly higher. This is said to range from 8½ to 10 tons in the case of ordinary castings (Y), up to 23 tons for Z when rolled hard. The most conspicuous advantage is in its behaviour with cutting tools. It is painfully familiar to all who have had to use aluminium, that such operations as filing, turning, drilling, and screwing are far from satisfactory with the pure metal. It drags and tears and clogs the cutting edges. Very small cuts have to be taken at high speed, with good lubrication. The case is very different with magnalium. It works cleanly in the lathe. When turned at a surface speed of 100 ft. per minute, without any lubricant, long spiral shavings come off and the surface left is free from any signs of dragging or tearing. It is also

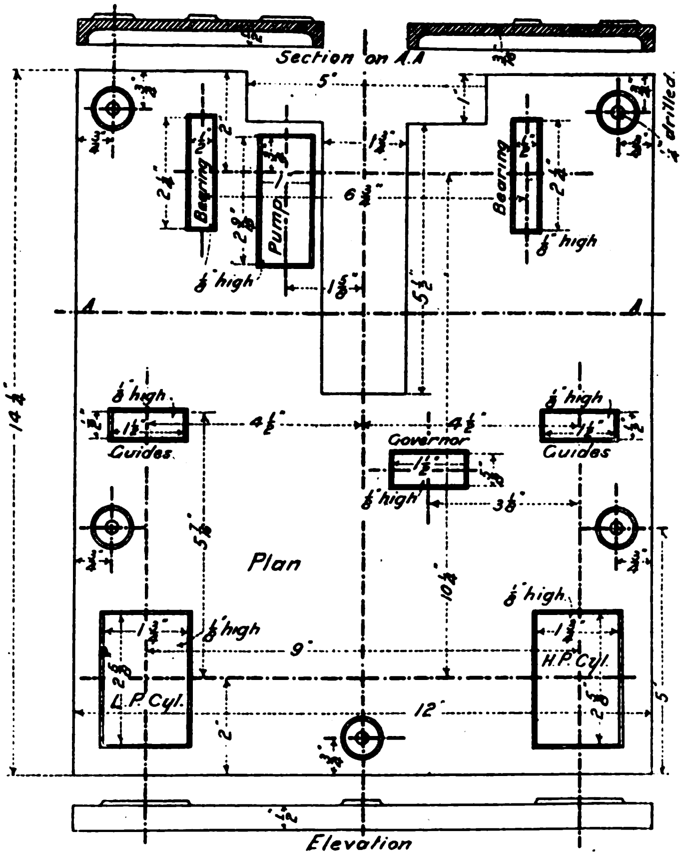


FIG. 8.—DETAILS OF BEDPLATE.

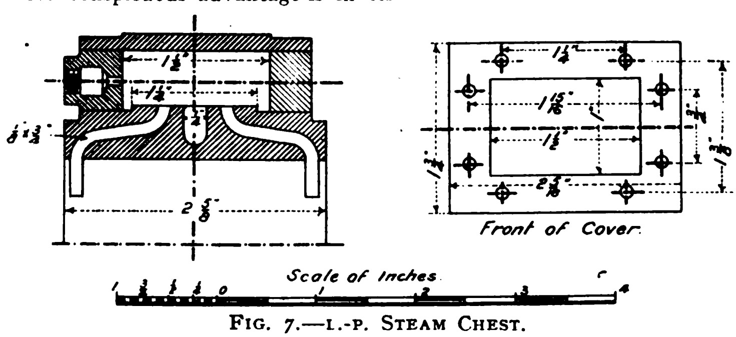


FIG. 7.—L.-P. STEAM CHEST.

free from tool-marks, a circumstance which suggests that the softness of the metal makes it flow on contact with the cutting edge. This idea is supported by the curious way in which the metal builds up on to the tool-edge when being turned or drilled without a lubricant. I find that a cutting edge, whose angle is about 65 degs., such as would do for steel, serves very well for magnalium. A less acute angle, such as is used for brass, is not so satisfactory. When turned in the manner here described, a silvery-white surface is produced on which any polishing operations seem superfluous.

In order to see if the presence of magnesium would render aluminium susceptible to corrosion, I made a comparative test by exposing sheets of magnalium to the laboratory atmosphere for three weeks, side by side with sheets of aluminium, zinc, copper and brass; all the surfaces being in a precisely similar condition. The magnalium showed no special signs of corrosion, and the laboratory atmosphere had decidedly more effect on the zinc, copper, and brass.

"Zisium" and "ziskon" are two light alloys prepared for use primarily in scientific instrument making. Zisium was first named zalium, but it was found that this name could not be registered. Both alloys are silver-white in colour and make good castings, in which form only they are supplied.

Zisium is the lighter, having a density of 2·95 as compared with 3·35 for ziskon. The latter is, however, much harder and stronger. The tensile strength of the metals (cast in sand) is stated to be nearly 5 and 11 tons per sq. in., respectively, according to tests made at the National Physical Laboratory. My experience of their working properties is confined to the making of turnings for the purpose of analysis. Zisium cuts like very soft brass, in short curly chips, using a tool as described for magnalium. Ziskon seems to have a texture resembling that of cast steel, though, of course, much softer. It needs to be cut at a slower speed than zisium and gives long shavings.

Want of time has prevented my doing more than making a qualitative analysis of each of the two sample castings of these alloys which I have had. The results show, as might be expected from the specific gravity, that both are aluminium alloys. Zisium, like magnalium, appears to be essentially aluminium, modified by the presence of small amounts of other metals. I find in it zinc, tin, and copper, with a trace of antimony, and a minute trace of bismuth and possibly thallium.

Ziskon has a different character. It is a zinc-aluminium alloy, containing perhaps one-fourth its weight of the former metal, as far as could be judged by a rough weighing of the zinc sulphide obtained in the qualitative analysis.

A Gasoline Schooner.—The *Sotoyome*, said to be the largest gasoline schooner in the world, made her trial trip in San Francisco Bay on July 16th. She is 680 tons, and is equipped with Union gas engines burning crude oil, and developing 300 horse-power. She will run between San Francisco and Albion.

A 1-in. Scale Model Broad Gauge Locomotive.

By the Rev. E. H. Aston, M.A.

The illustrations herewith reproduced represent the locomotive and tender which I have built in my spare time, and the former, I might say, is the first steam model that I have constructed. It is a 1-in. scale model, broad (*i.e.*, old G.W.R.) gauge. Castings for engine supplied by Martin & Co., West Ham, for model of G.N.R. (Mr. Patrick Stirling's) single 8-ft. express bogie engine. The boiler is of G.W.R. type, as used for Mr. Dean's single 7 ft. 8 ins. express bogie engines.

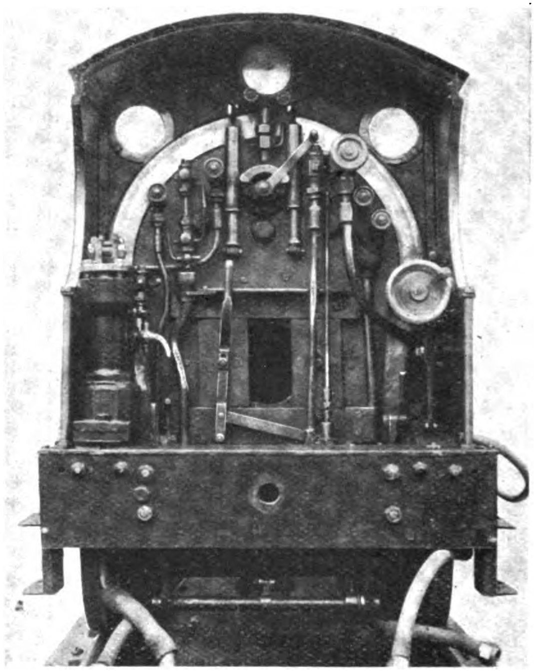


Fig. 1.—Interior of Cab.

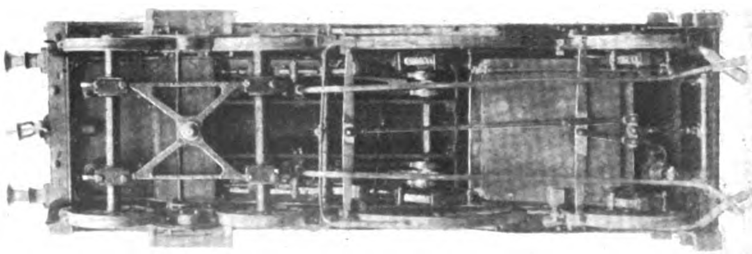


Fig. 2.—Underside View.

This model has outside cylinders 1 7-16ths in. diameter and 2¼ ins. stroke; driving wheels, 8½ ins. diameter; working pressure, 55 lbs. on sq. in. It is fitted with steam brakes on the engine, worked by brake cylinder beneath footplate, and hand-brakes on the tender; steam sanding gear, ring-blower under chimney, cylinder drain cocks, forward and back ashpan dampers, steam valve and pipe to warm the tender tanks, butterfly regulator valve in the steam dome, Eaton's injector, large hand-pump—all operated from the cab. Stephenson's link-motion reversing gear, worked by hand-wheel and square-threaded screw. The smokebox is extended, with circular front. Two small feed-pumps are worked by eccentrics on the driving axle.

The eccentric rods, etc., are made of steel. The boiler (6 ins. diameter) and firebox, which are of copper, are strengthened by 85 stays, and have gunmetal foundation ring and fire-hole ring. There are 13 copper tubes, solid drawn, ⅜ in. outside diameter. The fire is lighted with charcoal, and is continued with coke; and the boiler steams very freely when helped by the blower.

There are two safety-valves, controlled by spring balances. The pistons are of gunmetal, packed with two brass rings. The engine will move with 5 lbs. of steam.

The painting is according to G.W.R. colours. The weight, engine and tender empty, is about 100 lbs.; in working trim it is about 130 lbs. Length over all is 54 ins.; breadth, 11 ins.

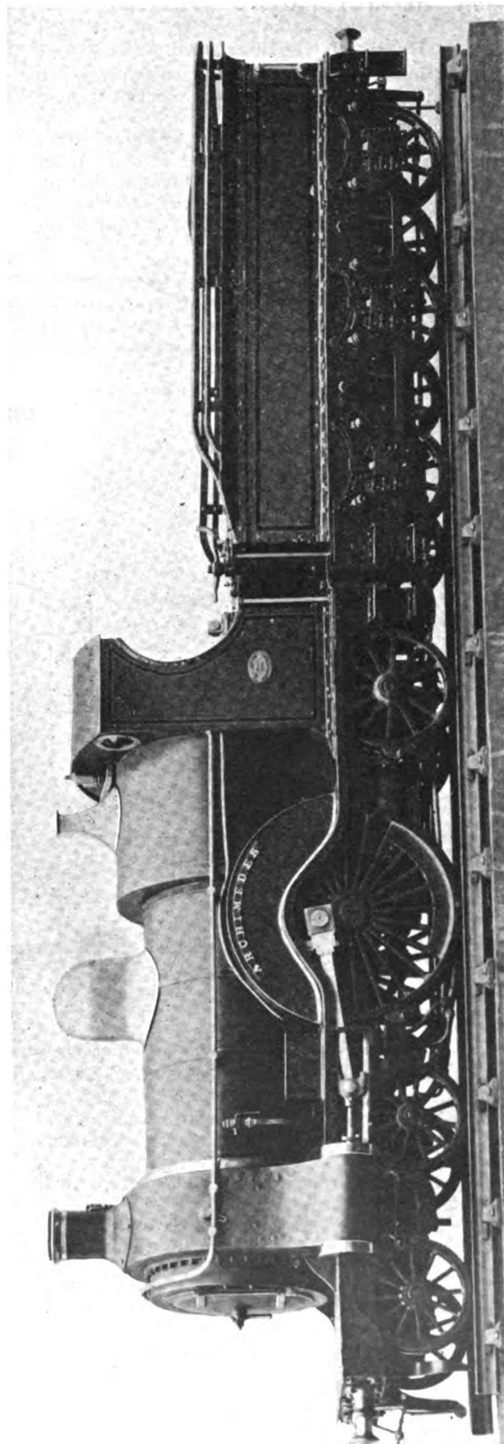


Fig. 3.—Rev. E. H. Aston's 1-in. Scale Model Broad Gauge Locomotive.

The "Holiday" Competition.

DURING the present holiday season we have decided to award every reader who sends us a description and original photographs of anything of engineering or model-making interest he may encounter during his vacation, which shall be sufficiently good to warrant insertion in our journal. The prizes vary in value from 5s. to 10s. 6d., according to merit. All winning competitors will receive a notice of the value of the prize awarded, when they can choose the tools or other articles they may wish sent to them. All entries should be accompanied by a separate letter, marked on the envelope "*M.E.* Holiday Competition." This letter should include the title of the article and any other information not necessary for publication. The article should be written *on one side of the paper only*, with the name and address of the sender on the back. The photographs and separate sketches enclosed with the contribution should similarly bear the name and address of the sender, otherwise delay may arise in the awarding of the prizes. It is essential that the copyright of the photographs must be the property of the senders, and the covering letter should contain a declaration to this effect. The competition will close on October 16th.

Benjamin Franklin Bi-centenary.—A movement is on foot among American engineering and scientific societies to celebrate next January the 200th anniversary of the birth of Benjamin Franklin.

Power in California.—The Central California Electric Company is to construct a 25,000 h.-p. hydro-electric plant on the banks of the river American at Alta station, about 60 miles from Sacramento. After passing the present pumping-station at Alta the water will be conveyed by means of a short canal to a point where a drop of 2,100 ft. can be obtained. There will be four direct-connected turbines of a capacity of about 6,500 h.-p. each, with polyphase generators working at a speed of 750 revolutions per minute.

A Model Force Pump.

By W. F. G. Bradford.

THE sectional drawing and photograph given herewith illustrate the construction of a force pump, designed and made by me some years ago for two purposes—firstly, to pump water into the boiler of a compound horizontal steam engine (upon which I have been engaged in my spare time during the past nine years, and which I hope very shortly to complete for a trial run); and fascinating hobby to save remnants and scrap, if there seems the faintest chance of it ever becoming useful, either by reason of its shape or size.

The delivery jet has an exceedingly fine bore, and is, I believe, part of a blowpipe I used at chemistry in my young days.

I was agreeably surprised by obtaining, after air pressure had been created, and then opening the cock, and evenly continuing the pumping, a throw which generally reaches between 25 and 30 ft., which is a very satisfactory result to me, an amateur. Should any readers wish for any constructional

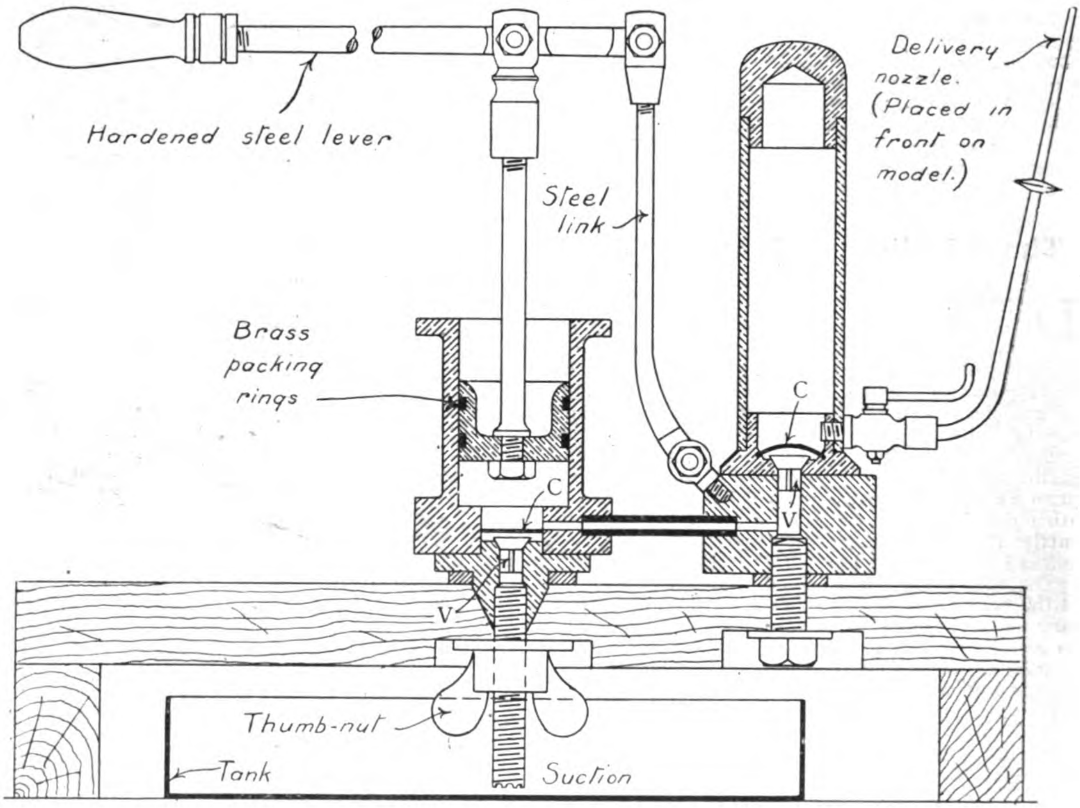


Fig. 1.—Sectional Elevation of a Model Force Pump.

and, secondly, being a schoolmaster myself, I required such a model for illustrating object-lessons on the subjects of pumps, levers, cylinders, air pressure, etc., and in machine and mechanical drawing classes.

The principle of this machine is so well-known, that readers will require no explanation of that; but a few remarks *re* the construction of this specimen may not be out of place. The base is of ½-in. American walnut, varnished. Valves are of the three-wing type, nicely seated by grinding in the lathe with fine emery and pumice and oil. The small delivery cock, and nuts and bolts, I did not make. The remainder is practically made from odd pieces of material, of which I have a box full, and often find a rough remnant from some other job which I can easily turn to account; and I would urge young beginners in this useful and instructive

details beyond the following, I should be pleased to supply the same:—Base, 2¼ ins. high by 9 ins. by 3½ ins.; plunger or ram, ⅞ in. diameter by 9-16ths-in. stroke; air chamber, ⅝ in. diameter (internally) by 2¾ ins.; total height of model, 6¼ ins.; centres of ram and air-chamber, 2⅜ ins. apart.

An Early Telephone.—What was probably the first telephone used for practical purposes in this country has just been taken down. It was constructed in 1870 by the late Mr. Alfred Cunningham and his brothers, and installed between the old Town Hall, Devizes, and Southgate House, the residence of the Cunningham family. It was made from the description and sketches which Edison contributed to the *Scientific American* about that time.

Practical Letters from our Readers.

[The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a nom-de-plume *if desired, but the full name and address of the sender* MUST *invariably be attached, though not necessarily intended for publication.]*

Model Railways and Signalling.

To THE EDITOR OF *The Model Engineer*.

DEAR SIR,—I would like to call your attention to a couple of points in connection with railway matters in your issue of July 6th.

In connection with the G.W.R. signal model, on page 16, "Description of Signals," I should imagine that signals Nos. 23, 24 and 25 would refer to direct M.L. movements, viz., down main line starting, home and distant, respectively.

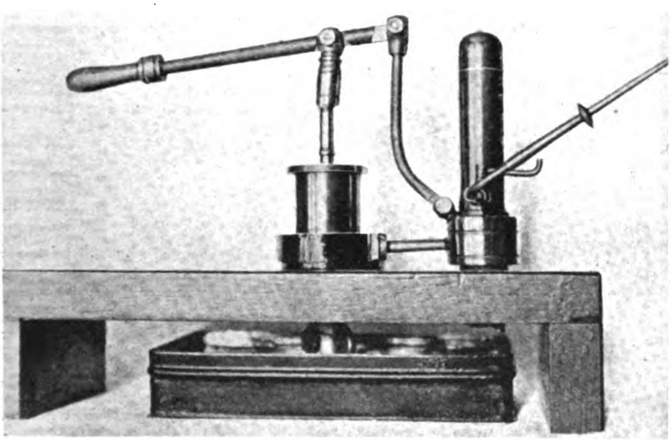


FIG. 2.—MR. W. F. G. BRADFORD'S MODEL FORCE PUMP.

The other is a criticism on "Midland's" design for a model railway (page 19), which, if he runs his trains on the "right," track, viz., the left-hand one, in railway practice the cross-over roads near cabins 1 and 2 would be reversed—*i.e.*, put in trailing way, instead of facing as shown on page 19, so facing points must be reduced as far as possible.—Yours truly, WM. F. ROGERS.

Buenos Aires.

Armature Reaction and Distortion of Field.

To THE EDITOR OF *The Model Engineer*.

DEAR SIR,—Referring to Mr. A. G. Warren's letter under the above heading in your issue of August 31st, I notice that in the second experiment *the field coils were disconnected*, and a current of 46 amps. passed round the armature, which reached very nearly full speed, and ran under these conditions for five minutes.

As this is the first experiment of its kind that I have ever heard of, I should be greatly obliged if the following particulars could be given through your columns.

Would not this current cause the armature windings to become very hot, if not over-heated, and also would the field-magnets still have their residual magnetism left after this experiment? Does the armature depend upon its own magnetism for a field? If so, how can it revolve? I should rather think that the magnetism produced in the armature core would tend to rob the field-magnets of their small amount of residual magnetism, instead of building it up to make a field strong enough for the armature to work in. I came across a case a few months ago where the field of a 210-volt motor had been discharged first in the operation of shutting the machine down, with the result that the armature was completely shattered, all the windings being spread open. Would not the same thing have happened in Mr. Warren's case if he had applied the pressure necessary to drive the motor under proper conditions?—Yours truly,

"FIELDLESS."

To THE EDITOR OF *The Model Engineer*.

DEAR SIR,—Noticing the query of your correspondent, Mr. A. G. Warren, in the issue of 31st ult., "Will it ever be possible to run motors without fields?" I shall be pleased to show him the photograph of the REMAINS of two large 250 h.-p. motors, the fields of which were broken by misadventure on the part of the attendant.

I should also like to know what work he could have obtained from his motor running with fields unexcited.—Yours truly, S. G. DIX.

Tonbridge.

On Buying a Business.

To THE EDITOR OF *The Model Engineer*.

SIR,—Permit us space in your valuable journal to make an enquiry as to the probability of obtaining support for a mutual Co-operative Society or Association, on building society lines, to collect and utilise subscriptions from engineers, ironmongers, assistants, foremen, workmen, and others, in order to assist them to acquire (wholly or in part) existing businesses, or to extend those already established in the metal trades. A large experience in the transfer of businesses has convinced us that there is need of such a society, and we believe there are many assistants and others who now place their savings in other channels to whom it would be a great benefit, enabling them to look forward to obtaining at a much earlier date the position of principal or manager than would otherwise be the case.

The rapid spread of industrial and trading companies, and of co-operation in various forms, is giving rise to a demand for qualified men as managers and secretaries of limited companies, and these posts are preferably filled by those who contribute a portion of the capital. The proposed company or society would fulfil two correlative functions, namely :—

1. Assisting young men to obtain partnerships and businesses by means of advances and recommendation.

2. Supplying vendors and owners with purchasers and managers having the command of capital and the qualifications likely to ensure success.

Please allow us to say that we are willing to lend our aid in organising and starting such a society, if assured of adequate support; and we shall be glad to hear from anyone desirous to join such an association.

We have given much consideration to this matter, and are preparing a short pamphlet explaining its objects and mode of operation, which we shall be pleased to send to anyone interested.—We are, yours faithfully, BROMHEAD & Co.

33, Cannon Street, London.

The Society of Model Engineers.

[*Reports of meetings should be sent to the offices of* THE MODEL ENGINEER *without delay, and will be inserted in any particular issue if received a clear nine days before its usual date of publication.*]

London.

THE first indoor meeting of the winter session will be held on Thursday, September 28th, at the Holborn Town Hall, at 7 p.m. It has been decided to make this a special track and general exhibit night, and all members are particularly requested to bring some exhibit, either models (finished or unfinished), tools (home-made or otherwise), whether the articles have or have not been exhibited before. To encourage members to bring exhibits, a first prize of 15s., and a second one of 7s. 6d., both in cash, will be awarded during the evening to such model, or part, tool, etc., as shall be deemed by a general vote of the members present to be the most interesting exhibits. Each member present will be entitled to vote for one exhibit other than his own, the exhibit obtaining the highest number of votes taking the first prize, and the next in order the second. In addition to the foregoing prizes, an extra prize is offered by the Southwark Engineering and Model Works, consisting of a set of castings, materials and working drawings for one of their ½-in. scale Tilbury locomotives. It is earnestly requested that those members possessing locomotives will bring and run them at the meeting; two straight tracks will be fitted up side by side, so that races may be run. The locomotives are, of course, included in the above prize scheme. —HERBERT G. RIDDLE, Hon. Sec., 37, Minard Road, Hither Green, S.E.

A GREAT Discovery of lead and silver has been made in the Great Laxey Mines in the Isle of Man. The main vein has proved to be 21 ft. wide, and its sides have not yet been reached. It runs upwards through two levels a distance of 90 ft., and there is every indication of its continuance upwards.

VILLAGE LIGHTED BY ELECTRICITY.—Bridgetown, situate a few miles from Dulverton, Somerset, claims to be the smallest village in England supplied with the electric light. A local wheelwright laid down a plant to supply his own premises. His neighbours expressed a desire for similar illumination, so the wheelwright added to his plant, and is now supplying electricity to others in the village. The population is less than 100.

Queries and Replies.

[*Attention is especially directed to the first condition given below and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-hand corner of the envelope "Query Department." No other matters but those relating to the Queries should be enclosed in the same envelope.*

Queries on subjects within the scope of this journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied, wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed, and also a "Queries and Replies Coupon" cut out from the advertisement pages of the current issue. (4) Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of Replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor,* THE MODEL ENGINEER, *26–29, Poppin's Court, Fleet Street, London, E.C.*]

The following are selected from the Queries which have been replied to recently:—

[14,463] **Charging Accumulators.** E. H. M. (Ramsgate) writes: I shall feel greatly obliged if you will favour me by answering the following queries:—I have bought a charging dynamo (8 volts 3 amps.), and wish to drive it off a water motor for charging the ignition accumulators of my own and brother's motor cycles. What I wish to know is (1) Can I charge two 4-volt accumulators—say, one of 8 amp.-hour, and one of 20 amp.-hour capacity—in series at the same time?—I mean off the above-mentioned dynamo? Or, can I only do one at a time? I should be greatly obliged for a rough sketch showing how to connect up dynamo, voltmeter, ammeter, and cells; also pilot light, if needed. (2) What is the rate of charge for cells of the above capacities when charged in series? Also, at what voltage should I have to put a resistance of, say, a 4-volt lamp when charging the accumulators singly? (3) How can I tell when cells are fully charged? Mine seem to gas the whole time when charging from four "Fuller" bichromate cells, each giving 1½ volts. What current will four "Fuller" cells give when connected up in series? (4) What is meant by an accumulator being so many ampere-hours? Does it mean that they will give a current of so many amps. for one hour, or 1 amp. for so many hours? (5) For how many hours will a 4-volt 8 amp.-hour accumulator light a 4-volt H.E. lamp on my motor cycle when fully charged? (6) I connected up the above-mentioned dynamo to two 4-volt accumulators in series, but it only ran for a few seconds, and then stopped. Why was this? (7) How can I tell which is the positive terminal of my dynamo? Neither is marked with a cross.

(1) Yes, by running the dynamo at a speed at which it will give full 10 volts, and adjusting the current to that at which the smaller cells may be charged. The charging must be continued until the larger cell is fully charged, but it will not harm the smaller cell, which will, of course, become charged before the larger one. You can, if preferred, remove the smaller cell when it is in a charged condition, and then continue charging the larger one at its proper rate, or as near as you can get to the proper rate, the volts of the dynamo being readjusted. For diagrams of connections, see our handbooks on small accumulators and on "Small Electrical Measuring Instruments." (2) See above handbooks. (3) Perhaps you are charging at too high a rate of current. A fully-charged accumulator should give 2¼ volts per cell on open circuit. The current given by any battery depends largely upon the resistance of the circuit connected to it, and will vary, therefore, according to circumstances; use an ampere meter. (4) See our handbook on Small Accumulators. (5) Depends upon the candle-power of the lamp—possibly for 12 hours with a low c.p. lamp; you can easily try. (6) Do you mean that the dynamo stopped giving current? If so, it was probably due to the resistance of the accumulators being too low. Put a couple of yards of No. 20 gauge bare German silver wire in series with the cells, and try again. Adjust length of the wire until you get current to required strength. (7) Buy some pole-finding paper from Mr. Avery, Fulmen Works, Park Street, Tunbridge Wells; also see our Handbook No. 24. Place two pieces of clean lead in dilute sulphuric acid, and connect them to the poles of the dynamo; send current for a few minutes, and the one connected to the positive pole will become brown. The lead pieces must not touch one another.

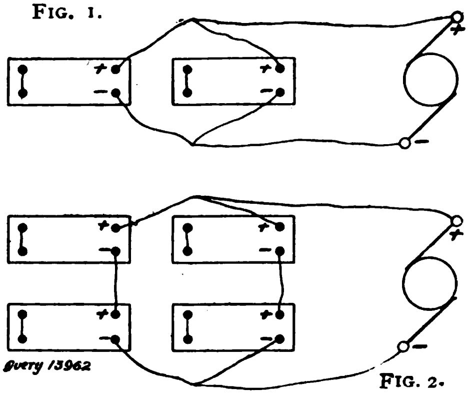
[14,457] **Lines of Force; Interrupters.** W. B. A. S. (Dublin) writes: Could you inform me of some practical test whereby the number of lines of force passing through the field of any permanent magnet could be ascertained and estimated, with a view to find out how much the magnetic strength had probably deteriorated since magnetisation to saturation? Would a

liquid interrupter of, say, Campbell-Swinton type put on in series with an electro-magneto machine set up induced currents in the armature liable to break down insulation owing to the rapid breaks of this form of interrupter? Would a condenser shunted directly across the terminals of the interrupter itself lessen these induced currents in the armature?

We do not know of any simple method of making such a test which would give accurate results for small differences of magnetism. You could try measuring the pull of the magnet upon its armature by means of a spring balance, or the power exerted by its poles upon a magnetic needle suspended at a distance, the deflections of the needle from zero being compared; but you would not know if the needle had remained of the same magnetic value, without comparing it with some standard, such as a coil of wire through which a definite current was flowing. You will find information on the subject in "Electric Light and Power Distribution," by Perren Maycock, Vol. I. *Re* electrolytic interrupter. Possibly it is a matter for experiment. We doubt if a condenser would be of any use; in the case of an induction coil worked with an electrolytic interrupter, the condenser is disconnected, as it becomes of no value, owing to the rapidity of the interruptions.

[13,962] **Charging Varying Numbers of Accumulators.** F. F. (Bishops Stortford) writes: I enclose herewith a rather long query, and should be grateful if you would give it your kind attention. I have a small Crypto charging dynamo (10 volts 4 amps.), which I use to charge motor cycle accumulators. When I run it light, it gives full 10 volts; but as soon as I switch accumulators on, the voltage across the dynamo mains drops considerably; and this drop varies, so that sometimes it reads 3 or 4 volts only, and sometimes 7 or 8 volts, according to the way of arranging and the number of accumulators in the circuit, as sketches show. As arranged in Fig. 1, with two 4-volt accumulators in circuit, the mains would show 3, 3½, or 4 volts, depending on what amount of voltage there is in cells when switched on. As the cells get charged the voltage across mains will rise to 5 volts, or so. When

FIG. 1.



Query 13962 FIG. 2.

ACCUMULATOR CHARGING DIAGRAMS.

arranged as Fig. 2, with four 4-volt accumulators in circuit, the mains will show 6½ or 7 volts, depending, etc. (as above), and rising to 8 volts, but never more than 8 volts. Is this all correct and as it should be, and am I doing right in charging 4-volt accumulators thus? If not, will you kindly give explanations and correct me.

The voltage of a shunt dynamo always varies according to the amount of current taken from it. In a small machine this variation will be very great. Your dynamo is behaving correctly. When you have the two 4-volt accumulators on, they evidently draw more current, or try to do so, than when you have four on; therefore the dynamo voltage drops lower. If you put two accumulators only in series with each other, you will find the volts rise. Always charge accumulators in series, if possible, and not in parallel at all, if you can avoid it. You can compensate for the variation in the volts by running the dynamo at higher speed, or by regulating the field strength by the use of a regulating resistance in series with the field-magnet coils. Try also a small amount of resistance—say, a couple of yards of No. 20 gauge German silver wire in series with the cells, arranged so that you can cut out more or less wire, according to the volts. Try three accumulators in series. The machine may stand 15 volts without getting too hot.

[14,521] **Experiments with Wimshurst Machine.** H. G. (Penarth) writes: I tried the following experiment with a 15 in. Wimshurst machine, but could get no results:—(1) I had a vacuum surrounded with a red liquid; I connected the two terminals of the vacuum tube—one to the positive comb, and one to the negative. On starting the machine, and with the spark from ½ in. to 1 in. long, I obtained no results. I then disconnected one wire, and ran the machine; then the tube was dimly lighted up. The wire disconnected was insulated, and was not connected with the earth in any way. Can you explain this? Should the tube not light when both the wires were connected? (2) I stuck with shellac varnish some tinfoil to a plate of glass. I joined two wires to it—one at opposite corners (as described in an issue of THE MODEL ENGINEER). This tinfoil was then scored with a needle. It was supposed to spark at the different sections when connected with a Wimshurst machine, but I could not get any result. Could you recommend a book of experiments for Wimshurst machines?

Try a spark gap on one of the discharging rods of the Wimshurst (as sketch on page 467 of THE MODEL ENGINEER for November 17th, 1904); or arrange the tube as diagram on page 80 of our Handbook No. 19. When you connect both discharging rods together, even through a vacuum tube, the charge leaks away as fast as generated; hence it is almost necessary to interpose a gap across, which the spark must pass. When you connected one end of the tube only, you obtained a discharge through it, but not the full strength of the machine—only a kind of leakage discharge. You should also see that the smaller ball is connected to the discharger, which is positive, by changing over the balls until best results are obtained, when you have them correct. *Re* experiment 2. Try the spark gap here also. We do not know of any such book, but you might try the experiments given in "The Induction Coil in Practical Work," by Lewis Wright, price 4s. 9d. post free.

[14,520] **Dynamo Driven by a Water Motor.** J. G. (Barnsley) writes: I am making a dynamo, and should be pleased if you would kindly answer the following:—(1) The drum armature has 24 slots and 12 sections, 5 ins. diameter by 5¼ ins. long—will this do? (2) I have 3½ lbs. of No. 20 D.C.C. wire for the armature, and 16½ lbs. No. 21 D.C.C. wire for the field-magnet. (3) What speed is necessary to obtain 110 volts? I want to run eleven 16 c.p. lamps; and what speed will be required to light from fifteen to twenty lamps? (4) Please tell me quantity of wire and number of slots. (5) The dynamo is to be driven by a water motor. What power will be necessary to light fifteen to twenty lamps?

(1) The sizes given for armature will do. (2) No. 20 gauge is not large enough to give current to light fifteen to twenty 16 c.p. lamps at 110 volts; it would do if you ran at a speed to give 200 or 210 volts. At 110 volts you will find twelve 16 c.p lamps about as much as the armature will stand without overheating. No. 21 gauge wire is too thick for 110 volts to use on the field-magnet; for good efficiency, No. 22 gauge would be better. You can try the No. 21 gauge, but we expect you will find the coils get very hot. For 210 volts, or thereabouts, No. 26 gauge wire should be used for the field coils. (3) Speeds for 110 volts, about 1,000 revolutions per minute; for 210 volts, about 2,000 revolutions per minute. This latter is rather a high speed. If you wound the armature with No. 18 gauge D.C.C. copper wire, you could then light fifteen to twenty 16 c.p. lamps at 110 volts, with a speed of about 1,500 revolutions per minute. (4) Get on as much wire as you can on the armature slots. A good size for these slots would be 5-16ths in. wide by ½ in. deep, which is the size we have taken in estimating the output of this machine. (5) The power required will depend upon the number of lamps which the dynamo is lighting. Twelve 16 c.p. lamps would require about 1¾ b.h.-p. at the pulley; twenty 16 c.p. lamps would require about 2½ b.h.-p. at the pulley. This does not allow for losses in belt, if a belt is used. The voltage can be adjusted by running at a higher or lower speed.

[14,523] **Manchester Dynamo Wiring.** W. F. G. writes: Will you please send me an answer to the following:—What size wire, and how much, for Manchester type dynamo? The size of armature is 2¾ ins. diameter, 2¾ ins. long, core of fields 1¼ ins. diameter, 3½ ins. long; armature ring type 12 slots. Could I get 400 watts out of it, and what speed shall I need to run it?

No. About 100 watts at most. Speed about 2,900 or 3,000 revolutions. Wind armature with ¾ lb. No. 22 S.W.G., and fields with 2½ lbs. No. 25 S.W.G. See Handbook, "Small Dynamos and Motors," 7d. post free.

[14,516] **Screw-Cutting; Metal Spinning in the Lathe.** A. L. (Newcastle-on-Tyne) writes: I have not had a screw-cutting lathe very long—only a few weeks—and have got your book "Practical Lessons in Metal Turning," by "P. M.," and find the screw-cutting wheels for several lathes with two, four threads to the inch, etc. But mine has six threads to the inch; and I would like to know what pitch you would call it? Would you give me some information on spun work in the lathe? I have watched the pages of THE MODEL ENGINEER for about three years, and have never seen an article describing what tools, etc., are necessary; and as I would like to make a trumpet for my phonograph, also some other little jobs, also state if it can be done on a 3½-in. screw cutting lathe, and what tools are required, and what metals are most suitable.

Your leading screw is ⅙-in. pitch. The rules for finding the numbers of teeth in change wheels given in the chapter on screw-cutting in the book mentioned are applicable to leading screws of any number of threads per inch; it is only necessary to substitute six in your case for the figure given for the number of threads per inch in leading screw. As explained in this chapter, it is usually more convenient to take the number of threads per inch, and not the pitch. For many threads the following is a simple rule for finding change wheels:—Take any convenient wheel for the one to go on the mandrel; multiply the number of its teeth by the number of threads per inch in the screw to be cut, and divide the result by the number of threads per inch in the leading screw. The answer is the number of teeth which must be in the wheel on the leading screw. The intermediate wheel is merely a transmitter of the motion, and may be of any convenient size. When you cannot find, amongst your set of wheels, correct numbers, you must use a compound train, the rules for calculating which are given in the book in question. *Re* spun work. Directions for spinning a phonograph trumpet are given in THE MODEL ENGINEER for July 28th, 1904, page 95. Any soft metal can be used.

[14,514] **Dynamo Output and Winding.** H. S. (South Hackney) writes: Will you kindly answer the following queries? I have a set of 16 c.p. dynamo castings; what output shall I expect to get from them when wound? What gauge wire shall I wind the armature and field-magnets with to get the greatest output, and what speed to run it at? Will it do for an electric furnace (Query 14,326) to melt 30 lbs. of iron? If not, what is the greatest quantity of metal it will melt?

Wind armature with No. 26 gauge single silk-covered copper wire; get on as much as you can—about 3 ozs. will be required. Armature to be a laminated cogged drum. If a Siemens H armature, then it should be wound with No. 23 gauge D.S.C. copper wire. Wind field-magnet with about 6 ozs. of No. 24 gauge S.C.C. copper wire on each core, both coils to be connected in series with each other, and in shunt to the brushes. Output about 8 volts 1¼ to 2 amps., at 4,000 revolutions per minute (approximate). Test machine at first with an 8-volt 1 c.p. lamp. This machine is far too small to be of any use for melting metals.

[14,166] **Converting from Air to Water-Cooled Motor for Boat.** J. G. (Greenock) writes: I would be glad of your opinion on the following:—(1) Would it be practicable to run a 2 h.-p. petrol motor, air-cooled, cycle pattern, to drive a 15-ft. rowing boat? (2) Using a fan for cooling purposes? (3) Fitting a water-jacket of copper over the radiating fins, with a pump to force water round the jacket? (4) Can you recommend a method of fitting such a jacket, either of copper or cast iron?

(1) Provided you could keep it cool, and could devise some way of connecting to propeller shaft. (2) Yes. (3) This would answer also. (4) You might try fitting a circular clamp or ring at top and bottom of cylinder casting, as Fig. 1. The fins would have to be cut off, and the cylinder walls turned down so that the bottom ring would slide over the cylinder till it reached its proper position, at which point a slight increase in diameter would have to be left when turning, and also slightly bevelled, as shown in Fig. 2. The top ring would go on last, and would have to be held in place by some suitable arrangement. All joints would have to be very carefully made, and the outer, or jacket, cover would have to be made up in the form of a tube from sheet copper neatly brazed up,

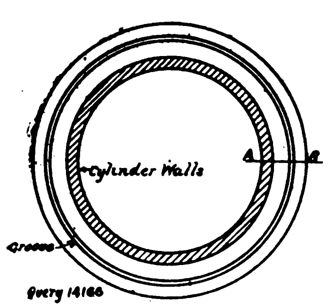


FIG. 1.

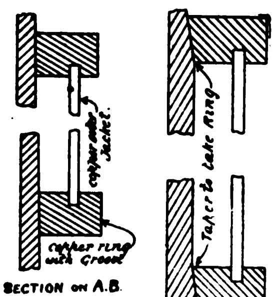


FIG. 2.

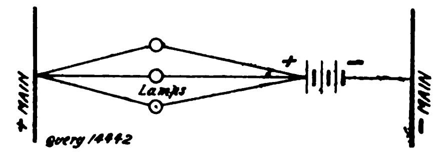
and of the exact diameter of the slot in the top and bottom ring. Much depends, of course, upon the general design of motor whether this arrangement can be adopted or not.

[14,574] **Electric Lighting for House.** I am hoping to light my house with electric light, and would be grateful if you would answer the following questions: (1) Would 1 h.-p. steam engine drive 450-watt dynamo? If so, state how many 8 or 16 candle-power lamps the above will supply engine-house (40 yds. from shop). (2) What size of wire should I lead from engine-house to shop? Does the rain or damp affect the above wire?

(1) Possibly, if everything was in good adjustment and dynamo efficient. You would get some output, of course, even if the engine did not drive the machine up to full output. Number of lamps will depend upon their efficiency. If you can get 450 watts out of the dynamo, you would be able to light about eight 16 c.p. lamps, or sixteen 8 c.p. lamps. (2) We cannot tell you what size of wire to use without knowing the voltage of your dynamo. Rain and damp will decidedly affect the wires, unless they are protected. You can, however, purchase wire which has a lead sheathing over the insulation; this will do very well for outdoor service.

[14,442] **Charging from Mains.** W. P. (Dovercourt) writes: Is it possible to charge accumulators in about four to five hours' run? The plant that I have charge of has 300 lights, and the dynamo gives 65 amps. at 230 volts, and the circuit that I should like to charge small motor car accumulators is from a 5 amp. circuit. The voltage of my lamps is 220, and if it is possible to do them will you please tell me what resistance I should want, and give diagram of same? We have no storage here, but run direct from dynamo to lamps.

Depends upon what is the maximum charging current allowed by the makers of the cells, and how far the cells have been run down. We doubt if you will find any makers' cells which can be safely recharged in less than eight hours, if run down to near their limit. Why not charge in two periods of four to five hours each? Charge through several of your 220-volt 16 c.-p. lamps in parallel for each



CHARGING ACCUMULATORS FROM MAINS.

accumulator; four or five lamps should pass enough current for the average car accumulator, but you can easily calculate by knowing the charging rate for the cells and the current taken by one lamp. We advise you to read our handbook on "Small Accumulators."

[14,591] **Running Small Motor from Primary Cells.** F. W. (Peckham) writes: Could you kindly give me a few hints on how to run a toy electric motor? I am interested in electricity through a friend showing me a copy of THE MODEL ENGINEER, and I have bought a battery and motor and lamp; also THE MODEL ENGINEER Handbooks Nos. 5 and 22. The battery is charged with water, 8 ozs.; sulphuric acid, 2 ozs.; bichromate potash, 2 ozs.; and the zincs are so fitted to be withdrawn when not in use. The name of the battery is the "Medical," and on the label is a red cross. I bought some wire (rather thin), and don't know the number, but it was sold at 2 yds. a penny. I removed the end covering, and put it in the terminal, and screwed it down, and the other end I connected to the motor terminal. I then took another piece of wire, and connected the other two terminals. I expected to see the motor start work directly, but it did not; neither did it after waiting an hour. I then proceeded to investigate matters. I heard a rhythmical sound coming from the battery, and on touching it I discovered the glass jar was quite warm; also the zincs and carbon. I took out the carbons and zincs, and found the zincs, as far as the solution had reached, were quite white; and that is all I can tell you. I have ordered, through my newsagent, your Handbook No. 14 on Motors, to see if there is any help for me. I could get no information from the shop where I bought the battery and motor, it being a toy shop, and in charge of females. The lamp, of course, according to your book, will want four batteries. (1) Did I do right in using two pieces of wire to connect motor to battery? (2) Shall I require more than one battery to work it, the same as the lamp will? The motor cost me 2s. 6d. Is it enough if I insert the ends of wire in the terminals, and screw them down; is it sufficient to connect it with the battery?

(1) Yes, you did quite right in connecting the motor to the battery, but when you found the motor did not start, you should have disconnected one wire, or lifted the zincs out of the solution, whilst you investigated the cause of the non-starting. There was very likely some small adjustment wanted, or it required a start by hand. As you left the battery connected, and waited, the current simply ran to waste through the motor, exhausting the solution and wasting the zinc. When starting a small motor, you should leave one end of a connecting wire free, and just touch its terminals with it to see if the motor will start, and not screw it down to the terminal until the motor is in adjustment and starts free. (2) One cell ought to run such a small motor very well; you can try two if you intend to get some more cells. You have the right kind of battery. You will probably find that either the motor has a dead point, and requires a slight push to start it, or the contact spring which makes and breaks the circuit requires adjusting, so as to make contact at just the right moment. You may be able to get some help from our No. 8 Handbook, and an article is now appearing in THE MODEL ENGINEER, under "Lessons in Workshop Practice," which deals with the testing of small motors. These little machines can, as a rule, be made to run splendidly with a small amount of understanding and perseverance; even if out of adjustment they can be made to work. We advise you not to give up, and to remember that knowledge is gained through failure. Shopkeepers often know nothing about these motors, which get out of adjustment in stock. An expert would probably put it right in five minutes. Be sure that your battery is in good order.

[14,600] **Gas Engine for Sawing.** A. E. H. (Alvaston-by-Derby) writes: Will you kindly tell me if a one horse-power gas engine will be powerful enough to drive a 12-in. circular saw to cut from 1 in. to 4 ins. thick wood? Also, will the engine have a good enough supply from the house three-light meter?

Yes, if you do not feed too quickly, and the saw is quite sharp. A three-light meter is *rather too* small; a five- or ten-light would be better. Perhaps if no other gas was being used but that for the engine, and a good pressure is available, a three-light one would give you enough. But the chances are the ignition burner would give trouble.

[14,494] **Repairing Old Cells.** J. W. H. (Leith) writes: I should feel much obliged if you would kindly inform me how to repair two motor cycle accumulators which have been allowed to stand uncharged for about a year. The cells are 20 amp.-hour and 12 amp.-hour at 4 volts pressure; and when I first examined them they appeared to be pretty badly sulphated. I have had them charged, and I was able to run my machine for about twenty miles, when they both refused to fire the engine. I allowed them to stand for a week, and on trying their voltage with the meter, they showed 4 volts and 3·7 respectively. They did not, however, keep up this pressure for any length of time, and I have been unable to venture out again, in case of being stranded. The larger one appears to have lost some of its sulphate, but has assumed a darkish-red colour. (1) Can I joint the celluloid cell satisfactorily when I cut it open at top to withdraw plates, and with what solution or cement? (2) What shall I use to remove the sulphate, and can the plates be thoroughly remedied? (3) When cleaned, do the plates require to be treated with anything to restore their former capacity? (4) How long do the cells require charging after being cleaned and cemented up again? And should they be quite as reliable as before?

(1) Try amyl acetate. Failing this, marine glue. (2) The only way to remove the sulphate is by prolonged charging at about three-quarters maximum charging rate of current until the sulphate scale becomes loose and falls off. (3) As to whether the plates can be restored to full capacity again, or near it, depends upon their condition. They can never be brought up to full capacity again, but if in fair condition, may be capable of doing considerable useful work. (4) After the first prolonged charge, do not let the cells run down much, but keep them well up, and give repeated prolonged charges for some time, until all the sulphate has disappeared. The plates may be carefully scraped to loosen or detach the scale.

[14,590] **Accumulator Upkeep.** W. T. S. (Stockton Heath) writes: Will you please help me in this small matter? I have bought a second-hand accumulator (glass cell, seventeen plates, size 10 ins. by 9 ins. by ¼ in., nine negative plates, eight positive), and I want to use it for an hour or so when our engine has stopped. Our supply is 220 volts 170 amps., shunt-wound, continuous current; and as I can disconnect my lights in the small office I work in from the main supply, and put them on to an accumulator, I bought this; and I should like to know the best way to charge it when required. (1) Can I charge it from the ordinary pendant in my office? If so, will you kindly fill in connections of the accompanying sketch (not reproduced), together with resistance required? (2) Or could I charge it direct off the bus bars of our switchboard? If so, would same connections do as in Question 1? (3) Will you please give me the output of this cell? It has been working all right up to three weeks since, but now wants re-charging. The voltage at present is 1·75 gravity of acid 1170. I have looked through your handbook, but shall have to ask your advice, on account of not being able to follow your instructions properly as regards resistance. Trusting for an early reply, and hoping this is not asking too much.

(1) Not properly; a cell this size requires about 30 to 40 amps. to charge it in a reasonable time. Your pendant would probably only carry 1 or 2 amps. (2) Yes, through a resistance. Your bus bars will be at 220 volts pressure, whereas a single accumulator cell does not require more than 2½ volts to charge it. It will also only give 2 volts when discharging, so would be useless for lighting your ordinary office lamps; it would only light one or more 2-volt lamps. (3) This cell would probably have a capacity of about 160 amp.-hours at low rates of discharge. You could ascertain by writing to the makers. It is rather a problem to charge such a large cell from a small private plant, unless you are content to charge at a low rate and allow it to go on for a long time. You should ascertain how much current you are at liberty to take from your supply, and then rig up a resistance to suit. Do not run the cell low down, if you can help it, but charge every day, and so keep it in as near a fully charged condition as possible. By this system you may be able to do your charging in the shortest practicable time. If you will let us know what amount of current you have available, we can advise you as to resistance.

[14,406] **Fusible Plugs.** G. G. (Peebles) writes: When the lead plug in the firebox of a locomotive fuses, how is a new one put in? Is it necessary to go inside the boiler to replace it? Could you give me a sketch of a lead plug?

No, but it is necessary to draw the fire and enter the firebox. The plug is withdrawn, and the lead or other fusible alloy, which melts out when the water is allowed to run short, is replaced. It is then screwed into the crown again, and the working conditions of the boiler resumed.

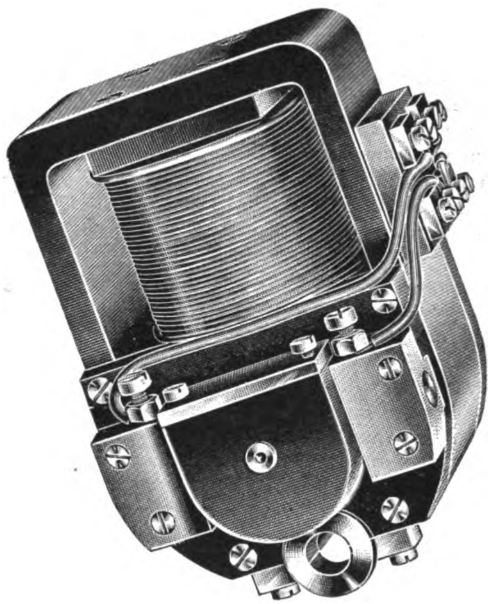
The News of the Trade.

[The Editor will be pleased to receive for review under this heading samples and particulars of new tools, apparatus, and material for amateur use. It must be understood that these reviews are free expressions of Editorial opinion, no payment of any kind being required or accepted. The Editor reserves the right to criticise or commend according to the merits of the goods submitted, or to abstain from inserting a review in any case where the goods are not of sufficient interest to his readers.]

** Reviews distinguished by the asterisk have been based on actual Editorial inspection of the goods noticed.*

*Motors and Castings for the "M.E." Electric Locomotive.

In connection with the supply of castings for the "M.E." Model Electric Locomotive, the design of which formed the coloured plate in our issue of January 5th last, we have received simultaneously from Messrs. W. J. Bassett-Lowke & Co., King well Street, Northampton, and Mr. A. H. Avery, Fulmen Works, Tunbridge Wells, a sample of finished electro-motors for this interesting model. These motors, which are made specially for the first-named firm by Mr. Avery, are excellently made and finished, and conform to



THE MOTOR FOR THE "M.E." ELECTRIC LOCOMOTIVE.

the published drawings in every particular. Castings, stampings, wire, and other material for constructing the motors, as well as finished machines, can be obtained from either firm. Messrs. W. J. Bassett-Lowke & Co. are also supplying sets of parts and materials for building the complete locomotive.

Mr. Stuart Turner's New Works.

We have recently had an opportunity of inspecting a new works built by Mr. S. M. Stuart-Turner, of Shiplake, for the production of his specialities in high-class engineering models. The equipment of the works has been carried out on excellent lines, and comprises high-class lathes, drilling and milling machines, shaping machine, and a comprehensive assortment of small tools. Not the least interesting features of the plant are the numerous special machine tool jigs and attachments which Mr. Turner has devised for the accurate and economic tooling of the various parts. A large number of sets of castings were being put through in view of the coming season's requirements, and the various samples we picked out at random and examined both for quality and accuracy were in every way satisfactory. In addition to his already well-known patterns, Mr. Turner has several new designs in hand, of which we shall give full particulars in due course. The new workshop is under the supervision of Mr. Turner's Henley agent, Mr. Masters, who is an enthusiastic model maker and an admirable mechanic.

The Editor's Page.

PROBABLY most of our readers will remember the description of the splendid model G.N.R. locomotive built by Mr. F. L. Baines, of Gainsborough, which appeared in our issue of March 9th last. We are now informed that this model will be on view in the window of Messrs. Clark & Co.'s establishment, Station Street, Doncaster, from October 16th to 21st, and in the window of the Rover Cycle Company's depot, Holborn Viaduct, London, E.C., from October 24th to about November 10th. During the following week it will be on view at the Rover Cycle Company's stand at Olympia. We can heartily recommend all our readers in these districts who are interested in good work to make a point of seeing this model if possible.

* * *

A somewhat novel departure is being made by the London Society of Model Engineers in connection with their first indoor meeting of the coming winter session, to be held on Thursday next, September 28th. Prizes are being offered for the most interesting exhibits by members on this occasion, the awards being allotted on a vote taken among those present. This should give an additional incentive to the exhibition of members' work, and we have no doubt that a very good show of attractive and interesting models and tools will be the result. The Society appears to be in a thoroughly healthy condition, and its enterprising committee apparently intend to make the ensuing season's programme more attractive than ever. The present time is a very appropriate one for intending members to send their names in to the hon. secretary.

* * *

In this issue we conclude a very instructive article on slide and micrometer calipers. This is a subject which we know is of interest to many of our readers, and we hope that the information given by our contributor will assist in clearing up the many little puzzling points which the use of measuring instruments of this kind present to the uninitiated. The greater accuracy of workmanship which is nowadays rendered possible by the high-class tools available in almost every workshop has caused a considerable increase in the demand for accurate measuring appliances, and there are very few good amateur mechanics who do not include either a micrometer or vernier caliper in their kit.

* * *

The amateur mechanic is now returning to his workshop, refreshed by his summer recreations, and imbued with new desires and ambitions in the model-building line. In looking over his stock of materials, parts, and tools, he finds some things for which he has no further use, and he thinks of others which he would like to have. There is a simple and inexpensive method by which he can usually turn the one into the other, viz., an advertisement in our Sale and Exchange column, through which he may either dispose of the goods he no longer requires, for cash, or may exchange them for something he really wants. With so many of our readers on the point of re-commencing winter work, the Sale and Exchange column ought just now to be in very general request.

Answers to Correspondents.

G. M. (Brighton).—Thanks for cutting. You will see we have a note on the subject.

J. C. (Maghull).—J. D. Wilson, Chippenham Mews, Harrow Road, London, W., supplies small quantities of moulders' materials.

Notices.

The Editor invites correspondence and original contributions on all amateur mechanical and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected or not, and all MSS. should be accompanied by a stamped addressed envelope for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

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Contents.

[*The asterisk* (*) *denotes that the subject is illustrated.*]

THE
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And Electrician.
A JOURNAL OF PRACTICAL MECHANICS AND ELECTRICITY.

EDITED BY PERCIVAL MARSHALL, A.I.MECH.E.

VOL. XIII. No. 231. SEPTEMBER 28, 1905. PUBLISHED WEEKLY.

A Model Winding Engine.

By E. L. P.

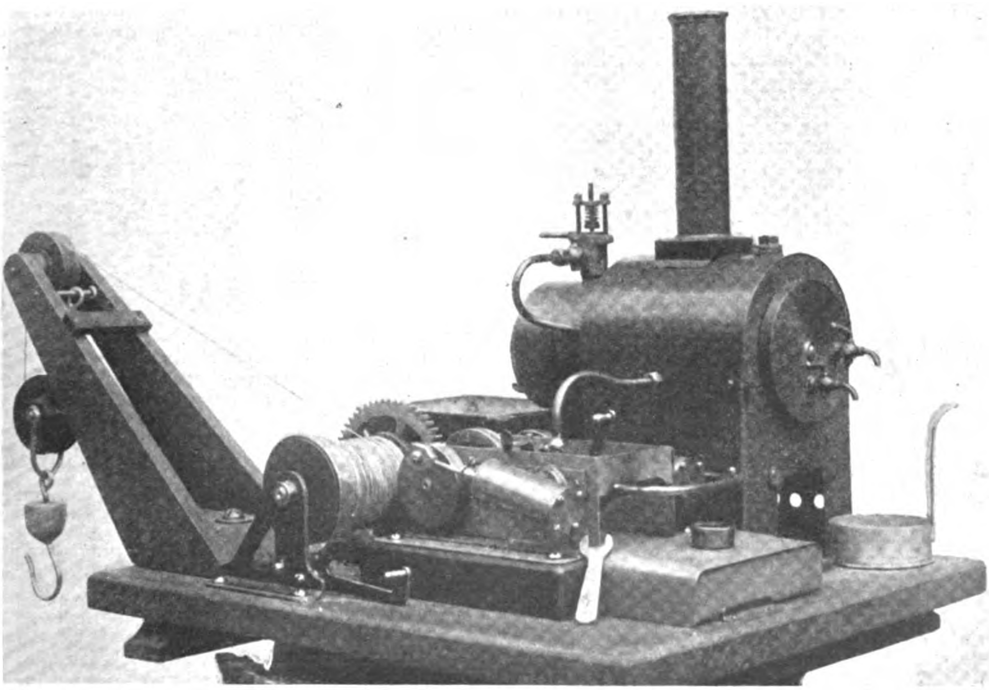


FIG. 1.—A MODEL WINDING ENGINE.

THE accompanying photograph is taken from a model winding engine I made for a friend a few months ago. The engine has two double-action oscillating cylinders, 7-16ths in. bore and 1-in. stroke, the crank pins in the discs being fixed at right angles. Steam is taken from the boiler at the safety-valve fitting; the pipe passes through the boiler casing to dry the steam, which enters a four-way cock placed between the two cylinders. This is moved by a lever, and will start the engine in either direction, according to which way the lever is moved.

The boiler consists of a piece of brass tube 2½ ins. diameter and 6 ins. long, with cast brass ends and one 3-16th-in. stay. It has eight 3-16ths-in. copper water tubes springing from two ⅜-in. horizontal water tubes, with a ¼-in. down tube at each end. Four water tubes enter the lower part of boiler at each side. The tubes are enclosed in a sheet iron casing, which also supports the boiler. Steam is generated by a spirit lamp, the working pressure being 10 lbs. per square inch.

The exhaust steam from engine is taken to a tank at rear of boiler, and passes through a coil of pipe, the tank being filled with cold water. The steam is condensed and the water is warmed up, and can

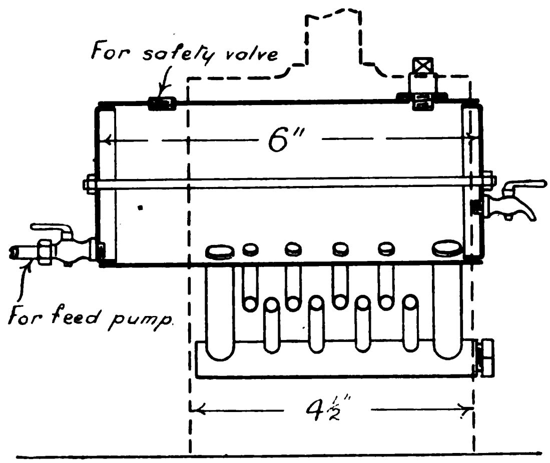


Fig. 2.—Section through Boiler.

be used for refilling the boiler. It was intended to pump the water into the boiler, but the pump failed to act when tried, and has been put on one side for overhauling.

At the centre of engine shaft there is a double-ended four-jaw clutch, which revolves with the shaft,

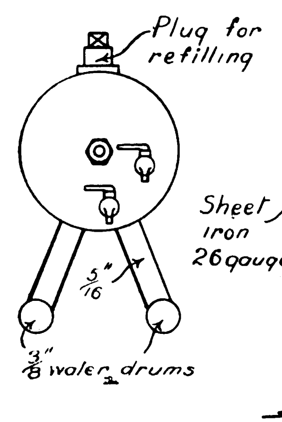


Fig. 3.—End Elevation.

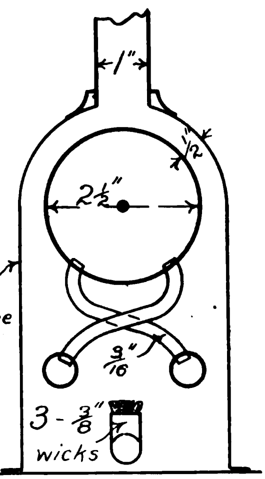


Fig. 4.—Cross-section.

and can be thrown into gear with a spur wheel for driving the winding drum on the left, or when thrown to the right, it drives a loose eccentric for working the feed pump. In the central position the engine runs free, and can then be used for driving any light model work from the grooved pulley, 1½ ins. diameter, fixed to the centre of clutch. It has driven a small model magneto machine for giving shocks; they were quite strong enough.

The spur wheel gears into a cog wheel on the winding drum in the proportion of 1 to 5½, and it has lifted a 5-lb. weight to a height of 3 ft. before the steam had run down to too low a pressure; but it will raise a weight of 1 lb. to a height of 25 ft.

There is a hand brake at one end of winding drum, and the lever operating it can be seen resting on the base. When the engine has raised a load, steam is shut off and brake applied, clutch thrown out; the load can then be lowered by easing off the brake.

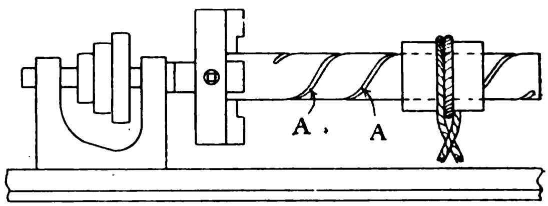
Workshop Notes and Notions.

[*Readers are invited to contribute short practical items for this column, based on their own workshop experience. Accepted contributions will be paid for on publication, if desired, according to merit. All matter intended for this column should be marked* "Workshop" *on the envelope.*]

Lapping Cylinder Liners, etc., in Lathe.

By "Sand."

As a good finish on the inside of cylinder, and especially piston value liners, is necessary in the construction of a successful engine, the following is a method which I adopted for lapping a piston valve liner:—When turning the liner, leave it a shade smaller than finished size inside. Obtain a



A Method of Lapping Cylinder Liners in the Lathe.

piece of rolled or turned hard steel rod an easy fit in the liner and about four times its length; file two grooves in it as shown in sketch; fix it in the lathe chuck, and, if overhead gear is used, fit a belt to drive the liner on the mandrel in the opposite direction to the lathe. If overhead gear is not fitted, wrap a piece of strong cord around the liner twice, and then crossed; the cord, being crossed in front, will prevent it working off the end of liner too quickly. Apply fine hard sand and oil to mandrel, and while the lathe is running at a high speed, keep the liner in motion by pulling the ends of the cord alternately, also moving it along the mandrel. After grinding sufficiently, clean the liner and mandrel thoroughly, and give them a good hard rubbing, as before, but with dry mandrel. This will give a highly polished and superior finished liner. The use of fine emery and oil for lapping purposes is bad practice, as it has been known with valve faces, etc., which have been ground in with emery, for the emery to stick into the metal and grind the face into holes when in use, no matter how they have been cleaned. Fine hard sand is now greatly used in preference.

Lubricating a Plain Bearing.

By "Sregor."

The accompanying sketch illustrates a simple and efficient method of lubricating a plain bearing.

and which I find very effective on a main bearing of a motor bicycle running at high speed. As will readily be seen by the sketch, the oil gets a through passage in the bearing. Fig. 1 is a section through centres of crank case X Y; B, the crank case; C, the brass bearing; and D, the crankshaft. The oil is splashed about the crank case by the crank when revolving, some of which drops in the hole (E), and runs along the groove which extends nearly to the end of bearing, and then falls

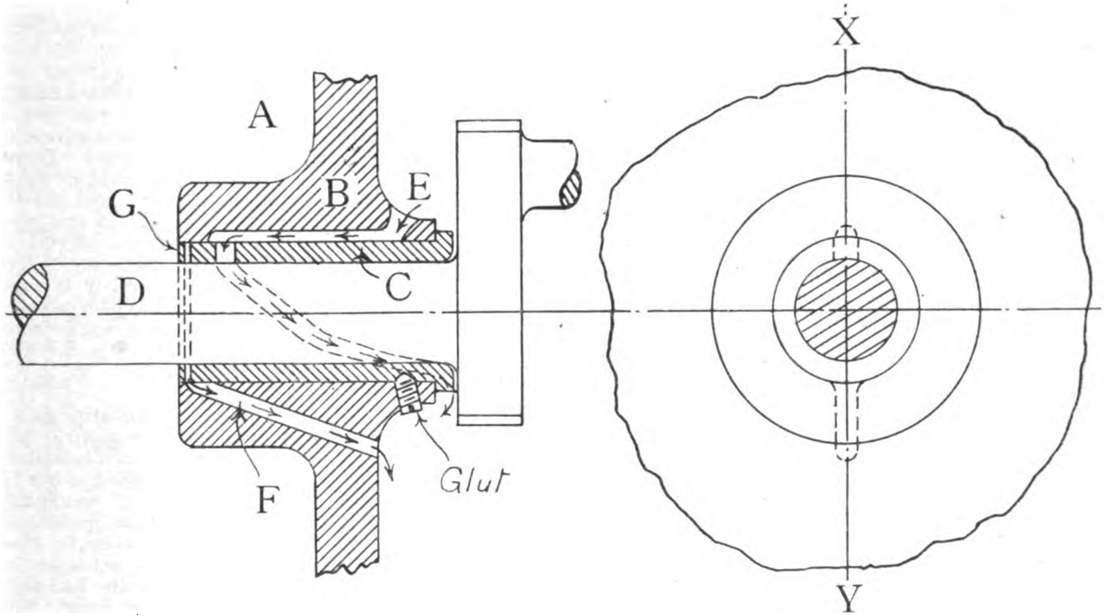


FIG. 1.—LONGITUDINAL SECTION. FIG. 2.—SIDE ELEVATION.

METHOD OF LUBRICATING A PLAIN BEARING.

through the hole in the bearing on to the shaft. From this hole a groove is cut along the surface of the bearing to the inside edge of same, cut spiral, so that when the shaft is revolving it tends to wind the oil along the groove back into the crank case, and lubricating the whole length of the journal, also minimising the possibility of the oil leaking out at the end of bearing, which is a serious defect in most bearings of this type. The groove must be cut according to the direction the shaft is to run; if cut the opposite way, the shaft will tend to wind the oil out at the end of bearing.

Another hole (F) is shown in sketch, which communicates the outside edge of bearing to the inside of crank case, which provides a passage for any oil that may leak out at this end. A metal washer (G) is fitted in the end of crank case, leaving a small space between the end of brass bearing and washer, leaving room for any oil to find its way into the groove F, and preventing it from getting outside.

A Simple Tube Expander.

By GEO. WANDS.

The difficulty found in expanding the ends of tubes in a model locomotive boiler (1-in. scale), led the writer to invent an expander easy to make and one which was found to do its work thoroughly. Taking, for example, it is desired to expand the tubes of a loco type boiler with tubes of $\frac{3}{8}$ in. diameter by 12 ins. long. Take a piece of steel rod, 14 ins. long by $\frac{3}{8}$ in., and screw each end about 2 ins. up (Fig. 1, A). Turn two nuts screwed to fit this rod and shaped as shown in Fig. 2, squaring the end of each for a spanner or wrench.

To use tool, put rod through the tube and screw on the nut at the firebox end; screw the other on at smokebox end (Fig. 3) and tighten up with spanner. A few turns will make the tube as tight as possible, and that without damaging the tube plates. The expander can be used for any size or kind of model boiler and has the advantage of expanding

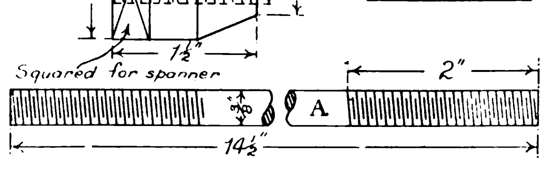


FIG. 1.

A SIMPLE TUBE EXPANDER.

both ends of tubes at the same time. The length of rod and the size of nuts being made to suit the boiler it is intended to be used on.

The Latest in Engineering.

Wear of High-speed Engine Bearings.—As an illustration of the small amount of wear in machinery bearings, even when running at considerable speed, provided the bearings are of sufficient area, with true surfaces and well-oiled, a high-speed engine, which was supplied for the electric plant at Digby, Nova Scotia, in June, 1892, has been running on an average ten to twelve hours each night until replaced by a larger engine, for over thirteen years. The engine is of the Robb-Armstrong, high-speed, centre-crank type, designed by E. J. Armstrong, M.E., the cylinders 10½ ins. diameter, and stroke 12 ins., speed 275 revolutions per minute. The main bearings of the crankshaft run in solid sleeves or shells, lined with babbitt, the journals, of forged steel 3⅞ ins. diameter by 12 ins. long, were ground and lapped, the shell being 2-1000th in. larger than the shaft journal, to allow for oil. The journals were oiled continuously by ring oiling and oil cups to keep up the supply. The shaft journals, which have not had anything done to them since the engine was started, were in good condition, and show a wear of only 1000th in. The shells or sleeves were replaced six-and-a-half years ago, and during that time show wear of only 6-1000ths in. The crank-pin for thirteen years' running was reduced only 7-1000ths in. at the centre and 5-1000ths at the ends. The steam valve, which is of the "Sweet" flat balanced type, was reduced only 3-1000ths in thickness by wear, and, when scraped perfectly parallel and true, was only 5-1000ths under the original size.—*American Machinist.*

An Improved Railway Chair.—A new form of rail chair has been patented by a German inventor, which permits of a ready and quick setting of the rails, as well as a rigid fixing. The chair is formed with a long base plate having a projection or block formed integrally with the base plate. A recess is provided in the base of the projection into which fits the lower head or plate of the rail, or the flange of the rail in the case of a flanged rail. When the rail is in position the fixing or coupling-piece is bolted down upon a tapered projection or boss formed integrally with the base plate of the chair, so that as the nut is screwed home on the bolt the tapered hole in the coupling or securing piece of the chair fitting over the tapered projection, tends to secure the rail more rigidly, and to tighten the rail in the chair.

Blast Furnace for Copper.—A smelting plant for copper—pyrite with chaleopyrite—has recently been started in California. The blast furnace is water jacketed, and is 57 ins. by 96 ins. at the throat, 40 ins. by 96 ins. at the tuyeres, which have an area of 26·67 sq. ft., or 5·06 sq. ins. per square foot of hearth. There is a tap hole for copper or for matte separation inside the crucible at each long side, and a slag tap hole in each short end. The matte tap hole is 9 ins. above the brick bottom, leaving always a bed of matte inside the fore hearth. In the first concentration, with 2 per cent. coke in the charge, a matte with 30 to 35 per cent. copper is produced. This is broken and re-concentrated with two-thirds of green ore on the charge, and the necessary quartz and limestone, using 3 to 4 per cent. coke on the charge and producing a matte with 45 to 50 per cent. copper. The blast temperature is from 460° to 700° F., being lowered for the second concentration to increase the copper content. The matte is tapped into moulds resting on lorries. The furnace gases enter a flue chamber of bricks with walls covered with wire netting and 1½ ins. of concrete, the face of which is painted with graphite to prevent the action of the sulphur upon the lime in the cement. The flue dust settles into steel hoppers, from which it is drawn off into small wagons on lines of 18-in. gauge, and carried to the briquetting plant. From the brick chamber a 21-in. steel pipe extends up a hill to a steel chimney 67 ins. diameter and 125 ft. high. A continuous scraper conveyor in the pipe drags down any collection of dust and delivers it into the last hopper of the flue chamber. The erection of a two-stand converter plant is contemplated, with a continuous reduction process. The matte from the first concentration will be converted, using silicious gold-bearing ores for the lining.—*The Engineer.*

Electric Furnaces and Metallurgy.—According to the *Western Electrician*, electric furnaces play a constantly increasing part in metallurgical processes. One has been designed recently to deal especially with the iron sands which are found in very large quantities at Calliope Dock, Auckland, New Zealand, and elsewhere in that colony. It is said that all previous attempts to treat this sand have failed in spite of the fact that it consists almost entirely of magnetite. The difficulty has been to reduce and smelt the sand, which chokes up all the types of blast furnaces which have been experimented with. The new electric furnace enables this sand to be treated continuously, and the inventor's figures give hope that the cost of treatment where cheap water power is available will be sufficiently low to make the process a commercial success. The furnace is used to reduce the iron sand into metallic iron or steel by the intense heat, impurities being removed afterwards. The attempt is interesting because the furnace is designed for a special object—the treatment of material which, although exceedingly rich in iron, has hitherto defied all the efforts of the metallurgist.

Discovery of New Cable Destroyer.—Several lead-boring insect larvæ are now known. In Australia, for a number of years, perforations have been noticed in the lead covering of telegraph cables suspended from poles by twisted steel wire, and as these have given trouble in the season of thunderstorms, they have been attributed to electricity. An investigation recently showed holes in the lead up to ¼ in. in diameter, as many as fourteen being discovered in a length of 16 ins. The little black insects (*bostrycus jesuica*) were found, and have been watched at work, their purpose seeming to be to reach the tarred linen covering portions of the wire under the lead. Other insects bore through lead to escape from confinement.

Lessons in Workshop Practice.

(*Continued from page* 201.)

XXII.—Metal Finishing: Polishing, Colouring, and Lacquering.

(*Continued from page* 462, *Vol. XII.*)

By Chas. W. Cook.

IN continuation of the tool method for finishing and polishing metallic surfaces, the following description of how a number of gunmetal cylinders were bored and faced will, it is hoped by the writer, serve to explain the method, and at the same time, point out a way of doing similar work.

It is often impracticable, owing either to the shape or length, etc., of the job, or on account of the size or unsuitability of the lathe, to fix work to the chuck or faceplate of lathe for boring or facing; consequently, under these circumstances, the alternative is to fix the work to the lathe saddle, and rotate the tool, this method of lathe working being exactly the opposite to that usually employed where the work is either held in the chuck or faceplate or between the centres and rotated, the tool being stationary, fixed in the slide-rest. For polishing this class of work, the use of the file and emery cloth, etc., is obviously out of the question; we are therefore compelled to both cut and polish with the boring or facing tool, this being done in the following instance:—

A number of gunmetal cylinders were required, each cylinder to be bored parallel throughout its length, and faced at either end square with the bore, exactly alike with each other, and smooth and highly finished. Fig. 1 will give a rough idea of the job, the dimensions of which were 4 ins. diameter of the bore and about 16 ins. long over-all, the ends of flanges being square shape, upon which a circular boss was turned, attached to this by means of eight studs being the cylinder cover.

In the ordinary way a casting would be bolted down to the lathe saddle on wood blocks, but in this case—the lathe was an ordinary 6-in. screw-cutting one—the saddle was quite unsuitable for this class of work, and it would have been a very difficult job to have fixed the work to it; so, to get over this trouble, and also to be of service for other jobs, a pattern was made and a cast-iron plate obtained and planed on both top and bottom sides, so that it should sit flat and level on the lathe saddle.

This iron plate was quite plain on the top side or face, and ribbed on the underside to strengthen it, and to allow it to stand clear of the projections on lathe saddle, and was about ½ in. thick when finished. After the cross or surfacing slide and screw was removed from the saddle, the plate covered the greater part of it, to which it was then fixed by means of screws, and made quite level and parallel with the lathe bed, this being effected by a judicious use of the scribing block gauge and sundry pieces of thin paper, the result being a useful little table on which these cylinders and many other jobs have been fixed and machined.

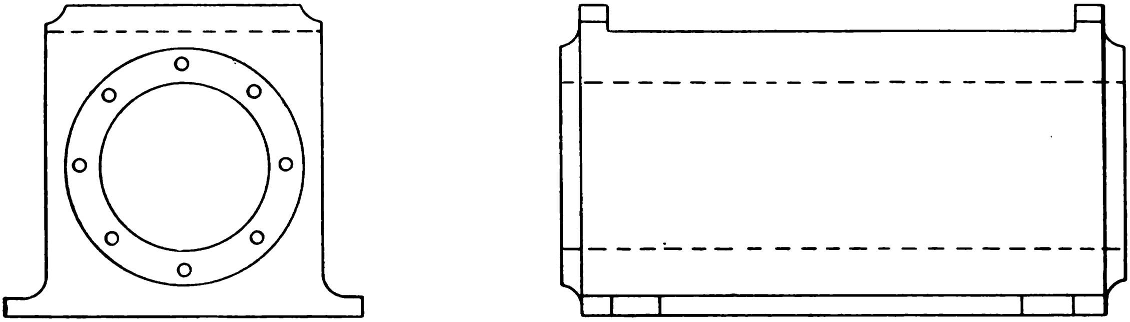


Fig. 1.

The advantages this little appliance possess are that, owing to its being machined on both sides, it is parallel, and in the same plane as the lathe bed, and consequently square with the lathe faceplate, it is also a miniature marking-off table, saving a great deal of trouble and uncertainty when setting a job, and with the aid of V-blocks and parallel strips of different thicknesses, work of a varied character and of smaller dimensions than these cylinders may be operated upon by both boring and milling tools.

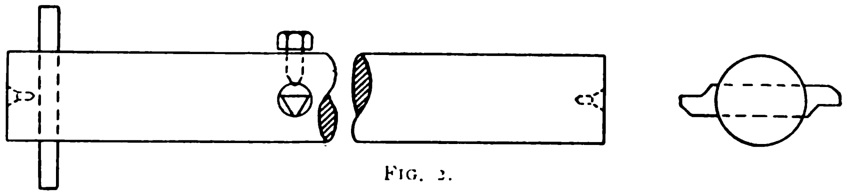


Fig. 2.

After the plate was made, the next tool required for the job was a boring bar, and this was made from an old piece of 2½-in. steel shafting about 6 ins. longer than twice the length of the cylinder. It was centred and well drilled up, and a cut taken over it from each end, for the purpose of trueing it up, and wearing down the centres, in order that when the bar was at work it would be less likely to lose its truth, and also for the purpose of bringing the lathe centres into alignment.

After this was done, holes were drilled in the bar (as shown at Fig. 2), the one at the end for a piece of ½-in. steel to act as a carrier, the steel rod being driven tightly through the bar, and the one in the middle of bar for a piece of ½-in. tool steel, this being the boring tool, and held in place by a ⅜-in. set-screw.

The boring bar was then ready, and as each cylinder had three cuts taken through it, three tools of different lengths were required, this being necessary, as each tool was double-ended—the first one 3 15-16ths in. long, the second 3-64ths in. longer, and the last 4 ins. long. These tools were shaped as shown at Figs. 3, 4, and 5, being roughing, cleaning up, and finishing respectively; the

FIG. 3.

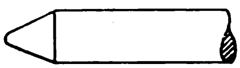


FIG. 4.

FIG. 5.

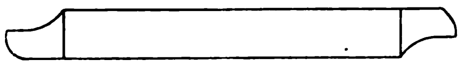


FIG. 6.

last-named being also the "burnisher" (as described in the last article), and hardened and tempered to a pale straw colour. The speed at which the bar revolved was slow, and the feed fine, no lubricant being used, and the cut allowed to go right through without stopping, the result being a perfectly parallel hole of a really beautiful finish.

Having bored the hole, the next consideration was the facing of the ends; and as these were required to be absolutely square with the bore, and of a high finish, it was necessary to devise a means of doing it without shifting the cylinder, and the following will explain how it was done.

A special form of slide-rest was designed (Fig. 7), a pattern was made, and a cast-iron casting obtained from it. The casting was then bored a good fit to the boring bar, and, as shown in the photograph, was sawn through, and two set-screws fitted to clamp it on the bar, this method of fixing being adopted to allow of the slide-rest being fixed at any part of the bar, and at the same time ensuring it always being square with it.

It was then planed, and a tool-rest, fitted in exactly the same way as a lathe slide-rest would be made, and a V-threaded screw (of twelve threads to the inch by ½ in. diameter) was made and fitted, and attached to the end of this screw was a five-pointed star wheel (as shown in the photograph), which, striking at each revolution a projection fixed to the lathe bed, gave the necessary feed or movement of the tool along the work, a fifth of the pitch of the screw being thus the movement of the tool at each revolution of the bar.

The tools were pieces of ½-in. square steel, the finishing tool being both cutter and burnisher (as described in the last article), the depth of cut being regulated, and the tool brought up to the work—or, rather, in this case, the work brought up to the tool by the leading screw of lathe, which was put in gear with the saddle, and, of course, out of gear with the mandrel, a large change wheel being fixed on end of screw to facilitate its movement by the hand.

The above method worked admirably, and after the necessary tools were made was as quick as any other, with this advantage—that the work was very highly finished and accurate; and, from start to finish, no abrasive material of any kind was used, the work being finished "off the tool." Of the two remaining methods of metal finishing by means of the tool applied direct to the work, viz., metal spinning in the lathe, and that of burnishing by hand, it may be mentioned that, as regards the first, an article dealing with the subject will appear later on; and of the second, that, although seldom used in the average mechanical workshop—being employed chiefly by the silversmith and for plated goods and high-class copper and brass work—nevertheless, a brief description of the method may be of interest.

Burnishing is simply rubbing or pressing a softer metal by means of a harder one, as, for instance, copper burnished by steel, the burnisher being made of either steel or stone, and of various shapes to suit the work to be operated upon. The effect of rubbing and pressing upon a soft metal by means of a harder one is to make the metal flow, pressing down the small eminences on the surface, and filling up the hollows and furrows, of which even a highly polished surface is made up, thus reducing it to a flat, smooth condition and, in consequence, considerably enhancing its lustre.

Steel burnishers for flat surfaces may be made from old files, the teeth of which have been ground

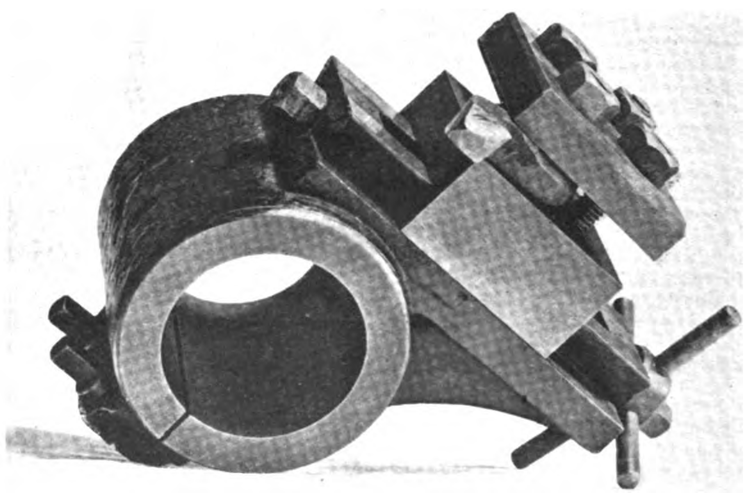


FIG. 7.—A SPECIAL FORM OF SLIDE-REST.

out, an 8-in. flat smooth and an 8-in. half-round smooth making very good burnishers, the edges and end of the flat file, and the half-round part of the other being filed up and nicely polished and hardened dead hard; while for small work, the tools may be made from smaller files.

The shapes and forms of burnishers are many and various, a few of the commoner types being shown

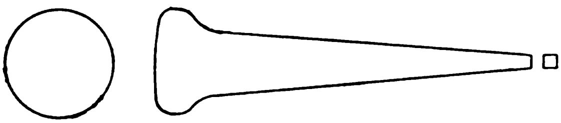


Fig. 8.

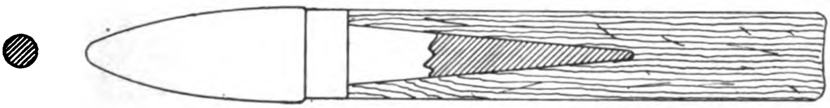


Fig. 9.

in the illustrations. Fig. 8 is turned from a piece of tool steel, highly polished and hardened glass herd, again polished, and fitted with a handle; Fig. 9, made from a piece of tool steel, and turned to a rounded point; Fig. 10, also turned to the shape shown; Fig. 11 is the tang end of a flat file filed up on all sides and nicely rounded and hardened glass hard; and Fig. 12 is also the end of a flat file filed to the curved shape shown, these being a few of the many shapes used, one used by the writer on several occasions being the face of a good hand hammer, as, with all of them, the principle is the same, the production of a highly finished surface by the pressure of a polished piece of steel of suitable and convenient shape upon the softer metal of the work to be operated upon.

The process consists of producing a series of lines by moving or gliding the burnisher backwards and forwards over the work, each line or stroke overlapping the one previously made, until the whole surface resembles that of a mirror.

The burnisher must be kept in good condition by rubbing it when it becomes dulled upon a piece of hide or leather charged with rouge or putty powder, and, when not in use, must be carefully protected from rust. It is also most important that a lubricant be always freely used on the work, or the burnisher would drag the surface and spoil the work, two very good lubricants for this purpose being newly made soap suds and vinegar water.

Having now brought to a conclusion the tool methods of polishing, or what may be regarded as such, since each of the methods described have been those where the work has been finished directly off the tool, we now come to the remaining methods and operations employed for the purpose. We will assume that the work to be polished has progressed beyond the preparatory stages of rough filing and grinding, etc., and whether the work to be turned out in the lathe, or work that has been operated upon by one or other of the machine tools, or filed up work in the vice, the polishing medium usually employed at this point is emery powder, paper, or cloth; and with this substance, if properly applied, it is quite easy to obtain really fine polished surfaces. As mentioned in the previous article, the polishing process consists of scratching: the finer the scratches, the higher the polish; and when the emery stage has been reached, the scratches left by the file should, by this time, be comparatively small and few in number, as the files employed on the work immediately before using emery cloth or paper ought to be smooth, and even dead smooth, for brass and gunmetal.

When filing with the object of ultimately polishing, care should be observed that the marks of the file are all in one direction; and to facilitate this, where the nature of the work permits, draw-filing should be resorted to, this being simply the holding of the file with both hands, one at each end—in exactly the same manner as a spokeshave is held when working wood—pressing it flat on the wood, and drawing it to and fro along it, the filing being thus at right angles to the length of the file.

Another way of obtaining a very good finish with the file is to use a dead smooth one of suitable size, holding it in the ordinary way, but instead of filing with the whole length of it, press

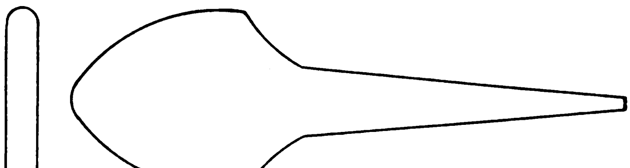


Fig. 12.

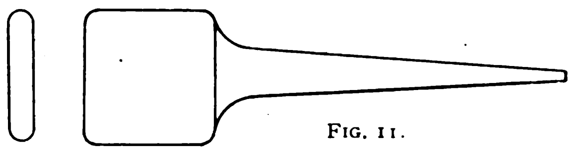


Fig. 11.

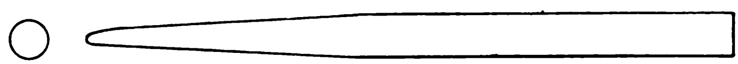


Fig. 10.

lightly on the work with the point, always rubbing in the same direction. It often happens, when filing, that very objectionable scratches are made on the work, due to minute pieces of the metal sticking to the teeth of the file; this is called "pinning," and can be generally prevented by well chalking or oiling the file.

Having now to obtain a still finer scratch, we employ emery, the method favoured by the writer being to tear off a length of No. 0 emery cloth, sufficient to wrap once round a suitable size file, rubbing the piece of cloth upon itself before using to remove any sharp, scratchy particles, and then rubbing the work in one direction until as high a polish as is possible has been obtained with this number of cloth, when we proceed in exactly the same way with the next number, 00; and so on until we arrive at the last and finest grade, No. 0000, paper; and this, used with a little oil, will effect a polish that, as a rule, will be found sufficient for all practical purposes.

If, however, a still higher degree of polish is required, we must employ still finer abrasive powders, such as putty powder, crocus, rottenstone, tripoli, rouge, etc., the writer's method of applying these being as follows:—

Obtain a piece of thick "baize," or "felt," free from dust, and use this to apply a paste made of either of the above powders, mixed up with paraffin oil or methylated spirit, the final touch being given by rubbing with the base of the thumb, using dry rouge or tripoli powder. The above-mentioned material, felt, is extremely useful for polishing metallic surfaces, a piece about ⅜ in. or ½ in. thick, held in the hand, and cut to a shape suitable for the work to be operated upon, and charged with well-washed emery flour powder and paraffin oil, being very effective in getting up irregular shaped surfaces and tarnished brass work, etc.

The next article will deal with colouring, figuring, and lacquering.

(To be continued.)

AT the Greencroft Mill, Hyde, a new steam turbine, the first of its kind to be used in Hyde, has been installed. The beam of the old engine, which ran up to a week or two ago, had been in use for a hundred years. The crankshaft of the old engine made thirty revolutions a minute. The turbine shaft makes 10,500 revolutions a minute.

HEAVY RAILS.—The rails on the Belt Line Road around Philadelphia are said to be the heaviest rails used on any railroad in the world. They weigh 142 lbs. to the yard, and are 17 lbs. heavier than any rails ever before used. They are ballasted in concrete, and 9-in. girders were used to bind them. All the curves and spurs were made of the same heavy rails, and the tracks are claimed to be superior to any railroad section ever undertaken.

NEW COALING FACILITIES.—Considerable interest is being taken at Liverpool in a new coaling appliance which has just appeared. This appliance is a kind of floating elevator, which puts coal into the bunkers of a steamer at a rate of about 150 tons per hour. It is a barge capable of holding 1,000 tons of coal, and the method of working is very simple. The hold is made in sections, each having false floors, and these can be raised to any angle so as to send all the coal to the centre. In the centre of the bottom of the barge is a continuous belt of buckets, which pass under the false floors and pick up the coal as they travel. On reaching the forward part of the vessel the buckets are raised to a great elevation in an upright position, and the coal is then placed into a weigher, which dips at each quarter of a ton, and sends the coal into a huge cylinder, through which the coal is conveyed into the bunkers of the steamer. Thus the coal is not only taken on board, but is weighed as well. The elevator works very smoothly, and experiments carried out at Birkenhead have proved the value of the invention. It is believed that this is the first of its kind in this country.

Marine Engineering and Shipbuilding Notes.

By CHAS. S. LAKE.

TURBINE STEAMERS FOR THE IRISH SERVICE.

MESSRS. JOHN BROWN & CO., of Clydebank, Glasgow, have in hand at the present time the construction of two turbine steamers, which have been ordered by the Great Western and Great Southern & Western Railways for the new South of Ireland route between Fishguard and Rosslare. The vessels will have a speed of 23 knots, and will have accommodation for 220 first-class and 100 second-class passengers. The new service will, it is expected, be inaugurated in the spring of next year.

NEW STEAMER FOR THE CHINA TRADE.

The trial trip of the *Fook Sang*, a large steamer built by Messrs. Wm. Dobson & Co., of Low, Walker-on-Tyne, for the Indo-China S.N. Company of London, recently took place off the Tyne, and was in every way successful. The vessel is 330 ft. 6 ins. long, between perpendiculars, has a breadth of 44 ft., and depth moulded to spar deck of 26 ft. 6 ins. She is built to the highest class of Lloyd's, and to the Board of Trade requirements, for passenger certificate, and is intended for the Hong Kong and Java trade, being specially fitted up for this service. A few first-class passengers are carried, and these are accommodated on the bridge deck, where there is also a large dining-room, with captain's apartments and chart room in a separate "house." The ship is lighted throughout by electricity, and the 'tween deck is arranged for carrying coolies. The engines are triple expansion type, with cylinders 23½ in. H.-P. (39 ins. intermediate), and 66 ins. L.-P. diameters by 45-in. stroke, supplied with steam from two large boilers fitted with Howden's force draught system, and working at a high pressure.

The machinery was supplied by Messrs. The North-Eastern Marine Engineering Co., Ltd., of Wallsend-on-Tyne. On the trial trip a mean speed of 12 knots was attained, and everything was carried through without any hitch of any kind whatever. After the trial the vessel proceeded on her maiden voyage.

A NEW AMERICAN MOTOR BOAT.

The Olds Motor Works Company, of Detroit, have recently built for the Detroit River a new motor boat measuring 35 ft. in length, 4 ft. 6 ins. in breadth, and 2 ft. 3 ins. deep. The hull has a double skin, the inner one being ⅛ in. thick, and the outer one 3-16ths in. mahogany. The keel is formed in one piece, of white oak, and the engine floors and beams are also of oak, being continued for some distance aft of the engine space by a gradual taper, thus very greatly stiffening the construction.

The decks are made of 3-16ths-in. mahogany, and, except under the weights of the engine, the frames measure ½ in. by ¾ in. The motor is of the six-cylinder vertical type, and the intake and exhaust valves are placed side by side. The six-throw crank is of nickel steel, carrying the flywheel at the front, and at the rear a flange bolted to a short length of shafting carrying the transmission gear.

It is stated that very little vibration is experienced when the revolutions are 1,000 per minute, owing to the reciprocating parts being well balanced. The cylinders are 5 ins. diameter by 5 ins. stroke, and the horse-power developed between 50 and 60. The ignition is of the high-tension type by means of an accumulator and spark coil, and a single carburettor is fitted for the six cylinders. On the trials the vessel made 20 miles per hour on the river.

A New Swedish Torpedo-boat Destroyer.

The writer is indebted to Messrs. John I. Thornycroft & Co., Ltd., for the accompanying photographs and particulars of the torpedo-boat destroyer *Magne*, recently built by them for the Swedish Government. The vessel is of what is known as the Shirakumo type, which has proved very successful in the recently concluded Russo-Japanese war. She is 219 ft. 9 ins. l ng over all, 20 ft. 9 ins. beam, and has a draught of 8 ft. 3 ins. at the screws. The machinery consists of two sets of four-cylinder vertical triple compound condensing engines, and four Thornycroft water-tube boilers, worked under forced draught on the closed stokehold principle. The coal capacity of the bunkers is 80 tons, sufficient for to give a radius of action of 2,800 nautical miles at a speed of 15 knots per hour. Three boats are carried on davits, one of the number being a Thornycroft petrol motor gig, 22 ft. long, driven by a 10 b.h.-p. motor. The others are respectively an 18-ft. cutter and a 14-ft. dinghey. Accommodation for sixty-four officers and men is provided, each officer having a separate cabin.

The armament consists of six 57 millimetre quick-firing guns, one mounted on the conning tower, one aft, and four on the broadside, and there are, in addition, two 45 centimetre revolving torpedo tubes. The vessel is sub-divided into several water-tight compartments by means of transverse bulkheads, and water-tight decks under the living spaces. She has a guaranteed speed of 30½ knots, to be maintained for three hours, with a load of 55 tons on board.

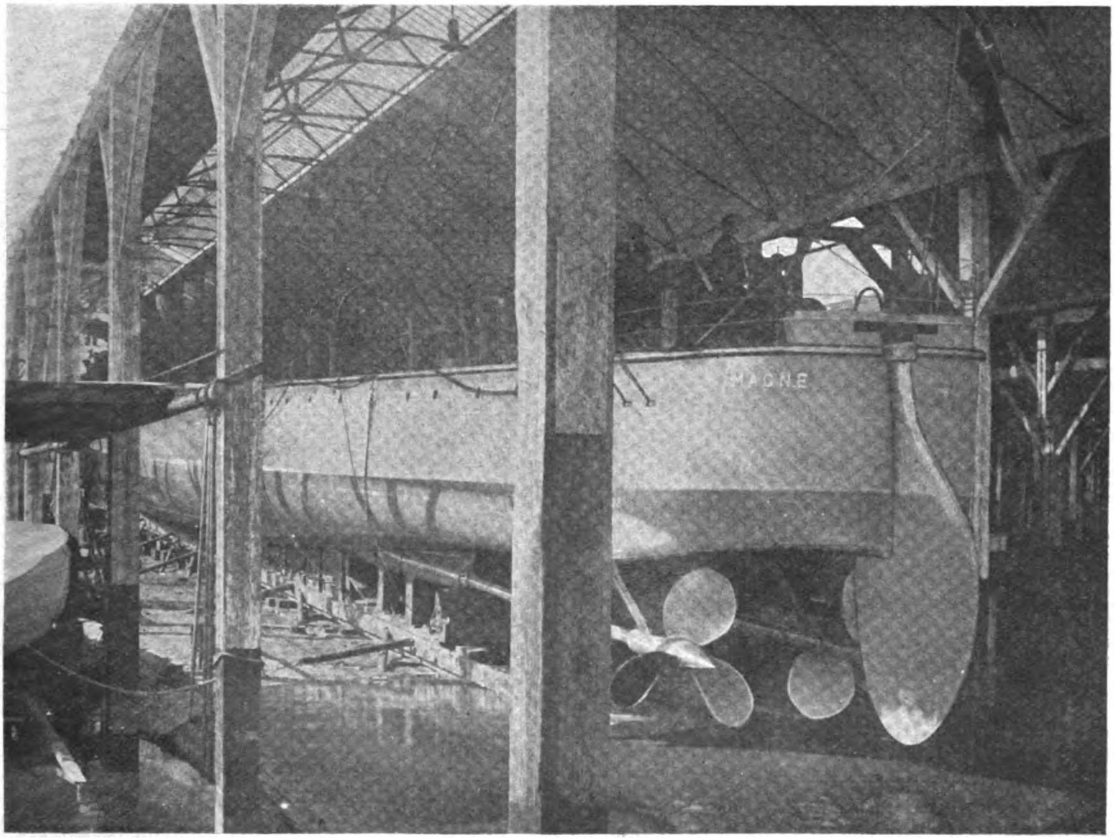


Fig. 1.—The Destroyer "Magne" on the Stocks before Launching.

The "Virginian" Record.

The record trip recently accomplished by the Allen turbine liner *Virginian* has aroused a very great deal of interest in shipbuilding circles. The vessel left Lough Foyle at half-past four on Friday, August 4th, and passed Belle Isle at seven o'clock on Tuesday, August 8th, thus making the run across the Atlantic in 4 days 2½ hours; or, allowing for difference between English and American time, 4 days 6 hours.

No steamer propelled by reciprocating engines has, so far as is known, ever made the trip between the points named in this time. The *Virginian* made the run from Moville, Ireland, to Rimouski, Quebec, in 5 days 22 hours 20 minutes. The latter place is the mail station, and is some hundreds of miles beyond Belle Isle. A record fo· rapid delivery of mails in Canada was effected, and but for the delay of seven hours caused by fog, a still more noteworthy performance would have been achieved.

Picturesqueness in Model Railways.

By E. W. Twining

(*Continued from page* 251.)

THE string-course mouldings and dripstone will require a few words. Fig. 11: C D shows the true Gothic sections for these three-quarters full size, and they should not be departed from. The smaller size C is for forming the dripstones of the battlements, and capping of all walls; the larger D for the string-courses and the dripstones over the tunnel (Fig. 9). These are to be cast in lead, the moulds being made in the following way:—Chuck on the faceplate of the lathe pieces of mahogany or other hardwood 1 in. thick or thereabouts, true on the face and as large as will revolve in centres clear of the bed; turn a ring or groove in each of these to the exact shape of the mouldings, large and small, respectively. When these are clamped in the vice as shown in Fig. 12, each with another piece also true on one side, capital moulds are formed. After casting no difficulty will be experienced in turning out of the mould; the ring should then be cut at the top where the metal was poured and straightened out, when they will be found to bend easily round the towers, and may be cut and mitred or used straight on walls and buttresses. Small brads

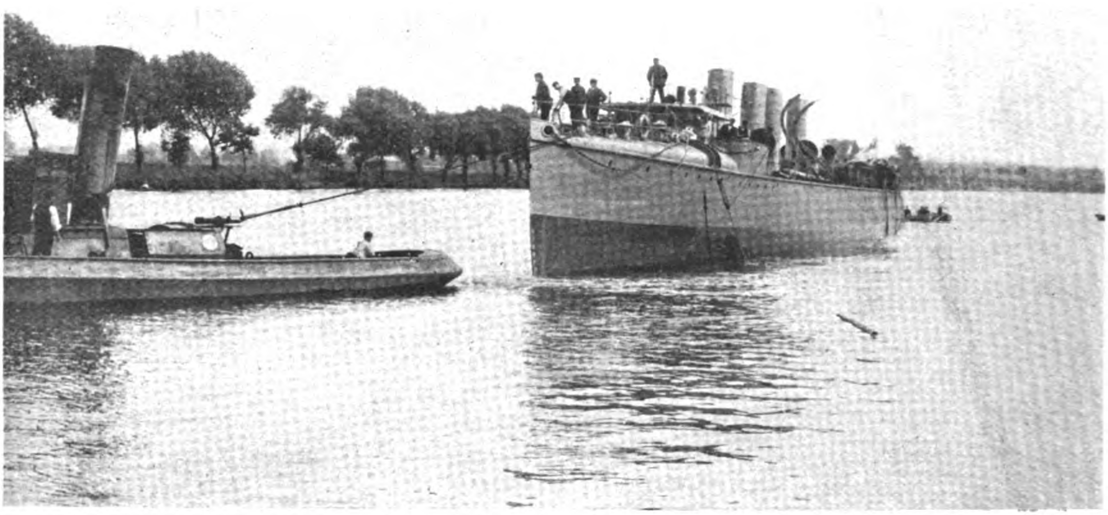


Fig. 2.—The Swedish Torpedo-Boat Destroyer "Magne" under Tow in the Thames.

(*Built by Messrs. J. I. Thornycroft, Ltd., Chiswick.*)

S.E. & C.R. Motor Trains.—The experimental motor train service tried by the South-Eastern and Chatham Railways on the Sheppey branch has proved so successful that it has been decided to place them on other branches, and six new trains are being constructed for this purpose at the Ashford works.

Boardite.—This is the name of a new article recently introduced for railway carriage wheel centres in place of teak segments. The material has been proved, on test, to be two and a-half times the strength of teak, and is not affected by fire or water. Its trial on the Great Western has been so satisfactory that an order has been given to the manufacturers. The material is also used for platform trucks.

about $\frac{5}{8}$ in. long can be used to nail with, the brad being passed through the lead in the hollow as indicated.

The same methods and mouldings will be used for both tunnels, and also for the bridge. Two special mouldings will require to be cast (moulds for which will be made in the same way as others)—viz., a cavetto to fit in the angle between A B, Figs. 6 and 9, the cross section of which will be as at E, Fig. 11, and a spandril moulding for the bridge to the shape F, Fig. 11.

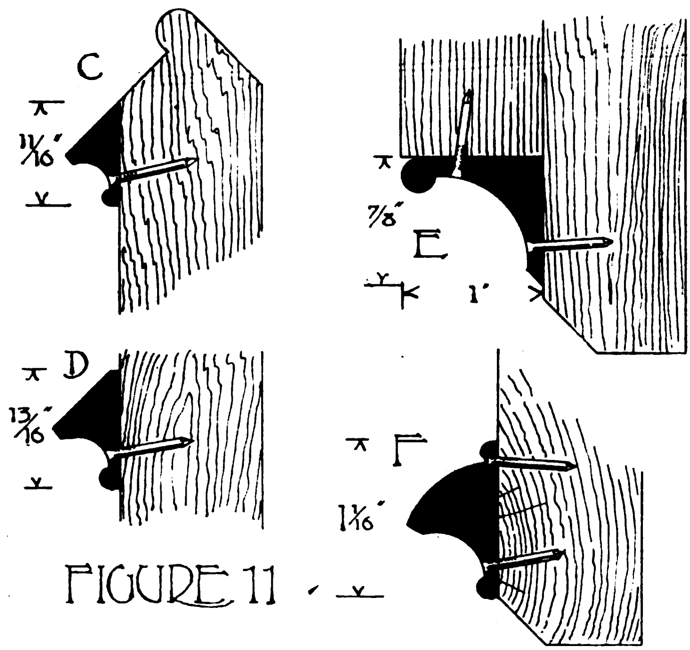


FIGURE 11

The spandril walls of the bridge should be held the required distance apart by wooden ties as shown. The arches of both tunnels and bridges should be formed of concrete in their proper places in the track. In the case of the bridge the thickness of concrete at the crown of the centre arch should be about 3 ins., and should gradually increase in thickness on each side towards the piers; at three-fourths of the distance from the crown to the centre of the pier the thickness should be about $4\frac{1}{2}$ ins., at which point the curve will reverse until the centre of the pier is reached—this will form the backing. As the cubic contents of concrete will be considerable, these measurements should not be exceeded on the score of economy. A single course of bricks should be placed underneath each pier, as well as the abutments, with a cement grout worked in between each brick. This will form a good foundation. A piece of thick strawboard or sheet zinc, bent to the shape of the arch, tacked across between the underneath edges of the spandril walls, will serve as centreing to support the concrete whilst it is setting. The woodwork should be keyed to the concrete by large screws passed through before putting in place; the cement will run round these and make the whole work secure. Concrete should be thoroughly mixed whilst dry on a board, then spread out roughly to a saucer shape and water poured on, stirred well, and not made too wet. For concrete, use Portland cement 1 part; sand, 2 parts; fine gravel, 4 parts. Before putting in concrete, plaster cement and sand equal parts around the centreing to a thickness of about 1 in. This will ensure a neat smooth soffit. When the concrete has set, the centreing can be removed. This method of arching can be adopted right through the tunnels or only for a foot or so from the entrance. Nothing can be better than the large earthenware drain pipes already suggested in the *M.E.* for the middle of tunnels.

In place of inner spandril walls to the bridge, the space above the arch and piers may be filled with gravel up to the level of the point at which ballast commences. The locomotive shown on the bridge represents $\frac{3}{4}$ in. to the foot scale model. It is introduced to enable the reader to get a clearer idea of the intended proportions of the bridge. The distance of 60 ins. between the piers would represent in practice a span of 80 ft.

The woodwork should be painted all over thoroughly before putting in place, and cracks puttied up. Make your own paint; you will then be more sure of its quality. Use best white lead with patent driers and boiled linseed oil, thinned with turpentine, colour with lampblack and a little light Brunswick (chrome) green until a light greenish grey is obtained. Do not attempt to paint the mortar joints between the courses of stone. These may be represented either by drawing lines with a hard blacklead pencil *before* the final coat of paint is applied, which in this case should be well thinned with turps, the paint being nearly transparent; or they may be indicated by indenting with a cold chisel driven on to the wood in straight lines, horizontally and vertically. Remember, the sizes of the stones are not uniform like bricks.

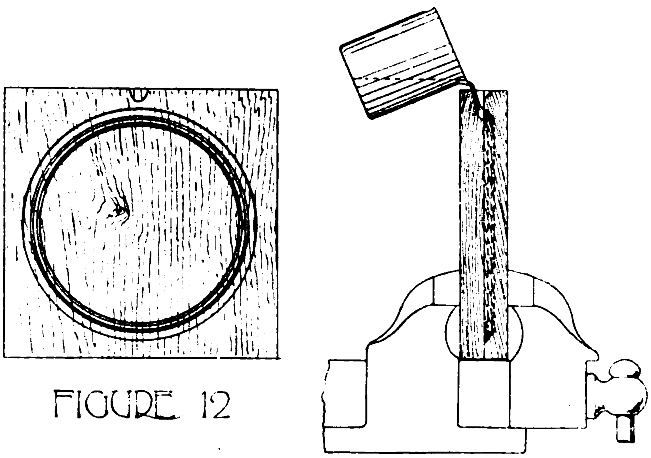


FIGURE 12

Fig. 14 is another example of Gothic bridge building, and spans a road at Rugby. It was erected under the superintendence of Mr. Robert Stephenson in 1837, and its ornate style is said to have been made compulsory on the railway company (then the London and Birmingham Railway, now London and North-Western Railway) by the authorities of the neighbouring Rugby College.

Not all readers, perhaps, will share in the writer's preferment of Gothic architecture as applied to railways. Some, no doubt, with classic taste would rather see a Grecian order or Italian Renaissance adorning their tracks. In the hope of assisting these, I would suggest that their bridges should be modelled on the lines of, say, Waterloo Bridge, with Grecian Doric columns at each pier. These columns could, of course, be turned up in the lathe, but as I have already said, the mouldings and heavy cornices in Classic and Renaissance will be found more difficult to reproduce, as a little consideration will show.

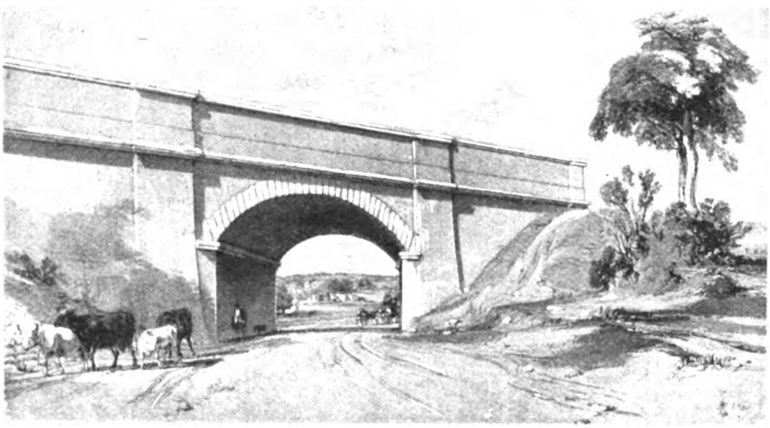


FIG. 13.—A SKEW BRIDGE AT BOXMOOR, LONDON AND BIRMINGHAM RAILWAY.

Fig. 13 is a reproduction of one of the skew bridges on the London and Birmingham Railway, at Boxmoor, and although it follows no particular style of architecture, is massive and bold in its proportions. The illustration (Fig. 15) is of the Colne Valley viaduct near Watford Junction, on the same line. The picture shows the viaduct as it was in 1837, since when it has been, like the other bridges, very much altered owing to the wi ening of the lines. The above figures are reproduced from original prints lent to the author by Mr. Henry Greenly. If Gothic be the style decided upon, before commencing work let the reader take a look at the towers and mouldings at Westminster Hall or any of the fine Tudor mansions scattered throughout England, and mark each feature of the style, then copy them in tunnels and bridges. His masonry will then have the merit of being built in a style of pure architecture, and not in a mongrel style or no style at all.

Now a few words about permanent way. The correct form of this will add considerably to the picturesqueness and realistic appearance of the line. "Tee" iron has been advocated, and many times used for rails. It has been, I believe, invariably used in conjunction with cross sleepers, to which it has been screwed. Tee iron so used has two disadvantages. First, it does not in the least resemble bull-headed rails, using chairs on cross sleepers; second, it will not keep to gauge, on account of expansion and contraction longitudinally.

The latter fault may be overcome by cutting the tee iron into lengths of about 2 ft. or 2 ft. 6 ins., but this introduces another difficulty—viz., that with cross sleepers some form of fishplate is required to bond the rails and keep them in line, otherwise the sleepers may shift to one side and the rails become out of alignment.

The suggestion I have to offer is this: that cross sleepers be abandoned and that Brunel's system of longitudinal sleepers, as used on the Great Western Railway until quite recently, and which may still be found in many places on that Company's system, be copied.

This arrangement will be found to possess many advantages over cross sleepers; to commence with, the expansion difficulty is overcome. The iron having been cut into 24-in. or 30-in. lengths, is screwed down to the sleeper with an allowance of about 1-16th in. between the ends of the lengths. The wood for the sleepers can be obtained from timber merchants in the form of laths 9 ft. long, 2 ins. deep, and $\frac{7}{8}$ in. thick; they are kept in stock to these sizes for building purposes, and are sold at about $\frac{1}{4}$d. per foot run. For our work they will not require to be cut in any way, except, perhaps, planing true on the top edge. One advantage in the use of these lengths is that they can be made up in the workshop complete, the rails being screwed on to one edge. The sleepers are kept apart by distance pieces, which serve also as cross ties.

Another advantage is the simplicity of laying the track, since it is only a matter of placing the completed lengths end to end in a shallow trench in the ground, with hardwood or metal plates screwed on each side of the ends to connect them, the space between the longitudinals and for a few inches on either side being packed with ballast.

Yet another advantage lies in the rigidity of the sleepers. A local disturbance of the ground underneath will not affect the truth of the line as it would with cross sleepers, by causing a settlement.

Curves may be worked by making a succession of saw cuts vertically in the lath to a depth of about $\frac{3}{4}$ in. at every 6 or 8 ins., the distance between the cuts depending on the radius required. These cuts will allow the lath to bend, the bend being made in the direction which tends to close up the saw cut. On such curves where this method is employed, it will be advisable to nail boards on the underside to keep the curve from spreading and

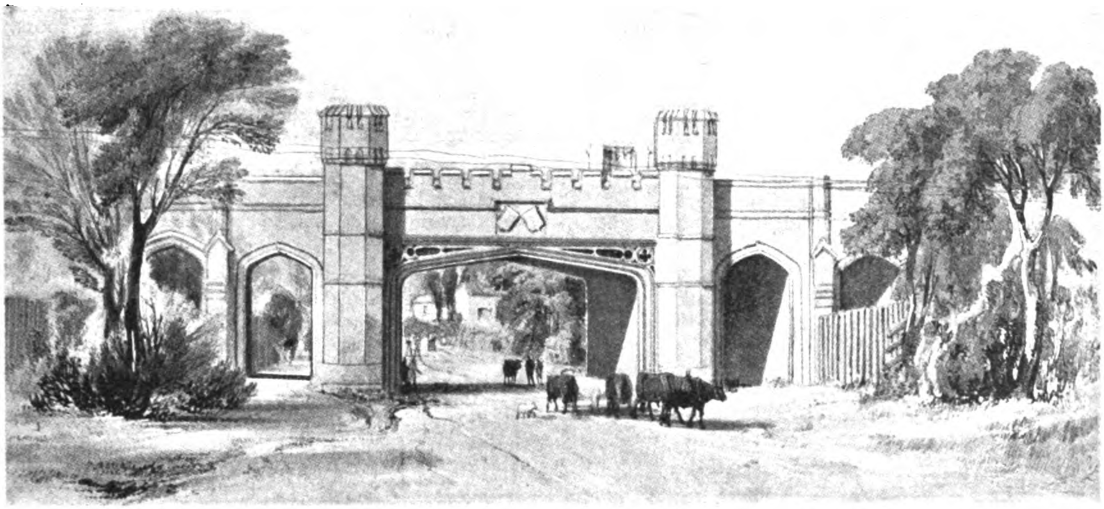


FIG. 14.—GOTHIC BRIDGE OVER ROAD AT RUGBY, LONDON AND BIRMINGHAM RAILWAY.

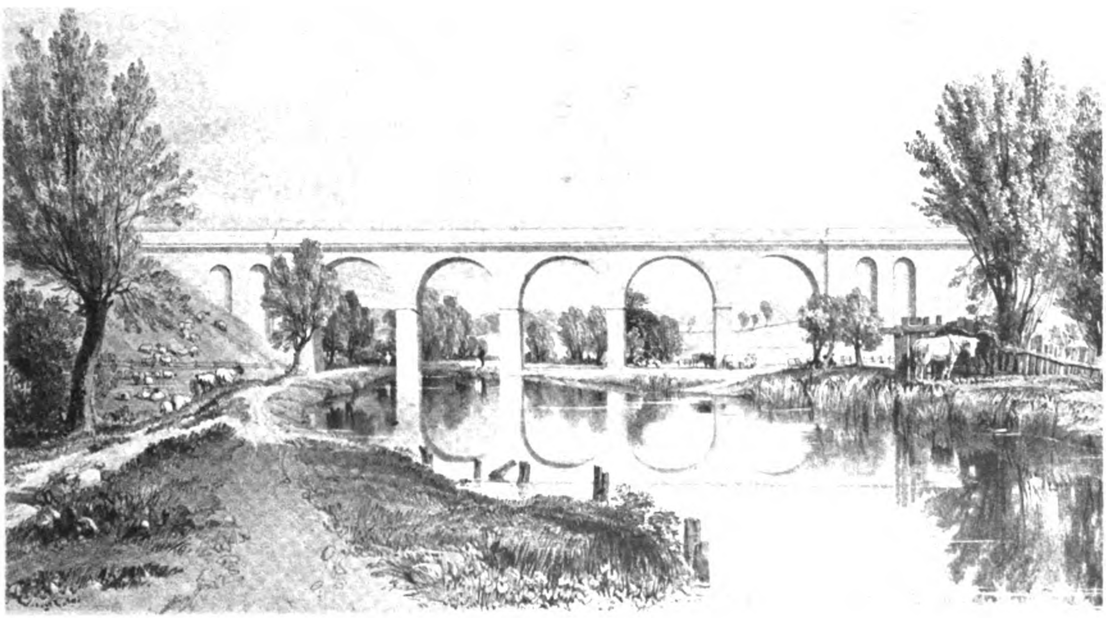


FIG. 15.—"THE FIVE ARCHES," WATFORD. IN 1837.

increasing in radius. The writer found that a very good way to get the curves true was to strike the radius with string and chalk on the floor of the workshop, and then after saw cutting the sleepers to build them up to the chalk line.

Those who have built or possess models of the Great Western broad gauge locomotives should certainly run them on a track as above described, as not only does tee iron closely follow the shape of the "bridge" rail, but the broad gauge engines never ran over cross sleepers. For ballast, finely broken yellow gravel or sandstone has a good appearance.

A special drawing of the above arrangement is deemed scarcely necessary, as the track is clearly shown in section and plan in Fig. 10.

In conclusion, all earthworks, cuttings, and embankments should be thickly sown with best lawn grass seeds, which should be carefully cut when it has grown to the height of about 3 ins. The best time for sowing is the month of April. Cork or rocks, the latter preferably, may be used to support the piling up of earth on the outside of tunnels, between which variegated grasses, moss, ferns, and ivy may be planted, whilst evergreen bushes, box, rhododendron and laurel may be set on the top. All these, especially ivy and ferns, are things which will lend a charm to the embattled turret and pointed arch, and make the iron track a thing of picturesqueness and beauty.

VARNISH FOR CAST IRON PATTERNS.—For small cast iron patterns the following is a very satisfactory method of v rnishing :—Apply boiled linseed oil to the iron, the pattern being heated to a temperature that will just char or blacken the oil; the oil appears to enter the pores of the iron, and after such an application the metal resists rust and corrosive agents very satisfactorily.

HARPER & BROTHERS have just added to their list of Electrical Handbooks a volume entitled "Practical Electric Wiring for Lighting Installations," by C. C. Metcalfe, A.M.I.E.E., of the Manchester School of Technology. The book is written for foremen, wiremen, and students, and for those who wish to acquire a practical knowledge of wiring, jointing, and fitting for the installation of electric light. The book is fully illustrated, and the price is 5s. net.

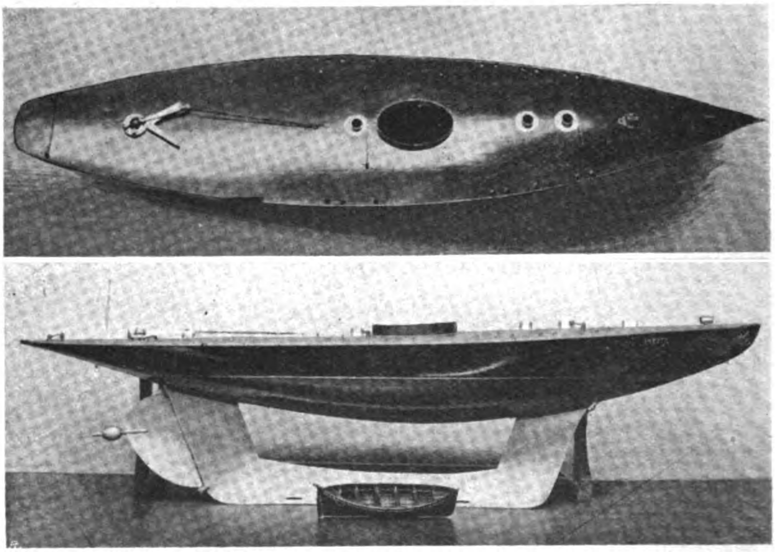
A MOTOR BOAT RUN.—A remarkable run for a motor boat was accomplished by Lord Howard de Walden's racing craft *Napier*, which, on August 24th, made the trip from Cowes to Yarrow's yard at Poplar without a single involuntary stop. The actual running time was 9 hours 55 minutes. On the previous day the boat ran from Cowes to the Werner Light and back in weather so heavy as to cause the suspension of the ordinary traffic from Portsmouth to Ryde.

Model 10-Rater Double-Fin Keel Sailing Yacht.

By CAPT. W. S. WALLACE.

THE accompanying photographs are of the model sailing yacht *Irene*, built to the design given in THE MODEL ENGINEER (1901), by the late Mr. W. H. Wilson-Theobald. The design and construction were adhered to, with very few modifications and additions. It is the design for a 10-rater double-fin keel which is now described in THE MODEL ENGINEER shilling Handbook on Model Yacht.

She is 51½ ins. on deck L.O.A. by 11·6 ins. beam, draws 3½ ins. water to bottom of hull at midship section, and has 2½ ins. freeboard. She is built of



FIGS. 1 & 2.—DECK AND SIDE VIEWS OF HULL OF CAPT. W. S. WALLACE'S MODEL SAILING YACHT.

pitchpine planks, bare ¼ in. in thickness, and there are nine planks each side. The keel, stem, and stern piece are of good yellow pine, the frames of Ame ican elm, also the gunwales, the frames being recessed into the latter. The bulkheads are ¼ in. cherry wood, and the deck—in one piece—is of white holly. There are five bulkheads, or permanent moulds, and twenty-one frames or ribs, all spaced 1½ ins. centre to centre. The stem is brass sheathed; the mast tubes, fin, steering gear, and all deck, mast and spar fittings are of aluminium.

The steering gear adopted is the same as that used by Mr. Savage in his fine sea-going model yacht *Hilda*, and is described in THE MODEL ENGINEER (May, 1903) by Mr. Rhodes, the inventor, and is all he claims it to be. As will be seen from the photographs, she can be rigged either as a cutter or fore and aft schooner, the same mainmast doing duty for both.

Rigged as a cutter (Fig. 3), her actual sail area is 1,500 sq. ins. (measuring the head sails as one triangle, it comes to 1,651 sq. ins.); rigged as a schooner (Fig. 4), the actual sail area is 1,553 sq. ins., or 1,668, taking head sails as one triangle.

Her displacement as a cutter is 22 lbs. ; as a

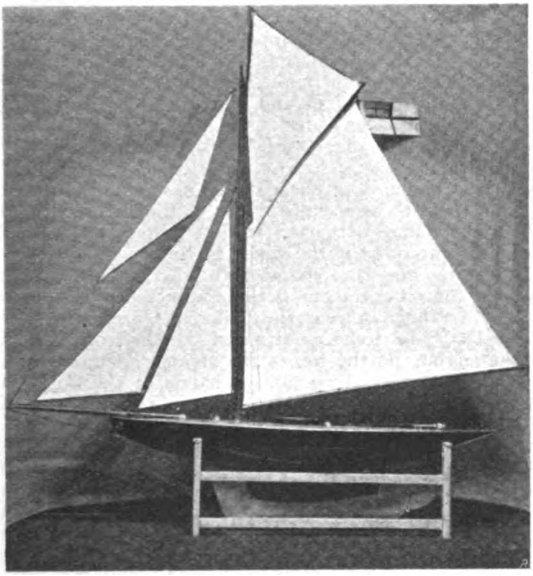


Fig. 3.—Rigged as a Cutter.

schooner, 23½ lbs. ; but this can be varied to suit circumstances, as the bulb ballast is so fitted that 1 lb. weight can be added to both ends, or a smaller amount as desired, just putting in sufficient at either end to gain the weight and trim desired. The fin keel slides in a groove in the bulb up to half its depth, and is held in place by two ¼-in. bolts passing through slots in fin keel, the length of the slots allowing the ballast to be moved bodily forward or aft for extra trimming purposes. The bulb is made of gunmetal. The deck is lined off ¼ in., to represent planks and covering board. After it was in position it was given as much raw linseed oil as it could take till saturated, and afterwards heavily French polished. The coamings on deck for hatch are aluminium, the hatch cover is mahogany, and top aluminium.

The inside of boat was given five coats of white zinc paint, put on very thin, and each coat given one week to dry and harden ; but the boat was perfectly water-tight without anything inside or out. The outside was painted with five coats of white and red lead mixed, put on as thinly as possible ; and after hardening, each coat was well rubbed down with fine, worn glasspaper. The outside painting was completed by the under water body having three coats of " Ardenbrite " copper enamel. Two coats of drop black, ground in gold size, were given to the top sides ; the oak moulding round deck was gilded, and the water-line and name painted in aluminium ; the whole afterwards receiving two coats of best carriage varnish, well thinned down with turps.

The painting is perhaps the only part which one may describe as being tedious ; but it need not be made so, for the deck and deck fittings can be under way while the inside is being painted, and the masts, spars, and sails afford sufficient to do while the outside painting is being done, but each coat of paint must have sufficient time to dry and harden ; and it fully repays one for the trouble afterwards by the superior finish and appearance, to say nothing of the wearing qualities. Masts and spars are French polished ; gaff jaws, goose-necks on booms, spider bands, and all other fittings to spars are aluminium.

The sails are of the best model sail cloth, and taped ; tacks and clews of all sails strengthened by gusset pieces ; fore and aft head sails fitted with hanks travelling on stays, try-sail and mainsail with rings on masts, all sails being easily hoisted or lowered as required.

The hull, when finished and minus deck, weighed only 4 lbs., but it is surprising how weight gets piled on afterwards ; the paint is accountable for a good deal, put it on ever so thinly ; the deck adds about another 1½ lbs. ; the mast tubes and flanges, deck fittings, steering gear, fins, masts, spars, and sails are responsible for the remainder.

According to the specification by the late Mr. Wilson Theobald, this vessel should only have a displacement of 16 to 17 lbs., and a 36-in. L.W.L. But two friends of mine have each constructed a model to the same design—one of pitchpine, the other of yellow pine, and there is not ½ lb. difference in weight between any of the three.

There are nearly 2,000 ¼-in. brass screws in this model, and it took me four months' spare time to build. I made full size working drawings of all parts, putting in all the water-lines and buttocks ; and it well pays one to do this for ease in working afterwards. It is the second model I have built to

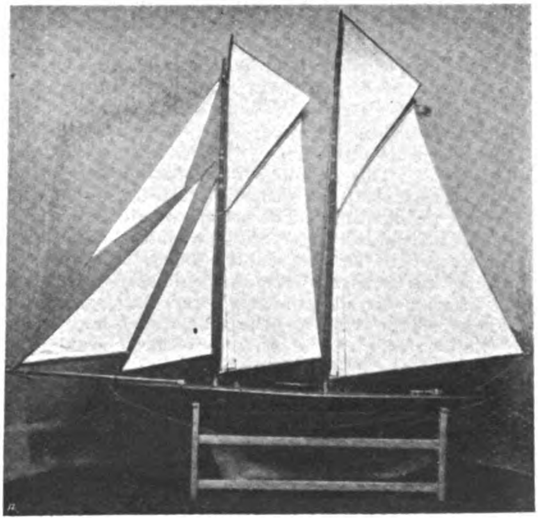


Fig. 4.—Rigged as a Schooner.

this design, the first being ¾ scale, and makes a fine model, but rather small for racing purposes.

In my opinion, this form of model is an ideal one, and it is a pity that so many model yacht clubs foster a form of yacht which is not a model of anything in existence—a mere plank on edge, with a centre fin 16 ins. or 18 ins. deep that can only sail " tacking to windward," and has to be towed back to leeward each time to make another series of tacks.

Mr. R. P. Kitchingman's design and specification described in a recent number of *Ours*, a 36 lineal rater, about same length and beam as the double-fin boat here described, has a displacement of 24 lbs., which seems to me to be about what she could be built to have; but I think 16 to 17 lbs. is too light an estimate for the double-fin keeler if the specification is carried out. At the same time, I much admire the design, and the description in your handbook is so lucid, that it ought to enable anyone with "gumption" to build a fine and most satisfactory craft.

The lifeboat shown in the photograph of the hull is one of the boats belonging to a steam schooner yacht, 7 ft. long, which I built twelve years ago, and is an exact scale model, with correct number of planks, ribs, knees, breast hooks, bottom boards, ring-bolts, etc., and is 10 ins. long over-all.

In conclusion, I may say that the whole of the work on this *Irene* has been done during winter months in the North Sea, and has often had to be lashed down to the cabin table to keep it from being flung about by the rolling and pitching of the ship when coming back to the Tyne with water ballast only.

The "Holiday" Competition.

DURING the present holiday season, we have decided to award every reader who sends us a description and original photographs of anything of engineering or model-making interest he may encounter during his vacation, which shall be sufficiently good to warrant insertion in our journal. The prizes vary in value from 5s. to 10s. 6d., according to merit. All winning competitors will receive a notice of the value of the prize awarded, when they can choose the tools or other articles they may wish sent to them. All entries should be accompanied by a separate letter, marked on the envelope "*M.E.* HOLIDAY COMPETITION." This letter should include the title of the article and any other information not necessary for publication. The article should be written *on one side of the paper only*, with the name and address of the sender on the back. The photographs and separate sketches enclosed with the contribution should similarly bear the name and address of the sender, otherwise delay may arise in the awarding of the prizes. It is essential that the copyright of the photographs must be the property of the senders, and the covering letter should contain a declaration to this effect. The competition will close on October 16th.

ELECTRIC LIGHT FOR ARCTIC EXPLORERS.—The Canadian steamship *Arctic*, which is at present under the command of Captain Bernier and preparing for an extended Arctic voyage, is to be provided with a novel electric light installation. Since fuel cannot be obtained for the generation of steam, and as the ship will have to spend many months in darkness, it has been decided to instal an air-compresser plant which will be operated by a windmill. The compressed air will then be used to drive the generators, which in turn will furnish current for charging the storage batteries used for lighting the vessel—*Electricity*.

A New Water-Tube Locomotive Boiler.

MR. J. BROTAN, chief engineer and deputy-chief of workshops of the I.R. State Railways, Pilsen, and a locomotive engineer of considerable experience, after making a particular study of the subject and carrying out numerous experiments, has designed a boiler which, he thinks, will be most suitable to present and future requirements.

This boiler is of exceedingly novel construction, and consists essentially of an ordinary cylindrical tubular boiler, with a water-tube firebox, the former being provided with what is known as a steam-collector, and the latter with what is known as a collector-tube, the one being connected to the other and arranged above the boiler and firebox respectively. The dome is situated at the front end of the engine, on the top of the steam collector.

The cylindrical portion or barrel of the boiler is built up of three mild steel plates 14 millimetres in thickness.

An engine fitted with this boiler was tried on the I. & R. State Railways, Austria, in January of 1901, and gave such satisfactory results that in the following year four more were ordered. These boilers had certain minor defects in the design of the firebox, which, however, were very soon remedied; and a boiler improved upon the lines suggested by the experience gained from them was constructed in 1904, and fitted into a four-coupled express engine. This engine has been running fast trains from Divaca to Pola and back ever since. Compared with other engines of the same class fitted with ordinary boilers, it is claimed that a saving in coal of 20 per cent. results in its favour.

With regard to the heating surface, it should be observed that, in reckoning that of the firebox, half the circumference of the water-tubes is considered as being effective, while the area of that part of the collector tube in contact with the fire is, of course, also taken into account.

In conclusion, one is forced to admit that the absence of all firebox stays and of rivets in connection with the fire is a tremendous advantage, apart from any other; for, without doubt, 90 per cent. at least of the ills to which a boiler is heir are traceable to these details.

ACID-PROOF VARNISH.—A new acid-resisting varnish called "Yar Ring" has recently been introduced by Messrs. Edwin Cooper & Co., Ltd., of 88, Leadenhall Street, E.C. It is claimed by the makers that this varnish will permanently resist the action of sulphuric acid, and that it is also not liable to peel off, even after prolonged use. It is therefore stated to be specially adapted for painting bars used in connection with accumulator work. It is well known that when charging secondary batteries acid vapours are given off. These are deposited on copper bars, in the shape of small globules, which finally coalesce into large drops, and become concentrated by evaporation. The drops frequently contain as much as 40 per cent. of acid. It is put forward as a special feature of "Yar Ring" that it does not contain any sulphuret of carbon, a substance which is injurious to the attendants. The varnish has been well tested, and the results are said to have been most satisfactory.

A Model Triple Expansion Marine Engine.

By J. Aiken.

THE model shown in the accompanying illustrations is the result of my spare time work during about twenty months. In the construction of this engine no castings have been used, and it has been built almost entirely without the aid of any drawings. It is complete excepting the pumps, which, at the time of writing, were not quite finished. The cylinders were made of solid-drawn brass tubing, ¼ in. thick.

The dimensions are as follows:—High-pressure, 1 1-16th ins. diameter; intermediate, 2¼ ins. diameter; low-pressure, 3 ins. diameter by 2¼-ins. stroke. The bottoms of the cylinders are in one piece, and the tubing for each is sweated on. The steam chests, of 1-16th-in. brass, are also sweated on to the cylinders.

The pistons are built up of 3-16ths-in. and 1-16th-in. sheet brass, and riveted together, making them 5-16ths in. deep. Covers for cylinders and steam chests are of 3-16ths in. brass, with stuffing-boxes and escape valves screwed in, all being entirely made by hand. The L.-P. tail rod is made of a French nail, 5-32nds in. thick, and the piston-rods (¼ in. thick) and connecting-rods (5-16ths in. thick) are rough forgings, finished off by the aid of a hack-saw, breast brace, and files; the reader will understand that the job was not the easiest.

In the condenser and back columns there are sixteen pieces of 1-16th-in. sheet brass, sweated together. The condenser contains thirty-six tubes, each 11 ins. by ⅛ in. The bed-plate consists of twenty separate pieces of brass, riveted and sweated together. The main bearings I filed out of ½-in. sheet Muntz metal. The crankshaft is composed of thirteen pieces, the shaft being ½ in. mild steel, and filed up; and the webs are ⅜ in. thick by ⅞ in. broad.

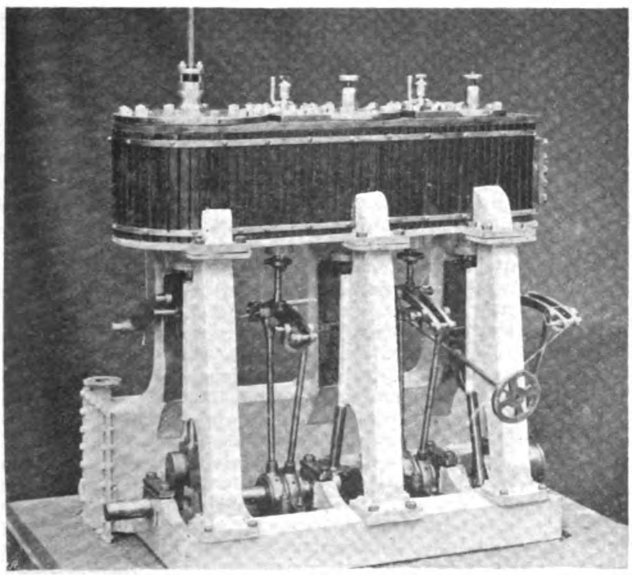


Fig. 1.—Front View of Model Triple Expansion Marine Engine.

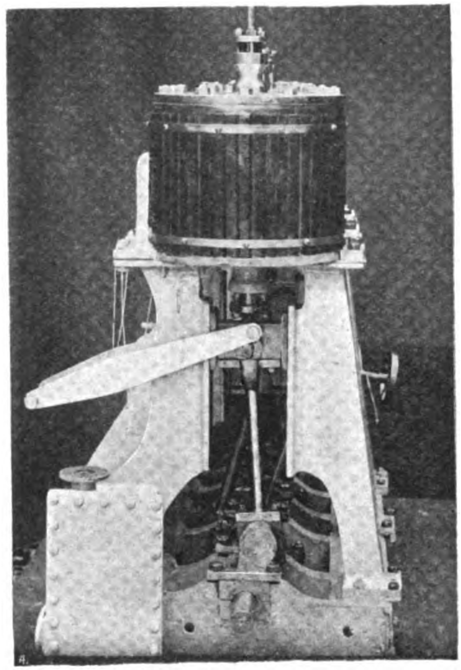


Fig. 2.—End View of Mr. J. Aiken's Model Engine.

Eccentric rods are made of 5-32nds-in. French nails, and the ends are cut out of ⅛ in. mild sheet steel with a hacksaw. The straps are cut from ⅛-in. sheet Muntz metal. French nails of 5-32nds in. thickness also form the slide rods, and the glands are filed from Muntz metal rod.

The only turning that I have had to put out to be done—not possessing a lathe—is the eccentric sheaves. The pump levers are made from ⅛-in. sheet steel, also the slot links, and the tumbler blocks are of Muntz metal rod.

I have lagged the cylinders with teak wood and brass bands. The cylinder feet are of sheet brass, sweated on, and the whole engine is mounted on a teak wood base.

In conclusion, I might add that the only sketch that I made was of the eccentric rods, in order to obtain the radii of the links.

An electrically-driven oil boat, 245 ft. long, 32 ft. beam, and rated at 1,100 tons, has been built for the Russian oil trade, using three Diesel oil engines for the production of power, which is transmitted to electric motors operating the propellers. The engines are placed amidships, and the oil tanks forward and aft. The entire control equipment for the motors is situated in the pilot house, thus doing away with all signalling apparatus to the engine-room.

Practical Letters from our Readers.

[The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a nom-de-plume *if desired, but the full name and address of the sender* MUST *invariably be attached, though not necessarily intended for publication.]*

A Model Reversing Gear.

To THE EDITOR OF *The Model Engineer*.

DEAR SIR,—A description of my reversing gear for model steam engine may be of interest to readers of these pages. The full-size sketches herewith serve to illustrate the arrangement. A (Fig. 1) is a side view of the eccentric complete; B and C

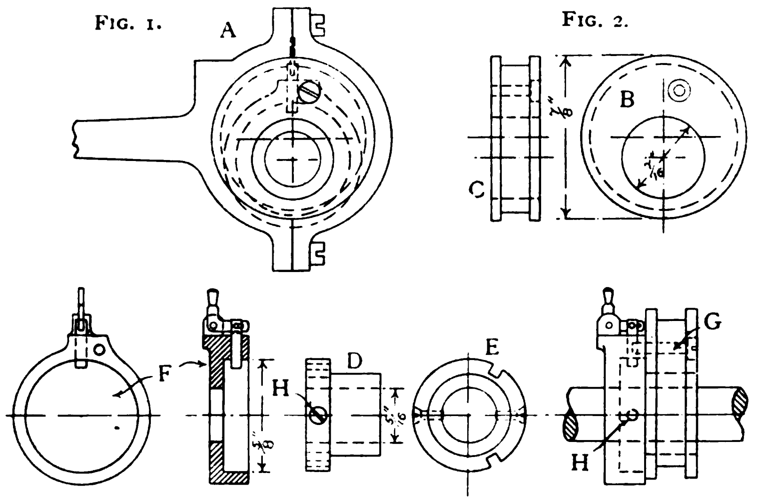


FIG. 1. FIG. 2. FIG. 4. FIG. 3. FIG. 5.

A MODEL REVERSING GEAR.

(Fig. 2) are side and end views of the sheave. A bush turned to fit on the axle is shown at D and E (Fig. 3), secured by two set-screws (H), which are 1-16th in. diameter. The pulley, as can be seen at Fig. 5, is slipped on to the bush, and is allowed to turn on the bush loosely.

The method of fastening the reversing gear to the pulley and axle is also shown at Fig. 5. The set-screw G bolts the gear to the pulley.—Yours truly, FRED WILSON.

West Hampton.

Resistance of Voltmeters.

To THE EDITOR OF *The Model Engineer*.

DEAR SIR,—I have bought a small voltmeter, reading up to 8 volts, from a firm who make electrical apparatus. It is one of the 10s. 6d. type, as advertised by firms in your paper. The other day I was experimenting with a 4-volt accumulator, an ammeter, and my voltmeter. I discovered that the voltmeter, when placed in series with the accumulator and amperemeter, allowed 1¼ amps. to pass. Surely this is far too much, for if we were using 6 volts, instead of 4 volts, the current passed would be as much as 1·87 amps. The resistance of the voltmeter is therefore only 3·2 ohms.

If one were to have several cells of fairly high internal resistance in series, one could not get a proper reading, owing to the resistance of the voltmeter being so low. This seems to me to be a very bad sort of instrument to be on the market. Why not use more wire of a finer gauge, and so increase the resistance? Could any of your readers enlighten me on this matter?—Yours truly,

"DYNAMP."

Model Railway Design.

To THE EDITOR OF *The Model Engineer*.

DEAR SIR,—In reply to "Charon" and your request for further correspondence on railway design, the following is a description of a railway track to meet "Charon's" requirements, the principle of which is embodied in a track we have nearly finished building, the trains being controlled by the signals, through the medium of electric brakes.

The brakes apply themselves by virtue of springs, and are kept off when the vehicle is running by an electric solenoid; the automatic coupling, and the uncoupling and reversing of engine to be described, being a suggestion which we hope at some future time to adopt, and on which I particularly invite criticism.

The principle of control is as follows:—Between the running rails is a third live rail, divided into sections between the signals, and supplied from a main cable under the track; all signals protect the section behind them by cutting out the current when they are at danger, so that a train approaching a signal at danger gradually draws up and stops; and not until the signal is lowered, whereby the current is switched on and the brakes pulled off, can the train proceed. This presents a difficulty in working at terminal stations, and also creates an exception to the above rule of the signal controlling the section behind it. Reference to drawing will help in following the explanation.

It being desirable to make the working realistic by letting a train pass a signal that is off, it will be understood that the "home" signal being down, the train will run by into station; but, seeing that there is no starting signal at far end of platform to protect train through station (as there would be in the case of a through station), the train would rush on and dash into buffers. To prevent such a disaster, two arms are placed on the "home" signal-post at terminal stations. The top one we term the "main home," the lower the "calling-on home." The "main home" is interlocked in the signal-box with the "distant" signal, so that this latter cannot be pulled off till the "main home" has been, and must be replaced to "danger" before the "home" signal can be. The "distant" signal, when at danger, cuts out the current between A and B (see drawing), and so brings a train to a standstill at the "home" signal but, when pulled off, allows a train to pass; but the pulling off of "home" signal does not switch the current on between *b* and *c*, but leaves it cut off, as when signal is at "danger," so bringing the train to a standstill in station.

Now, supposing it is required to take an engine down to turntable, the current must be on to allow it to pass, and the lowering of "calling-on" signal switches current in between *a* and *c*, permits this. To ensure safety, the lowering of either "calling-on" arm locks "distant" and "home" signals at danger. The main cable is controlled by a switch situated in any convenient place along the line, or in the signal-box, and worked by the driver of the train. The driver can be the signalman, or a separate person.

Example of a train's despatch, thus:—Train ready to start from departure line; signalman lowers outdoor "starting" signal, which at the same time switches in third rail; but even then the train will not start till the driver switches in the main cable to supply electricity to the third rail. It will be seen by this that the driver has perfect control of the train, but he cannot work it against the directions of the signals.

By means of a resistance placed in the main cable he can regulate the speed of train, or, by switching out main cable, he can stop the train anywhere on the line. But if a signal is at "danger," he cannot make it go by, for the switch of the third rail, working with the signal that protects that section, is cut out, and so the train stops, whether current is on in main cable or not.

Again, this main cable could be made to answer a modified form of block signalling, sufficient for model railways, inasmuch that if the signalman was made driver as well, and a switch in the main cable placed in each box, it is obvious that before a train could proceed it would require the consent of the signalman sending train and the signalman receiving it to switch in main cable before train could advance; and if one signalman did not switch in, it would be quite impossible for the other to send train independent of him.

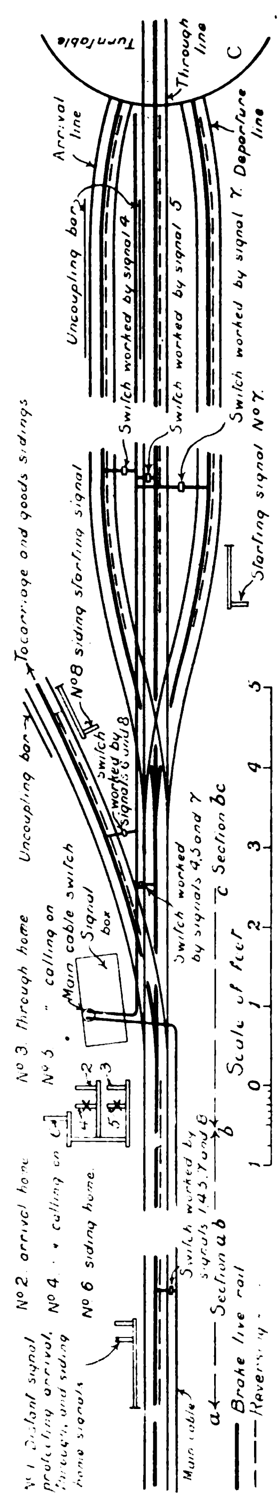
No matter how large or complicated the railway, and whether single or double line, this system of control of the trains by the signals by suitable switches can be adopted.

Steam is turned on and off by the same solenoid that works the brake—that is, when brake is applied, steam is turned off; and when brake is pulled off, steam is turned on.

Next the suggestion for the automatic coupling of the engine to train, and the uncoupling and reversing of engine from signal-box. First, it is necessary that the engine be connected to the carriages by some simple form of automatic coupling, such that when the engine is backed on to the train it automatically connects up. The engine to have a small catch either side of it, which, when raised by a bar fixed by the side of track, and worked from signal-box, would unfasten the automatic coupling.

This being efficiently arranged, it is necessary to have a second live rail between the running rails to supply current to a motor for reversing the engine. The second live rail will only require to be for a few feet in a few places at stations, at points where it is determined it will be necessary to reverse engine.

This second live rail should be about 5-16ths in.



PLAN OF ELECTRIC SIGNAL-CONTROLLED TERMINUS FOR A ¾-IN. SCALE MODEL RAILWAY.

By William E. Webb.

above running rail, and 5-32nds in. above the live rail for working brakes, and should not be placed where lines cross one another, or the collector of current for brakes, being below the level of this second live rail, would strike it, and accident result.

The second live rail must be placed about 5-32nds in. above the brake live rail, otherwise the reversing motor collector will take current from brake live rail, and actuate reversing gear when it was not required.

The turntable is intended to be turned round by spur and rack gear actuated by rods from the signal-box, and locked in position therefrom.

The "calling-on" arms on "home" signal should be rather shorter than the "main home," and painted red both sides, being distinguished by a cross fixed near the end of arm; they can then be used also for bay signals for exit from "arrival" and "through" roads.

Method of using above appliances for a train arriving:—

Train arriving runs into arrival line; the lever in signal-box actuating uncoupling bar is pulled over; the engine is then run on to turntable; the turntable turned and locked in position for "through" road, and on the "through" road "calling-on" arm being lowered, the engine runs up to just beyond the "home" signal gantry, where it is stopped. The reversing switch is then put in circuit, and engine reversed, and on arrival "calling-on" signal being lowered, is shunted back on to train, automatically coupling itself, when it is again reversed, and draws out with train to "distant" signal, when it can be shunted back into carriage siding or to departure line ready to start again.

It should be possible, and is intended, to perform the whole of the above operations without the signalman moving away from his box; in fact, it should be possible to run trains up and down the track, the signalman only requiring to move when the engine wanted attention.

Apologising for this long and rather late letter,—Yours truly, WILLIAM E. WEBB.

Harlesden, N.

Armature Reaction and Distortion of Field.

TO THE EDITOR OF *The Model Engineer*.

DEAR SIR,—A rather curious letter appears under this heading in your issue of August 31st, and in it occurs a mis-statement. I should like to point out to Mr. Warren that the component D *does* produce a torque, and that E does not. "E, it will be noticed, is acting in exactly the opposite direction to R in Fig. 2," says Mr. Warren. That is quite correct; but it must be evident from this that E does not produce any torque.

"Will it ever be possible to build a motor without fields?" he asks. For reply, I should be inclined to ask him—"Where do you think the *torque* is to come from?"—Yours truly,

Forest Gate. F. J. KEAN.

OIL fuel is used at the central power station of the New Orleans drainage works, which supply current to a number of electric pumping plants. Sudden heavy rains make it necessary to start up rapidly, and oil has proved more efficient than coal for the purpose.

The Society of Model Engineers.

[Reports of meetings should be sent to the offices of THE MODEL ENGINEER *without delay, and will be inserted in any particular issue if received a clear nine days before its usual date of publication.]*

London.

THE first indoor meeting of the winter session will be held on Thursday, September 28th, at the Holborn Town Hall, at 7 p.m. It has been decided to make this a special track and general exhibit night, and all members are particularly requested to bring some exhibit, either models (finished or unfinished), tools (home-made or otherwise), whether the articles have or have not been exhibited before. To encourage members to bring exhibits, a first prize of 15s., and a second one of 7s. 6d., both in cash, will be awarded during the evening to such model, or part, tool, etc., as shall be deemed by a general vote of the members present to be the most interesting exhibits. Each member present will be entitled to vote for one exhibit other than his own, the exhibit obtaining the highest number of votes taking the first prize, and the next in order the second. In addition to the foregoing prizes, an extra prize is offered by the Southwark Engineering and Model Works, consisting of a set of castings, materials and working drawings for one of their ½-in. scale Tilbury locomotives. It is earnestly requested that those members possessing locomotives will bring and run them at the meeting; two straight tracks will be fitted up side by side, so that races may be run. The locomotives are, of course, included in the above prize scheme.—HERBERT G. RIDDLE, Hon. Sec., 37, Minard Road, Hither Green, S.E.

Queries and Replies.

[Attention is especially directed to the first condition given below and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-hand corner of the envelope "Query Department." No other matters but those relating to the Queries should be enclosed in the same envelope.

Queries on subjects within the scope of this journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied, wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed. (4) Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of Replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor,* THE MODEL ENGINEER, *26—29, Poppin's Court, Fleet Street, London, E.C.]*

The following are selected from the Queries which have been replied to recently:—

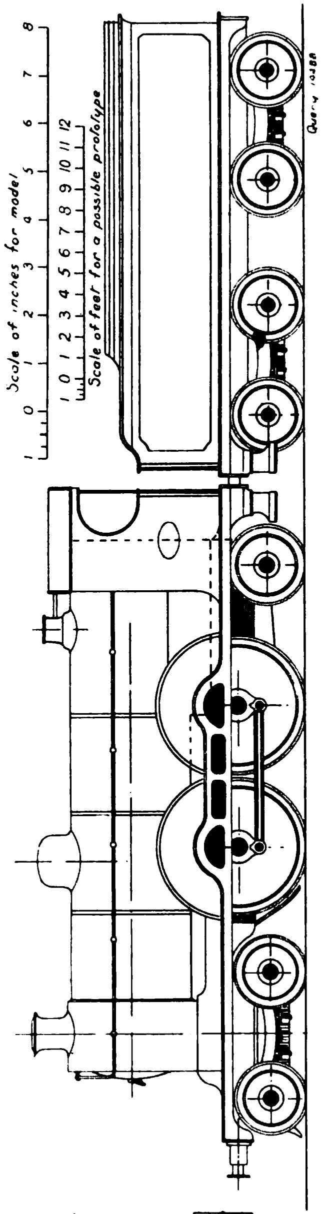
[14,511] **Small Dynamo Details; Accumulator Charging.** H. H. (Liverpool) writes: Since my last query (No 14,399) *re* small dynamo castings—which I have decided are not worth the trouble of fitting up, as the iron seems to be bad stuff—I have obtained, through the "Sale and Exchange" columns, a complete field-magnet (undertype), as Fig. 8, Handbook No. 10, and wire for same. I should be much obliged if you would give me some information to queries below, dimensions being as follows:—Height of field-magnet, 5¼ ins., bolted together as Fig. 8 in handbook; cores, 1¼ ins. by 1⅜ ins. and 2 ins. high; the yoke at top is 4½ ins. long and 1¾ ins. across top; armature tunnel, 1 9-16ths ins. diameter, 2¼ ins. long; poles, 1 in. thick from the centre of tunnel edge; weight about 10 lbs. Wire as per sample enclosed, 1 lb. 12 ozs. I was told this F.M. was 50 watts size—is this so?

(1) Would an eight-cog drum armature be suitable, and should it have four wire sections or eight? (2) Will 26 s.s.c. wire do for armature if connected in shunt, and about what quantity, as I can obtain plenty of that gauge? (3) If not 26, what other size? (4) What size commutator and pulley? (5) How many volts and amps. will it give, and at how many r.p.m.? (6) What resistance must be used to charge a 4-volt 20-amp.-hour accumulator from it—would a small 6-volt lamp do? I have also obtained a 4-volt 20 amp.-hour accumulator in celluloid case, which I have had to open to put in two new positive plates. (7) What can I use for cementing celluloid lid and fastening rubbers through which lugs pass? (8) Will this accumulator do to work ½-in. spark coil, and what length of fine iron wire would be needed for resistance? (9) Would a mercury break as described in Handbook No. 11 be better than a hammer break for a ½-in. spark coil I have made?

The output of a dynamo depends upon its speed: at double the speed you would get double the output; so that this must be stated before you can say what the output is likely to be. At a reasonable speed for an armature of this size, namely, about 3,000 revolutions per minute, we should expect about 30 watts output with a drum armature. (1) An 8-cog laminated drum, wound with eight coils, and connected to an eight-section commutator would be suitable; four coils could be used, but eight would be better. (2) No. 26 s.s.c. can be used for the armature. Get on as much as you can. (3) Field-magnet should be re-wound with No. 24 gauge s.c.c. copper wire; same weight as present winding, which is of too thick a gauge. Output about 15 volts 2 amps., but voltage can be regulated to some extent by running at higher or lower speed. (4) Commutator, 1 in. diameter by 1 in. long; pulley to be not less than 1 in. diameter—the larger it is, the better, as you will have less trouble with belt slip. (5 and 6) Depends upon the charging current allowable—say, 2 amps.; then about 8 yds. of No. 22 gauge bare German silver wire would do. Adjust the length of wire and speed of dynamo until current is of correct strength. (7) Try marine glue. (8) Yes, it should work this coil very well; a very small length of resistance wire will do. Try one yard. (9) We can recommend a mercury break, but not as essential on a coil of this size, if the hammer break is a good one. If you want to make something, then by all means make and try a mercury break; it is an interesting thing to experiment with.

[14,488] **Model "Atlantic" Locomotive.** C. A. H. (Bolton) writes: I should be obliged for the advice of one of your model locomotive correspondents as to a 2-in. gauge track and locomotive I am proposing to build for my son. As the railway will have to be inside a not very large room, I have decided on above gauge, and maximum curve radius will be 5 ft. I want the model to be fairly representative of a modern bogie express locomotive—single inside cylinder for preference—and as large a boiler as appearances will allow, so as to steam as long as possible without being short of water. I have Mr. Greenly's book on the Model Locomotive, and, briefly, the points on which I need special advice are: (1) size of cylinder, (2) size of wheels, (3) centres of ditto. (4) Would an "Atlantic" model be advisable so as to get a larger boiler and, consequently, longer running? In this case I would put trailing axle on a pony truck. (5) How much lateral play in bogie and trailing axle? (6) If an "Atlantic" is not advised, would a four-coupled, or a single-driver, like G.W., be better ("Lord of the Isles")? (7) Size of boiler with above object in view? And would a water-tube or a firetube boiler be preferable? (8) How long should engine run (approximately) with one supply of water? I should not like to increase gauge, and as I do not anticipate purely mechanical difficulties will hinder me very much.

We would advise a 7-16ths-in. scale model, and herewith reproduce a suitable design to a scale of quarter full size for a 2-in. gauge model. It would have made a better *working* model if you had allowed us to choose some simple type of tank engine. It is always advisable to provide a single-cylinder model locomotive with the smallest possible diameter driving wheels; but, of course, it is a difficult matter to satisfactorily accomplish this in modelling an express type. We tried smaller driving wheels in the design herewith, but the result was not pleasing. It is also inadvisable to employ outside cylinders for a single-cylinder locomotive. One cylinder would have to be a "dummy"; indeed, the whole arrangement would not be good, and it is doubtful whether any advantage over a two-cylinder model would be obtained, therefore we adopted the L.Y.R. style of 4—4—2 type locomotive, reducing the wheelbase to the smallest possible dimensions. The box at the side of firebox and between the rear splasher and the cab is introduced to cover the sides of the firebox at the point where in small models fitted with the water-tube boiler the paint suffers most. (1) The cylinder may be ½ in. by ¾ in.—this is a stock size, but a larger one will not spell failure if the superheating or drying of the steam is carried to a sufficient extent. The cylinder should be set forward of the centre line of the bogie and chimney, so that the longest length of connecting-rod will be obtained. This method of reducing the wheelbase is shown in the series of articles on "Atlantic" type models contained in the issues of The Model Engineer for August 25th, September 1st. September 8th, and September 15th, 1904 (see particularly page 223, September 8th number). (2) The driving wheels are 2¾ ins. in diameter. (3) The wheelbase dimensions (and all other proportions) may be scaled from the drawings. (4) See general remarks above. There



A DESIGN FOR A 2-IN. GAUGE MODEL 4—4—2 TYPE EXPRESS ENGINE.

are some advantages in an "Atlantic" over a 4—4—0 type express engine if the curves are not sharp, or if the wheelbase can be reduced to a reasonable limit, and the rear wheel under the cab given lateral play or mounted on a pony truck. (5) In the design, large bogie wheels are provided; but if any curves of the railway are such (*i.e.*, under 5-ft. radius) that it would be advisable to allow them to swing right under the frames—as in many designs contained in "The Model Locomotive," which we understand you have—then the diameter may be reduced to, say, 1 5-16ths in. or 1 3-16ths in, and the profile of the frame altered from the Caledonian shape to that used on, say, the G.N.R. The lateral play in the bogie pin slot may be as much as the frames will allow. The lateral play of the trailing carrying wheel will depend on the frame and lamp arrangements; ¼ in. each side of the centre should be sufficient. (6) A single-wheeled express engine would, of course, look well, but would have to have large driving wheel to gain a good appearance. This, however, is not the best practice in conjunction with the use of a single cylinder. (7) The external dimensions of the boiler, which may be of the water-tube type in preference to the ordinary type, can be scaled from the drawing. The outer tube may be 2½ ins. diameter, and the inner barrel 1¾ ins. (stock sizes). Water tubes, three or four in number, ½ in. outside diameter; see Plate II in "The Model Locomotive." (8) Everything depends on the workmanship, load, and track. Under the best conditions the water should last eighteen to twenty minutes. As you say that mechanical difficulties of construction are of secondary importance to you, a pump may be carried in the tender

[14,072] **Winding Small Dynamo.** A. F. (Bristol) writes: I should be much obliged if you would give me a little information on the following. I am making a small dynamo, of which I enclose a sketch (not reproduced). I have been advised to wind it with 1¾ ozs. No. 24 on armature, and 12 ozs. No. 24 on fields, to give 12 volts 1½ amps. Do you think this winding will give this output, or do you think it would be more likely to excite with any other winding? Would it be of much advantage to wind armature with silk-covered wire? What would be the effect of a commutator whose slots were of different widths?

We should not expect more than 1 amp. at the outside with 12 volts from so small a machine. We advise you to use No. 26 gauge s.c.c. wire for the armature; No. 24 gauge will do for the fields, though we should be inclined to try No. 25 gauge, as not taking so much current. It is a decided advantage to use silk-covered wire for the armature, as you can get on more turns—a vital matter with such a small drum armature. Liability to sparking at the brushes. Dynamo should be driven at about 4,000 revolutions per minute.

[13,987] **Kapp Type Motor.** H. R. G. (Ahyab) writes: Would you kindly elucidate the following *re* the Kapp motor in your book on "Small Dynamos and Motors"? First of all, It wish to know if the diagram is half-size, as I took it to be full-size? In calculating the amount of wire, I find the space available on the magnets is not large enough. I was intending the machine to be a 40-watt machine, so the amount of wire is 1¾ lbs. No. 24. I based my calculations on particulars given in a wire table in the "Practical Engineer Electrical Pocket Book," which gives the turns per inch as 26·3, and the feet per lb. as 683. As I was intending using lamps as a resistance, would you inform me as to what is the voltage and amperage of a current after passing through a 16 c.p. lamp on a 100-volt circuit?

The diagram of Kapp type machine (Fig. 11, page 18 of "Small Dynamos and Motors") is to scale. Its scale for various outputs

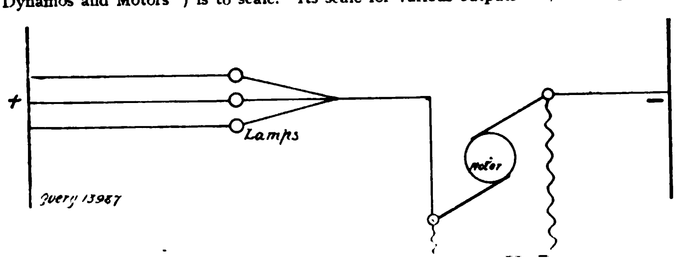


DIAGRAM OF ELECTRO-MOTOR CONNECTIONS.

is given on page 23—the middle set of scales. Ample allowances of wire are given in the winding tables. Get on as much as you can. A 16 c.p. lamp of normal efficiency takes about 60 watts—that is, ·6 of an ampere at 100 volts, if the lamp is a 100-volt lamp. Do not trouble about the voltage "after it has passed the lamp," as you express it, but merely put enough lamps in parallel—all 100-volt lamps—until the motor runs well enough. If you can get enough current through, the volts will take care of themselves. The lamps will be dull, as owing to the resistance of the motor, they will each take less than their proper current; and for this reason there will be some volts left to drive the motor. If you cannot get enough speed, try 90-volt lamps.

[14,473] **Magnetic Type Cut-outs; Meter Connections.** F. C. writes: In magnetic cut-outs, does the positive current flow round the coils of the magnet, and is the switch itself on the negative main, as sketch? How are meg-ohmmeters and ammeters and horse-power meters connected up, and which cables are they connected to? How do you detect eddy (or Foucault's) currents in an armature? What are their symptoms, and do they cause any trouble?

Cut-outs of magnetic type: the connections depend upon the use for which the cut-out is designed for. Can you not trace out the connections for yourself, or write to the makers? From your sketch, it would appear as if the current would be positive at the top connection, and pass through the switch (when closed) to the magnet coil, and then from the coil to the negative terminal. You will find information in a large book by Andrews, entitled "Electricity Control." Regarding instruments, the best course is to write to the various makers, who will, no doubt, be only too pleased to give instructions for proper connections. Eddy, or Foucault, currents in armatures are, as the name implies, eddying or whirling currents of very low E.M.F.; they exist in, and cause heating of the core, and are usually allowed for in the design of the machine. They also exist in solid armature conductors of large size or smooth cores. You could not deal with them, except by reconstruction.

[14,447] **Re-Winding Motor as a Dynamo.** J. G. K. (Wynberg, S.A.) writes: Would you kindly help me with the following? I have a four-pole enclosed fan motor, and would like to re-wind it as a dynamo. The size is—armature, laminated drum type, 3 3-16ths ins. diameter by 1⅜ ins. broad; twenty-three slots, 7-32nds in. wide by ¼ in. deep; commutator, 23 segments, 1 3-32nds ins. diameter by ¼ in. broad. Shell and magnet poles are built up of thin iron laminations. Will you kindly answer the following queries? (1) Number of wire to wind on armature, (*a*) how much, (*b*) how to wind it? (2) Number of wire to wind on field-magnets, (*a*) how much, (*b*) how to wind it? (3) What power will machine develop as a dynamo, driven at 2,000 r.p.m.? (4) Would bushes do in same? If not, what would be the best position for them? Sketch enclosed (not reproduced).

(1) Armature to be wound with No. 20 gauge D.C.C. copper wire. Get on as much as possible—1 lb. should be ample—winding to be as article in THE MODEL ENGINEER for February 5th and 12th, 1903 (pages 126 and 148). Coils can be hand or former wound. (2) Field-magnet to be wound with about ½ lb. No. 24 gauge s.c.c. copper wire on each pole, all coils to be in series with each other and in shunt to the brushes. (3) Output about 30 volts 6 amps. The volts can be adjusted by running at higher or lower speed. (4) Two brushes only can be used; the exact position must be found by trial. If you cannot shift the brushes, then shift the commutator round on the shaft, or alter connections to bars until best results are obtained. Coils midway between poles should be tapped by the brushes at any moment. If machine does not excite, try copper brushes.

[14,535] **Steam Engine and Dynamo.** A. R. C (Lincoln) writes: I should feel obliged it you would help me in a difficulty. I have two 4-volt accumulators of about 9 amp.-hour capacity. What size dynamo will be necessary to charge them? What voltage and amperage? What power engine will be needed to drive dynamo?

Employ a dynamo giving about 30 or 40 watts at 15 volts (amperage about 2 or 2½). A vertical high-speed engine 1¼ by 1½ stroke should do all you require. Heating surface of boiler should be 250 square inches or thereabouts.

[14,610] **"M.E." Electric Locomotive.** F. J. G. writes: I should be much obliged if you would let me know if any model-making firm has put castings of THE MODEL ENGINEER Electric Locomotive (1905) on the market. I have as yet seen nothing in your advertisement pages about this fine model, but think that surely some firm must have brought out complete sets of castings.

Messrs. W. J. Bassett-Lowke & Co., Northampton, are bringing out complete sets of castings for the locomotive and motors. The latter can also be obtained finished either from the above firm or from A. H. Avery, Tunbridge Wells.

[14,478] **Chloride Battery.** H. E. (Woodmancote) writes: I am looking after a chloride battery, which I charge about twice a week. Just lately I have noticed a kind of fur on the negative plates, particularly on the tops. I have been told that there is something to put in the acid to keep the plates clean, but have never heard of it before. I add clean rain water at nearly the end of a charge when the cells are gassing freely—is this correct? If there is anything to keep plates from fur, would you tell me what, and how much to use?

Write to the Chloride Electrical Storage Syndicate, Ltd., Clifton Junction, near Manchester; they will no doubt advise you as to what to do, and probably send you a sheet of instructions.

The News of the Trade.

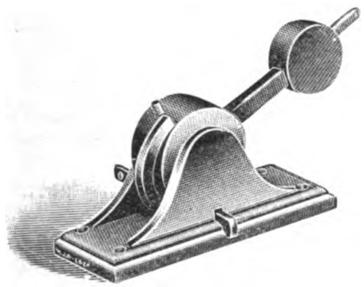
[*The Editor will be pleased to receive for review under this heading samples and particulars of new tools, apparatus, and materials for amateur use. It must be understood that these reviews are free expressions of Editorial opinion, no payment of any kind being required or accepted. The Editor reserves the right to criticise or commend according to the merits of the goods submitted, or to abstain from inserting a review in any case where the goods are not of sufficient interest to his readers.*]

• *Reviews distinguished by the asterisk have been based on actual Editorial inspection of the goods noticed.*

*A New Point Lever.

*The "M.E." Electric Locomotive Castings.

We have received from Messrs. W. J. Bassett-Lowke & Co., a new design of point lever for model railways which they have designed and are now making in large quantities at their works



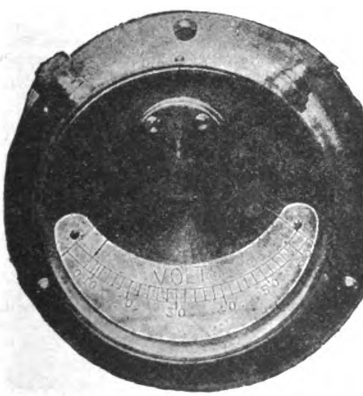
MESSRS. W. J. BASSETT-LOWKE & CO.'S NEW POINT LEVER FOR MODEL RAILWAYS.

in Northampton. The lever is very ingenious and, at the same time, a very simple device. It ensures a perfect closing of the points in either direction, without the use of springs or catches. The boss which the lever rotates is provided with a worm; this worm works into a moving bar, which is drilled to receive the point rod. The point lever, which works very sweetly, is made in cast iron and neatly painted, and is suitable for railways up to about 1 in. scale. Full particulars and prices may be obtained upon application.

With the point lever we received a set of castings of the MODEL ENGINEER Electric Locomotive, which are excellent in every way—true to the design, clean, and of good metal. We understand that a list of castings, and prices will be ready in a few days after the publication of this issue.

Volt and Ammeters.

We illustrate herewith the latest improved meter to indicate volts or amperes, now being supplied by the Universal Electric Supply Company, 60, Brook Street, C.-on-M., Manchester. Their



THE UNIVERSAL ELECTRIC SUPPLY CO.'S VOLTMETER.

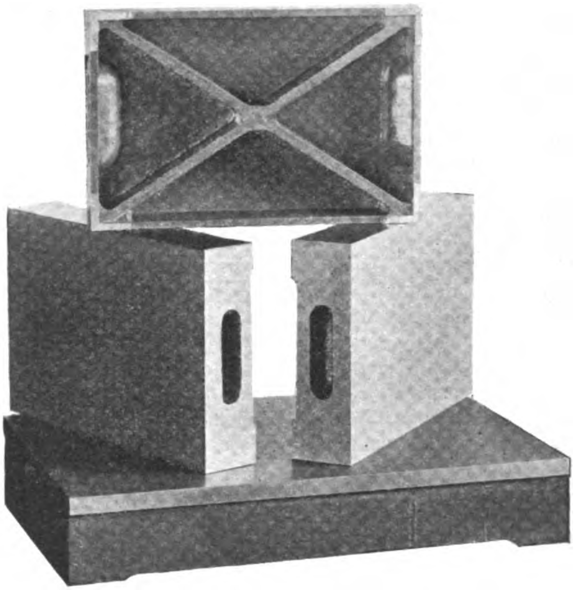
list of electrical supplies, together with a new supplement dealing with the various tools now supplied by them, will be sent to any reader of this Journal, post free, for two penny stamps.

Change of Address and Extension of Business.

Mr. F. Westrup Comber, lately trading under the title of the London Electric Company, Worcester, is removing to new premises at 58, Tything, Worcester. He is laying down electrically-driven plant, and will be in a position to do any class of model and electric work, as well as supply material for amateurs' use. It is also proposed to hold instruction classes in mechanical and electrical work. All enquiries should be addressed, in future, to Mr. F. Westrup Comber at the new address.

*A Revolution in the Manufacture of Surface Plates.

We have to record the introduction of a new process in the manufacture of surface plates, which should lead to the more general use, by the amateur especially, of this invaluable appliance. In the past model engineers—owing, in some measure, to the expense of a really good and true surface plate of all-round useful size—have been in the habit of employing various substitutes, for instance, the bed of the lathe, or a piece of plate glass; but Messrs. C. W. Burton Griffith & Co.'s new "Perfect" surface plates should alter this state of affairs. After exhaustive trials they have succeeded in perfecting a mechanical process of surfacing which will compare in



MESSRS. C. W. BURTON GRIFFITHS & CO.'S NEW SURFACE PLATES.

accuracy with costly hand-scraping, and are therefore in a position to offer first-class plates at greatly reduced prices. All plates finished by this process are carefully checked by micrometer before leaving the works, and are guaranteed not to vary from the mean surface by more than 1-5000th in. at any point. They also supply accurately planed plates for ordinary shop use, and guarantee in this case a variation of not more than 1-1000th in. from the mean. As these plates are made in large quantities, they are able to supply them at an extremely low figure. The plates are accurately machined on all the sides, and are provided, in the smaller sizes with convenient hand-holes. Hard close-grained iron only is used and all the plates undergo thorough ageing between the various processes. Rigidity is secured by ample ribbing; at the same time, however, the weights of the plate have not in any way been cut down. The plates are made in two grades—A and B—as mentioned above, in four sizes: 6 ins. by 4 ins., 8 ins. by 12 ins., 12 ins. by 12 ins., and 18 ins. by 12 ins., and well-made wooden covers are supplied at a nominal charge. Full particulars may be obtained from C. W. Burton Griffiths, Ludgate Square, London, E.C., and when writing, mention should be made of this Journal.

New Premises.

We are asked to inform our readers that Mr. T. W. Suter, who supplies electrical and mechanical novelties, has now opened new premises at Bruce Grove, Tottenham, London, N.

New Catalogues and Lists.

Geo. Wells, Needham Market, Suffolk, has sent us his new price list of tools and general requisites for the amateur's brass-foundry. The list, together with "The Amateur Brass-founder's Instructor," will be sent to any reader of THE MODEL ENGINEER post free for two penny stamps.

The Editor's Page.

MANY of our readers are probably thinking over the momentous question as to what they shall make during the coming winter months. We would suggest to new readers a careful study of the back numbers of our journal, and to all readers a study of our present advertising pages. Apart from a number of new patterns which are being introduced by the various model engineering firms, there is now an excellent assortment of sets of castings of all descriptions on the market, and there should be little difficulty in the way of any amateur finding something worthy of his skill and full of interest in the making. Incidentally, we may draw attention to our prize offer for the best model electric locomotive built to the design we gave in the first issue of the present year.

* * *

We give a further instalment this week of Mr. Twining's interesting article on "Picturesqueness in Model Railways." The author gives some practical instruction on the actual carrying out of some of the designs he suggests, and we feel sure these hints will be appreciated by our model railway readers. Perhaps those who have tried their hands at similar work will have employed other methods with equal success, and as this is a subject on which very little has been written we should be pleased to have Mr. Twining's article supplemented by correspondence or notes from other readers.

Answers to Correspondents.

J. W. (Aberdeen).—We regret that it is impossible to advise you on the matter. Your statements are very vague.

W. S. W. (ss. *Martin*).—Thank you for post card from Messina. To what address can we send you one in return?

F. B. (Liverpool).—Sorry we cannot use your article, which is beyond our scope.

J. C. (Leeds).—No coupon enclosed with your query. Please observe our rules.

K. H. M. (Bradford).—Our new 6d. handbook—"A Guide to Standard Screw Threads," gives all particulars of the B.A. threads.

M. B. (Bath).—We advise you to have back gear and slide-rest to your lathe for the work you intend doing.

J. H. C. (Yarmouth).—Yes; the last two volumes are still in stock, and can be supplied at usual prices.

L. B. (London, S.W.)—See issue of July 13, 1905, for description of tangent galvanometer.

A. H. F. (Brighton).—An amateur's wireless telegraphy outfit was described in our issue for August 10th last.

F. A. (Coventry).—The German firms only supply wholesale, and do not execute single orders. You cannot do better than buy through one of their agents in this country.

J. K. (Margate).—See notes on compound-wound dynamo on pages 200-201 of August 31st issue.

G. A. (Monkwearmouth).—Thank you for your letter; we are interested in contents, and are sorry to hear that the clubs have since gone out of existence. Why not try to revive one in your district?

W. W. (Dartford).—Yes, if the valve opens and closes quickly, a much fuller indicator diagram is obtained. We would advise you to study our little handbook, "The Slide-valve Simply Explained," by W. J. Tennant, A.M.I.Mech.E., price 6d. net, 7d. post free from this office. You will also find information to help in the chapters on valve and valve-gearing and motion work in "The Model Locomotive," by H. Greenly, price 6s. 4d. post free from this office.

S. H. (Burnley).—Please refer to recent Queries and Replies, which give full details.

N. B. (Eccles).—We have no letter of yours in hand.

T. C. (Walton).—We have no other drawings but those already published.

Notices.

The Editor invites correspondence and original contributions on all amateur mechanical and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected or not, and all MSS. should be accompanied by a stamped addressed envelope for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

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All correspondence relating to the literary portion of the paper, and all new apparatus and price lists, &c., for review, to be addressed to THE EDITOR, "The Model Engineer," 26—29, Poppin's Court, Fleet Street, London, E.C.

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Contents.

[*The asterisk (*) denotes that the subject is illustrated.*]

THE

Model Engineer

And Electrician.

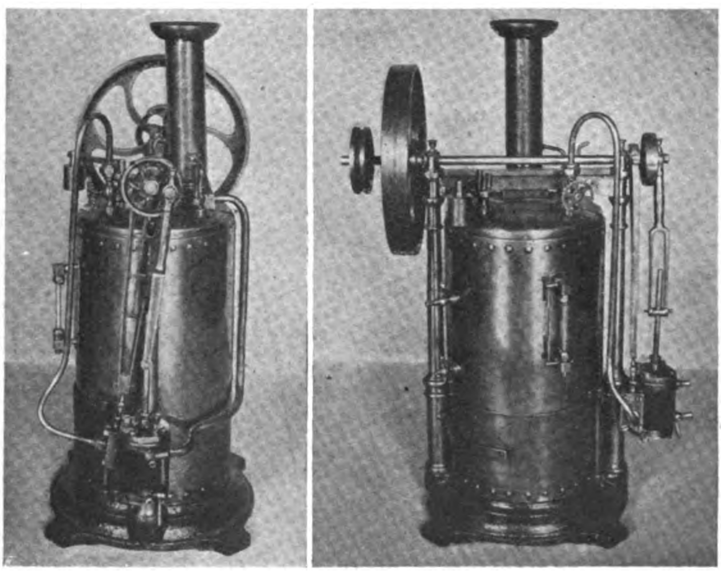
A JOURNAL OF PRACTICAL MECHANICS AND ELECTRICITY.

EDITED BY PERCIVAL MARSHALL, A.I.MECH.E.

VOL. XIII. No. 232. OCTOBER 5, 1905. PUBLISHED WEEKLY.

An Old Style Model Steam Engine and Boiler.

By S. E. HOLMES.



TWO VIEWS OF MR. S. E. HOLMES' MODEL VERTICAL STEAM ENGINE AND BOILER.

THE photographs herewith reproduced represent a small steam engine that I made during my apprenticeship days. It was my first attempt at model-making. The barrel of the boiler is made of a piece of solid drawn brass tube, $4\frac{1}{2}$ ins. diameter by 3-16ths in. thick by 10 ins. high ; the top is a stamping of $\frac{1}{4}$-in. sheet copper ; the crown of firebox is the same, but smaller diameter. There is a water space around the firebox, and a central flue $1\frac{1}{8}$ ins. inside diameter, with three cross tubes ; there are also six longitudinal stays. All joints are riveted and caulked, and the boiler is tested to 200 lbs. hydraulic.

There is a cover over top of the boiler to hide the nuts on stays ; this is made from a stamping of 1-16th-in. copper ; and was fitted to a piece of the barrel which projected over the top of boiler. The barrel was turned on the inside to reduce its thickness, and the cover is kept in place by four small countersunk set-screws. The fittings of the boiler are as follows :—Weight lever safety-valve, steam feed cock, filling plug, blower cock, two test cocks, and a two-cock water gauge, and were made out of bar brass.

All the patterns of the engine were made by me, the cylinder being $\frac{3}{4}$-in. bore by

$1\frac{1}{2}$-in. stroke; it is lagged with mahogany. The crankshaft is supported by two high-turned brass columns. The flywheel is $6\frac{1}{2}$ ins. diameter and $\frac{3}{4}$-in. face; it is a brass casting, as are also the pulley wheel and disc wheel. Everything is highly polished to give it a pleasing effect. The boiler and engine stand on a cast-iron bed, and I usually burn charcoal to get up steam. I have tested the boiler for safety to blow off at 65 lbs., which is also about the usual working pressure. The engine is capable of driving an ordinary Singer sewing machine.

Workshop Notes and Notions.

[Readers are invited to contribute short practical items for this column, based on their own workshop experience. Accepted contributions will be paid for on publication, if desired, according to merit. All matter intended for this column should be marked "WORKSHOP" on the envelope.]

My Slide-Rest.

By W. Hall.

The photographs reproduced herewith are of my slide-rest for a $3\frac{1}{2}$-in. centre lathe which I have built in my spare time. It is made entirely of steel forgings which an obliging blacksmith made for me, with the exception of the handles and adjusting slides, which are of brass. The photographs (Figs. 1 and 2) show the rest in two positions, Fig. 1 complete and Fig. 2 in two halves, showing the slides and adjusting pieces. The screws were turned on a friend's lathe, but as it was not a screw-cutting lathe, I had to thread them with a pair of stocks and dies, $\frac{1}{2}$-in. Whitworth. I did all the shaping of the slides myself on a machine which the foreman kindly allowed me the use of after the ordinary working hours. The tool-holder I copied from one in the workshop; it is made from a flat piece of steel $\frac{1}{2}$ in. thick, which works on a central stud. It has four setscrews, one at each corner for holding the tools, as will be seen in the photographs. The whole rest is a perfect success, and is a great improvement to my lathe, which originally had only a hand tool rest.

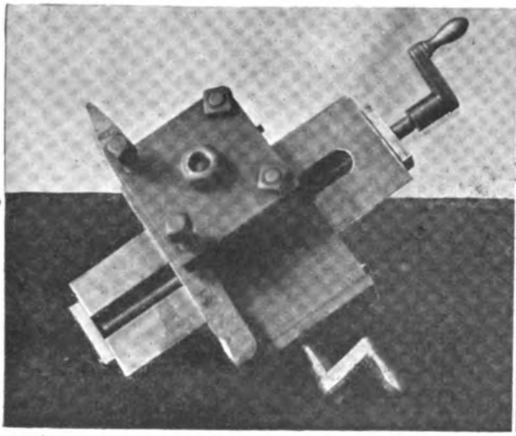


Fig. 1.—The Slide-Rest Complete.

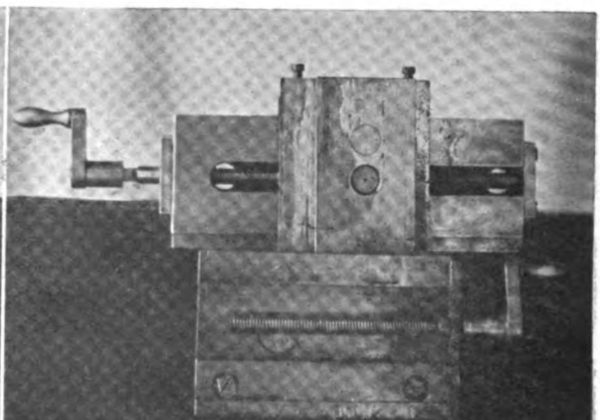


Fig. 2.—The Slides Disconnected.

A New Lathe Tool-holder.

By James Musgrove.

The difficulty of forging and grinding lathe cutting tools from heavy square stock has led to the devising and patenting of large numbers of holders, in which the cutter is a small section of steel held at a certain suitable angle. None of these have come into general use, as they have all had *defects*

Fig. 1.—Side View.

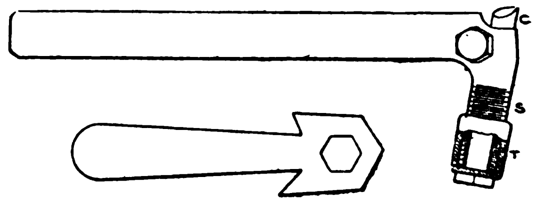


Fig. 3.—Spanner.

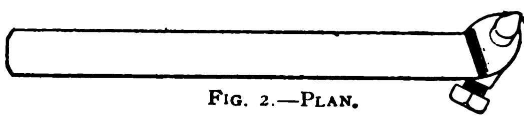


Fig. 2.—Plan.

A New Lathe Tool Holder.

which counter-balanced their *good points*. The introduction of the new and costly high-speed steels led me to think the matter out, and the result has been the construction of the tool of which particulars are now given. The tool follows the lines of the one manufactured by Messrs. Smith and Coventry, but with an important improvement which entirely obviates all risk of *slipping through downward thrust*. In the drawings (Fig. 1) is a side view, and Fig. 2 a top view of a right-hand holder which, with a left-hand one with cutter raked to the left, will do all plain turning and surfacing. This holder is suitable for a 6-in. or 7-in. lathe, and the stock is a piece of $\frac{3}{4}$-in. square mild steel bent over at the end and forged in a die to the shape of the socket as shown. The cutter C is a piece of

$\frac{3}{8}$-in. round self-hardening steel, and the hole through socket for same is drilled with a clearance angle, front and sides of 10 degs. The bottom part of the socket is turned concentric with the hole and screwed externally. A thimble T is threaded internally to fit over this socket, and the closed end forms a seat to take the thrust of the cutter. This thimble absolutely ensures the cutter from downward slip, and at the same time enables the height of the cutter (a most important point) to be adjusted with the greatest nicety. The cutter is finally secured by the hob-headed side screw as shown at side. The bottom of the thimble is shaped to a hexagon the same size as the head of the side setscrew, and a convenient spanner to fit both (Fig. 3) may be stamped from $\frac{1}{8}$ in. thick sheet steel with gauges on either side of the proper angle for grinding the cutters for wrought or cast-iron.

No turner having once given this tool a fair trial would ever go to the trouble of forging, shaping, and grinding his cutting edges out of the solid and expensive square stock, that is, for all plain turning and surfacing.

To sum up, the great advantages of this holder are as follows :—(1) The thrust of the cut being in the direction of axis of cutter enables small sections of costly steel to be used with the greatest economy. (2) There is very little overhang. (3) The height and position of cutting edges can be adjusted with the greatest facility. (4) There is no risk of the cutting slipping under heavy strain. (5) There is no forging about the cutters, which are simply cut off and ground to the proper angle. (6) In re sharpening, the surface to be ground is reduced to the minimum. Finally the saving in time, forging, shaping, and cost of solid steel, would soon pay for the holder many times over.—*Engineering Review.*

Overcoming a Tight Pulley Difficulty.

By James Treloar.

It is very often a difficult matter to remove a pulley off its shaft after it has been keyed on very tightly, or after it has become corroded through age. The usual method is to drive out the key from the tail-end with a drift and a hammer; but in this case the only effect of the drift is to burr up the tail-end of the key, thus making it more of a fixture than ever. Fig. 1 shows a very easy method of getting over the difficulty. The only articles required are a couple of **U** plates, as at Fig. 2, a clip as at Fig. 3, and a couple of stout bolts about 2 ft. long. The clip C is bolted on the shaft about a foot from the pulley, and on the same side as the tail-end of the key. One of the **U** plates is placed against this clip, the other plate against the pulley boss, the bolts passed through, and the nuts tightened up moderately, their relative positions being shown in Fig. 1. After a little oil has been smeared on that side of the shaft where the pulley has to be drawn, the nuts are tightened up in turn. If the pulley refuses to move, the plate A should be struck with a hammer smartly, but not heavily, when the pulley will begin to move, and will come off quite easily. If the pulley happens to be near the end of the shaft, the **U** plate (B) can be dispensed with, and a flat plate with holes for the bolts to be passed through can be used instead. This plate can be butted against the end of the shaft, thus doing away with the clip C also, and considerably simplifying matters.

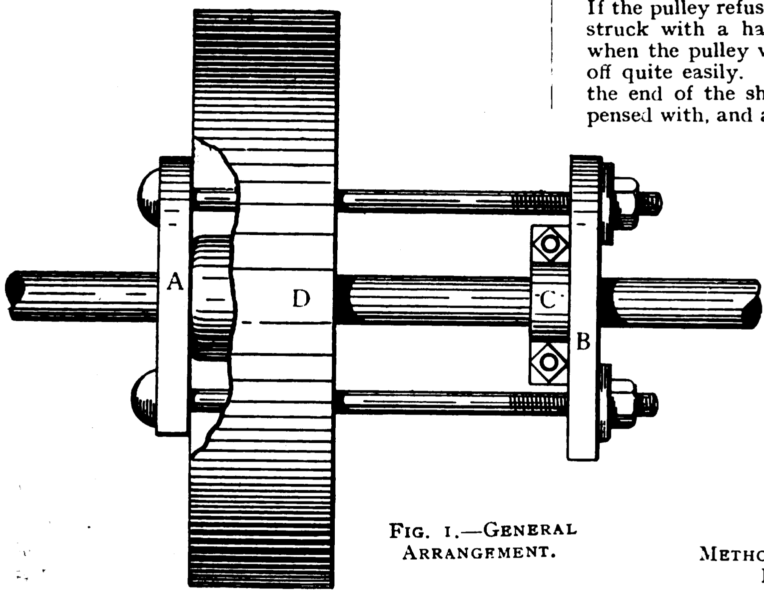


Fig. 1.—General Arrangement.

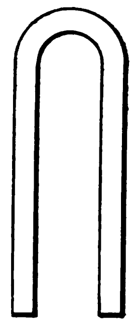


Fig. 2.

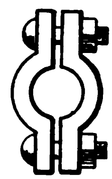


Fig. 3.

Method of Overcoming a Tight Pulley Difficulty.

The Formation of Radium from Uranium.—A very interesting discovery made by Mr. F. Soddy furnishes new evidence in support of the now generally accepted view that one element can, under certain conditions, be transformed into another. A solution containing over 2 lbs. of uranium nitrate was freed from all radium that it contained by repeated precipitation, and was then kept for eighteen months in a closed bottle. It was examined from time to time, and it was found that it gradually acquired the power of emitting an emanation absolutely identical in characteristics with that given off by radium. Hence the conclusion was arrived at that the uranium was very gradually transformed into radium, though only traces of the latter substance were present in the solution at the end of the period of observation.—*Knowledge.*

A ¾-in. Scale Model G.N.R. "Atlantic" Type Loco.

By H. G.

ALTHOUGH it is not true in every case, it may generally be said that the adoption of the largest pos ible prototype will result in the most powerful model locomotive being obtained. This fact, amongst other things, led to the building of the splendid working model of the well-known G.N.Rly. "Atlantic" type locomotive No. 251 shown in the accompanying photograph.

The model was built to the order of a gentleman who is an euthusiastic admirer of locomotives—G.N.R. in particular—both real and model—by Mr. Stuart Turner, of Shiplake, Henley-on-Thames. Mr. Stuart Turner's model and small power engine work is well known and appreciated by many of our readers, and its general excellence is reflected in the work to this locomotive.

The design is one which the writer has included in his book "The Model Locomotive: Its Design and Construction," where the drawings form two of the large folding plates given with this volume. The prospective owner of the model stipulated large cylinders, the ample proportions of the boiler provided in the prototype making it possible to employ cylinders of one inch diameter, without much fear of failure in the matter of supplying them with sufficient steam.

The cylinders are, of course, rather large for a model running alone; however, in the present case it was intended that the engine should always haul a passenger. Under ordinary circumstances, as the writer suggests in the above-named book, $\frac{7}{8}$-in.

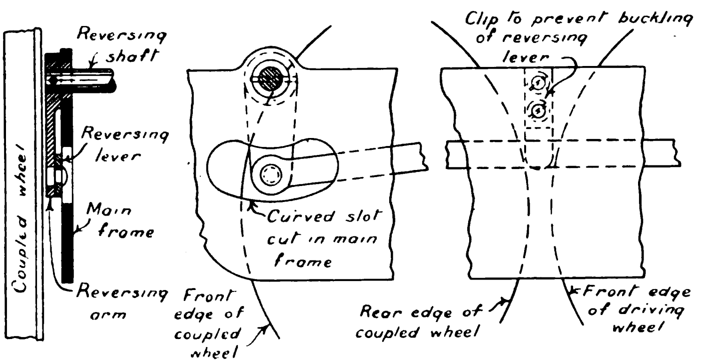


FIG. 2.—METHOD OF ATTACHING REVERSING ROD TO ARM ADOPTED IN THE ENGINE ILLUSTRATED HEREWITH.

bore cylinders would suffice, and the engine would then not be so likely to get out of hand if run on a track without any special means of control.*

The main frames are of 3-32nds-in. planished steel, and are continued from the front buffer plank inside the wheels, to the rear of the driving wheels, where they abut on a cross beam extending the whole width of the engine. To this cross frame the outside frames for the trailing carrying wheels are attached. In the locomotive under consideration these frames are of cast gunmetal, with flanges for fixing to the footplates, cross beam, and buffer plank cast in together. The laminated springs, which are dummy, to save expense and labour, and the horn plates are cast with the frames, a spiral spring being concealed in the buckle of the laminated spring. The absence of inside frames at the firebox end allows ample room for the firebox and burner arrangements, as well as simplifying the construction of the frames.

The driving wheels are $4\frac{7}{8}$ ins. diameter on tread, trailing wheels $2\frac{3}{4}$ ins. diameter, and the bogie wheels may be $2\frac{1}{4}$ ins. or $2\frac{3}{4}$ ins., according to the exigencies of the railway on which the locomotive is to run. The shape of the main frames at the bogie is arranged so that if the bogie wheels of small diameter are employed, they can swing under the frames, and the maximum lateral movement be obtained. In the engine shown two bogies are provided—one with wheels of the scale diameter, and the other with $2\frac{1}{8}$-in. wheels. The cylinders are 1-in. bore by $1\frac{1}{2}$-in. stroke, with a single steam-chest, and self-contained exhaust passages. The ports are 7-16ths by 3-32nds in. steam, and 7-16ths by 3-16ths in. exhaust, the port bar being 3-32nds wide.

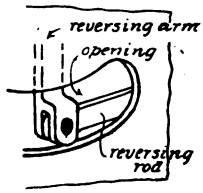


FIG. 1.—THE METHOD OF ATTACHING REVERSING ROD TO ARM SUGGESTED IN "THE MODEL LOCOMOTIVE."

The valve gear is the Stephenson link motion, but is a modification of that used in the prototype. To obtain the required valve travel the rods are lengthened, and are curved to clear the coupled axle, an intermediate valve spindle working in a guide in the motion plate being used instead of the swinging intermediate valve rod employed in the prototype. As the original engine is fitted with a complex system of levers and bell cranks to connect the weigh-shaft to the lever in the cab—this being necessary owing to the presence of the wide firebox—and such an arrangement being out of the question in a working model, a short lever in the cab, which is coupled direct to the reversing rod, is employed. This rod runs under the firebox, through a notch in the cross-beam, and passing behind the driving and coupled wheels between the latter and the frame, it joins the reversing arm of the weigh-bar shaft. There being very litt e room between the frames and wheels for this joint, a lozenge-shaped opening is made in the former to accommodate the fork and pin of the reversing-rod. Mr. Stuart Turner, however, devised an alternative plan of overcoming the difficulty, which was used in the present engine with success. Instead of providing the reversing-rod with a fork, a 5-32nd-in.

* During the very first trip the engine made on rails, in the writer's presence, it got out of hand, and was with difficulty stopped without serious damage occurring, the pressure at the time being only 25 lbs. per sq. in.

pin was riveted into the end of the reversing-rod, as indicated in Fig. 2. To maintain the reversing-rod in a straight line, and to prevent it buckling and rubbing against either of the coupled wheels, a clip is attached to the main frames midway between the two coupled wheels, as shown in Fig. 2.

firebox in the series of articles on the subject of modelling "Atlantic" locomotives, which appeared in THE MODEL ENGINEER last year (see issues of August 25th, September 1st, 8th, and 15th, 1904; Vol. XI). In these articles the drawbacks to the wide firebox are pointed out. For solid fuel the firebox is too shallow, and the space between the

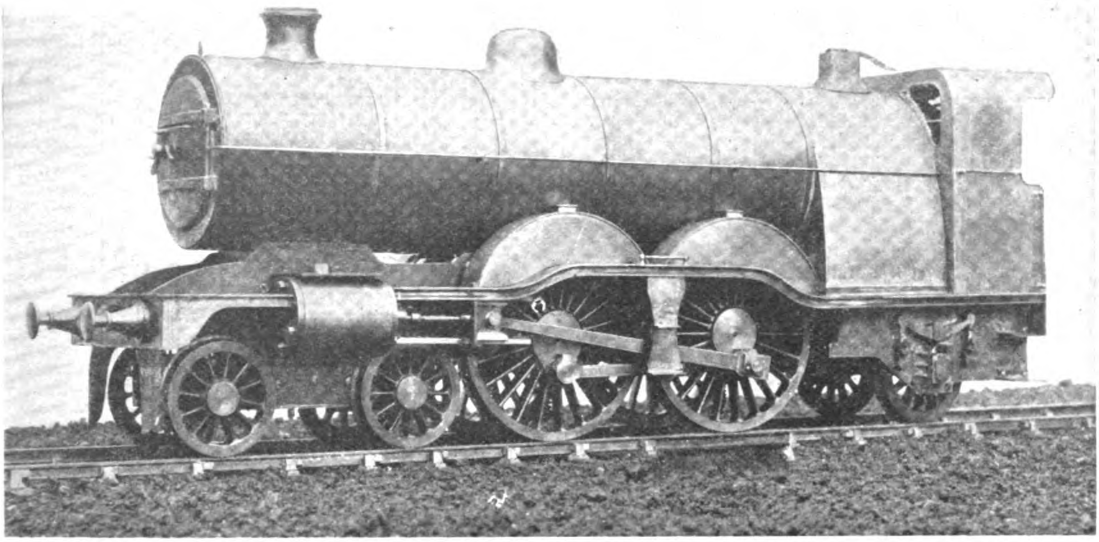


FIG. 3.—A ¾-IN. SCALE MODEL GREAT NORTHERN "ATLANTIC" TYPE LOCOMOTIVE, 251 CLASS.
Designed by Henry Greenly.] [*Built by Stuart Turner, Shiplake-on-Thames.*

This clip, and the placing of the reversing arm of the weigh-bar shaft outside of the reversing-rod, renders the use of a forked or bolted joint unnecessary. The footplates are of planished steel

ashpan and the bottom of the fire bars just above the trailing wheels is much too small for practical purposes of a working model. Again, although a single 3-in. diameter silent Primus burner works very

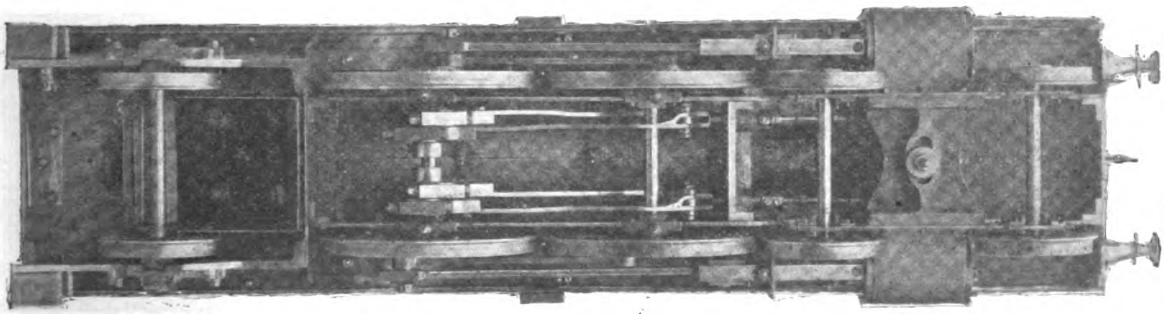


FIG. 4.—UNDERSIDE OF ¾-IN. SCALE WORKING MODEL G.N.R. "ATLANTIC" TYPE LOCOMOTIVE.

plate, bare 1-16th-in. thick, and brass angle is employed for the edging.

The chief feature of the whole design, however, is the boiler. Readers will remember the writer's remarks with regard to the possibilities of the wide

well, and where the locomotive is required for ordinary working on a model track with a load of, say, four to eight carriages or trucks only, should do all that is required, the full value of the heating surface the boiler provides is not obtained, and the fact remains that the more usual pattern of firebox with two burners would work equally well, if not bett r. However, the wide firebox has one great advantage in the matter of tube spacing. Model locomotive tubes are of necessity larger in diameter than the scale equivalent of those of the prototype, and therefore a comparatively large amount of the tube-plate area is not utilised. The wide firebox allows the maximum width of tube plate (see page 196 of the issue of September 1st, 1904), and a greater number of tubes can be arranged with a given diameter of boiler shell. It was this important factor, in conjunction with a desire on the part of the prospective owner for a model approaching in most of its main features to the original No. 251, that led to the adoption of the wide firebox, instead of the alternative suggestion given on page 176 of the issue of THE MODEL ENGINEER for August 25th, 1904. Several experiments (which, however, were not altogether conclusive, owing to the fact that proper arrangements for fuel and water supply were not available, the tender being then un-completed) were made, and it was forcibly demonstrated to the writer that the single Primus burner was not quite sufficient to keep a

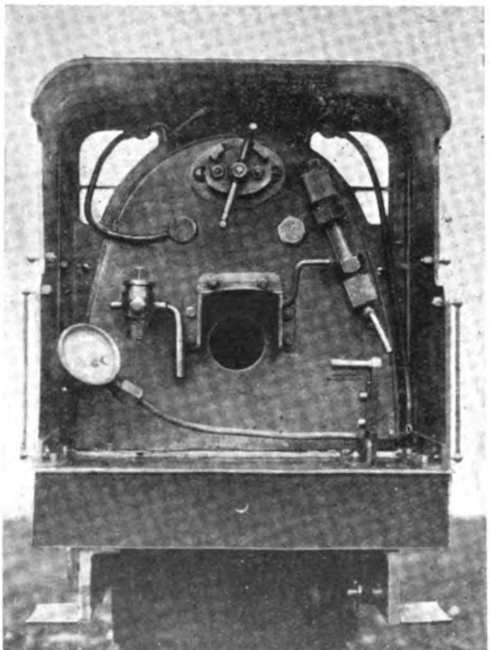


FIG. 5.—CAB VIEW OF WORKING MODEL G.N.R. "ATLANTIC" LOCOMOTIVE.

high enough steam pressure to continuously allow of one person riding behind the engine. The boiler was sufficiently powerful, as the experiment of using solid fuel in a grate, temporarily placed near the bottom of the flame guard, clearly proved. With such fuel, a constant head of steam of 50 to 60 lbs. could be maintained in spite of the water tubes in the firebox, which got in the way, the small grate area available for coal firing, and the inadequate size of the fire-hole*.

As a result of observations, the writer suggested the fitting of a special burner to fit the square firebox. This burner was made by Mr. H. E. Morriss, and was an adaptation of the petrol burners used on the "Locomobile" steam cars. It mainly consists of a square box, with air tubes of about ½ in. diameter through it. Petrol is the fuel, and, alto

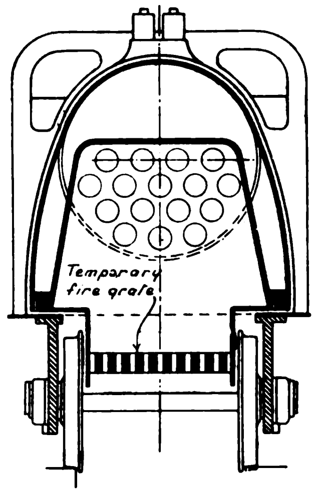


FIG. 6.—SECTION OF FIREBOX, SHOWING TEMPORARY FIRE GRATE BARS.

gether, the principle is almost the same as that on which the Primus burners work. Although the square box with the central air tubes is, perhaps, the better method of arranging a burner for the No. 251 style of firebox, as then the cold air cannot get to the sides of the firebox, the writer is of opinion that a cluster of petrol burners, of the type illustrated in THE MODEL ENGINEER, April 27th last, would do equally well, and he hopes that the recount of the experiences with the firing arrangements of this model will be of use to readers who are desirous of adopting this fine prototype.

The safety-valve of the model is a single one, but the exterior casing in a measure follows that of the original engine very closely. In "The Model Locomotive" (see Plate IX) a duplex safety-valve is shown. Further, instead of the ordinary regulator in the dome, one of the "undertype" pattern is employed. Small variations like these, however, do not affect the general design of the engine, and builders who wish to do so may modify the design. The sets of castings for the engine and for the tender are being supplied by Mr. Stuart Turner. They are in every way excellent, and can be recommended to the reader who is anxious to build a satisfactory working model of the now world-famous G.N.R. monsters.

* This, of course, was not originally intended for use as a medium for transferring fuel to the firebox, but simply for inspecting the burners.

The Latest in Engineering.

The Solignac Boiler.—The principle upon which this boiler works is as follows:—Its tubes are **U**-shape, but laid on the side, one leg of the **U** being over the furnace, with suitable baffles to give proper flow of the gases. The supply of water to each 1-in. tube is through a small hole in a diaphragm, and the tubes are thus limited in their water supply, and since the tubes are so short the circulation is perfect. In fact, the lower tubes convert all their water supply to steam. All the tubes deliver above water, and the mixed discharge descends in the drum, and steam separates out of the descending shower in a dry state. The boiler is cleaned by a reverse flow of steam. It is a very powerful steamer, gives an enormous output per square foot of floor space occupied, and can be got into full steam very quickly. With liquid fuel and fully heated feed it can, of course, be made to give full steam output immediately the liquid fuel is ignited, for it is safe to work the boiler as soon as there is water to cover the lower ends of the tubes, and it is not even necessary to wait until the full water level is attained in the drum. These qualities render the boiler particularly suitable for the exceptional loads of electric light stations, which have now to be met by keeping ready a large number of heavy boilers that are all the time losing heat by radiation. The Solignac boiler only requires a store of heated feed-water of a few gallons to be able to meet the most sudden extra load.

The Largest Atlantic Liner. — The new Hamburg-American liner, *Kaiserin Auguste Victoria*, the largest steamer afloat, was launched recently from the yard of the Vulcan Shipbuilding Company at Stettin, in the presence of the German Emperor and the Empress. The *Kaiserin Auguste Victoria*, which the Hamburg-American Line has had built for passenger and freight service between Germany and the United States, is 705 ft. long, 77 ft. wide, and 53 ft. 9 ins. deep; is constructed to carry 16,000 tons of cargo, with a displacement of about 40,000 tons, and her engines are designed to develop 17,500 h.-p. The speed of the *Kaiserin Auguste Victoria* will be moderate—17 knots an hour. This speed will enable her to reach Plymouth and Cherbourg in about seven and-a-half days and Hamburg in nine days. A welcome feature will be the three great promenade decks of enormous length and width, one of which will be reserved exclusively for promenading, while the others will be used for the placing of deck chairs. Like her sister ship, the *America*, the *Kaiserin Auguste Victoria* will have accommodation for 600 first-class passengers, 300 second-class, 250 third-class, and 2,139 steerage, a total of 3,289 passengers, while the crew, including stewards, will number some 600 officers and men.

Smart Marine Engine Work.—A record for smart repair work of the very highest class was recently achieved by Messrs. David Rollo and Sons, of the Fulton Engine Works, Liverpool, in connection with the replacing of the intermediate starboard engine of the White Star liner *Majestic*, in consequence of the breakdown on that vessel early in July. The *Majestic* on her voyage to New York met with a serious accident in her starboard engine-room: the cylinder, column, and bed-plate of the middle pressure engine were practically destroyed. It was decided to bring the ship back to Liverpool after partial repairs, and the disabled engine was thrown out of commission and the machinery on the port side worked as a high-pressure compound. On July 11th, Messrs. Rollo and Sons obtained the order from Mr. Ismay to commence the repair work on promising a trial of the engines on August 26th, the owners wishing to make every endeavour to prevent the *Majestic* missing more than a single trip, and naturally being unwilling to allow the boat to lose the splendid reputation she has achieved as a fast steamer by permitting her to continue running with a compound engine on one side. It was found that practically a new middle pressure engine had to be built, the cylinder weighing 19 tons, the engine column weighing over 10½ tons, the cylinder liner weighing nearly 5½ tons, and other heavy parts having to be cast and completed within the short period of six and-a-half weeks. Such a job to be finished in so short a time was a big one, and taking it all round it may be asserted that the engine builders set themselves the task of constituting a new record in this kind of work. The castings were put in hand long before the *Majestic* reached Liverpool, from the dimensions of the *Teutonic*, her sister-ship. By dint of continuous and never-ceasing work the operation, meaning as it did the casting of more than 45 tons of machinery and the complete fitting of the new engine on the steamer, were satisfactorily performed so as to enable the *Majestic* to sail on August 30th.

Steam Coaches in Lincolnshire.—The Great Northern Railway Company has commenced the erection of platforms or landing stages at various level crossings between Louth and Grimsby, as a preliminary to the provision of a new service of team coaches to run over its system in the intervals between the ordinary trains. The new service will supply several villages which are now some miles from a railway station.

Novel Motor Boat.—A novel type of motor boat has been designed in France for the International Cup. The hull has an absolutely flat bottom, 8 ft. wide in the centre of the boat. The principal novelty, however, is the propeller shaft. No part of the latter is either inside or in contact with the hull itself. It is attached at the rear extremity to a bracket projecting from the bottom of the keel, and the other extremity rests in a special casing, also projecting from the keel. In the casing is a chain-wheel connected by a chain with the motor shaft above. A large De Dietrich engine is employed to drive the boat. It is claimed by the designers that by the novel shape of the hull "skin friction" is reduced to a minimum, for the vessel merely glides over the water, the propeller shaft, its supports, and the lower part of the rudder alone being immersed.

An Amateur's Lathe.

By "Schoolboy."

THE accompanying photographs are of a 2¾-in. single-geared lathe which I made in my spare time, and which took about six months to complete. It is built up of castings, the patterns for which I made myself, with the exception of the flywheel, which was cast from an old barrow wheel. The crankshaft was also made for me by a local smith.

Before mentioning a few of the details, I may say that I had access to a well-equipped engineer's shop, which contained planing, shaping, milling, and slotting machines, two vertical drills, and several lathes of various sizes, and many other auxiliary accessories, which were found very useful. The fast headstock has conical brass bearings. The cone pulley has two speeds with V grooves, and there are also corresponding grooves on the flywheel. The hand-rest is made from a casting and a T forging. The loose headstock was bored out and a tight-fitting "spindle" inserted, with a hardened centre at the one end and a feed screw at the other, to which the hand wheel is attached. The bed is fixed to the dwarf legs by means of countersunk screws.

The stand consists of two cast-iron standards of half-round section, and an oak top, which is bolted to them. The boss of the flywheel was bored out a tight fit for the crankshaft, and is affixed to it by means of set-screws. The treadle is made from two pieces of flat iron, and a footboard, hinged to the stiffening bar at the back by means of T pipe joints. A small pulley runs on a spindle fixed at right angles to the flat iron. The motion is transferred to the crankshaft by a ½-in. pitch chain, which I find gives better results and causes less friction than a connecting-rod. The crankshaft runs in bearings which are only holes bored in the bosses of the standards, and it is kept in position by collars which are fixed to it with set-screws.

I have also nearly completed a slide-rest, made from castings which I procured from S. Holmes and Co., Bradford.

Though small and simple, I have found this lathe very useful in turning various pieces of work which were too small to centre in a lathe of larger dimensions.

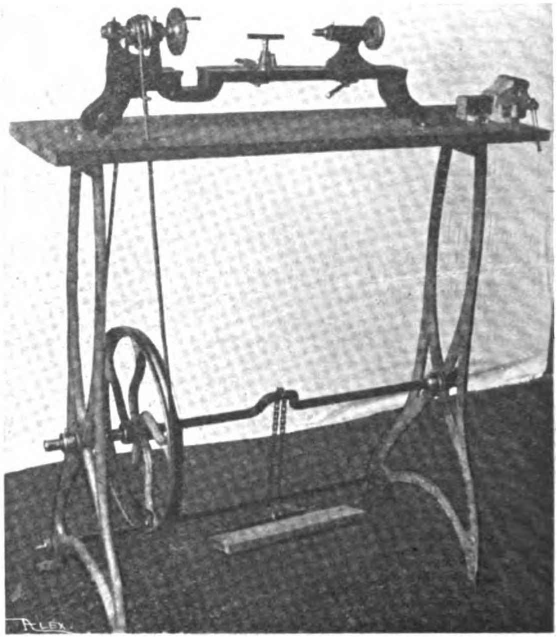


Fig. 1.—The Lathe Complete.

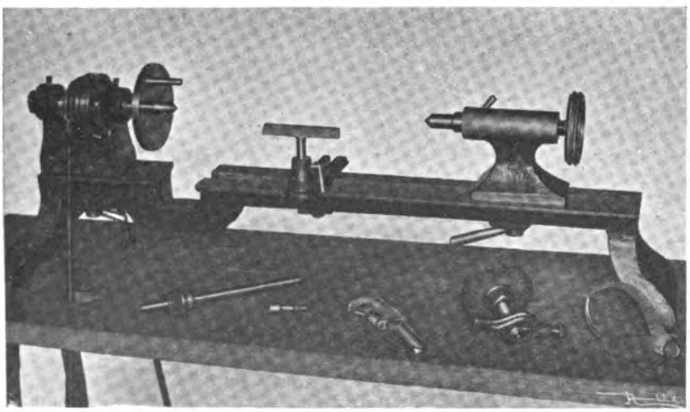


Fig. 2.—Enlarged View of Lathe Bed.

Solder for Aluminium, etc.—An alloy of zinc and cadmium, containing about 20 per cent. zinc, constitutes the best solder for aluminium, nickel, German silver, copper, iron, and steel, says M. le Chatelin; but as little as 15 per cent., or as much as 30 per cent. of zinc may be suitable in special cases. The alloys are prepared by adding the zinc to the cadmium while fused in a crucible.

A device hsa been patented in Australia whereby a number of radial or curved V-sectioned vanes or blades are disposed between the hub and rim of the wheel of a cycle for the purpose of assisting the propulsion of the vehicle by means of the air currents induced by the vanes.

Waterproof Glued Joints.—To render glued joints waterproof, rub common chalk on the surface of the wood where the glue is to be applied, and then coat with ordinary glue in the usual manner. The chalk will protect the glue from moisture so that the joint will hold as well after being soaked in water as before.

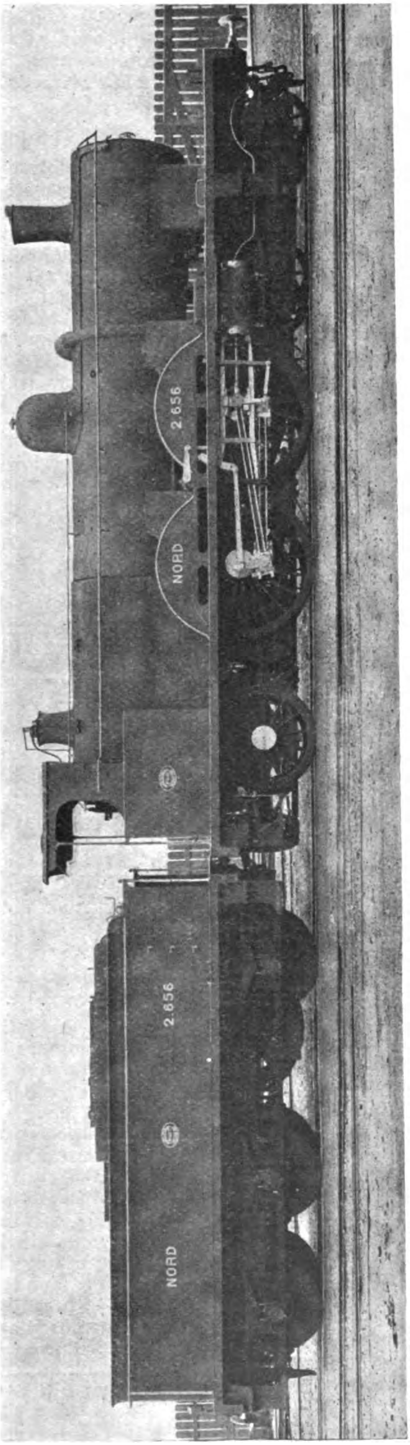


FIG. 1.—ATLANTIC TYPE COMPOUND LOCOMOTIVE OF THE LATER SERIES, NORTHERN RAILWAY OF FRANCE.

Notes on Locomotive Practice.

By CHAS. S. LAKE.

RECENT LOCOMOTIVE BUILDING.

THE first series of express passenger locomotives to be built from the designs of Mr. R. M. Deeley, Locomotive Superintendent of the Midland Railway, have now been completed at Derby Works. The engines are similar in all important respects to those of the same type which preceded them, but a few modifications have been introduced which tend to their improvement. A more liberal cab roofing has been provided—a sadly needed reform—and the boiler pressure has been raised. This is now 200 lbs. per sq. in. The cylinders are 19½ ins. diameter by 26 ins. stroke, and the coupled wheels have a diameter on tread of 6 ft. 9½ ins. The engine number is set forth in extra large gold figures on the sides of the tender.

One of the "Metropolitan" type tank engines owned by the Midland Company has been rebuilt and converted to the 4—4—2 type by having the frames lengthened and a pair of trailing carrying wheels added to support a large bunker which has been fitted. A covered in cab has also been provided.

On the L. & N.W.R. several new engines of the "Precursor" class have been completed at Crewe, and a number of Webb 3-cylinder compound goods locomotives have been converted to 2-cylinder simple engines. The first of the new 4—6—0 type express locomotives with four simple cylinders is now out on the L.S.W.R. The cylinders are 16 x 24 ins., coupled wheels 6 ft. diameter, and total heating surface 2,727 sq. ft.

NORTHERN RAILWAY OF FRANCE COMPOUND LOCOMOTIVES.

Readers of THE MODEL ENGINEER who have an especial interest in matters relating to locomotive engineering will doubtless be well acquainted with the outward appearance of those celebrated locomotives, the de Glehn system compounds of the 4—4—2 type in service on the Northern of France and other railways in that country. By the courtesy of Mons. du Bosquet, Locomotive Superintendent of the Nord, the writer is enabled to refer in greater detail than before to the latest series of engines put to work on that railway, and to illustrate the description with sectional drawings kindly provided for the purpose by the designer. The locomotives of this class are virtually of the same size and power as the first of the de Glehn compounds supplied to the Great Western Railway of England. The cylinders are four in number, two high-pressure and two low-pressure. The former are placed outside the frames and drive the second pair of coupled wheels, whilst the low-pressure cylinders are located between the frames, below the smokebox, and drive the crank axle of the leading pair. Both the H.-P. and the L.-P. cranks are set at right angles to each other, and the angle between the two cranks on each side of the engine should be 180 degs., strictly speaking; this being the most advantageous position for steadiest working of the moving parts. Instead of this, however, they are fixed at an angle of 162 degs. to one another, the L.-P. crank leading at that angle in front of the H.-P. crank. The object of this is to prevent any loss of time at starting, and by its adoption the admission of steam to at least three of the cylinders is ensured. This disposition of cranks is also favourable to greater regularity of the torsional moments acting upon the axles. The steam chests are placed above the cylinders in each case, piston valves being used for the high-pressure, and D-shaped slide-valves for the low-pressure, actuated by Walschaerts' motion throughout.

The boiler is of large proportions, and has a Belpaire pattern firebox, upon which the safety valves are mounted, in a casing of neat design. The regulator is located in the dome, and from thence steam passes to the high-pressure cylinders by way of a pipe encircling the outside of the boiler. After having propelled the pistons in these cylinders, it passes forward to the low-pressure pair, and there acts expansively on the larger pistons. A starting valve is provided to allow of the driver admitting boiler steam at a reduced pressure to the L.-P.

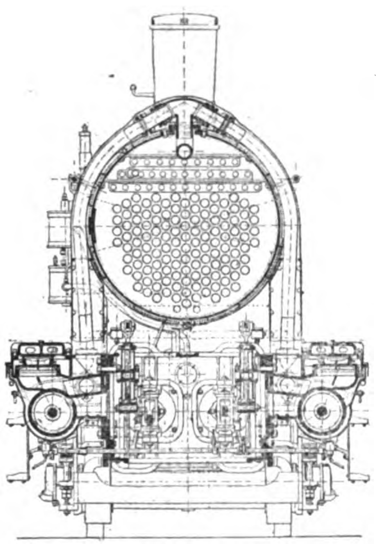


FIG. 2.—CROSS-SECTION THROUGH H.-P. CYLINDERS AND BOILER.

cylinders when necessary, and at such times other valves are brought into play, by means of which a direct escape is provided for the exhaust steam from the H.-P. cylinders into the atmosphere.

In this way the engine may be worked to suit the varying conditions met with in hauling heavy traffic at high speeds, additional power being available when required, such as on banks and at starting, when train resistance is, of course, most severely felt. The engines have dimensions as follows :—Cylinders (H.-P.), 13 3-16ths ins. diameter; L.-P., 22 1-16th ins. diameter ; stroke, 25 3-16ths ins.; coupled wheels, 6 ft. 8½ ins. diameter ; trailing wheels, 4 ft. 7¾ ins. diameter ; bogie wheels, 2 ft. 11⅞ ins. diameter ; coupled wheelbase, 7 ft. 0⅝ in. ; total wheelbase (engine), 27 ft. 10⅝ ins. ; boiler (diameter), 4 ft. 9 5-16ths ins. ; number of tubes (Serve, ribbed), 126 ; diameter of tubes (outside), 2 9-16ths ins. ; working pressure, 228 lbs. per sq. in. ; grate area, 29·5 sq. ft. ; heating surface (total), 2,325 sq. ft. Adhesion weight, 34·5 tons ; weight of engine loaded, 65 tons. These locomotives when tested on the Northern Railway have hauled loads of 360 English tons behind the tender a distance of 95¾ miles, including one 13-mile bank at 1 in 200 and another of 1 in 333 for ten miles, at an average speed of 56 miles per hour, the lowest speed on the banks being 52·2 miles per hour.

A Huge American Switching Locomotive.

The "switching" or shunting locomotive in this country is generally quite a small type of engine without tender, and although possessing considerable hauling capabilities, is in the large majority of cases only of moderate size and weight. In the United States, where goods trains are made up to equal loads of 3,000 tons, and even more, without the engine, shunting locomotives are to be found which are equal in proportions to some of the largest main line ones. Quite recently the American Locomotive Company have built at their Brooks

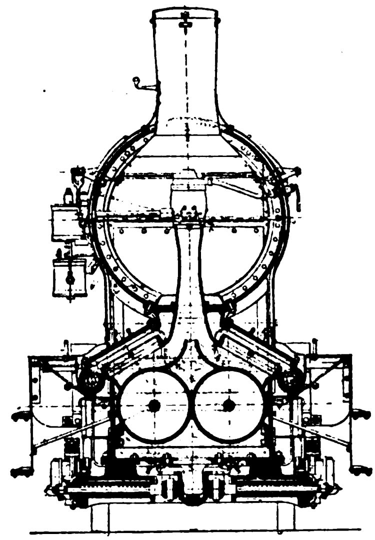


FIG. 3.—CROSS-SECTION THROUGH L.-P. CYLINDERS AND SMOKE-BOX.

Works some exceptionally powerful engines having ten wheels (all coupled), outside cylinders 24 ins. diameter by 28 ins. stroke, and a boiler 6 ft. 8 1-16th ins. diameter at the front end. Other equally remarkable dimensions are associated with the design, the total heating surface, for instance, being 4,625·4 sq. ft., the grate area 55 sq. ft., and the working steam pressure 210 lbs. per sq. in. Perhaps the most noteworthy feature is, however, the weight of the engine, which is no less than 120½ tons (without tender) in working order. The whole of this is, of course, available for adhesion, there being no additional carrying wheels beyond the five coupled pairs, which are 4 ft. 4 ins. diameter.

The engines work in gravity distributing yards, and have to work over "humps" or summits having grades of 0·67 per cent. and 2·00 per cent.

EMANIUM.—A new radio-active substance extracted from residue of thorianite is named emanium; it is said to emit the Beta rays abundantly.

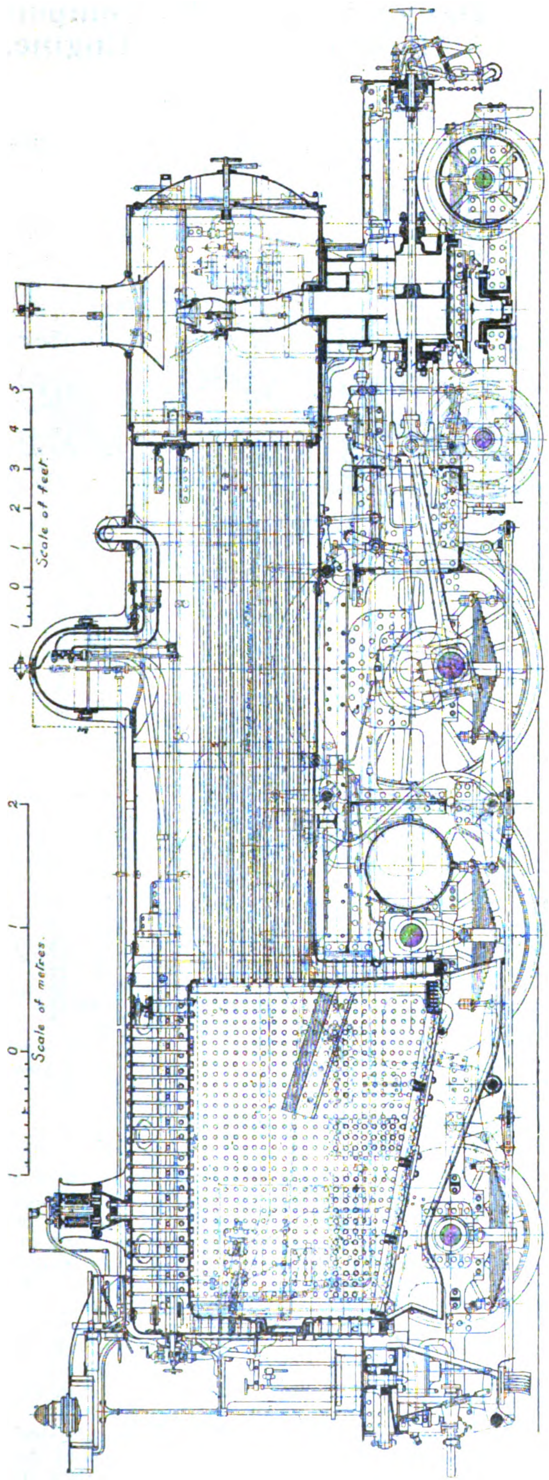


FIG. 4.—LONGITUDINAL SECTION.

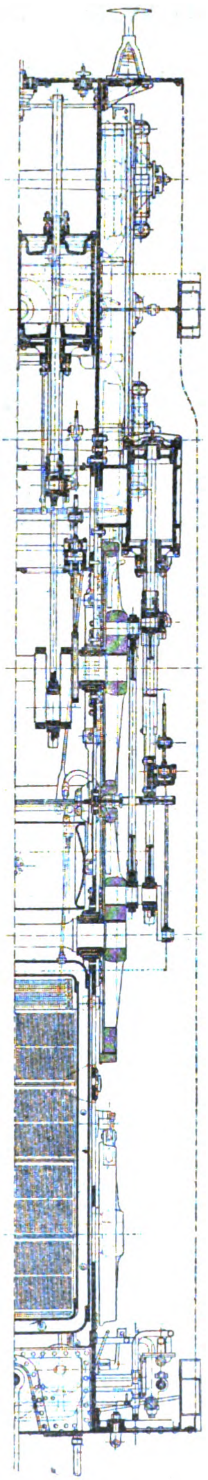


FIG. 5.—HALF SECTIONAL PLAN.

ATLANTIC TYPE COMPOUND LOCOMOTIVE OF THE LATER SERIES
NORTHERN RAILWAY OF FRANCE.

For description] [see page 421.

The Smallest G.W.R. Station.

THE distinction of being the smallest station on the Great Western Railway belongs to Wanstrow, which is situated on the Wells Branch in Somersetshire, between Witham and Cranmore. Before the station was erected—about fifty years ago—the parishioners, feeling the disadvantage of having to go some three miles to join a train or despatch produce, and realising that it would not pay a railway company to build a station in their midst, decided to provide one at their own expense. This was done, the structure consisting of a platform about 24 yards long and a small waiting-room. On the platform is one lamp. No stationmaster, porter or other staff is kept at Wanstrow, the station being under the supervision of the Witham stationmaster, who pays occasional visits to the place. There are no signals, and consequently a signalman is not wanted, and the line being single, worked on the electric train staff system, the stoppage under such conditions can be made with perfect safety. The daily service is now five trains in each direction. Owing to the shortness of the platform, not more than the guard's van and one coach can stand at it. To enable passengers to readily alight, the ticket collectors at the stations on either side of Wanstrow request them to take a seat in the coach next the guard's van, and the driver draws the train up carefully to the required position to stop.

Passengers travel without tickets, and are "excessed" when they reach the next station. The guard takes notice of the number and class to enable correct charges to be made—*G.W.R. Mag.*

Design for a Model Compound Horizontal Steam Engine.

By RICHARD A. ELTON.

(Continued from page 278.)

CONTINUING the description of the design, the front covers are made thick in order that the ends of the bored guides can be recessed into them. They and the guides are clearly shown in the details. The guides are bored and turned; the

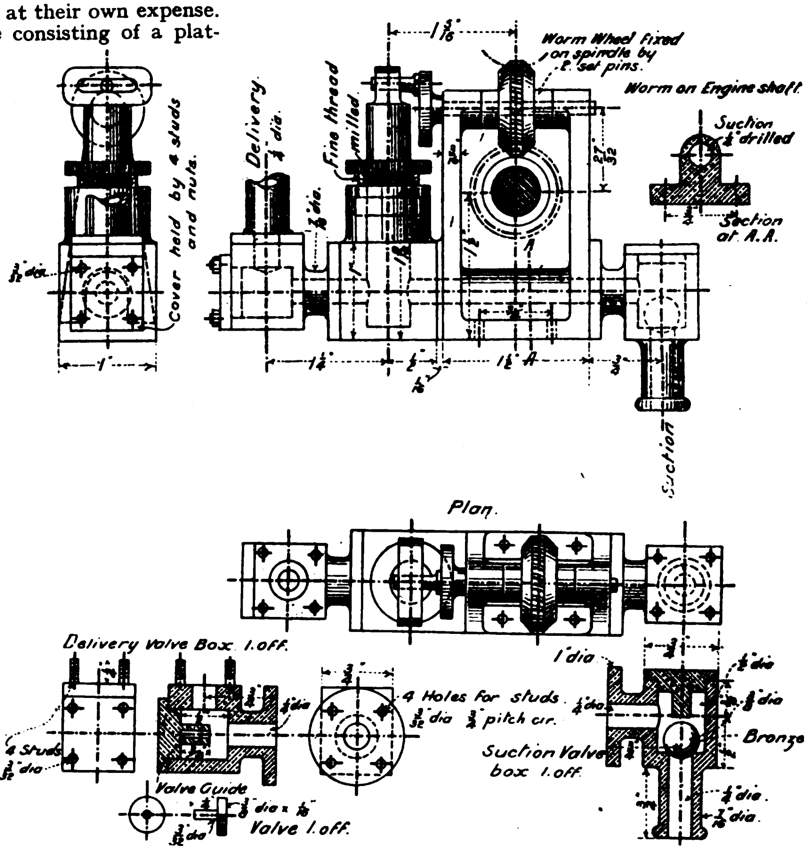
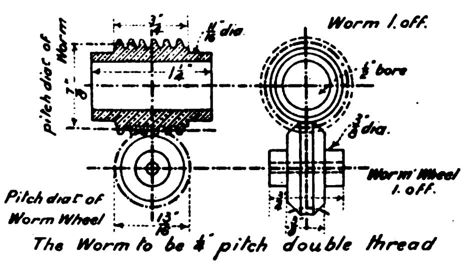


FIG. 9.—DETAILS OF WORM WHEEL GEAR AND VALVES.



The Worm to be ¼" pitch double thread

The W. Wheel ⅛" pitch 20 Teeth

central portion (outside) will look better if left as a casting untouched by the tool. The crankshaft end of the guides is supported by the bracket shown, which is bored out to fit the front end and fashioned with three screws as Fig. 19. Guides and brackets can be cast iron or gunmetal. I have shown no rings on the pistons. It seems to be an open question among model makers as to whether they are any use on such small engines, or only conduce to friction. My own opinion is that the engines are better without them, granted good workmanship and high speed.

The piston-rod and cylinder head are steel, also the connecting-rod. All nuts on moving portions of the engine must be pinned to prevent slackening back.

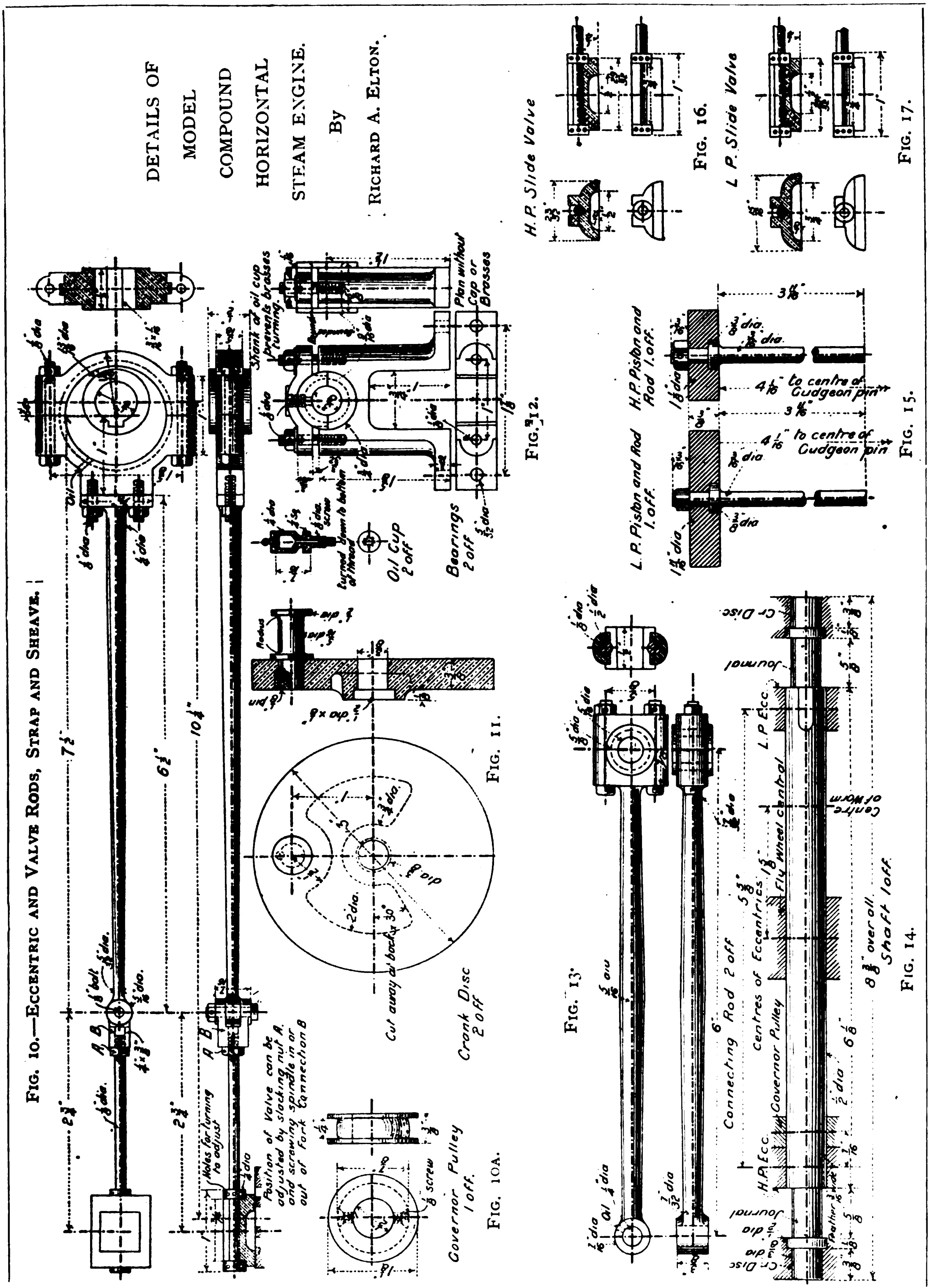


Fig. 10.—Eccentric and Valve Rods, Strap and Sheave.

Fig. 10A.

Fig. 11.

Fig. 12.

Fig. 13.

Fig. 14.

Fig. 15.

Fig. 16.

Fig. 17.

The cranks are of the disc type, fastened to the shaft by a screw, half in shaft and half in disc. The discs are balanced by cutting away at the back on one side; they should be cast in iron or gunmetal—details are given in Fig. 11. The main shaft may be turned down from mild steel. This is shown in Fig. 14.

The flywheel, in cast iron, is all straightforward work; the rim can be rounded for belt driving, or, as shown in Fig. 4, grooved for rope driving.

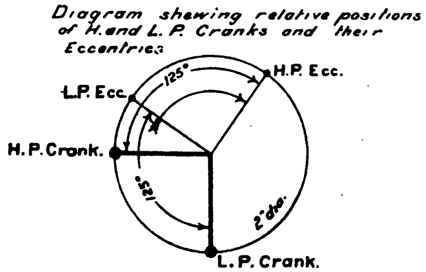


FIG. 18.

The eccentric pulleys and sheaves should be gunmetal, the rods and valve spindles steel. The valve can be adjusted slightly by screwing its spindle in or out of the fork at the end of the spindle.

The worm on the shaft is double-threaded; it would be better if cut from the solid shaft, but this is a matter for the maker to settle. If separate, it should be cut in gunmetal: the wheel should also passes through the upright pedestal of the worm wheel. The suction valve is a bronze ball, the delivery valve a flat brass valve. The governor, arrangement and details of which are shown on opposite page, is belt driven from the shaft. It may be adjusted by altering the length of the connecting link, by shifting it to a fresh hole; also by the spring at the H.-P. valve chest, acted on by the wing nut shown in the details (Fig. 21).

Notes on the Treatment of Tool Steel.

By J. M. T.

(Continued from page 255.)

THE WATER ANNEAL.—Sometimes steel is received from the maker so soft that it drags very much when it is cut in the lathe—very much like copper. This can easily be done by over-annealing, and if steel is over-annealed, it is impossible to leave a nice smooth finish on the work, especially if it is a thread that is being cut. This can be cured by slightly hardening the steel, and it can be done in this way: heat the piece of steel to the recallescence point—that is, to a medium red—and then take it from the fire and let it cool in a dark place until all the colour has disappeared; then plunge it in water. This is called water annealing; and the reason why it cuts better is that it is not quite so

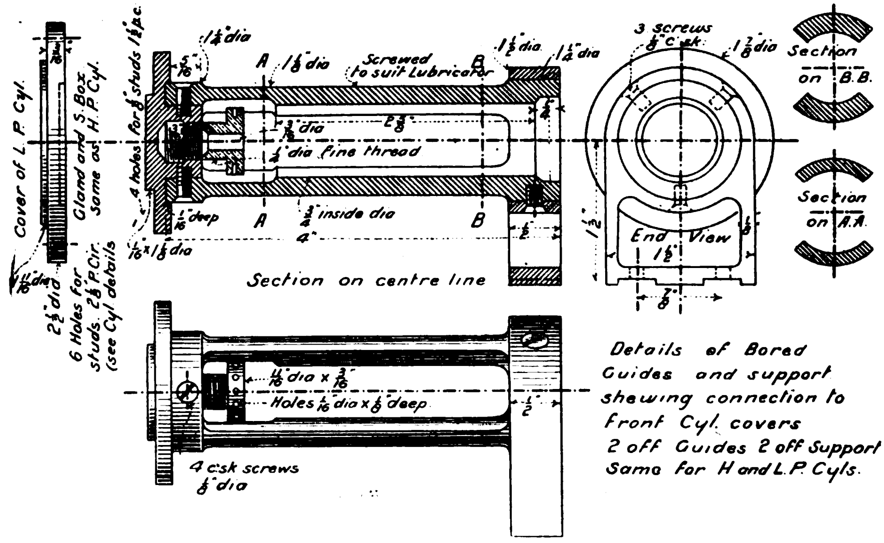


FIG. 19.

be gunmetal. Details of this are shown in Fig. 9, on page 324.

The stroke of the pump can be reduced to half, by screwing the crank pin, driving it into the hole in the disc nearer to the centre. Or if the pin be screwed into the central hole, the pump can be stopped altogether. The valve boxes are of gunmetal cast solid, and bored out to requirements. It should be noted that the suction of the pump

soft as before—in fact, it is slightly hardened. If steel is allowed to cool very slowly, it becomes very soft. The water annealing hastens the cooling just enough to leave the steel in the best cutting condition. If properly done, it leaves the steel soft enough to cut without undue wear upon the cutting tool, and without breaking in advance of the cutting edge, and hard enough not to drag like copper.

Tempering Steel.—We next come to the process

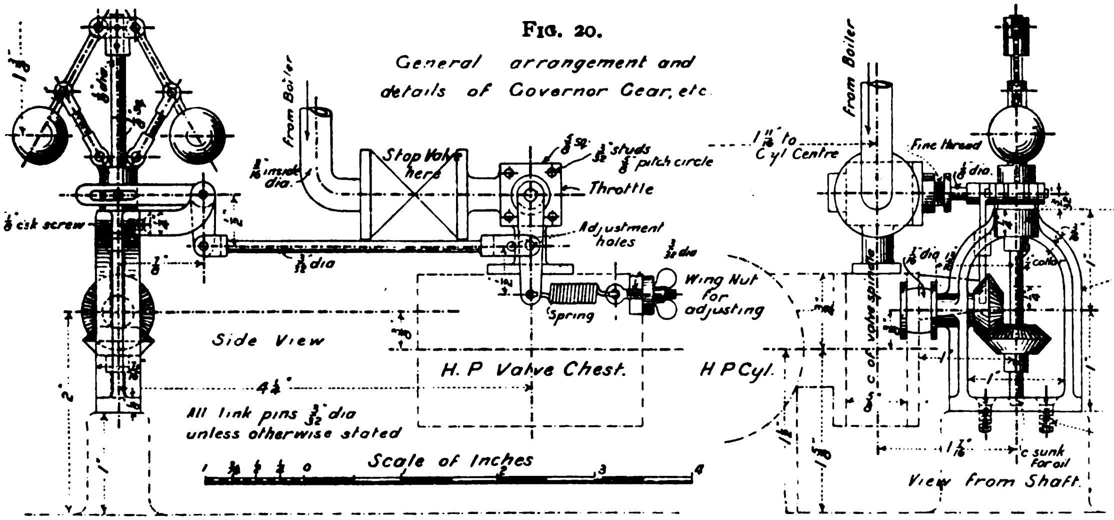


FIG. 20.

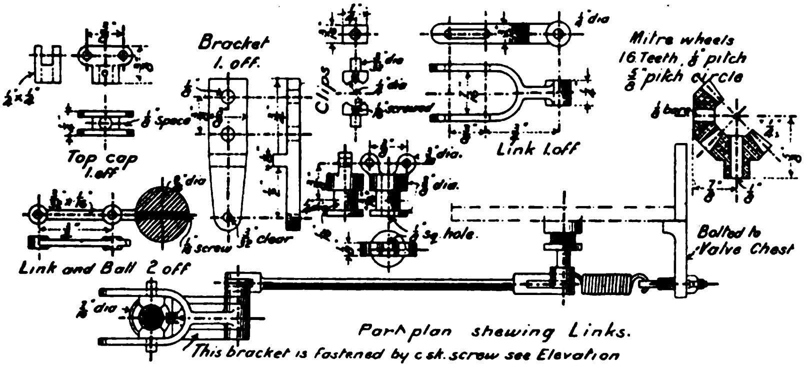


FIG. 21.

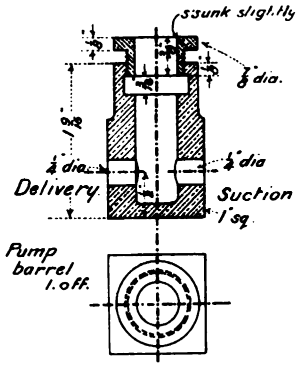


FIG. 22.

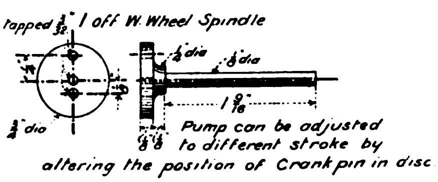


FIG. 23.

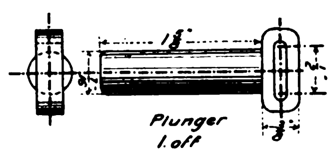


FIG. 24.

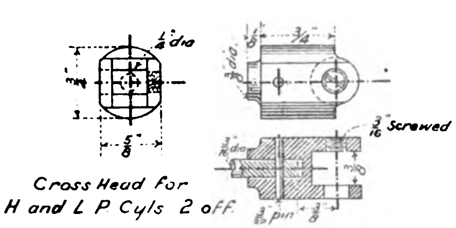


FIG. 25.

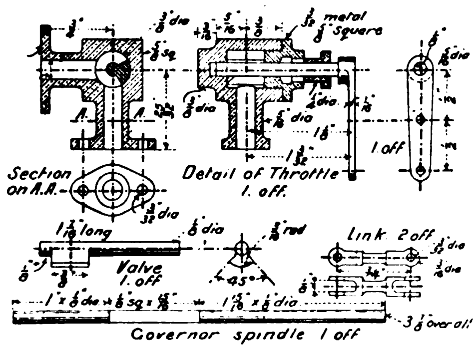


FIG. 26.

DETAILS OF MODEL COMPOUND HORIZONTAL STEAM ENGINE.

For description] By RICHARD A. ELTON. [*see pages* 324—326.

of slightly softening hardened steel, known as "tempering." This is accomplished by slightly heating the hardened steel, and then allowing it to cool; and this may be done in a great number of ways. Perhaps the most familiar way is to brighten part of the piece and hold it over a fire, and watch the surface change colour, and then plunging it in water, when the desired colour shows itself. This colouring of the surface of heated steel is caused by the steel combining with the oxygen in the air, or oxydising, and for some unknown reason the oxide assumes most beautiful tints. Why it should give such beautiful and different colours, I do not know, unless it is the depth of the oxide that determines the colour. These colours are very useful in determining the temperature to which the piece has been heated, as each individual colour always occurs at a particular temperature. For instance, the first colour noticed is a pale straw colour, which is equal to a temperature of 430° F., then comes full straw at 460°, dark straw at 470°, brown at 500°, purple at 530°, blue at 550°, light blue at 580°. After this the steel becomes dull red (760°) right through, and we pass beyond the tempering colours; and if steel is wanted softer than light blue, it is not worth while hardening it at all: it could be more easily done by rolling or plunging in some heated liquid.

A difference of a few degrees is sometimes quite sufficient to make a piece of steel either suitable for the work required of it, or practically useless; and it will be seen that for really fine work it would be very unreliable to trust to getting just the exact shade of colour that would indicate the right temperature, so other ways have to be used. Perhaps the best way is to heat the pieces in a muffle out of direct contact with the fire, and gauge the temperature with a thermometer, keeping the pieces at the desired temperature as indicated by the thermometer for a few moments, and then allowing them to cool gradually. A piece of steel could be kept at a definite temperature for any length of time, and it would not get softer and softer—in fact, it would be greatly improved, because it would help to relieve strains, and make the piece tougher. When there are only a few pieces to deal with, a very good substitute for the muffle is some sort of Bunsen burner and a kettle of oil, gauging the temperature with a thermometer suspended in the oil. Oil is a bad conductor of heat, and so it must be well stirred about all the time, or the pieces at the bottom of the pot will be much hotter than those higher up, and the thermometer will not register the heat properly. It is best to let the pieces cool down with the oil, in order to relieve strain and toughen them. This is no use if the piece is required to show the tempering colour, as they are protected from the air by the oil, and so oxidation cannot take place.

If they are wanted coloured, they must be brightened after removal from the tempering bath, and coloured in an open flame. I might say here that the colour of springs and other things does not necessarily mean that they were tempered to that colour; in fact, they may never have been *hardened* at all. It is very often done to give the piece a good appearance, and may be no indication of the temper to which the piece was drawn. Then, again, light straw may be too soft for a certain tool, but it can easily be brought to the right temper in the oil bath, or possibly boiling water 212° F. would be most suitable, and certainly easily done.

It is a very good plan to take the steel from the hardening bath, just when all vibration on the tongs has ceased, and put it into boiling water for an hour or so; this will temper it slightly (enough for some purposes) and tend to remove hardening strains. All steel, after hardening, has strains left in it, no matter how carefully the hardening is done. Sometimes the pieces will crack in the hardening bath, sometimes very soon after removal, and sometimes it will be several minutes, or hours, or even days, before the cracks show themselves. Sometimes the pieces will crack while they are being held in the hand, and I have seen pieces literally hopping about the bench when, a few minutes before, they appeared quite sound. For this reason, it is best to temper as soon as possible after hardening, or, at any rate, to put them in hot water or oil, where they can cool slowly, and so relieve some of the strain. It is the practice for some work to "age" the steel, as it is called, by keeping it in a hot-water tank for months, perhaps, and also to place a number of pieces in a slowly revolving barrel, so that they may be considerably knocked about and jarred. As will be seen, if the piece has to stand much concussion in use, this is a very good way of sorting out these with bad hardening strains.

When polished steel (and, of course, other metal and substance) is brought into contact with a flame, the moisture in the atmosphere is condensed on the surface, and forms a thin coating of water. This water is quickly boiled away; but as it goes you will see that it is rusting the steel, and it gives the steel the appearance of being tempered to straw colour, and also it prevents the temper colours showing plainly. This can be overcome in two ways—either by re-polishing the steel after it has got beyond the temperature of boiling water, or heating it up in an already hot and dry atmosphere, either in a muffle, hot tube, or hot sand. It can also be overcome by coating the steel with a thin film of oil; but this needs great care, as the steel does not colour so well under oil, and, also, the colours are not the same for the same temperature in the two cases.

When a great many pieces of one kind are made, it saves a great deal of time and expense if the two operations of hardening and tempering can be done in one operation. Experiments are made with different hardening compounds until one is found that gives this piece the desired hardness and toughness on being plunged into it. Some springs, for example, are treated in this way. Small ones are plunged into a mixture of oil and tallow, and large springs into boiling water; but it must require a good deal of experience to get satisfactory results. Milling cutters are treated in this way, and no doubt many other things. I have noted down some points to be remembered if the steel is to be hardened successfully. It is well known that steel is reduced in size by successive passes between grooved rollers while in a red-hot state. Three objectionable things take place—the piece is scaled; it is decarbonised at the surface; and the *outside* is more compressed than the *inside*. This is very noticeable in bars of steel above 1½ ins. diameter, and it can be seen by examining the fracture of a bar of steel of large section. After 1½ ins. or 1¼ ins. diameter, the bars are annealed, and the subsequent passes are not heavy enough to produce any effect that could be seen by the eye. Nevertheless, the steel is strained, and unless the piece is turned upon centres that are truly in the centre of the piece, more strains will be relieved on the one side than on the other, and these strains will manifest themselves when the steel gets soft, by being made red-hot, ready for hardening. Steel for cutting tools should always be reduced considerably in diameter to get below the scale and the decarbonised portion. The scale is, of course, absolutely useless, and the decarbonised portion will not harden properly, and so cannot keep a fine cutting edge.

(*To be continued.*)

A Primary Spark Coil for Gas Lighting.

By Geo. W. Stead.

THERE are many amateurs who do not possess sufficient courage or skill to make a proper induction coil with primary and secondary windings, and the following description of a spark coil, which contains a primary winding only, may be of interest to such. It can be made very cheaply, and the most unskilful amateur need not despair of making a really efficient piece of apparatus. The dimensions need not be strictly adhered to, as a few yards of wire, more or less, makes no appreciable difference to the efficiency of the coil :—

First procure the baseboard, any good wood, such as walnut or mahogany, which must be 10 ins. long, 4 ins. broad, and ⅝ in. thick ; plane and sandpaper this smooth. Next procure two pieces of the same kind of wood for the coil ends ; these are

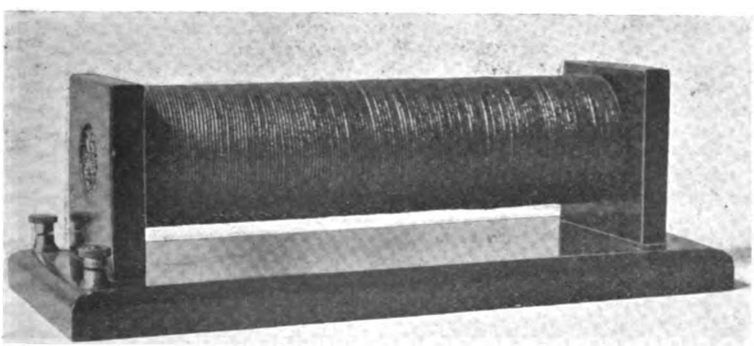


Fig. 1.—A Primary Spark Coil for Gas Lighting.

2⅝ ins. square and 7-16ths in. thick. After smoothing up, mark the centre and drill a hole in each 1⅛ ins. diameter. To make the barrel of the coil, which is a paper tube, get a piece of wood about 12 ins. long, and turn or plane it to exactly 1 in. diameter. Now procure some brown paper about 9 ins. broad and as long as convenient ; brush one side well with flour paste, or very thin glue, and proceed to wrap this round and round the wooden mandrel until a paper tube is made 1⅛ ins. diameter ; that is, 1-16th in. thick of paper all round. Do not wind too tight, as the paper contracts considerably as it dries. When the tube is formed, slip it off the mandrel and allow to dry. A very light cut may now be taken off the mandrel just to allow it to make a moderately tight fit into the paper tube. Slip the mandrel into the tube, and place on the two ends, so that the measurement from outside to outside is 8½ ins. Fasten them well in place with glue or seccotine, and when dry,

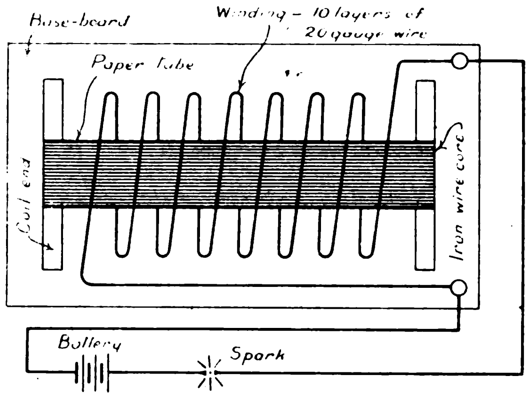


Fig. 2.—Diagram of Winding and Connections.

the coil is ready for winding. Ten layers of 20-gauge cotton-covered copper wire, weighing about 2½ lbs., are put on winding as closely and evenly as possible. A coat of shellac varnish puts on a finish, and keeps out the damp. If 20 gauge wire is not at hand, a few gauges thicker will answer quite as well.

The paper tube can now be cut off straight with the ends of the coil by running a sharp penknife round while still on the mandrel. The coil is now slipped off, and the paper tube filled quite full and tightly with lengths of soft iron wire, 20 or 22 gauge, and about ¼ in. shorter than the length of the coil.

The coil is now practically finished, and only requires to be screwed centrally on to the baseboard by two screws passing from underneath into the coil ends. The starting and finishing ends of the wire are brought through the baseboard, and connected respectively to the two terminals. The woodwork may be either French polished or varnished.

To work the coil, it is only necessary to connect two or three Leclanchés or dry cells, as sketch. When the two free ends of the wire are brought into contact and then separated, a fat spark is produced, which ignites the gas easily. Of course, the wire must be insulated when making this experiment, or a rather smart shock will be felt. This coil has been used to light a gas stove : instead of striking a match every time, a kind of trigger arrangement being used to make contact. Of course, neither the coil nor the battery need be near the place where the spark is required, but may be stowed away in a cupboard or ceiling out of sight, and wires led down to the place required. To those who wish for a more elaborate system, special gas burners are sold which contain the necessary make-and-break contact, and only require the two ends of the wire connecting to them.

Practical Letters from our Readers.

[*The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a* nom-de-plume *if desired, but the full name and address of the sender* MUST *invariably be attached, though not necessarily intended for publication.*]

A Mississippi River Steamer.

To the Editor of *The Model Engineer*.

Dear Sir,—In The Model Engineer for June 15th, 1905, there is a "cut" taken from a photograph of what is erroneously called a "Mississippi Saloon Steamer." I say erroneously because this type of steamer has never been used on the Mississippi, it being unsuited for service on that river.

The model in question is an excellent representation of what we call a "Sound" steamer, and they are employed on the land-locked waters along our coast, and reach their highest development in the steamers plying on Long Island Sound, between New York and Newport, and on the Hudson River between New York and Albany.

The Mississippi steamer is shown in the two photographs which I enclose herewith. These are the bow and stern views of the steamer *Valley Queen*, and were taken by me while on a visit to New Orleans about four years ago.

The Mississippi steamer is a queer-looking affair to one who is accustomed only to the types of vessels to be found along the sea coast. They are long, narrow, shallow draft boats, with very high superstructure. The hold is never employed for the stowage of freight; all freight is carried upon the main deck, which is open, as you will see by the photographs. The engines are very long stroke, small bore cylinders, working at extremely high pressure. The boilers are mounted on the deck, with a sheet iron casing, lined with brick, which forms the furnace. The boilers are of small diameter, and very long, frequently as much as 40 ft., while the diameter rarely exceeds 48 ins. They usually have five large flues running the full length of the boiler, the furnace being underneath, the hot gases travelling the full length under the bottom of the boiler, returning through the flues, thence up the stacks or chimneys. These chimneys are very tall and are surmounted with a fancy cap, as shown. The connecting-rod (or "Pitman," as it is called on these Mississippi steamers) is made up of a large piece of timber, frequently as much as 30 ft. long, with a wrought-iron strap around the edges, often having a depth of 18 ins. at the middle, tapered towards the ends, the wrought-iron strap carrying the connections for crank-pin and wrist pin. The valve gear is a very queer arrangement of levers operating a poppet valve, as, owing to the high pressure of steam carried, this form of valve is the only one that can be successfully employed.

These photographs show a stern wheel boat, which is like the majority of those employed on the Mississippi, Ohio, Missouri, and Red Rivers, and, in fact, all the rivers of the West and South-west.

There are a few side-wheel boats which in general appearance resemble the steamer shown in the photographs. The side wheels are placed well aft, about one-third of the length from the stern, and each wheel was operated by an independent engine of the same type as that used for the stern wheel boat, there being no connection between the two wheels. This was necessary because of the narrow and constantly changing channels of these rivers, due to the rapid currents. The side-wheel boats, except in the service between New Orleans and St. Louis, have almost gone out of service, and been replaced by the stern-wheel boat, which is considered best adapted to the peculiar conditions on these rivers.

You will note the great gang planks hanging from derricks at the bow of the boat. These are always carried swinging out ahead of the vessel when under way. Landings are made anywhere along the river, the bow of the boat simply being run up to the bank, held in place by the motion of the wheels, the gang plank lowered, and as soon as the cargo is aboard the boat is backed off. Lines are never carried ashore, except when the vessel is moored at the end of her run. For making river landings along the route, the boat is never made fast.—Yours truly,

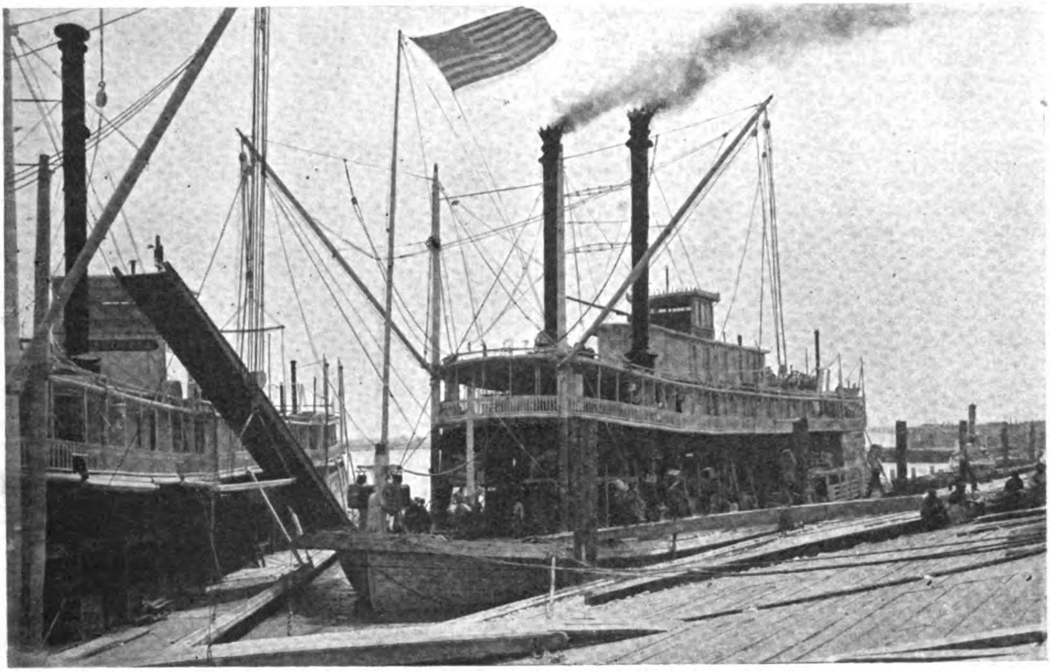
New York, U.S.A. P. D. Johnston.

Making Small Wing Valves.

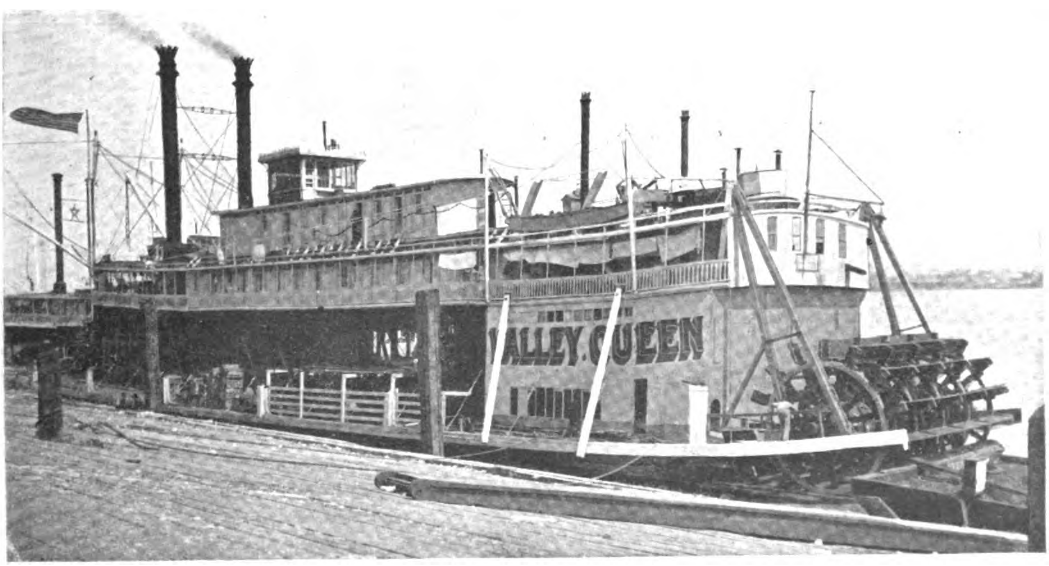
To the Editor of *The Model Engineer*.

Dear Sir,—Referring to Mr. E. W. Fraser's criticism and amendment (in your issue of September 7th), of my contribution to "Workshop Notes and Notions" in the issue of August 24th, I beg courteously to thank him for the same, but to emphasise the fact that at the time I happened upon the method I advocated, my resources as regards machinery and apparatus were limited. True, I had a single gear lathe—very small—and a compound slide-rest, but the poppet, or back centre, was very shaky; moreover, I had no up-to-date chucks, nor milling spindles, and it was for the benefit of others in a like position to my own that I gave publicity, through the medium of that most useful section of your splendid journal, to the means I was forced to employ at that time of producing the valves I required; and though theory may have it that no file should touch the stem of the wing valve, my results prove that nothing has been lost in practice.

Some day I trust I may find myself as well equipped as Mr. Fraser evidently is, then I shall not need perhaps to so frequently call in originality, nor employ non-professional methods. With the limited amateur, it is well to remember what a sage once said, "Necessity is the mother of invention," and one of the greatest benefits derived from my hobby has been the compulsion to think and scheme. It has meant concentration, and has made my humble engineering attempts a true recreation and change from my daily routine of school teaching. I trust many more have had a



The Mississippi Stern Wheel Steamer "Valley Queen."



A Stern View of the "Valley Queen" at New Orleans.

similar experience. Apologising for the length of this reply.—Yours faithfully,
New Cross, S.E. W. F. G. BRADFORD.

Making a Box Spanner; Acetylene Gas Generator.

TO THE EDITOR OF *The Model Engineer*.

DEAR SIR,—In the *M.E.* for September 14th there is an article on "How to Make a Box Spanner." I think "A. G." is going to a lot of unnecessary trouble in the matter, as a drill *can* be made to drill directly either a triangular or hexagonal hole quite easily. If "A. G." cannot drill holes with corners, I think he could do it much cheaper and better by buying mild steel tube, and then he could work it in the same way as he suggests.

Referring to the letter by Mr. Nathan Sharpe on the generation of acetylene gas, I think his genrator would be very suitable for a bomb, as the jet is liable to get choked either by chemical action or by chemicals getting blown into it. If your correspondent had been in, or seen, as many bad accidents as I have he would not use a closed generator.—Yours truly, "PRACTICAL."

ADVANCE OF MECHANICAL TRACTION.—A record was recently taken, from nine in the morning until nine in the evening, of all vehicles passing to and from London along the main Bath road through Hounslow, and the statistical results were as follows:—Cycles, 4,577; motor vehicles, 557; electric trams, 407; horse vehicles, 209; total, 5,750. These results show the enormous strides that have been made in mechanical traction.

AN EXHIBITION OF MODELS AT YARMOUTH.—A very successful exhibition in aid of the Hospital has recently been held under the auspices of the local branch of the Engineers' Society, in the Corn Hall, Yarmouth. The exhibits include a large number of interesting model steam engines, sailing and steam yachts. Mr. F. Brown was awarded a first prize for his cutter *Britannia*, and a special prize for excellence was given to Mr. W. Brown for the cutter *San Toy*. The highly commended mark was given to an old three-masted Yarmouth yawl, *Royal Sovereign* which was loaned, and also to Mr. H. Critten for his model lifeboat. Mr. A. E. Beeching was commended for his model lifeboat, and a similar mark was given to a four decker man-of-war lent by the Telhouse Museum. The model of the Silk Factory plant was exhibited by Mr. J. Fisher Bexfield. A first prize was awarded for a compound surface condensing engine, made by Mr. F. Lepard, and a second prize for a horizontal reversing engine made by Mr. H. Harper; the third fell to Mr. T. Brown for his splendidly made vertical boiler, and the fourth to Mr. J. Redgrave for his horizontal engine, while the fifth went to Mr. J. W. Grimwood for a horizontal engine. Some other prizes were given to Mr. C. Duncan for a marine engine, driving a screw; to Mr. Wade for a well-finished dynamo; and to Mr. Rumblelow for his ingenious model of a domestic hot water supply. One of the engines exhibited was a model of one used in Yarmouth silk factory thirty years ago There was also a model of the old Southtown bridge, and one of the bridges proposed to replace the present structure spanning the Yare between Southtown and the Hall Quay.

Queries and Replies.

[Attention is especially directed to the first condition given below and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-hand corner of the envelope "Query Department." No other matters but those relating to the Queries should be enclosed in the same envelope.

Queries on subjects within the scope of this journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied, wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed. (4) Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of Replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor,* THE MODEL ENGINEER, *26–29, Poppin's Court, Fleet Street, London, E.C.]*

The following are selected from the Queries which have been replied to recently:—

[14,476] **Silver Plating.** P. H. (Bristol) writes: Is it possible to silver plate with an ordinary bichromate battery or salammoniac battery? If so, may I ask you to tell me the most simple way of obtaining the solution to plate a cornet, and what time will be necessary to do this?

A single bichromate cell could be used, but it is scarcely worth while making up a plating bath for a single article. The article to be plated must be perfectly clean, and free from grease; it is placed in a solution of cyanide of silver dissolved in cyanide of potassium, and connected to the zinc of battery. A sheet of silver is connected to the carbon of the battery, and also immersed in the solution. The current strength is regulated by means of a resistance. The sheet of silver and article to be plated are suspended in the solution, and must not touch one another. For further particulars, see "Electro-Platers' Handbook," by Bonney, price 3s. 3d. post free, or Fowler's "Electrical Engineers' Year Book," price 1s. 9d. post free, which also gives some information on the subject.

[14,490] **Steam Screw-Down Valves.** W. J. (Briton Ferry) writes: (1) How should an ordinary steam stop valve (any size) be connected, the steam to enter under the valve or on top of the valve? I connect all stop valves with the steam from the boilers to enter under the valve. If this is not correct, and the steam should enter on top of the valve, will you please give reason why?

It is generally advisable to arrange for the steam to enter under the valve, as then the stuffing-box and gland are relieved of all duty when the steam is shut off.

[14,453] **Oil Filter.** H. J. B. (Middlesbro') writes: Will you kindly give me some idea how to make a small oil filter? I am running a small gas engine (1½ h.-p.) and using Price's gas engine oil, and am under the impression that if oil could be cleaned, it could be used over again. I have a light copper vessel, 12 ins. high by 8 ins. diameter, which I think I could utilise. I thought of using asbestos fibre, or slag wool, as a filtering medium—would either be satisfactory? Or could you suggest any better medium?

We do not advise you to use the oil twice over for the cylinder. It could be filtered and used for bearings and general machine use. A pad of slag wool might be used successfully. Pack it well into an inner vessel, and allow oil to percolate through and drip into a reservoir underneath. The inner vessel must be perforated at the bottom with a number of fine holes.

[14,457] **Rust in Gas Engine Water Tank.** C. B. (Dorset square, N.W.) writes: Will you kindly advise on red rust forming in water tank of gas engine? There are two water tanks. The red rust only appears in the hottest of the tanks (the one with water from the engine). The rust collects in small patches about 6 ins. apart all round the circumference of tank, and about 6 ins. below the surface, and then collects in larger quantities, about three-parts the depth of tank, and in perfect line with the small patches near the surface, mainly collecting on the ridges of the hoops or bands, of which there are three. My opinion of the cause of this is that rust collects from the joint made of iron piping from the engine to the tank, which rusts and floats in the water, and collects on any rough part, and then dropping and collecting in larger quantities on any protecting ridge, viz., bands of tank. Do you think emptying tanks and giving interior a coating of a preservative paint will prevent this? I might add that where these larger quantities of rust form it eats through and perforates the tank.

Probably the coating of zinc is worn off the inside at parts. You could have the tank cleaned and re-galvanised, if it is worth it, or simply coat it with some preservative compound, which could be had from any builders', ironmongers', or engineers' stores.

[14,382] **Petrol Motor Valve Gear.** H. C. F. (Bexhill) writes: I am building a petrol motor, air-cooled with radiators, from a set of castings. What I want to know is—can I use eccentrics to work the valves, instead of cams and springs; and would I need any springs to hold the valves down on their seats when they have to be, or will the pull of the eccentrics be enough? I think it would be much easier to construct in this way than with cams and springs, as there is no chance of springs getting weak and cams getting worn. The chief thing is, will the eccentrics be sufficient to work the valves, or shall I need springs as well? The cylinder is 2¼ bore by 2½ stroke. What power ought it to develop (*a*) with petrol, and (*b*) with oil, and (*c*) with gas? I have a ½-in. spark coil—will this be a large enough spark to work the ignition? I intend to work it with a piston-rod and cross-head, and connecting-rod, instead of the usual gudgeon pin and connecting-rod. Will this do?

We do not think any form of eccentric without springs for closing the valves would be successful. With eccentrics, the adjustment would have to be made to the minutest fraction of an inch, and then the slightest wear would upset the working of valves. About ½ to ¾ b.h.-p. The difference between petrol and gas, with this engine, would be inappreciable. With heavy oil (paraffin), it would be slightly less. Spark coil might do; try it. This has no advantage. See our new handbook, "Gas and Oil Engines," by W. C. Runciman, price 7d., post free. It will help you considerably.

[14,712] **Induction Coil.** B. H. (Oldham) writes: I bought an induction coil at a clearance sale at a good shop in Manchester for 11s. 6d., to all appearances in perfect condition. Core of coil is 3¾ ins. long and ½ in. diameter. Bobbin is 2 ins. diameter when fully wound. The wire is silk covered, though I do not know whether double or not. Condenser ½ in. thick, leaves and plates as per sample which I enclose for your inspection. I use four double fluid bichromate cells, all in perfect order and newly charged, and I find the mutiple arc connection gives the best result. Seeing where the primary wires go in and come out of the bobbin ends, I fancy there will be two layers to the primary coil. What I want to know is—What is the proper length of spark for a coil as above? I get 3-16ths-in. to ¼-in. for a regular thing, but sometimes for the first spark I get 5-16ths-in. What number of cells and what combination would give the best results with the coil? If I do not get better results after your advice, would it be in the power of a novice to unwind and examine the secondary coil and rewind as well as it is done now? Would a condenser with sheets of foreign notepaper act better than one with sheets as per sample? The contact-breaker is a vibrating hammer type with contacts of platinum a little thinner than the primary wire. The break forms quite a bright little point of light when seen in a dark room. Would a mercury make-and-break act more efficiently than the present one? Any advice on the making of such a make-and-break will be gratefully received.

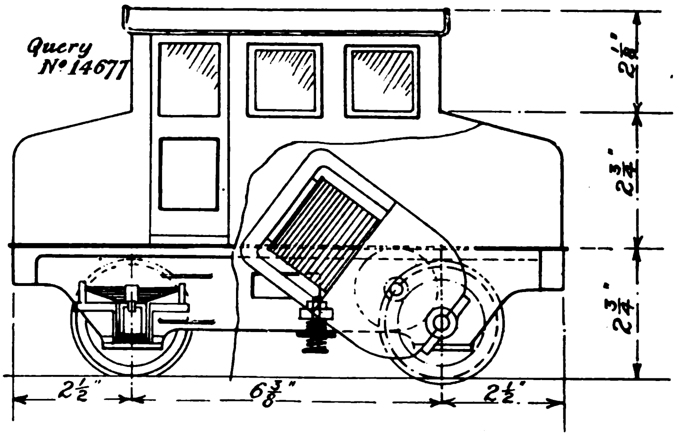
We consider that you are obtaining very good results from this coil, and should not expect better. The battery power is a matter for trial. It is, however, not advisable to force too much current through the primary. Your present battery seems about right. This spark length is sufficient to produce beautiful effects with small vacuum tubes up to about 6 ins. long. The platinum contacts have considerable influence upon the working of a coil. The larger they are the better will the coil discharge. If you wish to experiment, fit some new contacts made of thicker platinum wire than the present ones. We do not think a mercury break would make much difference with so small a coil, but it is an interesting piece of apparatus to make and experiment with. The best way to experiment with a condenser is to make it in several sections, and try them one or more in parallel until you find the best effect. It will probably not make much (if any) difference in the spark length. The sample of secondary wire which you sent is No. 28 gauge; it is probably not a piece of the true secondary, but only a thickened end of it for connections. The true secondary is likely to be No. 36 or 40 gauge.

[14,549] **Model Steamer Machinery.** F. H. (Forest Gate) writes: As I am building a model T.B. destroyer, I should be glad if you would advise me on a few matters concerning it. It is 40 ins. long, 4 ins. beam, and 2¾ ins. internal depth, so there is very little room for the engine and boiler. It was originally designed for electricity, but I found the castings, zinc, carbon, etc., much too heavy. I got the design for the engine from your handbook, "Machinery for Model Steamers," Chapter V, Fig. 33. As it is too high to go into the boat, would it be practicable to reduce it to three-quarter the size given? Would it drive the boat at a good speed (using four small propellers) off the boiler shown in sketch (not reproduced)?

Yes, you may reduce the engine considerably, say, about two-thirds of present size, the cylinders becoming ½ by ½ in. instead of ¾ by ¾ in.; but we would advise a single cylinder, ⅝ by ⅝-in. stroke in preference to the double cylinder engine. The boiler you have sketched is impracticable, owing to very small furnace. We suggest a single flue boiler 3½ ins. diameter of light solid-drawn tube, 7 ins. or thereabouts in length. The furnace tube, which should be placed as low down as practicable, should be 1⅝ ins. in diameter, with the cross-water tubes, ½ in. outside diameter, brazed into the furnace tube. Employ a small petrol or benzoline burner arranged horizontally. See issue of April 27th, 1905, for a suitable design.

[14,677] **Electric Locomotive.** F. J. G. (Sheerness) writes: I am sorry to trouble you again so soon, but I find that the Model Engineer Electric Locomotive is too great an undertaking. Will you give the leading dimensions, or (better) outline drawings of the Swedish State railways locomotive, described and illustrated on page 90 of your issue of July 27th?

We herewith reproduce a sketch, in outline, of a model 3½-in. gauge electric locomotive, following the lines of the Swedish State engine, a photograph of which was published in our issue of July 27th last. The Model Engineer Locomotive motor may be adopted, and if it is thought that the adhesion will not be sufficient, then some method of coupling the wheels together can be employed (see issue of May 11th, 1905). The wheels may be the same diameter as the Model Engineer Locomotive; also the gearing. The main frames may be 4 ins. apart, and the width over footplating 5½ ins. The switches may be placed in the opposite end of the cab to the motor. The motor may be slung to the crossbar shown in the sketch, an eye-bolt taking the place of the screw in the corner of the bearing plates of the motor. Through the eye of this bolt a vertical bolt holding the spiral springs should be placed. The controlling of the locomotive will have to be effected from the track by resistances or other suitable means.



A Model 3½-in. Gauge Electric Locomotive.

[14,626] **Materials for ½-in. Scale Model Locomotive.** "Deesag" (Sheffield) writes: What is the relative strength of mild steel, copper, and brass used for making (*a*) frames, (*b*) boiler, (*c*) cylinders, (*d*) axles and bearings? Which metal would you advise me to use in the construction of the above-mentioned parts of a ½-in. scale locomotive?

The difference in the strengths of the materials is not an all-important consideration in a model locomotive—except, perhaps, in the matter of the boiler—so much as their suitability for the work. Mild steel would be used for frames, axles, motion work, and foot-plating; tensile strength about 25 tons per sq. inch of section. Cast iron for wheels, chimney, and other odd parts; 5 to 7 tons per sq. inch. Copper for boilers; 12 to 15 tons per sq. inch. Gun-metal (cast) for cylinders, angles, motion plates, brasses, axle-boxes, horn plates, wheels, and all small cast parts; 10 to 12 tons per sq. inch. Brass for similar purposes to above; 9 to 10 tons per sq. inch of section.

[14,638] **Cranks for Petrol Engine.** A. K. (Kirkwall) writes: I am making a two-cylinder petrol motor, and I would like to know what angle to set the cranks. I have seen them set a 90°; but would it not be better to set them at 180°?

We would strongly advise that the usual practice of setting the cranks of a two-cylinder engine at 180° apart should be adopted. The reciprocating parts are thereby placed in much better balance.

[14,534] **Model Steamer Machinery.** S. E. T. (Eastern Transvaal) writes: (1) What length of boat shall I require and beam for a set of Mr. Stuart Turner's twin-cylinder launch engine,

1-in. bore, ¾-in. stroke? (2) Will the boiler (Fig. 9 *re* "Machinery for Model Steamers") be powerful enough?

(1) The engines in question are suitable for a boat of about 6 ft. in length, and 9 ins. beam. (1) We would advise a return tube or a single-flue boiler with cross tubes; the total heating surface should amount to at least 160 sq. ins. A benzoline burner will prove the most reliable heating arrangement.

[14,685] **Engine Boiler and Dynamo.** G. S. J. (Harlow) writes: I have a horizontal engine, 3-in. bore by 4-in. stroke. (1) What size dynamo would engine drive satisfactorily? (2) What would be the approximate b.h.-p. of the engine? (3) With what size boiler? What type should boiler be? (4) How many r.p.m. should I run the dynamo at?

(1) At 90 lbs. pressure and 300 revolutions per minute the engine should drive a dynamo giving an output of 350 watts. (2) The brake horse-power of the engine would be about ½. The boiler, working under draught, should have at least 1,000 sq. ins. of heating surface. Without the aid of the exhaust, probably 1,500 sq. ins. would be required. (3) The boiler may be of any type. A multitubular, vertical, or locomotive boiler would work well, and take up less room than one of the vertical centre-flue type. (4) The dynamo will probably require to run at 2,600 to 2,800 revolutions per minute.

[14,671] **Coal for Ignition Purposes.** H. H. (Blackheath) writes: I should esteem it a favour if you would be kind enough to help me in building an ignition coil for a small gas engine. What is the amount of wire, and size, on primary and secondary coils? Also, what other parts are required? I have a good 4-volt accumulator, capacity 20 amps., and I think that with your help I shall easily make it, as I have made all sorts of shocking coils.

Try the ½-in. size spark coil, as per particulars given in our Handbook on Induction Coils. You will require a sparking plug fitted to the cylinder, or some form of make-and-break; also a timing arrangement. See diagrams of connections for ignition arrangements in recent issue.

[14,707] **Lighting Small Lamps from Secondary Cell.** E. G. G. (Highbury) writes: I have a 4-volt 12-amp.-hour accumulator, consisting of two cells, each containing seven plates, size 3¼ by 2½. Could I light eight 3½-volt lamps connected in parallel (each lamp takes ¼ amp.) for three hours right off without damaging the accumulator? If it will not light eight lamps, could you please inform me the largest number I can safely light with this accumulator?

Cell will give about ¾ amp. fairly well. Its capacity is about 8 amp.-hours, at 4 volts—*i.e.*, when both cells are in series, the eight lamps will take, at your estimate, about 2 amps.; hence, as far as the capacity goes, cell should do it; but 2 amps. is rather a heavy current to draw from such a small cell. If cell is a good one, it might stand this discharge.

[14,698] **Electric Light for Dark Room.** F. C. (Paddington) writes: I am thinking of fitting my dark-room with electric light for occasional use of half-an-hour. Which would be the least trouble—a non-polarising bichromate (Chapter 4) electric battery, or a Bennett tin pot battery, described in THE MODEL ENGINEER April 9th and 16th, 1903? If the Bennett requires the least attention, please state size of cell and of iron gauge, using No. 2 Leclanché zincs, and hours of light with 4-volt 1-amp. lamp. In place of iron borings, could I use old cocoa tins and iron wire cut up? If the constant bichromate is best, how much salammoniac is required, and how much bichromate to the pint of water? How many hours' light would a quart Leclanché cell and porous pot and cylinder of zinc give at 1-amp. discharge? Do both solutions require renewing when the battery runs out, or is salammoniac only necessary? Would iron tacks be better than cocoa tins and wire?

You must be prepared to experience a certain amount of trouble with any battery to keep it in good order. It is difficult to say which would require least attention; in your case we should be inclined to try the Bennett tin pot battery, as described in THE MODEL ENGINEER. The larger you make the cells the better; any convenient size tin will do. The cells described in THE MODEL ENGINEER should give a total of about fifty hours' light with a lamp taking 1 amp.; a 4-volt lamp would require four cells in series, but you will do well to make up a fifth cell, which can be connected to the others if the voltage drops a little. As soon as the cells show signs of running down, they must be re-charged. You can use tacks or small pieces of iron wire, but why not keep to the directions, and use iron borings? They can be obtained from any engineering shop, or from the firms mentioned in the description, at trifling cost. The description is so complete that we must refer you to it for further information.

[14,701] **Motor for Electric Loco.** H. E. N. (Acock's Green) writes: I am making a small electric loco, and am fitting it with a 10-watt motor, as described in your Handbook No. 10, Chapter 6. I find it will only just revolve the armature, and has not the slightest power. (1) I have made a 1¼ tripolar armature, and wound it with 1¼ ozs. of No. 22 D.C.C.—is this enough, or would it be better to try finer wire? If so, what size? (2) I have made the field-magnets 1¼ ins. wide to take the larger armature, and they are not so thick as specified in your book, because I am cramped for room. They are wound with about 10 ozs. of No. 22. If you could tell me where you think my mistake is, I should be very much obliged.

(1) We should advise you to re-wind the armature with No. 24 gauge D.S.C. copper wire, though this is not absolutely necessary, and the present winding can be tried again; but we decidedly advise you to re-wind the field-magnet with No. 19 gauge S.C.C. copper wire connected in *series* with the armature. (2) This field winding can be used either with the present armature winding or suggested new winding. If you will try this new field winding, and use a good battery—say, three bichromate cells in series of about quart size each—we think you will be satisfied with the result. The brushes should be adjusted until you get them into position for best effect.

[14,710] **Pole-Finding Liquid.** "ELECTRO" (Darlington) writes: (1) I have a glass tube filled with some chemical, and sealed at both ends. It is fitted with two terminals, and on touching these with two leads, the positive end at once turns the liquid a reddish colour. I have broken the glass, and wish to repair it. What is the chemical? (2) Do you know any book dealing specially with marking-off and metal plate work; and where can it be obtained?

(1) *Re* pole-finder: try a solution of sodic sulphate, coloured with syrup of violets. When current is passed through this, the positive end becomes red, and negative end green. (2) "Metal Plate Work," by C. T. Millis, price 9s. 4d. post free, is a good book on the subject.

[14,714] **Common Fault with Small Dynamos.** T. W. B. (Dartford) writes: Having bought your book on "Small Dynamos and Motors," I set-to and made a Simplex dynamo (5 volts 2 amps.), and after having wound it for the third time (my insulation being defective on previous occasions), I tried it as a dynamo. My motive power is a water motor, and I drove the dynamo every speed up to 5,000, but I cannot get it to excite, whereas as a motor the machine runs beautifully from a 4-volt 18 amp.-hour accumulator. When trying it as a dynamo I have tried reversing the direction of rotation, connections, etc., each time, having a 3-volt lamp and wire resistance in the circuit; but I cannot get it to build up. I have got the armature (which is an eight-cog drum) running within 1-32nd in. of the pole-pieces as close as I can safely get it, but with no result. Do you think I have not got the residual magnetism strong enough? I have separately excited the fields with the 4-volt accumulator. What do you think is the smallest current necessary to excite or magnetise the fields? If the conductors on the armature are too few in number, could I take some off the field coil and equalise matters? I have used No. 22 S.S.C. wire—1½ ozs. for the armature, and 8 ozs. for the field-magnets. I do not feel inclined to unwind this machine again, so I hope you will be able to give me a hint to get out of my difficulty without doing so.

This is a common fault with very small dynamos, especially when fitted with a drum armature. It is sometimes impossible to remedy it. The only chance is to increase the number of conductors on the armature by re-winding with finer wire. In your case we advise you to re-wind the armature with No. 26 gauge S.S.C. copper wire, and get on as much as you can. Test with a 6-volt one C.P. lamp, as well as the present one. If the machine runs well as a motor, it shows that there is nothing wrong with the workmanship. The field coil should be connected in shunt to the brushes, and the latter moved until you get them to the position for best effect; it should be driven in the same direction as that in which the armature runs as a motor. Do not take any wire off the field-magnet; it should rather be wound with finer gauge wire. If you find results sufficiently encouraging, we advise you to re-wind the field coil with same weight of No. 24 S.C.C. wire.

[14,581] **Steam Engine Proportions.** H. (Gorton) writes: I am making a steam engine (horizontal type), 1-in. bore, 1¼-in. stroke, valve face 1⅛ ins. by 1 in.; and I should feel much obliged if you will tell me (1) the best size of the ports. We intend to drive a dynamo with it, so I suppose it will have to run at a good speed? (2) The amount of lap it will be necessary to give the valve, and the amount of travel? (3) The size of dynamo it would drive at a given pressure of steam, and the output? I have not yet made the boiler for the above engine, and should be pleased if you will answer me the following:—(4) The size of boiler and number and size of tubes? (5) The working pressure to drive the engine at a good speed?

(1) The steam ports of a horizontal engine of the proportions you have adopted should be about ½ in. by 3-32nds in., port bar 3-32nds in., exhaust ports ½ in. by 3-16ths in. However, if there is room, you can make the port ⅝ in. long, with advantage. (2) The lap should be 3-64ths in. The lead should be about 1-64th in. (not more). The valve travel will be 9-32nds in. (3) We would not recommend a dynamo larger than 20 watts, which the engine should easily drive at 400 r.p.m. and 50 lbs. boiler pressure. (4) The boiler should have at least 150 sq. ins. of heating surface, and we would recommend a locomotive type with 4½-ins. diameter barrel, 9 ins. long, and a firebox, 4½ ins. by 6½ ins. long, fired by two Primus burners, or by coal briquettes. Tubes should be about ten to twelve in number, and ½ in. outside diameter. A vertical multitubular boiler, without firebox, fired by, say, three small Primus burners, would also be successful. This boiler should be about

7 ins. in diameter and 8½ or 9 ins. high, with about fifteen tubes, ½ in. in diameter. (5) Working pressure about 45 to 50 lbs.

[14,602] **Boiler Queries.** C. A. K. (Birkenhead) writes: (1) What would be the heating surface necessary for S.V. engine, 2 ins. by 1-in. bore, at 250 r.p.m., at 80 lbs.? (2) How is it calculated, and is there any difference in the calculation for an ordinary and for a flash boiler? (3) What would be the heating surface necessary for the ¼ h.-p. turbine described in No. 109 of THE MODEL ENGINEER, Vol. VIII? (4) What size force pump would be required (*a*) for the engine, (*b*) for the turbine?

(1) Calculate the heating surface according to the tables given in the issue of January 1st, 1902 (page 22), always allowing more for losses in a small engine than in a large one. The heating surface recommended would be 180 to 200 sq. ins. (2) No, not very much, but the weight of the boiler is a consideration. (3) We should reckon that a ¼ h.-p. turbine should be supplied by a boiler having at least 600 sq. ins. of heating surface, because natural draught would have to be relied on. (4) The pump would be about the same size in each case—that is, if the engine and turbine are of approximately the same efficiency.

[14,540] **Steam Dynamo Driving Plant.** A. B. (Blackheath, S.E.) writes: I should be very thankful if you would advise me as to the following. I have a small dynamo of about 6 volts, and I am desirous of having a launch type engine to drive same. Would you please give me advice of what type of boiler and best method of firing; bore and stroke of engine; approximate dimensions?

We presume that a 12 or 15 watts (*i.e.*, 6 volts, 2 or 2½ amps.) would be about the output of your dynamo; if so, a high-speed vertical engine 1 in. by 1 in., running at, say, 400 revolutions per minute, with a boiler supplying steam at 50 lbs. pressure, will suffice. The boiler, which should have about 160 sq. ins. of heating surface, may be a vertical one, without firebox, and be fired by a single 3-in. (No. 5) Primus burner. It may be 5 ins. in diameter and 9 ins. high with out, about eighteen tubes—⅜ in. outside diameter—running through it. We should advise you to obtain an ordinary Primus stove, and simply cut off the irons which hold the ring.

[14,525] **Launch Boiler.** B. M. H. (Sierra Leone) writes: Would you kindly advise me, through the columns of your paper, on the following? I have built a model steam launch cylinder, 1 in. by 1 in., which I want to run at about 400 or 500 revolutions. I have a model marine boiler, but I find it quite unable to keep up a good head of steam; also it is too large for the model. I want to know what would be a good type of boiler, smallest size suitable (space available 10 ins. by 6 ins. by 4½ ins.). Model-making, with the help of your paper, helps to pass many hours in this out-of-the-way spot.

We would recommend you to use a single-flue horizontal boiler, the furnace of which should be provided with cross tubes ½ in. in diameter. The diameter of the shell may be 5 ins., the length about 10 ins., furnace tube 2½ ins. diameter. The firing should be a benzoline burner.

[14,648] **Leaky Pistons.** E. M. A. (Nottingham) writes: I have got a small engine, ½-in. bore, 1-in. stroke, and I lose half the power with the piston leaking. I have tried a brass ring on the piston, but the engine seems too small for that. Could you advise me which would be the best packing to use?

A good many models suffer from the same complaint, and all sorts of things are blamed instead of the real cause. The only method of ensuring a tight piston is good workmanship. For packing such a small cylinder we would not advise piston rings, but a deep groove filled with darning cotton. See "The Model Locomotive," price 6s. net., 6s. 4d. post free.

The News of the Trade.

[*The Editor will be pleased to receive for review under this heading samples and particulars of new tools, apparatus, and material for amateur use. It must be understood that these reviews are free expressions of Editorial opinion, no payment of any kind being required or accepted. The Editor reserves the right to criticise or commend according to the merits of the goods submitted, or to abstain from inserting a review in any case where the goods are not of sufficient interest to his readers.*]

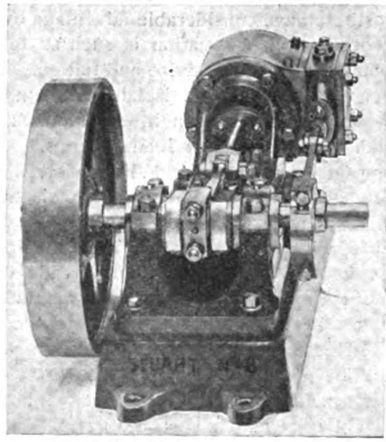
• *Reviews distinguished by the asterisk have been based on actual Editorial inspection of the goods noticed.*

•Milling and Cutting Tools.

We are informed by the Model Manufacturing Co., 53, Addison Road North, London, W., that they are now making a large variety of milling and cutting tools, in addition to their usual model specialities. As a sample of their work, they have sent for our inspection one of their spiral fluted hand reamers, which they are making in all sizes from ¼ in. to 1 in. diameter. The sample is an excellent specimen of workmanship, and speaks well for the quality of this line of tools. The spiral flutes are left-handed, this making for smooth cutting and preventing seizing or chattering. Full particulars may be had on application to the firm at the above address.

•A New Design of Model Horizontal Engine.

Considering how great a favourite amongst power users the horizontal steam engine is, it is not in the least surprising that this type of prime mover is so popular with model engineers generally. Nearly every beginner makes this his first model. With these two facts in mind, Mr. Stuart Turner, of Shiplake, Henley-on-Thames, has just brought out a new set of castings, which will enable the novice to make up an efficient working model of a horizontal engine of modern design. Mr. Stuart Turner also, recognising that many of the prospective purchasers of his set are likely to have a limited number of tools at their disposal to help them in the construction of the model, has arranged to include several of the most important portions of the engine partially finished. The model has an overhung cylinder, 1 in. bore by 1 in. stroke, with double-webbed crank, and is of a type eminently suitable for dynamo driving and high-speed work generally. The bedplate, base, flywheel, cylinder valve chest, and eccentric sheave are of clean soft cast iron, and the cross-head, connecting-rod, eccentric straps, bearings, and valve spindle glands of an excellent quality of gun-metal. The bedplate is sent out planed for the guides and the base, and also truly bored and faced for the cylinder. The latter is bored, faced, and has ports milled. The piston is completely finished, and fitted with a gun-metal piston ring. The crankshaft is of cast steel, and the piston and valve rods of a non-rusting alloy. Workmanlike drawings are despatched with the castings; indeed, we can hardly imagine a better set of castings being placed on the market. We also understand that the castings are to be obtained at a specially low price for the next fourteen days.



MR. STUART TURNER'S NEW MODEL HORIZONTAL ENGINE.

New Catalogues and Lists.

Portable Accumulators, Ltd., 210, Shaftesbury Avenue, London, W.C.—The illustrated price-list issued by this firm contains particulars of their single cells and complete batteries in glass, ebonite, and celluloid. A leaflet has also been sent to us descriptive of the Pfluger ignition accumulators for motor-cars and boats and the Pfluger voltmeters and charging board.

Ford & Co., 55, Market Street, Stalybridge.—We have to hand a catalogue giving prices and particulars of the small electro motors dynamos, coils, battery lamps, volt and ampere meters, portable accumulators, small power gas and oil engines, electric bells, and many electrical novelties which are supplied by the above firm. List will be sent to all readers upon receipt of stamp to cover postage.

W. Macmillan & Co., 34, Mar Street, Alloa, N.B.—The new illustrated price list of this firm's specialities has been sent to us, dealing with petrol and paraffin motor boats, finished motors for the same, complete sets of castings and forgings for these, as well as for petrol cycle motors, small power gas and oil engines, high-speed enclosed type steam engines and dynamos, and general motor accessories. The list will be sent to readers of THE MODEL ENGINEER for one penny stamp.

S. Holmes & Co., Albion Works, Bradford.—We have received a neat little booklet illustrating the "Gem" specialities, such as their well-known twist drill grinders, high-speed sensitive drilling machines, and the combined bench grinding and drilling machine. The list will be sent to readers of this Journal upon receipt of stamp to cover postage.

The Editor's Page.

A CONSIDERABLE number of our readers take an interest in electricity from other than an amateur's point of view, and are desirous of distinguishing themselves at one or other of the various examinations in electrical subjects. Those who are in a position to attend classes at some technical institute have considerable advantage over those whose occupation or location is such as to prevent their obtaining personal advice and tuition. To assist all electrical students, and isolated students in particular, we are publishing a little handbook, entitled "A Guide to the Electrical Examinations." This has been specially written by Mr. F. H. Taylor, A.M.I.E.E., who, in addition to being an able electrical engineer, has had a long experience in teaching and preparing students for examination. He will be known to many of our readers as the author of the articles we published some time ago on "How to Become an Electrical Engineer," and "Private House Electric Lighting." The price of the book will be 1s., or post free 1s. 2d. For those who prefer it in a more permanent form, it will be supplied bound in cloth at 1s. 6d., post free 1s. 9d. In addition to complete information as to the places and subjects of the various examinations, certificates and awards, and other official details, the book will contain some practical hints on preparing for and dealing with examination papers, and also an extensive appendix of selected questions from recent papers, with their solutions.

* * *

We frequently hear from readers who express their gratitude to the pages of THE MODEL ENGINEER for knowledge which has been of service in enabling them to improve their position. In a letter received the other day, the writer informed us that he had just obtained a position as driver of a motor omnibus, for which he had qualified himself through reading the *M.E.* and also the *M.E.* series of handbooks. We need hardly say that we are always pleased to hear that our journal has been of such practical service.

Answers to Correspondents.

Loco (Liverpool).—We regret that we cannot fully describe the arrangements of link motion, slip eccentric, and other gears, when such are so completely dealt with in the book you name. Yes, the cylinders are correct for the size of driving wheels.

W. W. K. (Bothwell).—See our issue of December 15th, 1905. This motor would drive a 100-watt dynamo.

R. S. (Oldham).—Your query has been returned through the post.

W. J. W (Enniskillen).—As far as we know the idea is novel, but is not worth patenting. It is doubtful whether it would be mechanically successful.

F. S. Y. (Margate).—(1) We would advise you to write to the secretaries of the several societies. Address of the Institute of Chemistry, 30, Bloomsbury Square, and of the College of Preceptors, 2 and 3, Bloomsbury Square, London, W.C. (2) We think Latin is compulsory in the Matriculation Examination.

J. H. W. (Burton-on-Trent).—You would need a 40-watt machine, giving 20 volts 2 amps., or a battery of 9 or 10 accumulators of, say, 20 amp. hours each.

A. B. (New Cross, S.E.)—An illustrated description of a Perfect Scale Model Locomotive was given in our issue of March 9, 1905, Vol. XII.

W. P. (New Zealand).—Copper pipe is unsuitable for flash boilers. Our Colonial and foreign querists need only send us a coupon from the last issue they have received.

R. A. P. (Shropshire).—We doubt whether your suggestion is the best one. If you do add further tubes, have them expanded in. See page 189 of the issue of THE MODEL ENGINEER for April 15th, 1902, for a method of improving the output of a vertical centre-flue boiler.

Notices.

The Editor invites correspondence and original contributions on all amateur mechanical and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected or not, and all MSS. should be accompanied by a stamped addressed envelope for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

This journal will be sent post free to any address for 13s. per annum, payable in advance. Remittances should be made by Postal Order.

Advertisement rates may be had on application to the Advertisement Manager.

HOW TO ADDRESS LETTERS.

All correspondence relating to the literary portion of the paper, and all new apparatus and price lists, &c., for review, to be addressed to THE EDITOR, "The Model Engineer," 26—29, Poppin's Court, Fleet Street, London, E.C.

All correspondence relating to advertisements and deposits to be addressed to THE ADVERTISEMENT MANAGER, "The Model Engineer, 26—29, Poppin's Court, Fleet Street, London, E.C.

All subscriptions and correspondence relating to sales of the paper and boo s to be addressed to Percival M rshall & Co., 26—29, Poppin's Court, Fleet Street, London, E.C.

Sole Agents for United States, Canada, and Mexico: Spon and Chamberlain, 123, Liberty Street, New York, U.S.A., to whom all subscriptions from these countries should be addressed.

Contents.

[*The asterisk* (*) *denotes that the subject is illustrated.*]

THE
Model Engineer
And Electrician.
A JOURNAL OF PRACTICAL MECHANICS AND ELECTRICITY.

EDITED BY PERCIVAL MARSHALL, A.I.MECH.E.

VOL. XIII. No. 233. OCTOBER 12, 1905. PUBLISHED WEEKLY.

A 20-Rater Model Sailing Yacht.

By H. E. B.

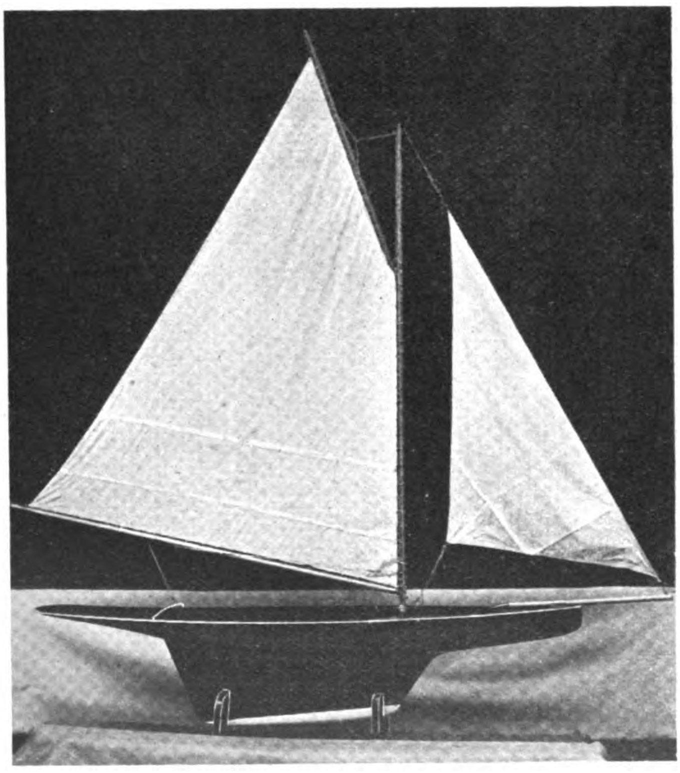


FIG. 1.—A 20-RATER MODEL SAILING YACHT.

As will be seen from the photograph, the model here described is of a type familiar to the yachting readers of THE MODEL ENGINEER, viz., that produced by the L. & S.A. or 6,000 Rule. As a description of so large a model as a 20-rater is so very seldom seen in these pages, I thought the following would prove of interest. The dimensions are as follows:—L.O.A., 72 ins.; L.W.L., 48 ins.; beam extreme, 16 ins.; extreme draught, 14; displacement, 34 lbs.; S.A., 2,475 sq. ins. The model is built up with pine planking on oak timbers, the deck being made of mahogany, and the mast and spars of spruce. In the construction a departure was made from the usual method of building a keel boat; in this instance, the model was built wrong side up on moulds as described in that excellent article on "Built-up Models," by the late Mr. Wilson Theobald, but instead of the usual narrow keel, a broad keel, 4 ins. in width at the widest part and tapering to 1 in. at either end, was inserted in the moulds, then the model was planked in the usual way, the planks being riveted to the timbers with ½-in. copper pins. Having proceeded so far, the outside keel was cut to the required shape as Fig. 6, and pieces of pine were bent and screwed on the inside of various widths to obtain the required hollow joining the hull and keel together; then by taking off the corners with a gauge,

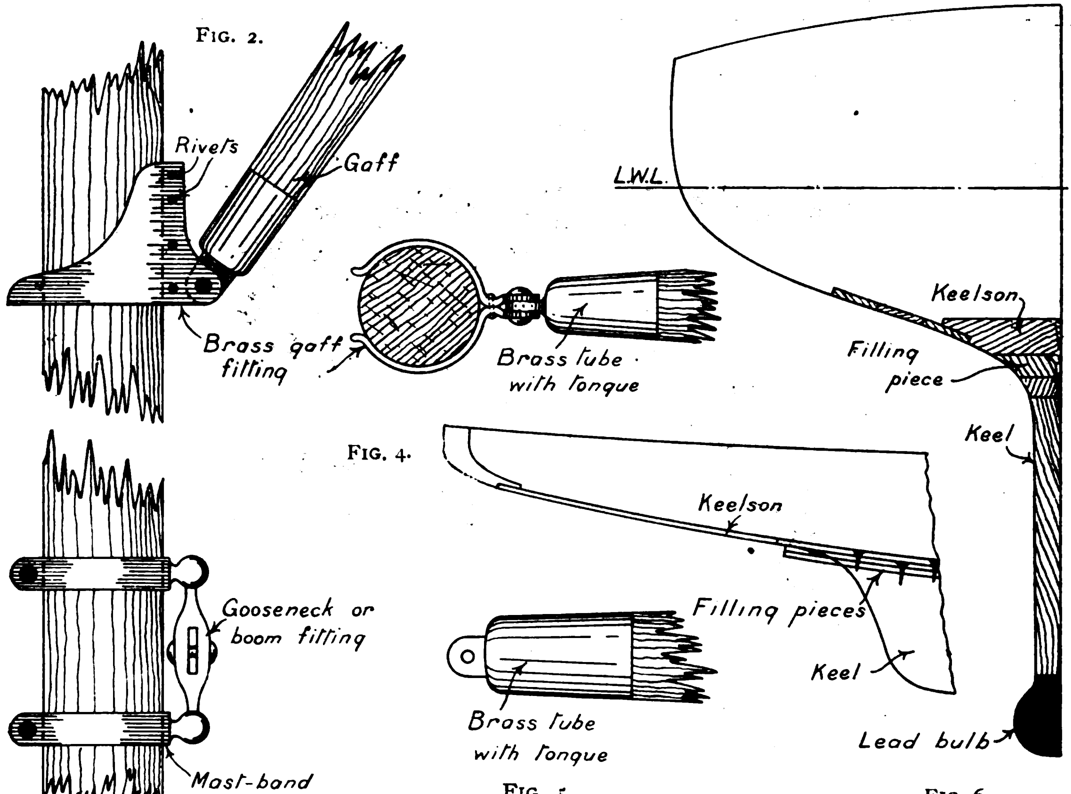


FIG. 2. FIG. 3. FIG. 4. FIG. 5. FIG. 6.

DETAILS OF A 20-RATER MODEL SAILING YACHT.

a keel boat was obtained with very little more trouble than a fin keel.

Experienced readers will know how much more troublesome a keel boat is to build owing to the reverse curve of the planking into the deadwood; my object was to overcome this. The same method can be used with any section. Other points of interest are the gaff and boom fittings, as shown in Figs. 2 and 3; these are perhaps a little more elaborate than are usually fitted to model racing yachts, but I think the strength and efficiency obtained will more than repay the extra trouble incurred. The sketches herewith reproduced will explain much better than words can describe the general shape and method of construction of the fittings, and as will be seen from the photograph, the finished article appears fully worth the trouble expended.

Workshop Notes and Notions.

[Readers are invited to contribute short practical items for this column, based on their own workshop experience. Accepted contributions will be paid for on publication, if desired, according to merit. All matter intended for this column should be marked "WORKSHOP" on the envelope.]

Colouring Metals.

Iridescent blue colours on metals can be produced with a solution made by dissolving 7 ozs. of cream of tartar in 1 gal. of water, and 3½ ozs. of tin salt in 1 quart of water. The two solutions are mixed and boiled, and the precipitate allowed to settle; the clear solution is poured off, and added with constant stirring to a solution of 6½ ozs. of sodium hyposulphite in 1 quart of water. The combined solution is then heated to boiling, and the articles are immersed. They have to be taken out when the requisite shade is obtained. Another solution is obtained by dissolving freshly precipitated carbonate of copper in ammonia water. Copper-sulphate solution, of the strength of ¾ lb. to the gallon, is precipitated by the gradual addition of a concentrated solution of sodium carbonate. The resulting copper carbonate is filtered off and well washed on the filter. It is then brought into another vessel and dissolved in ammonia water in such a manner that a small quantity of copper carbonate still remains undissolved, and the solution is therefore not too ammoniacal.

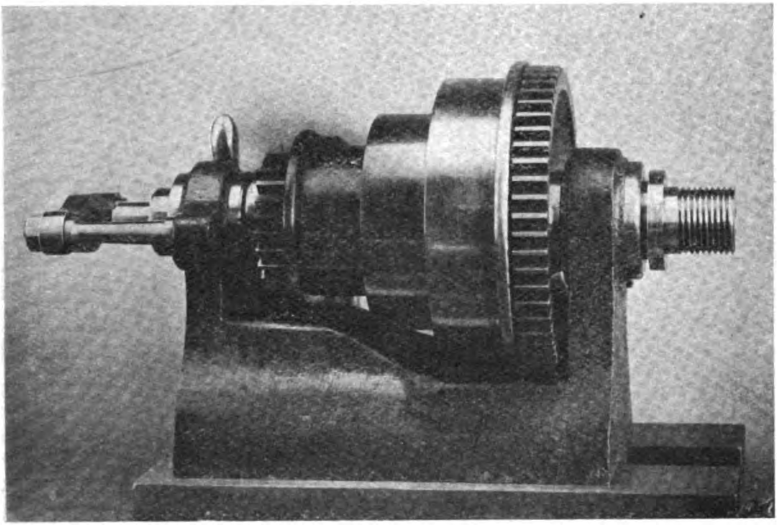


FIG. 1.—FRONT VIEW OF HEADSTOCK.

To File a Sharp Scriber.

To file a scriber point, take ordinary drill rod of any size desired and catch same in a lathe chuck, leaving, say, about ⅞ in. or 1 in. projecting. Then with a good sharp, smooth file start the point by filing it blunt, say, at about an angle of 60°; then gradually file the angle sharper and sharper by merely changing the position of the file (which should be at least 1 in. wide), so it stands more and more in a line parallel with the piece being filed. By this method it is possible to get a long slim point, whereas if the file is held at the finished angle to begin with, difficulty arises due to the fact that the file has too much surface to cut, and the point gets weak and springy. Finish point by holding on side of good straight emery wheel or disc grinder while soft, so that the grinder marks run from point to back; after hardening, oil stone only.—*Machinery.*

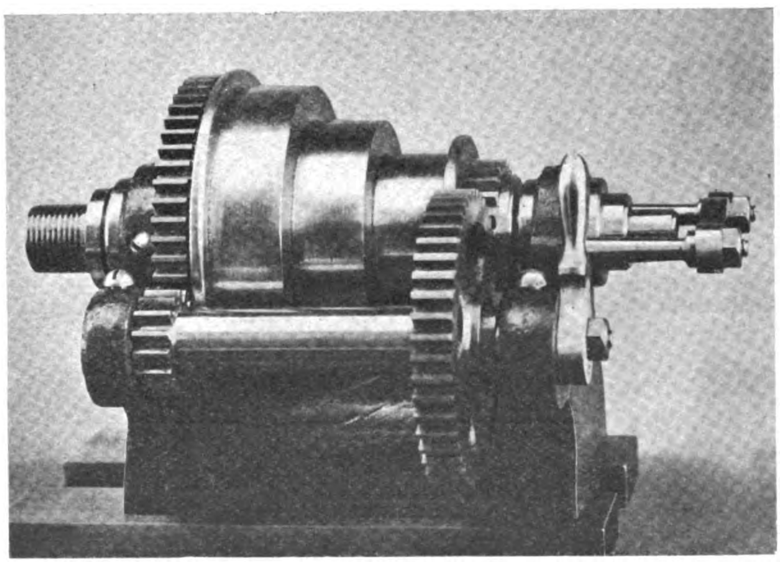


FIG. 2.—REAR VIEW OF HEADSTOCK.

A Headstock for 3½-in. Centre Lathe.

By G. WOOLSTENCROFT.

The following is a short decription giving a few of the leading particulars of headstock which I have made for a 3½-in. centre screw-cutting lathe. A drawing and two photographs are also reproduced. The lubricators are a similar type to those fitted to Drummonds' 3½-in. centre lathe, and the pin for putting in and out the back-gearing is not very dissimilar to the method employed on Hendey Norton lathes. These have been omitted from the drawing. The first job I took in hand was the turning and boring of the gear blanks; they were then sent away to be cut; the teeth are ¼-in. circular pitch. The small gear secured to the speed cone is of steel, and was made a tight driving fit, then drilled and tapped and plugged up as shown in drawing. The speed cone was the next item. It is turned all over and has speeds of 4¼ ins., 3¼ ins., and 2¼ ins. diameter, respectively. The spindle is of steel and has a ⅜-in. clearance hole right through. The bearings are taper. The front bush was turned to a tight driving fit, and afterwards drilled and secured in place by a setscrew. Both bushes are of hard brass, the back one being adjustable by means of two collars. The headstock was first planed on the bottom, then roughly drilled in drilling machine previous to boring in the lathe. All final boring and facing-up of bosses was done in the lathe. The back-gear is thrown in and out by eccentrics operated by handle shown in the photograph. All parts were made on a 3½-in. centre Drummond lathe, without the use of a chuck of any description, all work having to be clamped to the faceplate. The spindle nose is 1 in. diameter and is screwed 12 per inch. All collars, etc., are 24 threads per inch.

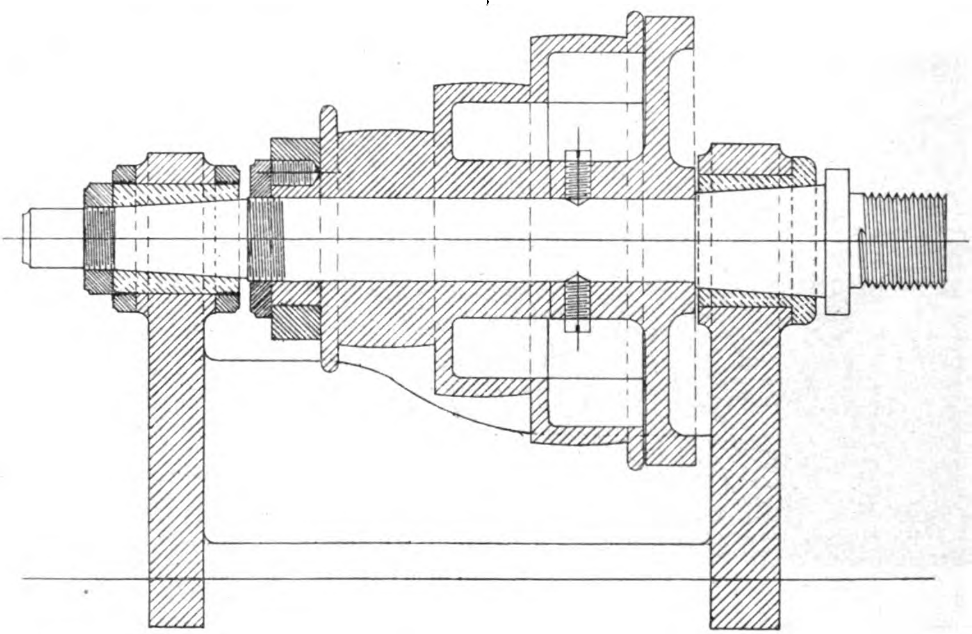


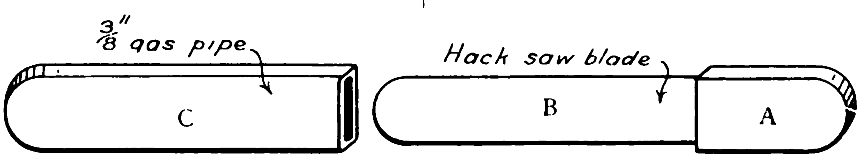
FIG. 3.—LONGITUDINAL SECTION OF HEADSTOCK FOR A 3½-IN. CENTRE LATHE.

The taper of bearings is 1 in. in 8 ins. All castings were obtained at a local foundry. I shall be pleased to give interested readers any further particulars.

An Easily-made Feeler Gauge.

By JAMES TRELOAR.

The only materials required for this handy little tool are a broken hacksaw blade, and a piece of ⅜ brass gas pipe. The saw blade should be ground down to the required thickness on an emery wheel, and the heat generated during the process will be found to have brought the hard steel down to a nice temper. If an emery wheel is not handy, the blade can be softened, and then filed to the necessary thickness, afterwards being slightly hardened. A piece of tube, about an inch long, should now be cut and flattened down until the blade just enters. A few additional blows will now make it quite tight on the feeler, thus acting as a handle for it. Another piece of tubing a little longer than the projecting portion of the blade should now be taken and flattened out until the blade will slip into it; this serves as a case for the feeler. After the ends have been rounded off, a handy tool is provided, which is useful in any workshop. In the drawing given below A is the handle, B the blade, and C the case.



AN EASILY-MADE FEELER GAUGE.

TO BLACKEN BRASS FOR TEMPLET WORK AND OTHER PURPOSES.—The brass must be thoroughly cleaned, and then heated slowly over a charcoal fire, care being taken not to allow the brass to touch the charcoal, or, indeed, not to allow any sparks from the charcoal to come in contact with the brass, or it will cause red spots. As soon as the brass is slightly red, dip it into nitric acid and re-heat, just short of red. Rub strongly with a stiff bristle brush, and clean with a greasy cloth. This gives a fairly permanent dead black finish.

FAST SAILING SHIPS.—Germany's superiority in the matter of speed under steam is well-known, but it is also interesting to mention that she likewise holds the record for speed under sail. The huge five-masted Hamburg ship *Preussen*, 5,081 tons gross, has done 368 miles in twenty-four hours, and under good conditions has attained to seventeen an hour. The five-masted bark *Potosi*, 4,926 tons gross, has a record of 16½ knots, and she has done fine work—for example, Iquique to the Lizard in fifty-seven days. The *Preussen* has done even better—Hamburg to Iquique in fifty-seven days.—*Shipping Illustrated.*

Experiments on Electric Oscillations and Waves.

BRUSH DISCHARGES.

(*Continued from Vol. XI, page* 493.)

By R. P. HOWGRAVE-GRAHAM, A.I.E.E.

(2) To each terminal of the Tesla coil a wire 3 or 4 ins. long is fastened—the points directed straight outwards from the terminal. As this experiment puts a greater strain on the insulation than the preceding ones, it must be commenced with a small amount of power, and the coil watched carefully as the power is increased.

At the points of the wires a brush discharge will appear branching out in all directions, subdividing into finer and finer purple twigs, and ending in radial blue lines, which form what might almost be described as a ball of light-bristles. The effect is greatly increased by connecting a fairly large capacity area with one of the terminals, in place of the piece of wire. A sheet of zinc 12 or 15 ins. square held in a wooden retort-stand forms a sufficiently large and well insulated capacity.

In this and most of the succeeding experiments the whole apparatus presents a very striking appearance, all wires leading from the secondary to other apparatus giving out brush discharges along their whole length; any points allow a much easier formation of these discharges, as do sharp edges, though to a less extent: the zinc plate will therefore glow all round its edges, but the four corners will give off tufts or spurts of light to a considerably greater distance. For further illustration of this point, see Fig. 37 in the last article, where the brushes can be seen "spurting" out from each of the points in the knurled head of the terminal.

Fig. 38 is from an untouched photograph of a wire arranged as described above, and, as was the case in the photograph shown in the last article, only the brightest part of the discharge appears, the finer purple branches and the straight blue streaks not being even suggested. The width of the bunch of purple branches of which this is a photograph was about 3½ ins., and the diameter of the sphere of radial blue lines was from 7 ins. to 8 ins.

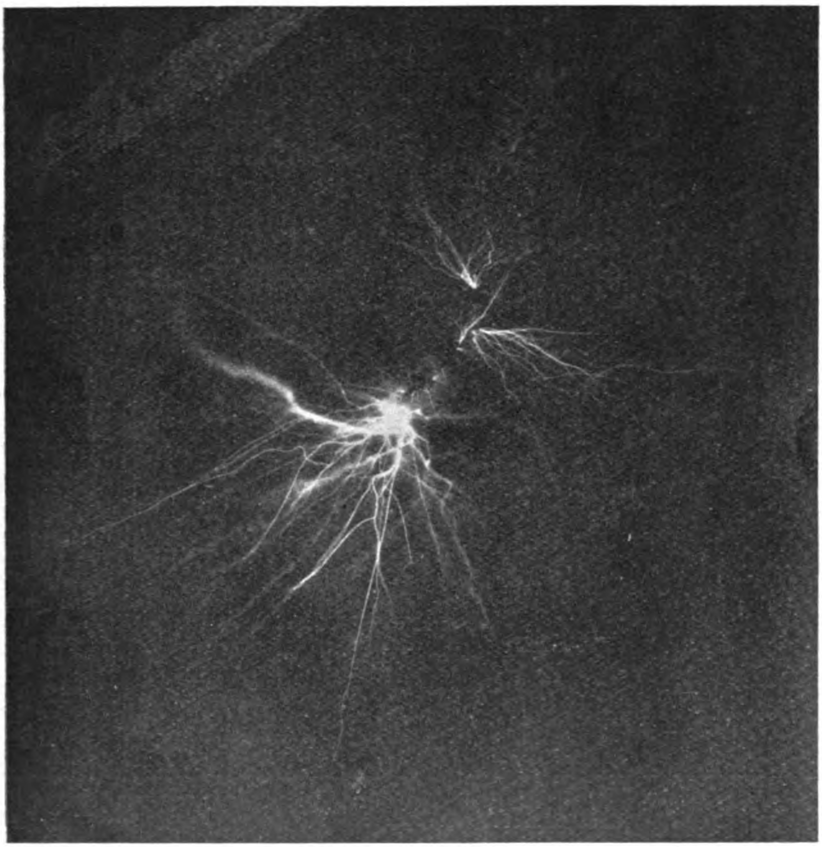


FIG. 38. (*From a Photograph of Brush Discharge.*)

Fig. 39 is from another photograph, and has been worked upon and manœuvred with as much accuracy as possible to give the reader a more correct idea of the appearance of the discharge than the photograph Fig. 38 is capable of doing. The purple branches have not been greatly added to, but an attempt has been made to draw in the blue streamers somewhat as they actually appear. Unavoidable loss of detail in the process of preparing the block has somewhat falsified the effect, which after all must be seen in reality to be appreciated, for no representation on paper can really do justice to the subject; the huge ball of blue streaks springing from a bunch of purple ramifications, and all converging towards the centre, is perforce represented in one plane, which does not permit of any true perspective effect.

(3) The insulated plate may now be brought well in front of the coil and connected with one terminal of it by a wire, everything being so arranged that there can be no possibility of a spark passing to the body of the coil from the wire or the plate. One of the pointed discharge rods is similarly connected with the other terminal of the coil, and is placed just outside the distance at which actual sparks pass from it to the plate. The discharge spreads outwards from the point, and renders the separate brushes and streamers more easily distinguishable than those produced by the point-to-point discharge.

(4) A very striking effect can be produced by leading off a pair of thin wires, 3 or 4 feet long, and cotton- or silk-covered or bare, from the two terminals, and suspending them from a horizontal string or dry wooden rod, so that they hang parallel and a short distance apart. The best distance and the best length of the wires must be ascertained by experiment. If the wires be too long, their capacity becomes too great, and there is not sufficient electricity to charge them to the requisite potential. The broad band of glowing brushes and streamers between the wires is very beautiful, if matters are properly adjusted.

(5) If a ball connected with one terminal of the coil be brought up to a large plate or ring of metal, the distance being just over the sparking limit, fine brushes are produced, and a very curious effect can sometimes be seen: a brush starts at some point on the ball, and travels along the surface in an irregular line. In reality, of course, each succeeding spark produces a brush a small step further along the line of travel; but there is a very curious effect of continuity. The writer used a ball of about 2½ ins. diameter, which had, at one time, been lacquered, and it is probable that the presence of the lacquer was concerned in the production of this brush with a moving point of origin, for though it did not seem specially to follow the lines where the lacquer had visibly gone, it often appeared to start afresh along a line already once travelled over.

(To be continued.)

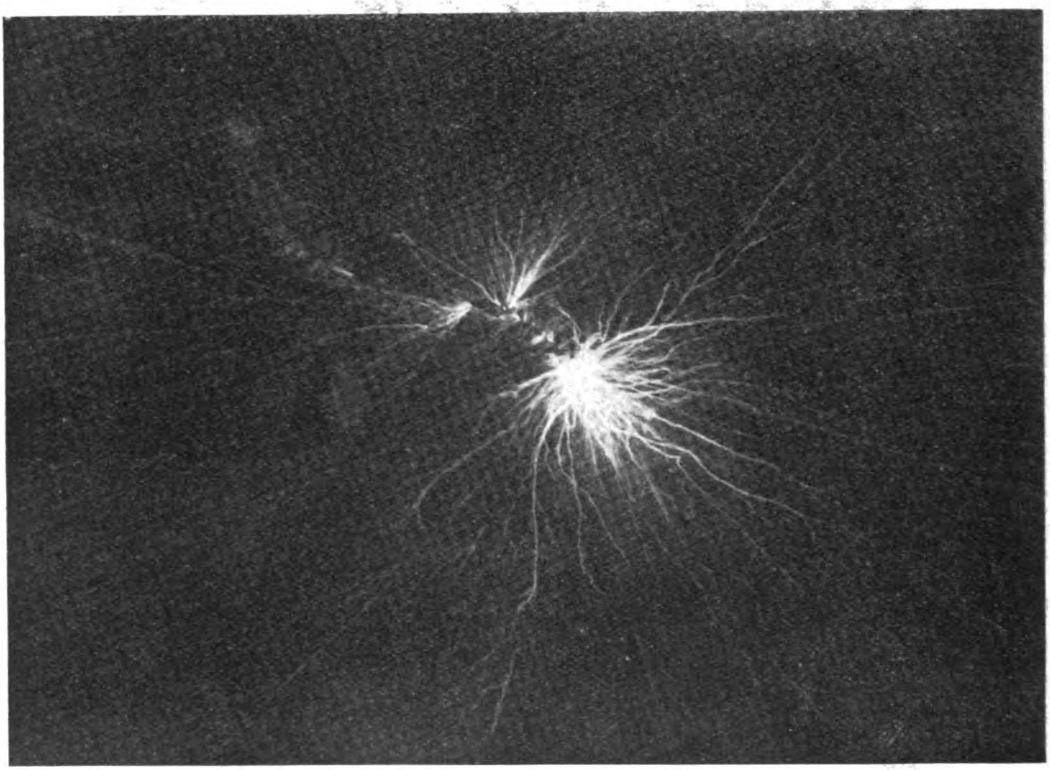


Fig. 39.

£10,000 has been placed by Mr. Yarrow with the Council of the Institution of Civil Engineers. This money is to be utilised for educating the necessitous members of the profession.

Lessons in Workshop Practice.

(*Continued from page* 296.)

XXIII.—Practical Notes on Selecting and Using Small Dynamos and Motors.

(*Continued from page* 201.)

By A. W. M.

Motors, like dynamos, have various types of armatures and systems of field-winding, each having characteristics which adapt it for certain purposes. All dynamos can be used as motors, but many motors are useless as dynamos, though good machines for their particular work. The most simple kind of electric motor is that in which no winding is used on the armature, which consists of an iron bar, or series of iron bars, mounted on a spindle, so that they are attracted to the poles of the field-magnet, but not repelled, current being cut off from the field-magnet coils at the moment when the armature is exactly opposite to the poles. These machines are often called contact motors, because the current is interrupted by means of a rotating contact-breaker acting against a fixed spring. Though this class of electric motor is generally of very small size, a number of them have been made of comparatively large dimensions, and the type is still in commercial use for working scientific apparatus of various kinds. When testing a motor of this kind, the first thing to do is to ascertain if the field-magnet winding is in order by sending a current through it, preferably from a bichromate or other powerful battery. Leclanché cells are not, as a rule, suitable, as they do not give sufficient current, except for very small motors. The contact-breaker should be cleaned, and the armature held in such a position that the contacts touch; then connect the battery. If the field-magnet is in good order, its poles should strongly attract a piece of iron, or exert a decided pull on the armature. If it does not do this, there is probably a break somewhere in the winding. The field-magnet being in order, the important thing to attend to is the timing of the contact-breaker. This should make contact, and permit current to flow through the magnet coils when the armature approaches the poles, and it should break contact when the armature has almost reached the poles. If the time of contact is prolonged until the armature is exactly opposite the poles, there is a risk of a backward pull on the armature; and it is better to make sure that the magnetism has died away by the time the armature has exactly reached the centre of the pole.

Fig. 10 shows such a motor, having a single bar armature with the contact-breaker making contact as the armature approaches the poles, and breaking contact as it is opposite the centre of the poles. When the armature has more than one bar, the contact-breaker has a series of contact points, each of which makes connection with the contact spring, and thus allows current to flow through the magnet coils as each armature bar approaches the magnet poles, and breaks contact as each bar arrives at the centre, or slightly before the centre of the poles. It is quite possible for such a motor to be fitted with several field-magnets, so that several armature bars are pulled simultaneously, thus increasing the power of the motor, or in succession, so that practically one bar is always being acted upon and the dead point eliminated. In all these motors the same kind of action takes place, and the successful working of such a motor depends upon the contact-breaker completing and breaking the circuit at just the right moment. The order of proceeding is to first make sure that your battery will give a fairly strong current, then ascertain if the field-magnet receives magnetism when the contact-breaker touches the contact spring; lastly, adjust the timing of the contact so that the armature is pulled and released at the correct moments. The contact-breaker should be fitted with silver or platinum contacts if good results are to be obtained. Brass and iron or steel corrode, and become coated with a deposit at the places where the contacts touch, which prevents the current from flowing, and will cause the motor to stop. The contacts must be clean. If the armature fails to rotate, examine these contacts and ascertain if they are dirty. Motors of this class are also made with fixed armatures and rotating field-magnets. The principle upon which they work is, however, precisely the same, and similar contact adjustment should be made.

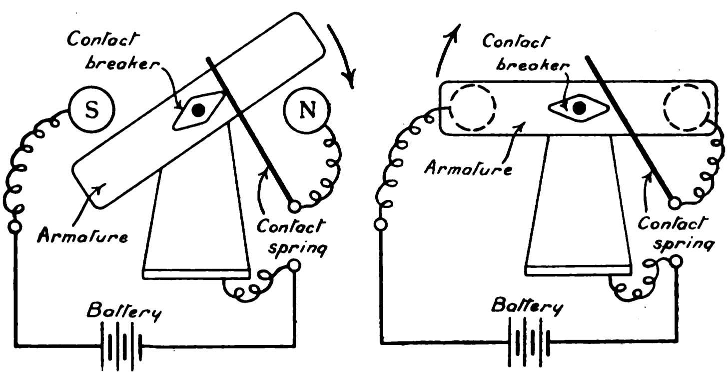


Fig. 10.

The next stage in motor development is that in which a winding is placed upon the armature. All continuous current motors of this class have a commutator, as it is necessary for the current to be reversed in the armature winding at certain times, either in the whole of the winding at once, or in successive portions. If the current is reversed in the whole of the winding, a two-section commutator is used. When the winding is in sections, the commutator has as many sections as there are coils in the armature.

When testing motors having wound armatures, it is a good plan to still adopt the system of first ascertaining if the field-magnet winding is in order by sending a current through the coils, and trying if the poles will attract a piece of iron, the armature being disconnected, so that no current can pass through its winding. If the magnet poles do not exert a strong pull upon a piece of iron when the winding is connected to some source of electricity, the fault may be due to one of three causes —first, a break in the wire; secondly, a short-circuit; thirdly, coils acting in opposition. The first cause may be determined by placing a galvanometer in series with the battery (see THE MODEL

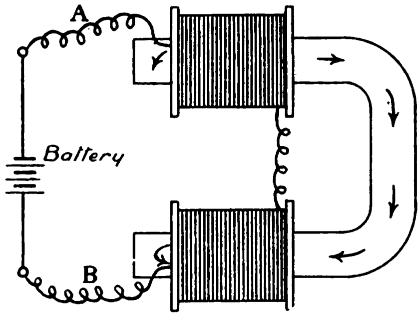


FIG. 11.

ENGINEER Handbook, No. 24), or by the absence of a faint blue spark when the battery wire is suddenly disconnected. If there is a break in the windtng, it must be found (if necessary) by unwinding the coils, and when located, the broken ends should be joined together and preferably soldered. The second cause is more difficult to detect; it means that the current, after entering the coil, is diverted, and instead of flowing through the windings, manages to escape and reach the outgoing end by a short cut, the coil as a whole thus being inactive. Such a fault would exist, for instance, if the end wires A and B (Fig. 11) of a magnet-winding formed the ends of the bottom layer of each coil, and each made a metallic connection to the core of the magnet, owing to defective insulation: a current would flow from the battery; but, instead of circulating through the magnet coils, it would leak to the core at A, and flow through it, as indicated by the arrows leaving at B; so that though there was no break in the winding, yet no magnetism would be produced. The fault must be found and the leaks stopped before the motor can be made to work. (The way to test for such a leak is explained in THE MODEL ENGINEER Handbook No. 24.)

The third cause of failure does not often exist when a single bobbin only is used to excite the field-magnet, but it is not uncommon when there is more than one bobbin on the magnet core. As an example, Fig. 12 is a diagram of the winding of an ordinary horseshoe magnet, showing the direction of winding and current, the coils being connected correctly to produce N. and S. poles. Suppose that by some means the coils had been connected as in Fig. 13, they would now be in opposition, and no magnetism would be produced. The fault is rectified by so changing over the connections between the two coils that the direction of the current is reversed in one of them. When doing this, you merely regard the current as flowing out from one coil at its end, which is not joined to the battery (as A, Fig. 13); so, to reverse the current in the second coil, you would join A to end B of the second coil. To ascertain if the coils are in opposition, disconnect one of them entirely, and connect the other to a battery. If the magnet poles are then magnetised, it will prove that the other coil was not connected correctly, or that some fault exists in it. To make sure if the fault is merely one of connecting up, join each coil separately in turn to the battery: if each one produces magnetism in the poles, the fault was in the connections; but if one coil fails to produce magnetism in the poles, there is some fault in the coil itself, which must be found (if necessary) by unwinding it.

The field-magnet of machines of Manchester type (Fig. 14) and four-coil type (Fig. 15) is, to some extent, an exception to these directions. The field coils of the Manchester machine really oppose one another, but produce a useful effect, because each core carries its own magnetism independently of that of the other. There are really two magnets side by side; if the coils do not oppose each other, the magnetism will be contained in a closed magnetic circuit, and no definite N. and S. poles will be produced. A safe way to test if both coils are in proper working condition is to remove the top yoke and test each coil in turn; if in working

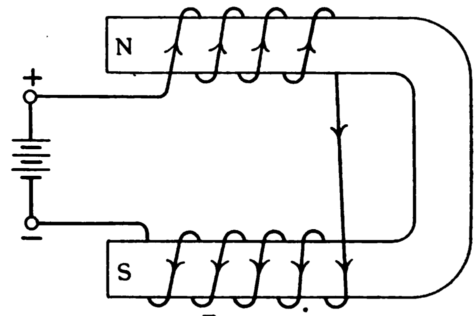


FIG. 12.

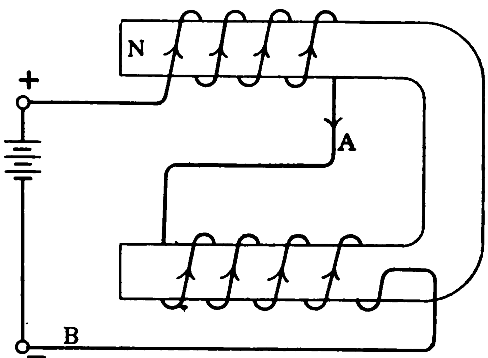


FIG. 13.

order, each should produce a strong magnetic pull at the exposed end of the core. It is not necessary to disconnect the wire joining the two coils in series.

(*To be continued.*)

ANOTHER NEW AIRSHIP.—Mr. J. Sawyer, of Beckenham, has invented a flying machine without a balloon, but which has an areoplane on a new principle, and the motor power is electric.

Notes on the Treatment of Tool Steel.

By J. M. T.

(*Continued from page* 329.)

Annealing.—By annealing is meant allowing the steel to cool slowly from a red heat so that all strains may be relieved, and the steel left in a soft condition. It is accomplished by treating the steel just as you would for pack-hardening, only leaving it to cool down with the muffle overnight, or at any rate, for several hours.

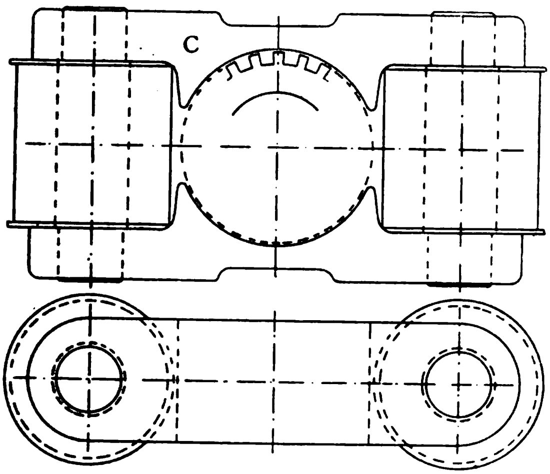


FIG. 14.

It may be done though, by heating the piece in an open flame or fire, and plunging into a bucket of sawdust. The steel thus forms for itself a very hot covering, and may even be too hot to handle two days after placing in the sawdust. If the piece is slender and, for any reason, has not been turned on closely-centred stock, or if it has been hammered or bent cold, it should certainly be annealed before hardening, or the piece is sure to warp. Sometimes a piece of steel is required only hard in parts, and then the part required soft must be protected from the contents of the hardening bath in some way, so that it is not chilled suddenly, or only heated to redness for the required distance, or only plunged in so far as the piece is wanted to be hardened.

If the piece is heated up farther than is wanted, it must not be plunged into the bath and kept there rigidly, but must be moved up and down slowly for an inch or so, in order that there may not be any sharp dividing line between the hard and soft portions, or the strain at the point where the steel projects from the water will be excessive, and the piece will be very liable to crack; or if it does not crack, a very little pressure or a blow will cause it to do so. A much better way is to heat it up only just far enough, so that it may be plunged right into the bath. In this way the strains are spread over a considerable length, and there is no sharp dividing line. The other way is to protect the parts with fireclay to a depth of an inch or more according to the size of the piece. Heat the whole thing up, and dip wholesale into the bath.

Fireclay, being mixed with water, contracts and cracks when heated, and so it is best to wrap the piece loosely with soft iron binding wire, bedding it into the fireclay, and so give the clay something to keep it together, and prevent it falling off, and so exposing the steel.

Sometimes a thick iron ring, or plate, can be used, but generally fireclay is best, as it can be put just where it is wanted, and can be so shaped that there will be no sharp dividing line.

Case-hardening.—Some tools, and certain parts of machines and other things, are required very hard on the outside, and yet they must be very tough, and tool steel is not very suitable for this class of work. A better way is to make the piece out of mild steel or iron, and case-harden it—that is, to allow the mild steel or iron to absorb carbon for several hours while at a red-heat, and then plunging it into water.

It simply means turning the mild steel into cast steel; the depth to which this change takes place depends upon the time that the steel or iron is kept at a red-heat in contact with the carbonising material. Mild steel only absorbs carbon slowly—perhaps 1-100th or 2-100ths in. per hour—so that if the box is run about two hours, there will be a thin skin of cast steel on the outside, and all the rest will be soft mild steel, or iron, as the case may be, and it will possess the valuable quality of *toughness*, as well as *hardness on the outside*.

It is often much better to make parts of machines of mild steel, and case-harden them, as they often stand better in use than cast steel would. They are cheaper to make, and there is much less risk in hardening. It is found best to allow the box, after it has been kept hot the required number of hours, to cool down quite cold, and then to reheat the contents, either separately or in the box,

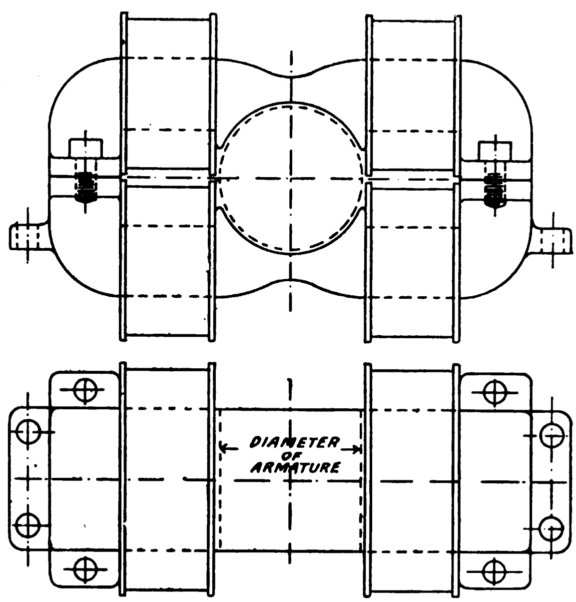


FIG. 15.

and harden them in the ordinary way. This closes the grain of the steel, and some say the outside is much harder. I do not know whether it is really harder; but it certainly closes the grain, and so makes the piece tougher. Sometimes case-hardened work is required soft in parts, and this can be done in several ways. One is to protect the parts with fireclay, as mentioned for cast steel work. Another way is to leave the parts wanted soft, large, and after casing it allow the piece to cool; then cut away the material where wanted, heat up again, and harden in the ordinary way. By this means the casing of cast steel is removed, and the piece will only harden where the casing remains. Another way is to surround the parts that must be hard with the carbonising material and the rest with dry fireclay, or something that contains no carbon, and heat up and harden in the ordinary way. It could also be done by dipping the piece only as far into the water as it is wanted hard, but the use of fireclay, as just mentioned, is just as good, and much cheaper. Then *nickel* will not absorb carbon, and the piece might be nickel-plated and the plating removed where the piece was wanted hard, and treated as usual. The material for case-hardening needs very careful choosing. Some Bessemer steels have just enough carbon combined in them to cause them to harden right through slightly; and if this is the case, they will be too brittle if hardened in water and left at that. This brittleness can be overcome by tempering, but then the piece is too soft for many purposes. Many of the cones in cycle bearings are case-hardened.

Gun parts, sewing machine parts, wrenches, screws, and many other parts of machines are case-hardened. They are cheaper to make this way, instead of being made in cast steel, and better for their purpose. The very pretty mottled appearance of case-hardened work is sometimes only produced for appearance, and because a piece has these pretty marks it does not necessarily mean that it has been case-hardened. The pieces are polished, and then treated in just the same way as if they were to be hardened; but they are not quenched at a high enough heat to harden, and they are only kept red-hot for a short time; in fact, I am not sure if they are quenched at all, but simply left in the closed boxes to cool naturally.

(To be continued.)

A Mammoth Drop-Hammer.—The Billings and Spencer Company, Hartford, Connecticut, are constructing a $2\frac{1}{2}$-ton drop-hammer which, it is believed, will be the largest friction-board lift drop-hammer in the world. It is being constructed for the Bethlehem Steel Company, South Bethlehem, Pennsylvania. It is to be used in the manufacture of heavy gun forgings which the latter company make for the United States Government. The Billings & Spencer Company are working on the hammer day and night. The base weighs 36 tons, the shoe forging weighs 1 ton, and the shoe-key weighs 160 lbs. The dimensions of the driving pulleys are 60 ins. by 13 ins. by $4\frac{1}{2}$ ins. The length of the rear roll shaft is 94 ins.; that of the front roll-shaft, 60 ins. The distance between the points of ways is 30 ins.; the extreme fall of the hammer is 6 ft. 4 ins.

Two Fast Model Steamers.

By J. E. Greenwood.

The two boats shown in the photographs were both designed and built by the writer during the last eighteen months. They were not intended to be models of any existing boats, but were built with the idea of getting the best possible speed out of them, and in this I think I can claim to have been fairly successful.

The smaller boat (Fig. 1) I built last year with the intention of entering her in The Model Engineer Speed Competition. Her speed, however, did not come up to my expectations, so I did not enter her. She is 42 ins. long by 6 ins. beam, and draws about 4 ins. in running order. The hull is of wood, and is partly cut out of the solid block and partly built up. She was originally fitted with a single cylinder engine, with a cylinder $\frac{3}{8}$-in. bore and $\frac{3}{8}$-in. stroke, driving a single propeller $2\frac{1}{2}$ ins. diameter by 6 ins. pitch. The boiler was made of tinned steel, and was $4\frac{1}{2}$ ins. diameter by 8 ins. long, with one furnace tube fitted with ten cross tubes, giving a total heating surface of about 90 sq. ins. This boiler, fired with a paraffin blast lamp, supplied the engine with steam at 30 lbs. pressure and drove the boat at just over three miles per hour.

During the past winter, I have fitted a new engine and boiler to this boat. The engine has a single cylinder $\frac{3}{4}$ in. by $\frac{3}{4}$ in., which drives two crankshafts which are geared together by two steel gear wheels $1\frac{3}{4}$ ins. diameter by $\frac{1}{4}$ in. thick. This engine drives twin screws which are $2\frac{1}{2}$ ins. diameter by 6 ins. pitch. The boiler is made of copper and is $4\frac{1}{2}$ ins. diameter by 8 ins. long. It has one furnace tube $2\frac{1}{2}$ ins. diameter, with seventeen cross tubes $\frac{3}{8}$ in. diameter, which gives over 100 sq. ins. of heating surface. The shell is of very thin sheet copper and to strengthen it I have wound 1-16th-in. copper wire spirally round it the whole length, the coils being about $\frac{1}{4}$ in. apart and each coil soldered in four places. It has stood a test of 100 lbs. per sq. in., and supplies the engine at about 40 lbs. pressure. Since these alterations have been made I have run her several times over a carefully measured course of 58 yards. Her best time for the distance is 35 seconds, which works out to about $3\frac{1}{2}$ miles per hour. I have shown the engine separate in the photograph, as it is a rather novel design. I have also taken the lagging off the boiler to show the copper wire. The smallest of the four propellers shown is the one I originally fitted to this boat, and the other three are for two boats now in course of construction, one of them being a twin-screw boat. This boat is painted red up to the water-line, and black above, with a narrow green band between; the deck is white.

The larger boat (Fig. 2) is only just completed; in fact, I am still experimenting with her to try and increase the speed. She is 54 ins. long by 7-in. beam by $4\frac{1}{2}$ ins. deep amidships. She draws about $2\frac{1}{2}$ ins. of water (exclusive of the propeller), and weighs about 16 to 18 lbs. in running order; the weight, of course, varying with the quantity of water in the boiler. She is built of tin-plate in narrow strips in the manner described in The Model Engineer handbook on "Model Steamer Building." She is extremely sharp at the bow, well rounded amidships, and the bottom slopes up to a very broad flat stern. Her shape is very similar to several of the French racing motor boats. She is very stable in the water, and shows no inclination to heel over from the reaction of the propeller, and she is fitted with water-tight compartments at each end and is quite unsinkable. The rudder looks rather small, but it is very efficient. The engine of this boat is the original single engine out of the 42-in. boat. It drives a single propeller, 3¾ ins. diameter and about 7 ins. pitch, which is built up, the blades being let into a long torpedo-shaped boss. The propeller shaft fits the stern tube for about 8 ins. of its length, and when lubricated with vaseline, works perfectly free, but is

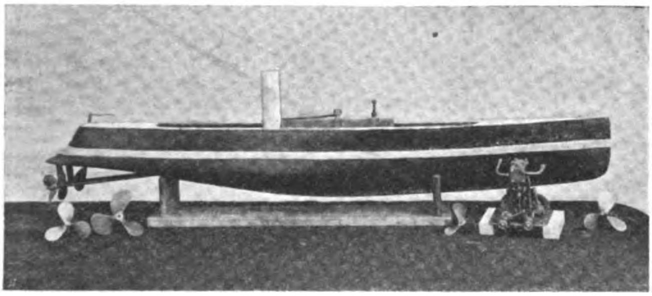


Fig. 1.—A Model Steamer and Machinery.

quite water-tight. I have tested the engine with an indicator with the propeller out of water and it runs at over 3,000 revolutions per minute. In the water I should estimate the revolutions at about 1,500.

The boiler is made of 20 B.W.G. tinned sheet steel, and is 5 ins. diameter by 10 ins. long over all, and 8 ins. long in the water space. There is one furnace tube which is oval in cross section, being 3¾ ins. wide by 2½ ins. high. It contains twenty-three cross tubes arranged vertically in three rows, and the heating surface is about 130 sq. ins. The firing is by a blast lamp worked with petrol, the tank for which is just behind the engine under the deck. This lamp gives a large and very hot flame quite free from smoke or soot, and keeps about 50 lbs. pressure. I am going to cover the boiler with asbestos and fit a superheater in the smoke-box, and I then hope to get better results. The best result up to the present over a carefully measured course of 58 yards is 20 seconds. This was the best of several runs, the others varying from 21 to 25 seconds. The fastest run works out to a speed of about six miles per hour. I hope to improve on this speed when I have completed the alterations.

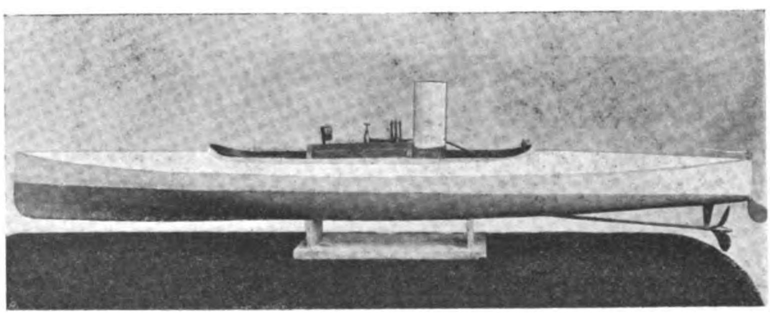


Fig. 2.—Another of Mr. J. E. Greenwood's Fast Model Steamers.

The colour of this boat is light green up to the water-line, and above this the deck and coamings are white. The inside of the boat and the boiler is painted with Brunswick black, which stands the heat very well.

For the Bookshelf.

[*Any book reviewed under this heading may be obtained from* The Model Engineer *Book Department, 26–29, Poppin's Court, Fleet Street, London, E.C., by remitting the published price and the cost of postage.*]

The Telegraphist's Guide. London: S. Rentell and Co., Ltd. 2s. net.

This is a thoroughly reliable practical manual on technical telegraphy, and will be found useful to the student who wishes to qualify for the City and Guilds or the Departmental technical examinations. The book is extensively illustrated by line diagrams, which are excellently done, and some photographs of apparatus are included, and form a commendable feature. We observe that the correct mathematical meaning is attached to the time constant of an inductive resistance $\frac{L}{R}$, over which a good deal of confusion exists in the minds of many technical telegraphists. The section on repeaters and the new quadruplex arrangement are well done, and, generally, the book will be a most valuable aid to the enquiring telegraphist. Considering the importance to which type printing instruments are likely to attain, it is to be regretted that the authors have not seen fit to include a description of the Hughes' instrument, which has been in use in the Service for some years, and would form a good introduction to the complicated mechanisms the telegraphist will have to deal with in the near future. It is, however, only fair to point out that, in this respect, all English books on Telegraphy are alike, as they either ignore, or only cursorily mention, the beautiful apparatus of Hughes.

Switzerland has a great scheme in view—the conversion of all its State railways to electric traction. They cover 1,520 miles of route, 242 being of double track.

Speed of Vessels.—An English writer quoted in Consular Reports says: "The highest ambition of those who aim at speed is to exceed a speed in knots greater than the square root, and a quarter of the vessel's length. The Atlantic liners cannot do it; motor boats and the torpedo-boat destroyers can, but such speed is attainable only at enormous extravagance."

The Latest in Engineering.

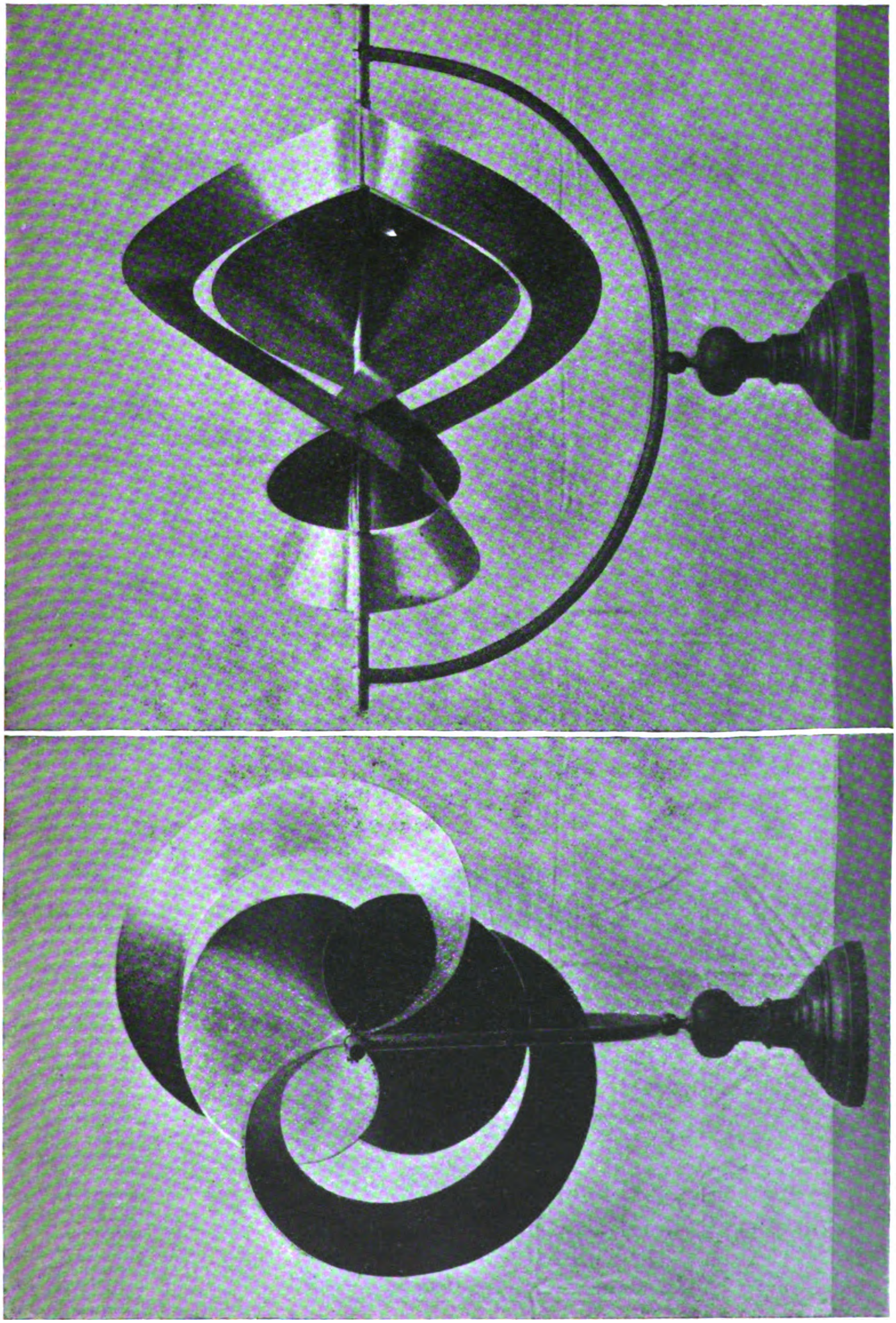
An Articulated Locomotive.—A unique type of locomotive has been recently introduced into service on the Rhodesian Railway, which has just been extended to Kalomo, ninety miles north of the Victoria Falls. This locomotive was built by Messrs. Kitson & Co., of Leeds, for the purpose of working heavy freight trains over the severe grades and sharp curves of the line, and has been capable of drawing twice the train-loads hauled by the most powerful locomotive on the Rhodesian railroad. The engine is divided into three main portions—the superstructure and two steam-driven trucks. The superstructure consists of boiler, coal-bunker, water-tanks, and cab, which rest on two long girders that are themselves carried at two pivot-points on the six-coupled trucks. By this means the whole weight of the engine is upon the coupled wheels, and is on that account available for adhesion. It can be accurately adjusted by means of a special spring connection introduced at a selected position away from the bogie. Each bogie is in itself an engine with a pair of cylinders, valve motion, brake-gear, and sanding-gear complete, and bears the weight of half of the superstructure on a recessed steel casting. There are bolts passing through slot-holes in these castings which form a connection between the bogie and the superstructure, and a further security against an excess of movement is provided by the addition of check chains. The mechanical details by which the power is supplied and controlled for each of the bogies has been carefully designed. The steam is carried from the front end of the boiler by means of ball-and-socket joints to each pair of cylinders. The exhaust of the front bogie is carried through the smokebox, and is sufficient to keep up a draught through the firebox, and so maintain steam. The exhaust steam of the hind bogie is passed into the atmosphere, but could be utilised either for the purpose of increasing the draught or for an exhaust steam injector if required. The driver supplies steam to both sets of cylinders by one movement of the regulator handle, and in the same manner he is enabled to reverse both engines, put the brake on, and actuate the sanding-gear by one movement of each of the handles concerned. Each bogie has six wheels coupled, each of 4 ft. diameter, and two outside cylinders of 16 ins. diameter by 24-in. stroke. When in working order, the total weight of engine and tender is nearly 125 tons.

New Italian Battleship.—The new Italian battleship *Napoli* was launched recently at Castellammare. The *Napoli* will form a division of four homogeneous ships with the *Vittorio Emanuele*, *Regina Elena*, and *Roma*, but this last will not be launched until this time next year. The *Napoli* was laid down on October 21st, 1903. Her length over all is 474 ft.; between perpendiculars, 435 ft.; beam, 82 ft.; draught, 25·8 ft.; displacement, 12,624 tons; number of engines, two; number of cylinders in each engine, four; number of boilers (Babcock & Wilcox), 22; engines, 15,200 h.-p. under natural draught, and 19,000 h.-p. under forced draught; speed, probably 22·5 knots; ordinary load of coal, 1,000 tons; special load 2,000 tons; radius of action at 12 knots with 2,000 tons of coal, 10,000 miles; armament, two 12-in., twelve 8-in., sixteen 3-in., two 2·95-in., and ten 1·85-in. guns, two mitrailleuses, and four torpedo tubes. Her armour belt will run her whole length and be 9·18 ft. broad, with a maximum thickness of 9·84 ins. Protection for 12-in. and 8-in. guns, 7·87 ins.; for small guns, 3·15 ins.; for conning-tower, 9·84 ins. Her complement will be 36 officers and 679 men, or, when serving as flagship, 44 officers and 760 men.

A Steam Engine Improvement—An ingenious arrangement, chiefly designed for locomotive engines, for keeping the exhaust port open a longer time and for reducing back pressure, has been invented by Mr. R. Eltringham, of Fourth Avenue, Heaton, Newcastle-on-Tyne. The main piston valves are used for the admission of steam only, and not for the exhaust. An exhaust port of ample area is placed in the middle of the cylinder so that the trunk piston just leaves it full open at each end of the stroke. Two valve spindles are provided, each of which passes through from end to end of the trunk piston, which has a central space. Each spindle has a valve-head at each end fitting a seating in the piston, and the spindles are of such length that when one valve is closed the other is held full open. When the steam is admitted to one end of the cylinder the pressure closing the valves at that end opens the others fully to the exhaust, so that when the piston again covers the exhaust port, the exhaust steam for the remainder of the exhaust stroke passes through the valves in the piston to the central space then open to the exhaust port. The exhaust port is always open to the condenser or the atmosphere.

A New Propeller.—We are enabled to illustrate on opposite page a new biconcentric screw propeller, with which experiments have been conducted at Valencia with very remarkable results. It is the recent invention of a Spanish engineer, Don José Fola. The steamer *Monserrat* was fitted with the propeller and made a trial the other day, at which a large party of scientific men were present, with Señor Enriquez and Dr. Barrachina, who are associated with Señor Fola in the invention. The result of the trial trip is said to have confirmed the extraordinary propelling powers of the invention, the speed being, it is alleged, 60 per cent. higher than with ordinary screws, and with an economy in fuel. The invention of Señor Fola is hailed as a scientific event of the greatest importance.

Automatic Railway Booking.—The L. and N.W. Railway Company are experimenting with the "penny-in-the-slot" booking system. There is a very popular twopenny journey on this line, namely, that between Willesden and Uxbridge Road, and to save the time of booking clerks and for the convenience of passengers, the trip can now be booked automatically. There are two slots in the machine, a penny must be placed into each, then upon pulling the handle a dated third class, single-journey ticket is delivered.



Side View.

End View.

A NEW BICONCENTRIC SCREW PROPELLER.

Traction Notes on Road and Rail.

By Chas. S. Lake.

Road Service by the North-Eastern Railway.

The N.E. Railway Company has recently put into service between Bridlington and Flamborough a series of motor char-à-bancs, each capable of accommodating thirty-four passengers. The total length of the vehicles is 22 ft. 6 ins., and the wheel-base is 13 ft. 9 ins. The seats, of which there are seven, placed in the usual manner for this kind of conveyance, viz., transversely, are arranged in tiers, so that passengers can obtain an uninterrupted view of the country as well from the rearward seats as from those in front. The body of each vehicle is mounted upon a "Durkopp" chassis, fitted with a four-cylinder petrol engine developing 24 h.-p. The cars have so far given very satisfactory results.

A Similar Service on the Northern Counties Railway (Ireland).

The Northern Counties Committee (Midland Railway), Ireland, have also recently inaugurated a motor char-à-banc service, using Messrs. John I. Thornycroft's standard 24 h.-p. char-à-bancs, which are similar in size and design to those referred to above. One of the vehicles, when tested, climbed with ease a hill graded at 1 in 7, with a full load. The petrol tank gave an ample head of petrol in its usual position.

British Vacuum Cleaner Company's Vanette.

The writer is indebted to Messrs. John I. Thornycroft & Co., Ltd., for the photograph and drawings herewith reproduced. The chassis is of the firm's own construction throughout, and is fitted with a four-cylinder, 20 h.-p. engine, and arrangements are made to provide for driving the British Vacuum Cleaner Company's pump by a Thornycroft engine when it is not driving the car. The body consists of a box containing the plant referred to above, and fitted with a rail on top to carry any tools and

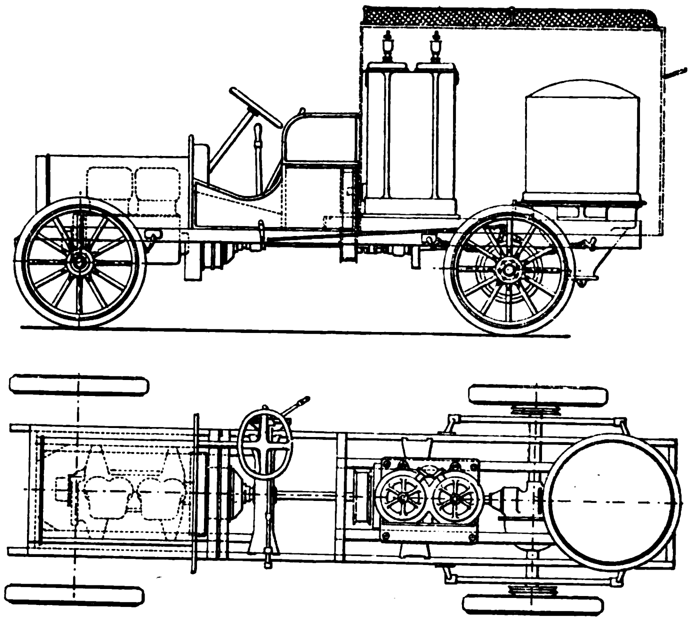


Fig. 2.—Sectional Plan and Elevation.

Fig. 1.—A Thornycroft Vanette for the British Vacuum Cleaner Co., Ltd.

materials necessary, and has seating accommodation for five persons. The great advantage of this vehicle is that it is self-contained. At a moment's notice it can go rapidly anywhere, and, having arrived at the premises where the cleaning work is to be done, the petrol engine is used to drive the cleaning plant instead of the car, which remains stationary; and thus the work can be done in the minimum time, and, consequently, with the minimum of inconvenience to the owners of the house. From this it will be noted that the machine possesses numerous advantages over any other kind of cleaning plant, and there are undoubtedly very great possibilities in the use of it. The British Vacuum Cleaner Company, Ltd., are already very well known in connection with their extremely efficient and rapid method of cleaning carpets, etc., and there is no doubt that this new motor self-contained cleaning plant will result in a very great increase in their business.

Electric Locomotives for the Great Northern P. and B. Railway.

Messrs. Hurst, Nelson & Co., of Motherwell, near Glasgow, have recently delivered to the order of the London Underground Railways Co., Ltd., two storage battery locomotives for service on the Great Northern, Piccadilly, and Brompton Railway.

One of these locomotives is, by the courtesy of the builders, illustrated herewith. The main floor is constructed of steel girders and plates, having built upon it a casing which runs practically the whole length of the vehicle. The locomotive measures 50 ft. 6 ins. over buffers, and is 8 ft. wide. A driver's cab is provided at each end, fitted with a master-controller of the British Thomson-Houston type, whilst one of the cabs also contains the electrical and brake apparatus. The power is obtained from the battery, and there is no need for collector shoes. The main battery compartment accommodates about 36 tons weight of accumulators, and the equipment of each car consists of eighty cells, each having twenty-one plates. The normal discharge current is 179 amps., with a maximum emergency load of 800 amps. The locomotives each weigh about 64 tons, and their free running speed when hauling a train load of 60 tons varies between 7 and 9½ miles per hour. The batteries have been supplied by the Chloride Electrical Storage Co., and are capable of storing sufficient energy to operate for a whole day without recharging. The locomotives are equipped with automatic centre coupler buffers and with the Westinghouse, as well as hand brakes. They mark one more interesting development of electric traction methods in London.

Metropolitan Railway Electric Locomotive.

No. 1 electric locomotive on the Metropolitan Railway, which has already been illustrated in The Model Engineer, recently hauled a goods train composed of eighteen loaded wagons and two brake vans, weighing in all some 280 tons, from Willesden Green to Uxbridge (Metropolitan) and back without difficulty. This load is much in excess of that for which the locomotives, which weigh 50 tons each, were designed, but there appeared to be a margin of power in hand even then.

L. & N.W.R. Steam Motor-cars.

Reference to these cars was made on page 272 of The Model Engineer of September 21st. By the courtesy of Mr. C. A. Park, M.Inst.C.E., Carriage Superintendent of the L. & N.W. Rly., we are enabled to illustrate the design herewith and give the principal dimensions. The car body is 57 ft. long over all, and has rounded ends. It is 9 ft. wide, 8 ft. 5 ins. high at centre, and 6 ft. 7 ins. at side cornice.

The engine is of the locomotive type, with horizontal inside cylinders, 9½ ins. diameter by 15-in. stroke, and wheels 3 ft. 9 ins. diameter. The boiler, which is also of the locomotive type, has a working pressure of 175 lbs. per sq. in., a total

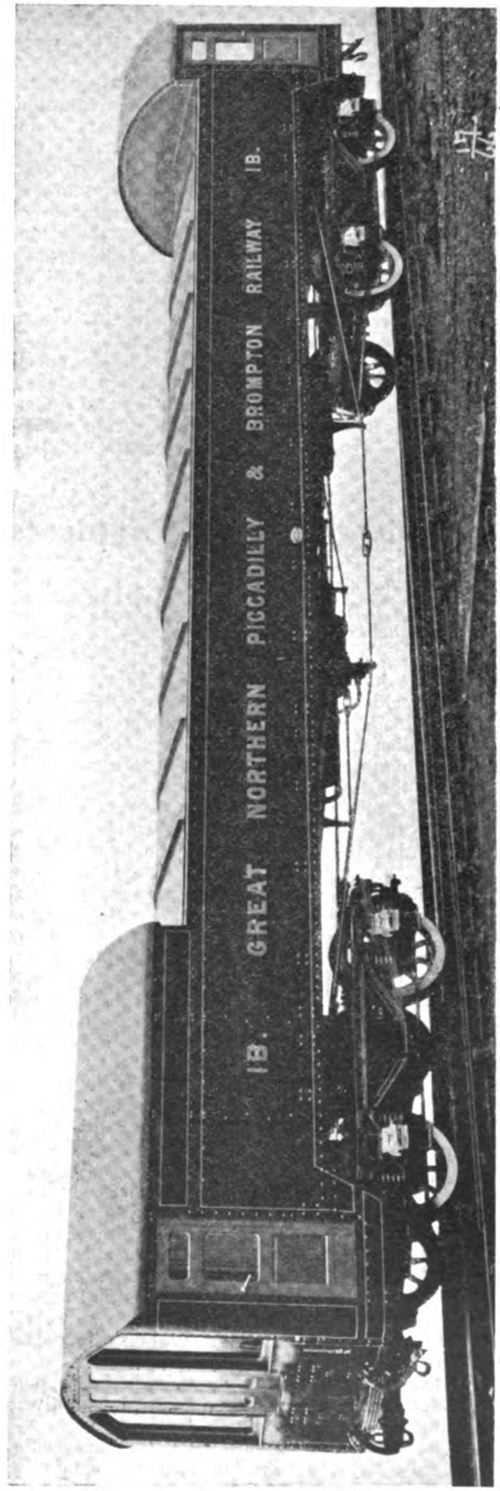


Fig. 3.—Storage Battery Locomotive: G.N.P. & B. Railway.

heating surface of 317·27 sq. ft., and a grate area of 6·38 sq. ft. There are two sets of water tanks, one set fitted on the engine truck, and the other suspended from the underframe. The total capacity is 455 gallons. The coal is carried in bunkers in the engine compartment, the capacity being 14 cwt. The engine can be operated from either end of the car. From the plan view (Fig. 3) it will be noticed that the car is divided into six compartments as follows: from left hand:—Engine room, luggage space, passenger saloon, vestibule passenger saloon, driver's end compartment. Passengers enter and leave the car by the centre vestibule, which is controlled by an attendant. Direct access to the saloons is given by this vestibule, and the seats are placed transversely in each, with gangways down the centre. Accommodation is provided for forty-eight passengers with a limited amount of luggage. The weight of the entire car, with tanks and boilers full, is 43 tons 8 cwts.; 27 tons 8 cwts. being carried by the engine truck and 16 tons on the carriage truck.

The Society of Model Engineers

[Reports of meetings should be sent to the offices of THE MODEL ENGINEER *without delay, and will be inserted in any particular issue if received a clear nine days before its usual date of publication.]*

London.

THE first indoor meeting of the winter session was held at the Holborn Town Hall, Gray's Inn Road, on Thursday, September 28th. The chair was taken by Mr. D. Corse Glen, and upwards of seventy members and visitors were present. The minutes of the previous meeting having been read and approved, eleven new members elected, and date of next meeting announced, the Chairman read the rules governing the competition to be held later in the evening. A very fine show of models were on view, nearly all of which were entered for competition, the workmanship on the greater portion of which being of very high quality. Many of the locomotives were shown at work on the Society's tracks, and some of the other models were under steam. The models entered for competition were the following:—W. Clayton, hydraulic capstan, elevating slide-rest, and pair of cylinders for horizontal engine; F. R. Welsman, hydraulic buffers (unfinished); H. T. Smith, main frames, bogie trucks, and portion of controller for *M.E.* electric locomotive; H. F. Jefferson, wall telephone instrument; H. G. Riddle, travelling crane; Dr. Hovenden, model single L.B. & S.C. Ry. locomotive (clockwork), and track; W. H. Dearden, calipers, gauges, squares, scribing blocks, drill chucks, etc., and a partly finished model Caledonian locomotive; H. C. Willis, 10-wheel tank locomotive; H. Hildersley, screw-cutting attachment for plain lathe; J. Glover, horizontal steam engine; W. W. Deacon, shocking coil apparatus and needle telegraph instrument; J. C. Taylor, "Agenoria" locomotive (unfinished); J. W. Webb, ¾-in. scale guard's van; W. F. G. Bradford, model force pump and coupled steam chest and cylinders; A. J. Coe, pair of cylinders 1-in. scale Caledonian locomotive; A. Bowling, G.W. Ry. type single locomotive.

Amongst unentered models were a model water tube boiler by Mr. Allman; Mr. Crebbins, locomotive "Cosmo Bonsor"; and several locomotives and parts shown by Messrs. Wright, Clark & Wallis.

The votes of the members were taken during the evening, resulting in the first prize—a set of castings, materials, and working drawings for ¾-in. scale London, Tilbury and Southend locomotive, offered for competition by Messrs. Wright, Clark & Wallis—being awarded to Mr. J. C. Taylor, for his partly finished "Agenoria" locomotive; the second prize (15s.) was awarded to Mr. W. H. Dearden for his partly finished Caledonian locomotive; and the third prize 7s. 6d.) to Mr. H. T. Smith (new member) for his partly finished *M.E.* electric locomotive. The Chairman presented the prizes amid much acclamation, and a very enjoyable evening then came to an end.

FUTURE MEETINGS.—The next meeting will be held on Monday, October 23rd, at 7 p.m.—HERBERT G. RIDDLE, Hon. Sec., 37, Minard Road, Hither Green, S.E.

Practical Letters from our Readers.

[The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a nom-de-plume *if desired, but the full name and address of the sender* MUST *invariably be attached, though not necessarily intended for publication.]*

Bicycle-driven Dynamos.

TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—Seeing several paragraphs on the above subject in the *M.E. & E.*, I thought a description of one I made nearly two years ago might be of interest to some of the readers.

I took off back tyre of bike wheel and pasted a strip of stout canvas around inside of rim to reduce the rough surface where spokes entered rim. The back wheel was now mounted in this way:—Two pieces of wood about 5 ft. long were nailed to a cross-piece about 10 ins. long, one at each end, a notch was cut out of the middle of the smaller piece for the fork of the bike to rest in. This was placed under the point where the forks of frame meet, just under the saddle, and the other long ends of the pieces of wood were nailed to the floor.

With about fifty turns of the pedal per minute I can get 3,000 (approx.) off dynamo. One can either sit on saddle and pedal or turn with hand. The front wheel is fixed to floor. I often have half an hour's "grind," and charge up, or partly so, a small accumulator; but it is tiring work to keep up for any length of time. In conclusion, I might say the dynamo is an 8-section cog-drum, shunt-wound, with an output of 10 volts 4 amps. I find that three stranded whip cord, well stretched before joining, makes an excellent strap, equal to leather, besides being far cheaper.—Yours truly, D. R.

Armature Reaction and Distortion of Field.

TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—Referring to the queries of "Fieldless" in your issue of September 21st *re* my letter on "Armature Reaction," published in your issue of August 31st, I will deal with them in the order given:—

(1) Overheating of armature.

The motor was, as stated, an 8 h.-p. one, taking 110 volts, thus requiring nearly 70 amps. at full load, with an efficiency of about 80 per cent. A current of 46 amps. would, therefore, not overheat

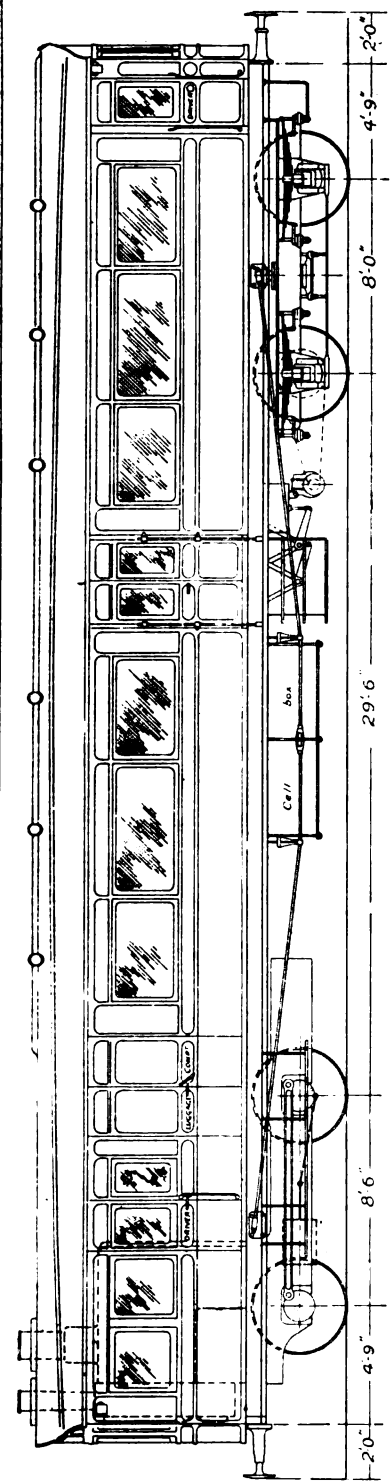


Fig. 4.—Longitudinal Elevation.

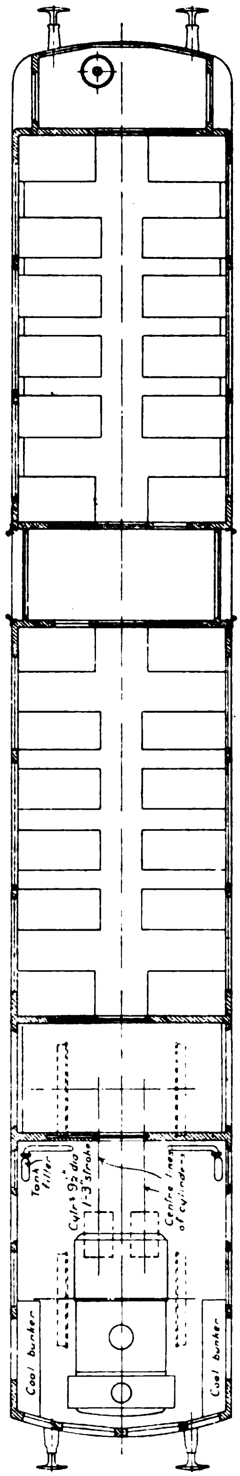


Fig. 5.—Sectional Plan.

STEAM RAIL MOTOR-CAR, LONDON & NORTH-WESTERN RAILWAY.

(*For description see page* 351.)

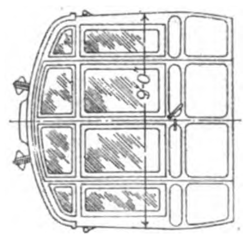


Fig. 7. Rear End.

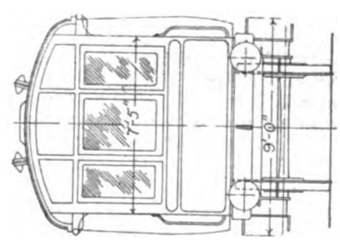


Fig. 6. Front Elevation.

the armature, especially as it was running at considerably above its normal speed.

(2) Loss of residual magnetism.

It will be noticed in Fig. 4 (see my letter of August 31st) that the direction C of the armature field is nearly perpendicular to that produced by the field-magnets, which will, therefore, be practically uninfluenced.

(3) "Does the armature depend upon its own magnetism for a field?" Yes. The field-magnet poles are only used to distort the field thus produced.

(4) "If so, how can it revolve?"

I think your correspondent will agree with me that if the armature were isolated, no iron but the core being present, the field produced would be in the direction of the line joining the brushes. Also that the presence of the field-magnets will cause a distortion, and that the direction of the field, where it passes through the conductors, may be considered to be similar to C (see Fig. 4). Now C may, as I stated, be resolved into two components, D and E. But D being in the line joining the brushes, will produce no torque on the motor, and as far as we are concerned may be neglected. E, then, is the only useful component. Now we have an armature conveying a current as indicated, and a field, due to the armature, in a direction at right angles to the line joining the brushes. These are the essential conditions, and therefore the motor should revolve.

With regard to the breakdown of the 210-volt motor, "Fieldless" states that the armature was shattered, and the windings spread open. From this I infer that the armature burst, and was not burnt out. The explanation for the necessary rise in speed to bring about this is fairly simple. If for any reason the torque on the motor becomes great the speed will rapidly rise, with disastrous consequences. Now the torque on the motor is proportional to the field strength F multiplied by the current C, but

$$C = \frac{V - K S F}{R};$$

where V = voltage on mains, K = constant for motor, S = speed, R = resistance of armature.

$$\therefore \text{Torque is proportional to } \frac{V - K S F}{R} \times F$$

$$\textit{i.e.}, \text{ is proportional to } F V - K S F^2$$

Now if the machine is running under ordinary load, $K S F^2$ will be nearly as large as V, and a decrease in F will produce a large increase in the torque at that speed, and the speed will rise until steady motion again takes place. If the fields are broken when the load is not too heavy this is what takes place, and the terrific rise in speed is enough to burst the armature. If the motor had been on a heavy load, K S F would have been small compared with F V, and a decrease in F would have caused a proportional decrease in the torque, and the motor would stop. This would mean that the armature would be developing no back E.M.F., and the current would either blow the fuses, or if there were none, would burn out the armature.

In my case, if the full voltage had been applied, all I can say is that the motor would have ceased to exist; but "Fieldless" will notice that the maximum voltage applied was 11·9.

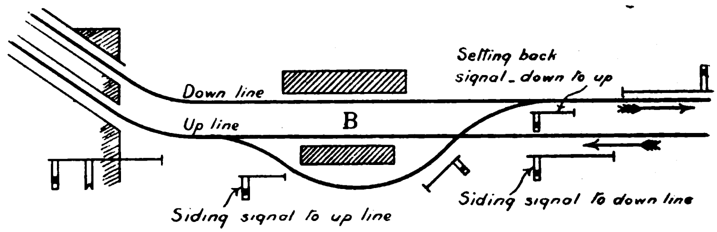
In reply to the latter part of Mr. S. G. Dix's letter, I hope he is not under the impression that it would be possible to get much work from the given motor without the fields excited. If he has noticed my figures he will see that the design must be considerably altered to adapt itself to low voltages and high currents. This would bring about a corresponding increase in the field strength, and I think it quite possible to build a motor on this principle. I have not had the opportunity to try this experiment on a low voltage machine, but there are small machines used in practice as charging dynamos giving about 11 volts 300 amps.; I think if the experiment were tried on one of these, a very reasonable amount of work could be obtained from the machine. Hoping I have made these few points clear.—Yours truly, A. G. WARREN.

Abbey Wood.

Model Railway Design.

TO THE EDITOR OF *The Model Engineer*.

DEAR SIR,—With further reference to this interesting subject, I thought I had described my design for the above in your issue of July 6th clearly; if not, allow me to point out to Mr. Rogers (Buenos Ayres) the paragraph commencing—"If, however, the trains *were not* run according to the usual practice—*i.e.*, run on the left-hand set of metals, the facing connections of the cross-over roads would become trailing." The reason for this is owing to my obtaining them second-hand from a friend who gave up his model railway material, a portion of which had the points in the opposite direction to what I required, which causes the diversion from the trailing position.



PART PLAN OF MODEL RAILWAY. By "MIDLAND."

Since writing my description of July 6th, I have altered the cross-over at Station B, as shown in the sketch above. You will see this arrangement gives facilities for attaching and detaching vehicles from either the up or down main line, also admits of trains shunting to allow others to pass, in addition to being used as a cross-over.

I intend to install electric bells between stations A and B; also mechanical block instruments (my own construction and design), so that the block system may be worked, and, when completed, I will send you illustrations of the apparatus, together with a description of its working.

I should like to see some further designs from model railway enthusiasts and their methods of working either from a practical or as a pastime point of view.

With regard to Mr. Rogers' remarks respecting the G.W. model signalling plan, *re* Signals 23, 24, and 25, I concur that he is correct in assuming these should be main line movements, as signals Nos. 22, 21, and 20 are applicable to the branch line.

In conclusion, allow me to mention that there are some good designs in the handbook on Model Railways published by Messrs. Bassett-Lowke respecting signalling arrangements, etc. It is very concise, and gives some good ideas for the smaller gauge railways.—Yours faithfully,

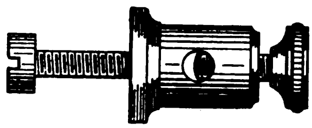
"MIDLAND."

Carbon Terminals.

To the Editor of *The Model Engineer*.

DEAR SIR,—In reference to "J. A. B.'s" method of fixing carbon terminals, which was given on page 242 of September 14th issue, I should like

A CARBON TERMINAL.



to say that a certain wholesale firm manufactures terminals as shown in the accompanying illustration, and I venture to say that it would save time, labour, and expense to buy these ready made.—Yours truly, ALFRED GAIN.

Oxford Street, W.

THE "MAGIC SPHERE" is the name given to an invention by Sir Hiram Maxim which is said to neutralise the law of gravity. The machine is to be erected in an open air pleasure resort, and will take the form of a miniature "earth," 50 ft. in diameter and raised 20 ft. above the ground on a pedestal which will revolve, making the sphere revolve also. It is claimed that people walking in the sphere will imagine that their bodies are leaning outwards in mid-air.

A LARGE LIFTING MAGNET.—The Electric Controller and Supply Company, Cleveland, Ohio, have recently brought out a very large lifting-magnet, which has been designed for handling stock such as pig-iron, light or melting stock, small castings, bolts, rivets, etc. It has a lifting capacity of 1,200 lbs. of pig-iron, small castings, bolts, nuts, etc., and 1,100 lbs. of medium weight castings. As a magnet will of course, lift a much greater weight when the latter is in one piece than when in a number of small pieces, the one in question is used for lifting a large ball employed in breaking up scrap iron. This ball weighs 11,000 lbs. The magnet is in the form of a disc, and is slung with its faces horizontal from three chains attached to a ring.

NEW ELECTRIC DELIVERY VAN.—A somewhat novel form of electric motor delivery van has recently been brought out by the Titan Maskinfabrik, of Copenhagen. It is a three-wheel vehicle intended for loads up to about 5 cwt. A 1½ h.-p. electric motor of the double-pole type drives the single rear wheel through chain gearing. The electrical energy is furnished by a battery of forty cells of Cologne Accumulator Works type, arranged in two groups in the bottom of the van body. The controller is adapted to give two forward speeds, two braking positions, and a reverse motion. The driver is mounted over the rear wheel, and controls the steering by a lever at his right. A pedal operates a band brake working on a disc attached to the rear wheel; when the brake is applied, the current is cut off.

Queries and Replies.

[Attention is especially directed to the first condition given below and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-hand corner of the envelope "Query Department." No other matters but those relating to the Queries should be enclosed in the same envelope.

Queries on subjects within the scope of this journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied, wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed. (4 Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of Replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor,* THE MODEL ENGINEER, *26—29, Poppin's Court, Fleet Street, London, E.C.]*

The following are selected from the Queries which have been replied to recently:—

[14,559] **Spark Coil.** K. S. W. (Bradford) writes: I am thinking of making a 6-in. spark coil from particulars given in your MODEL ENGINEER Series No. 11, but before commencing would like you to answer a few questions for me, if possible. In the particulars it gives quantity of primary wire as 2 lbs. No. 12 D.C.C. (1) How many layers would this make? (2) Is insulation by using shellac varnish necessary between each layer? (3) Has the number of layers to be odd or even, as, if the number of layers are even, both ends of primary wire will come out at the same end of coil? Does this matter? (4) What should be the length of the primary coil? The secondary is 8 ins. long. (5) Would a coating of shellac varnish be any good between each layer of wire in the secondary sections? I intend to use S.C.C. wire, number 36 gauge. (6) Would twelve bichromate cells connected in series work this coil satisfactorily? In your handbook it says the coil requires 20 volts 6 amps. to use coil to any purpose. How could I connect the twelve cells up to obtain this? (7) If twelve bichromate cells will not do, how many should I get, and how would you advise me to connect them – in series or in parallel, or ten in series and two in parallel, or how? (8) Will a mercury break put into the circuit be of any consequence, or would it be likely to do harm to the coil? (9) How many paraffined waxed filter papers should be put between each section of secondary coil? (10) Does the ebonite easily split when drilling holes for the screws? (11) Is it necessary to have ebonite ends for the bobbins? If not, what is the next best thing to use that is not so expensive? I hope I have not asked you too many questions, but I wish the coil which I shall make to be perfect, and if careful work will make it so, it will be.

(1 and 3) There should be three layers on the primary. (2) Not necessary, but preferable; we advise you to use it. (4) The primary winding should be slightly longer than the secondary. The exact number of turns does not matter. You can find out how many turns of wire go to 1 in. of length, and the length of a single turn, by trial winding, and from this calculate about what length the weight will come to; but as before said, the exact number of turns and weight does not matter. (5) We think you will do well to use paraffin wax throughout for the insulation of the secondary; silk-covered wire is better if you can afford it. (6) Use large size cells of at least 3-pint capacity. (7) Try six cells in series to commence with, and increase the number in series until you get full spark length. Make ample trial adjustments of the contact-breaker with each number of coils, and use platinum contacts as large as you can afford; the larger they are the better. (8) A mercury break would be a very good thing to use. You can try the coil with an ordinary hammer contact-breaker first; an independent break can be used at any time by merely screwing up the hammer break with a piece of paper between the contacts, so that it will not vibrate, and connecting the mercury break across the contacts to act instead. (9) Four. (10) No, but it is a material that requires careful handling, especially in cold weather. (11) Preferable, and we advise you to use ebonite. Failing this, try teak or mahogany well boiled in paraffin wax.

[14,588] **Steam Engine Proportions.** R. S. (Manchester) writes: I am making a built-up horizontal engine, 1-in. bore, 1¼-in. stroke. Would you kindly answer the following questions? (1) Length of bed, piston-rod, and connecting-rod, weight of fly-wheel? (2) Size of ports, travel of valve? (3) What pressure would be needed to drive it at 200 revolutions per minute?

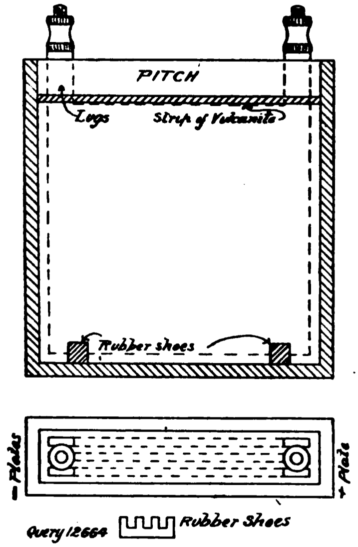
(1) These dimensions depend on the general design. The length of piston-rod should equal thickness of piston plus clearance at end of cylinder plus depth of gland and stuffing-box and clearance, plus the amount fitted into cross-head. The connecting-rod should be about three times the length of the stroke—say, 4½ to 4¾ ins. centre to centre of brasses. (2) Steam ports ⅛ by 3-32nds in.,

exhaust ½ by 3-16ths in. Lap of valve, 1-20th; bare travel of valve equals lap plus port opening by 2 equals (1-20th plus 3-32nds) by 2 equals, say, 9-32nds in. valve travel. (3) Depends on the friction of the engine.

[14,545] **Undertype Dynamo Construction.** F. D. (Lichfield) writes: I am making a small dynamo from a set of castings advertised as 16 c.-p. The field-magnet is wound with 1 lb. No. 24 S.W.G. s.c.c. copper wire, there being thirty-two layers (about 1,300 turns) in all. The armature is built up of stampings, and is 1½ ins. diameter, 1¼ ins. long. I intended winding it in four sections, as in your handbook, "Small Dynamos and Motors," as it is my first attempt at dynamo building. (1) Will you please advise me what gauge wire to use for armature, and how much? (2) What should be the output of above dynamo in volts and amps.? (3) Also, what current it will require to work same as a motor?

(1) Wind armature with No. 25 gauge s.s.c. copper wire. Get on as much as you can; about 4½ ozs. will be required. (2) The output will depend largely upon the speed. Try it at about 3,000 revolutions per minute. You may get about 12 volts and 2 to 3 amps. if the air space is short and iron of magnet very good. Test with a 12-volt 2½ c.-p. lamp to find out if machine is working. (3) The current it will take as a motor will partly depend upon the load put upon the pulley; at light load about 1½ amps., with, say, 8 to 12 volts. You could load it up to 4 amps. without harm. The machine would probably run with 4 volts as a minimum, and, of course, give out less power. The field coil should be connected in shunt to the brushes for both dynamo or motor use.

[12,664] **Water Motor; Sealing up Accumulators.** W. L. (Chorley) writes: Will you kindly answer the following questions:—Could you kindly give me a drawing for a water motor or tell me where I could get one to work to. This I want to make to drive a dynamo to light eight 8 c.-p. lamps at 25 or 50 volts. What horse-power shall I require, and what voltage



SECTION OF ACCUMULATOR.

do you think best? The water pressure is on an average of 45 lbs. per sq. in. I have been making a 4-volt accumulator and when I charged it all the red lead dropped off the positive plates. Could you give me a reason? Will you kindly tell me what to make the top up with so that the acid will not spill, as I intend to use it for my bicycle?

A ¼ h.-p. water motor will be found to have been described and illustrated in December 15th, 1901 issue. This would have to be enlarged somewhat to give sufficient power to develop current in dynamo to light eight 8 c.p. lamps. Make the diameter of cup wheel 6½ ins. or 7 ins. over all instead of 5 ins. as shown on drawing (page 270–271), and the casing, of course, larger too, to correspond. The nozzle would be about 3-16ths-in. instead of 5-32nds-in. The precise diameter of this, however, will be found by trial. About ¼ h.-p. will be needed. Voltage of dynamo could be 30 or 50, and should give respectively 6·5 or 4 amps.—*i.e.*, approximately 200 watts. *Re Accumulators.* Either you have charged with too heavy a current, or paste has not been well pressed into the grids, or has been too moist or soft when supplied. Fill in top with pitch (molten) to which has been added a little bee's-wax to make it less brittle when cold. We trust these details will assist you.

[14,543] **Dynamo for Charging.** W. B. (Aberdeen) writes: I would be pleased if you would give me drawings and windings of an undertype dynamo, 15 watts, 15 volts, 1 amp. at 1,000 r.p.m. I would like the speed kept as low as possible, as it is to be driven by a ¼ h.-p. water motor, run at about 60 lbs. which is useless on a 60-watt machine. We have a splendid pressure here, not far from 60 lbs., and it is rather disappointing to pay 30s. for a thing they said would drive a 100-watt dynamo easily; more than that, the pulley on it was about a foot out of truth. Would loading the wheel with lead do any good? The dynamo is for charging.

The speed you mention is very low for a dynamo of this output, if the machine is to be of small size. For design, we refer you to Fig. 8, page 18, of our Handbook No. 10, made to the 60-watt scale; armature to be of cogged drum pattern, eight cogs, and wound with eight coils, two in each slot, connected to an 8-section commutator wound with No. 26 gauge s.s.c. copper wire. A quantity of about 5 ozs. will be required. Field-magnet to be wound with 1½ lbs. No. 22 gauge s.c.c. copper wire on each coil, or more if you can get it on in the space. Coils should be connected in shunt to the brushes. As regards speed, this must be found by actual trial; it may be anything from 1,000 to 2,000 r.p.m. approximately. To get lowest speed practicable, the armature should run very close indeed to the pole-faces. A bored out tunnel would be necessary. Test machine with a good 15-volt 5 c.-p. lamp. *Re* water motor. A good 60-watt dynamo would give its full output with less than ¼ h.-p. Before you condemn your water motor we suggest that you make further trials. House water pressure is a variable and deceiving quantity; besides, the question is not only one of pressure, but of flow also. Your jet may not pass sufficient quantity of water. Perhaps you are not giving the motor a fair chance to do its work. Fit it with a smaller pulley, so as to allow it to run at a high speed, or couple the dynamo and motor spindles together by means of a flexible coupling, and make some trials. Read the article in THE MODEL ENGINEER for September 3rd, 1903, on "Designing and Testing Water Motors." If the pulley is out of truth, it should be turned up in a lathe; balancing with lead would cure vibration. How did you test the dynamo? Perhaps the fault is there, and not at the motor.

[14,529] **Four-pole Dynamo.** W. R. (Dursley) writes: I should be glad if you would kindly help me out of a little muddle I am in just now. It is with a four-pole dynamo. The yoke of it measures 2½ ins. across, with an inside diameter of 4¼ ins., and an outside diameter of 5 ins., which leaves the yoke just ⅜ in. thick. The poles are made of wrought iron, 1¼ ins. long, 1 in. wide, and ⅜ in. deep, and a cast-iron cap (or shoe) 3-16ths in. thick, 1½ ins. (on long) across, and 1¼ ins. wide. The armature core has a diameter of 2¼ ins. with 12 slots ⅜ in. deep and ¼ in. wide, and measures 1⅜ ins. long. The armature was coil wound with twelve coils, each containing sixteen turns of No. 22 S.W.G., and was connected in parallel. The field coils were wound 800 turns of No. 25 S.W.G., each coil containing 200 turns. There was also a rocker-arm which could be shifted to any position, and four gauze brushes set at equal distance. But it took 15 amps. to start as a motor, so I cut out one coil and one bar (com.), and made a series wound armature, and then it ran with 5 amps. but gives no output at all as a dynamo. If you would kindly give me instructions as to how I could get 30 volts 5 amps. out of this machine I should be greatly obliged. The span of armature coil was from slot 1 to slot 4, and 4 to 7, and 7 to 10, and 10 to 1, and so on; so you will see that each coil was exactly in centre of each pole.

Rewind armature with No. 25 gauge single silk-covered copper wire. Get on as many turns as you possibly can. Wind on the plan shown in Fig. 49, page 36, of our Handbook No. 10, but, of course, with twelve coils to suit your core, instead of sixteen, as given in the figure. The commutator need not be cross connected, as you have four brushes. You will, instead, cross-connect opposite brushes. Can you not get more wire on the poles? The field winding should have a resistance of at least 35 ohms. Your present winding will take too much current for 30 volts. You will have to run at about 3,000 revolutions per minute. If you will say what weight of wire you can get on the field coils, we can advise you as to gauge. We advise you to try the machine at various speeds with the present field coils, and ascertain if the machine excites, and what output you can get without undue heating of the field winding. We doubt if you will get more than 15 volts 5 amps. from this machine. It should, however, work very well as a motor with 15 volts pressure.

[14,715] **Telephone Failure.** S. R. (York) writes: We have made the wall telephone as described in page 35 of your sixpenny handbook on "Telephones and Microphones," and find that we cannot hear at all when anyone is speaking through the transmitter, which consists of pencil carbons as described; but we can distinctly hear any slight knock or tap on the board on which the transmitter is fixed. We should be very glad if you could tell us what you think is wrong with it.

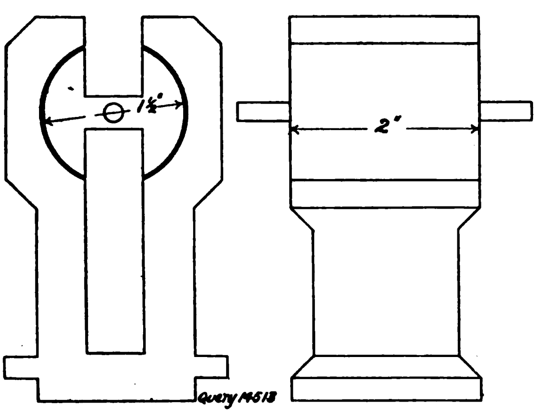
This may be due to the carbons sticking or to the board in which they are mounted not responding to the high frequency tone of the voice. The board should be as thin as possible, consistent with mechanical conditions, and not too small; and it should be possible to rotate the carbons without their jamming at all. As you can hear taps distinctly, it would appear that the circuit is correctly joined up.

[14,554] **Steam Engine Proportions.** S. R. W. (Poplar) writes: Will you kindly answer me the following queries *re* model launch engine I am about to build? (1) Engine to be 1-in. bore, ¾-in. stroke. Am going to build cylinder up from S.D. brass tube, 1 in. inside diameter; piston will be 3-16ths in. thick. How long should cylinder tube be to get best working results? (2) Size of steam and exhaust ports? (3) Size of steam and exhaust pipes? (4) Also would it be any disadvantage to use the same size tubing for steam and exhaust, providing the tube is large enough for the exhaust steam?

(1) If the clearance at each end of the cylinder is 1-16th, and the "checking-in" of the cover 1-16th in., then, with a piston thickness of 5-16ths in., then (2 by 1-16th) + (2 by 1-16th) + 5-16ths = ⅛ + ⅛ + 5-16ths in. = 9-16ths in. This amount added to the stroke of the piston = ¾ + 9-16ths = 1 5-16ths in., which is the total length of the cylinder tube. (2) The steam ports may be ⅜ in. by 3-32nds in.; exhaust ports ⅜ in. by 5-32nds in.; port-bar, 5-64ths in. or 3-32nds in. (3) 3-16ths in. diameter steam and ¼ in. diameter exhaust pipes. (4) No trouble will ensue; 3-16ths in. diameter pipe really would do for both steam and exhaust.

[14,513] **Running Small Motor from 100-volt Mains.** G. P. (South Shields) writes: I would be very much obliged if you would put me right in the following. I have a model dynamo (as per sketch) which I wish to drive as a motor for a fan, from dynamo working at 65 volts. Armature of model is Siemens H wound with about 3 ozs. of No. 22 cotton-covered wire. Fields, series wound with about 12 ozs. No. 22 c.c. wire; commutator, of course, in two sections cut slantwise. Brushes are just thin strip of brass, and model lights a small lamp when running about 3,000 revolutions, but requires to have brushes pressed on commutator with a good pressure, and that, of course, cuts it. I should like to know what alterations I would require to make to drive it as I say, and what size wire to connect up to mains; also would the same do to drive from dynamo running at 100 volts pressure? Would making a drum armature be better, and what size wire and quantity should I put on and would carbon brushes be better? Would a fan about 12 ins. diameter be suitable for it?

You can use the Siemens H-armature, but a drum would be preferable. If the motor is wound to suit 65 volts it would be necessary to use a resistance in series with it when connected to 100-volt mains. Windings for 65 volts are as follows:—Field-magnet to be wound with No. 26 gauge s.c.c. copper about the same weight as at present, and connected in *series* with the armature; Siemens armature to be wound with No 30 gauge s.s.c. copper wire; or drum armature with eight cogs wound with eight coils, two in each slot, and connected to an eight-section commutator, wound with No. 34 gauge s.s.c. copper wire; get on as



FIELD-MAGNETS FOR OVERTYPE DYNAMO.

much as you can; about 4 ozs. will be the weight. We advise a 10-in. diameter four-blade fan. You can adjust the speed by altering the pitch of the blades. If motor does not run fast enough, put the field coils in parallel with each other, taking care to obtain N. and S. poles. Carbon or copper gauze brushes would be an improvement.

[13,720] **Electric Light Installation; Shocking Coil.** G. R. (Weymouth) writes: Many thanks for your reply to my enquiries *re* Accumulator Installation (February 16th, No. 13,618). I find that I made a mistake, and quoted you the wrong book. The one I meant to refer to is No. 22 *M.E.* Series on "Electric Lighting," and the installation (or one somewhat similar) I wish to set up is described on pages 54 to 60. I therefore repeat the three questions you were unable before to reply to. (1) How many 8-volt lamps could be lighted at one time, and what candle-power would these lamps give? (2) What current capacity are these accumulator plates; sizes as given in your book? Also how long would it take to fully charge them with 12 gravity cells? (3) Would current be too great to keep one lamp going all night as a night light? (4) Would this installation give sufficient current to work a motor powerful enough to drive an ordinary sewing machine? If so, I suppose it would not be possible to run motor sometimes with lights on as well? I note your reply *re* inserting resistances or cutting out one or two cells. (5) Please say whether the simplest plan would not be to have two sets of accumulators and charge up one set direct from batteries, then connect straight to wires for lights, then connect other set to batteries; so always keeping one set charging while the other set was doing work. (6) Also, I cannot quite understand your remarks in "Small Accumulators," pages 40 and 46.

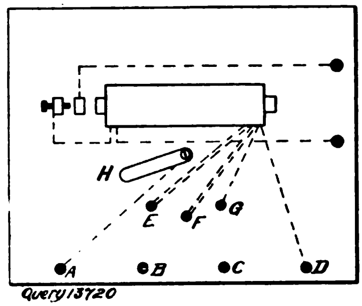


DIAGRAM OF COIL CONNECTIONS.

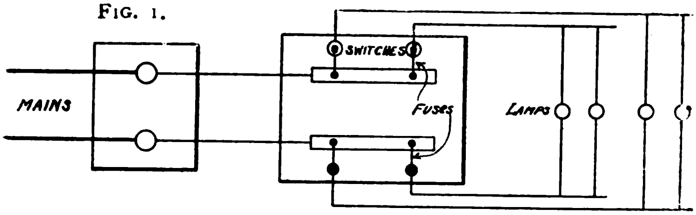
You give, in the first place, a method for working out the capacity of accumulator plates, but on the latter page (in giving an example of same) you seem to go on another method. (7) What difference if any, does it make in current capacity, having two negatives to one positive plate instead of one negative and one positive? Also what advantage is it to have 3-16ths in. or ¼ in. instead of ⅛-in. plates? (8) In charging an 8-volt accumulator from a dynamo what is the greatest E.M.F. and current one could employ so as to charge up in quickest possible time? (9) *Re* zincs for using in gravity cells is it possible to use sheet zinc? Also, are there several qualities of same, as I notice in most catalogues of electrical goods price quoted is about 1s. per lb., while local men here quote about 3d. or 4d. per lb. I have also bought a second-hand shocking coil, and cannot quite understand the connections. I give a rough sketch above: Dotted lines indicate direction of wires seen underneath the board. The connection of wire for primary coil I can clearly understand. (1) Will you say what is the object of having the four terminals, A, B, C, and D, as B and C do not appear to be connected in any way? (2) What is the object of switch H? I was told that a quart bich. cell was usually used for this size coil, but that a pint cell would work it well. I tried cell of latter size, and with switch H at E could get a shock from terminals A and D, but with switch at F or G could get no result. (3) What voltage and current would the coil take? Its size is 8 ins. long by about 3 ins., excluding ends. (4) How is an indicator made to use with coil—one with clock face and pointer to travel right round the circle?

(1) Three 8-volt ½-c.-p. lamps, if of good efficiency, for about three hours. (2) About 7 amp.-hours; probably take about twelve to fifteen hours. You should never, however, discharge an accumulator so much that its volts fall below 1·8 volts per cell. (3) Not if lamp was of very low candle-power; not more than 1 c.-p. and of good efficiency. (4) It would not be advisable to run motor and lights as well as there would be too great a drain on the cells; for very light work and a first-class motor speeded so as to allow it to run at a high speed with moderate speed of sewing machine, you could use the cells for this purpose. (5) Yes; we should consider this would be good plan, especially if the charging is done at low rate of current, as it is advisable to keep a gravity Daniell cell always discharging to prevent intermixing of the solutions and deposit of copper on the zinc block. You must remember that as all the current has to come out of the Daniell battery its capacity is a measure of what you can do. (6) On page 40 the rate of charging is dealt with for small cells on the basis of 6 amps. per sq. ft. of positive plate; page 46 deals with larger cells, but the basis of 6 amps. per sq. ft. of positive plate can still be considered a fair charging rate. It is simply a question of not exceeding the maximum charging rate and continuing the charge until the cells are full. Capacity per area of plate will be greater in proportion the larger the cell, different makes of cells and plates also vary. Chapter 3, perhaps, will help you, as it deals with plates not very much larger than those you contemplate using. (7) If you only use one negative to one positive plate you very much increase the internal resistance of the cell, as both sides of a positive plate are active; consequently, the cell is not so efficient as current from one side of the positive plate must travel a longer distance to the negative. A negative, on each side of a positive, should always be used. Up to a certain limit the capacity of a plate increases with its thickness, and the plate is also mechanically

stronger. You could try 3-16ths-in. plates. (8) Ten to 11 volts and current at the rate of 6 amps. per sq. ft. of positive plate (reckon both sides), if you exceed a certain rate the plates buckle and the cell becomes hot. (9) Yes; but a block is better; zinc for batteries must be of as high a degree of purity as possible to avoid local action—that is, small, wasteful currents which occur in impure zinc, and waste it away. Our advice is to avoid cheap zinc and deal with the firm who will guarantee to supply zinc of good quality.—*Shocking Coil*. (1) Terminals B and C were possibly intended to take a primary shock, but have not been connected. (2) Switch at H appears to be to switch in sections of the secondary coil so as to increase the shock, when you move it on to F and G you should get an increasing result or decreasing according to the method of connections. Perhaps the switch is not making contact or some of the connecting wires are broken. (3) Four volts, and 2 or 3 amps.; but you ought to be able to get shocks with a single bichromate cell of 1 pint size. (4) A cord from the regulating handle of the coil switch can be carried round a pulley on the spindle of the pointer, and kept tight by means of a weight at the other end of the cord, but you would only get three movements of the pointer; to get a constant and gradual regulation you require a sliding tube over the core of the coil as explained in our handbook. "Induction Coils."

[13,945] **Wiring for Small Workshops.** S. M. G. (Hunslet) writes: (1) I have seven Leclanchés which I want to use to light a 6-volt lamp. Please state how many cells are necessary for, say, five to seven minutes at a time. It only makes a dull light with the seven cells. (2) I have had the mains put in my workshop at a pressure of 200 volts. The meter and other requisites are already fitted. I have wired for lamps as per sketch, Fig. 1, A and B being main switches. Please sketch diagram for fuses and switches; two light with one switch on switchboard. (3) I also wish to do a little plating (silver). What resistances should I use if I connected in place of lamp M?

FIG. 1.



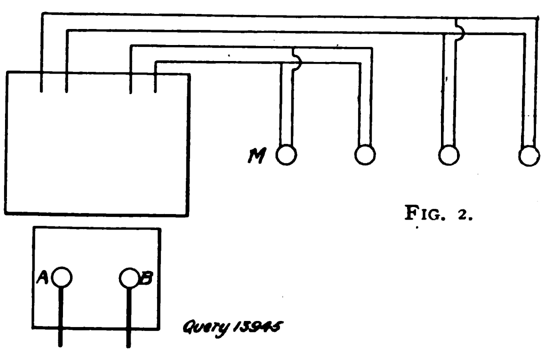


FIG. 2.

(1) A Leclanché cell gives rather more than 1 volt, say about $1\frac{1}{4}$ volts, so that seven cells in series should light your lamp very well, if it does not take too much current; we suspect it takes too much current or your porous pots and their contents are old and worn out. This type of cell cannot send any but an extremely small current for more than a minute or two, as it rapidly polarises. The remedy is to obtain a lamp which is made to take a very small current, and then if the cells still refuse to run it (provided they are in good condition) to obtain a second lot of cells and try them in parallel with the first lot, and then a third lot, if necessary, until you reduce the load per cell to an amount at whch they will maintain the light. Or make a non-polarising bichromate battery as described in our handbook No. 5. (2) See Fig. 2. (3) As far as we are aware the current supplied in Leeds is alternating current, and therefore useless for electro-plating unless it is rectified by means of a rectifier, or turned into continuous current indirectly by the use of an alternating current motor driving a dynamo. You must have continuous current for electro-plating and charging accumulators.

[14,686] **Motor for Small Boat.** F. P. (Kingston) writes: Will you kindly let me know what size motor (after the style of drawing, not reproduced) would be required to drive a "double-sculling skiff," and how many accumulators of the following size required to drive it? Size, 4 ins. by 3 ins. by 1 in.; 4 volts 0–5 amperes.

We cannot recommend a motor of this type for such a purpose. You require a motor to give at least $\frac{1}{4}$ b.h.-p.—$\frac{1}{2}$ b.h.-p. would be better for river use. A number of designs are given in our Handbook No. 10; the size would be 150 to 300 watts, series wound for 36 volts—say, eighteen accumulator cells, or three accumulators in series of the size described in Chapter 3 of our Handbook No. 1. The size mentioned in your letters is altogether too small. Of course, you can use a much smaller outfit just for amusement: but it would be of little practical use. You will find designs of motors similar to your sketch in back numbers of THE MODEL ENGINEER. Take the largest you can find, and have ample battery power. If you will select the design, we will advise you further as to winding and battery.

[14,690] **Motor for Electric Loco.** H. E. N. (Acocks Green) writes: I am making a small electric locomotive, and am fitting it with a 10-watt motor described in your Handbook No. 10, Chapter 6. I find, when putting a current of about 10 volts through, it will not start itself, but when you help it over with some force it will run, but it has not the slightest power. (1) I have made a $1\frac{1}{2}$-in. tripolar armature for it, and put $1\frac{1}{2}$ ozs. No. 22 wire on it. Is this enough? I have been recommended to try finer wire. (2) I have made the field-magnets $1\frac{1}{4}$ ins. wide, because of the larger armature, and they are not so thick as in your book, because I am cramped for room. Their chief dimensions are as on sketch. I have wound them with about 10 ozs. of No. 22. If you will advise me what to do on these matters, I shall be very much obliged.

(1) Tripolar armature will do very well. Perhaps you have connected the field coils in series with the armature. If so, this would account for the trouble, as No. 22 gauge wire would not be suitable for series connection. It should be connected in shunt to the brushes. A series winding is, however, the correct thing for traction purposes. We suggest that you re-wind the armature with No. 24 gauge D.S.C. copper wire, and the field-magnet with No. 18 gauge s.c.c. copper wire, connected in series with the armature. A battery to give about 6 volts 2 amps. should be used—say, two or three bichromate cells in series. Perhaps your present battery will not give enough current. To start a shunt-wound motor, one of the brushes should be lifted up for a moment whilst current is on. A series wound motor will start without this being done. You could try your present winding with the field coil in shunt. The battery must be able to give plenty of current—say, 3 or 4 amps.; 6 volts is ample pressure.

[14,508] **Overtype Dynamo.** T. T. (Montrose) writes: I desire to construct a bipolar overtype dynamo, with compound windings of 1 k.w. capacity at a pressure of 50 volts, an armature of 24 slots to be used (two windings in each slot), with 24-segment commutator; speed 1,500 r.p.m., armature to be made of approved laminations, field-magnets and pole-pieces to be cast iron. The questions follow upon which I wish advice. What diameter and length should armature be? The proper diameter of its shaft? And should paper be placed between the laminations? What should be the depth and width of the slots? The size (B. and S.) D.C.C copper wire, and the length of each coi (24 coils to be connected as follows), beginning 1 with ending 24, etc. The length and diameter of winding space on field-magnets about the entire length of magnet from base to top of horns? The sketch (not reproduced) shows about the style of magnet that will be used. How much of armature should the pole-pieces enclose—that is, what opening should exist at top of horns? The size (B. and S.) D. or S.C.C. wire for shunt, and the length for each spool, and ditto for the series winding? The dynamo will be belt driven from a gasolene engine, and of what h.-p. should this engine be? In making answer, please let your calculations be liberal, so that the thousand watts will be obtained with ease without extra demands upon the machine.

The query is beyond the scope of our query columns. We can give a complete reply through our Expert Service Department at a fee according to the information required. The fee for a reply giving the information asked for in the letter, without any drawing except an outline sketch giving proportions of field-magnet, would be 10s. 6d. We point out, however, that the rules given in the "A.B.C. of Dynamo Design," by A. H. Avery, price 1s. 2d., are applicable to other designs than the particular one selected by the author; and a two-pole overtype dynamo could be designed from them. The following would be approximate data to go upon:—Armature $4\frac{1}{2}$ ins. diameter by $5\frac{1}{2}$ ins. long, shaft 1 in. diameter at centre of core, magnet cores $3\frac{1}{4}$ diameter, of circular section wrought iron, wound with about 15 lbs. No. 19 B. and S. gauge s.c.c.; armature wound with 14 B. and S. gauge D.C.C. copper wire. Engine should give about 2½ b.h.-p. If magnet cores are of cast iron, they should have an area of about 20 sq. ins. each, and a greater weight of wire will be required.

[14,567] **Small Electric Lights.** S. A. H. (Rondebosch) writes: I would like to fix up an electric light, and not being in a position to charge an accumulator, nor get one charged, I shall have to work it with cells. (1) Will you kindly let me know what class of cell, and how many, will be required to light about a 1-c.p. lamp, lamp to be in use for not more than ten minutes in every twenty-four hours? I don't want a bichromate battery. (2) When buying the lamp, what kind shall I have to ask for? (3) What gauge wire will be required for connecting, battery being about 10 ft. from lamp?

(1) The best cell is the constant pattern bichromate, but if you will not have this, we recommend you to obtain copies of THE MODEL ENGINEER for April 9th and 16th, 1903, and try the modified "tin-pot" battery, which is very fully described in those issues. Failing this, try the gravity Daniell pattern, as described on page 59 of our Handbook No. 22. (2) When buying the lamp, you must state the voltage it is to be worked with its candle-power. Pay a good price and get a good lamp. You will do well to get a spare one in case you burn out the first one. Six volts would be a convenient pressure to work at. Such a lamp of 1 c.p. would take about ½ amp., if of good efficiency. (3) No. 22 gauge wire.

[14,538] **Spark Coil.** C. H. (Kentish Town, N.W.) writes: Could you explain why my ½-in. spark coil which I have made will not spark at secondary terminals, even at 1-32nd in apart? I can get a fair shock from secondary coil, but not as strong as that from the primary coil—ought this to be so? I have got two bichromate batteries and one dry cell, which I used for trying to spark the coil, and I find I get a stronger cracking spark at the primary terminals (by making and breaking circuit with wire) without dry cell. Could you explain this? I may state that all connections are all right. For the condenser I have twenty-five sheets tinfoil, 3 ins. by 1½ ins., as you say in your handbook, interleaved with waxed paper, and this I have got doubled as sketch, so as it wil fit at bottom of coil case; this, connected up, seems to make no difference to the violent sparking at contact-breaker. Also, I may state, the secondary winding is perfect in insulating, but not wound on quite level. This, I think, ought not to interfere with the sparking so much as not to get one spark at least 1-32nd in. in length. Also will you, when replying to this letter, give me sketch of connections for ½-in. spark coil, with no trembler blade, with four terminals and condenser?

The shock from the secondary of a ½-in. spark coil should be absolutely unbearable—in fact, should not be voluntarily taken. A dry cell is not suitable for working such a coil—it should not be used. The two bichromate cells, if of fair size—say quart size, or larger—should work the coil very well. Perhaps your cells are not in proper condition. Try the coil with the condenser laid on the flat. Perhaps you have short-circuited it. If it still does not give any better result, make a new one; you may have spoilt the present one when bending it. A good condenser is absolutely necessary. If you still fail, the fault may be in crossed turns in the secondary winding, which short-circuit one another. A few such turns would be most detrimental. *Re* connections, you merely join the primary and secondary to their respective sets of terminals, and connect the condenser across the break, as Fig. 9, page 19 of our handbook. The break can be placed anywhere convenient.

The News of the Trade.

The Editor will be pleased to receive for review under this heading samples and particulars of new tools, apparatus, and materials for amateur use. It must be understood that these reviews are free expressions of Editorial opinion, no payment of any kind being required or accepted. The Editor reserves the right to criticise or commend according to the merits of the goods submitted, or to abstain from inserting a review in any case where the goods are not of sufficient interest to his readers.]

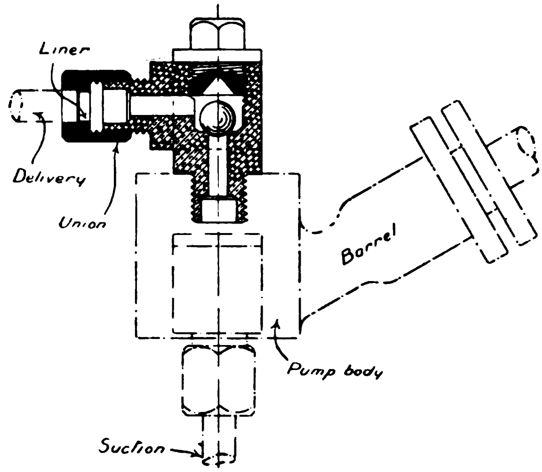
** Reviews distinguished by the asterisk have been based on actual Editorial inspection of the goods noticed.*

Change of Address.

Messrs. Archibald J. Wright, Ltd., inform us that they have removed from Islington to larger premises. Their new and only address is now Leyton Green Road, London, N.E.

*An Interchangeable Valve Box for Pumps.

To obviate many of the difficulties experienced in making up model force pumps from castings, Mr. Stuart Turner has designed a neat self-contained valve box and valve which, by simply exchanging the union, can be used for either the suction or delivery side of the pump. As the accompanying illustration shows the pump barrel casting having been drilled for the plunger, two tapped holes at right angles to each other are all that are necessary to attach the valve boxes and complete the pump. In the sketch the delivery is shown in section on the top of the body, the suction valve box going in at the side facing the reader. These valves, which may also be used for other purposes where a non-

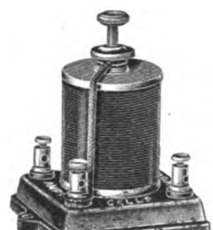


STUART TURNER'S INTERCHANGEABLE VALVE BOX AS APPLIED TO A MODEL FORCE PUMP.

return valve is required, are made to suit a 3-16ths in. diameter pipe, and can be obtained at a very reasonable figure from Mr. Stuart Turner, Shiplake, Henley-on-Thames, or from Messrs. W. J. Bassett-Lowke & Co., Northampton.

*Automatic Cut-in and Cut-out.

The illustration we give herewith represents Mr. A. H. Avery's new and improved form of automatic "cut-in and cut-out," one of which has been sent to us for inspection. The advantages of such a compact and efficient instrument are obvious to those who have to deal with accumulator charging to any extent. When once adjusted, this instrument automatically closes



MR. A. H. AVERY'S AUTOMATIC CUT-IN AND CUT-OUT.

the circuit when the charging pressure rises to the correct value, and similarly breaks the circuit should the voltage fall for any reason. Adjustment is performed by tightening or slackening of the milled-head screw. Prices and further particulars may be had of Mr. A. H. Avery, Fulmen Works, Tunbridge Wells.

New Catalogues and Lists.

The Charles Cohen Tool Co., 34, Barbican, London, E.C. —The new illustrated price list which we have received from this firm should be of interest to all model engineers and electricians, as it deals with watch and clock makers' tools and materials, which are specially suitable for model making; also tools for electricians, scientific instrument makers, model makers, etc. Amongst the many items dealt with may be mentioned the variety of cabinets, chests, and bench trays for holding tools and small accessories; watchmakers' sets of punches, drills and drill stocks and turns, riveting tools, anvils, clamps, pliers, nippers, files and burnishers, screwplates, stocks and dies, sliding gauges, calipers and compasses. The list also includes hand and bench vices and drilling machines, small lathes and accessories, hand and circular buffs, emery wheels, circular and hand saws, and frames for same. About 2,000 illustrations are contained in the list, and a distinct advantage will be found in the fact that the price of each size of every article is given. The list will be sent to any reader post free for six penny stamps.

The Editor's Page.

A READER whom we recently advised with regard to some alterations to his lathe, writes us as follows :—"I am able to congratulate myself on two things—firstly, that I obtained your advice, and secondly, that I acted up to it as far as I was able in the time at my disposal. I have fitted a new tool-steel mandrel to my lathe, and had the headstock re-bored. I was surprised when I took out the old mandrel of mild steel to find how little wear there had been, and I think I can safely say that, except for possible accidents, my new mandrel will last for my life time. I have run a ¼-in. hole through the mandrel (9½ ins.), which took me 5½ hours, which was considerably less than I expected : and was also very pleased to find that the drill emerged exactly in the centre of the end. I cut the thread on the nose, and also for the lock-nuts, and they are both quite successful (though I say it), and though they were almost my first attempts at screw-cutting. I have also made a pair of taps to fit nose, and bored out a face-plate and two chuck plates. I had a taper reamer (Morse) broken in half, the larger end being ⅜ in., so I ran that into the end of the mandrel, and that seems to work all right for centres, though perhaps a larger hole would be better. I think I can now consider that the headstock is practically complete, though I shall have question or two to ask you some time soon. I had my driving wheel bored out to inch from ⅝-in., and it now works on a straight shaft with outside cranks instead of on a pin—a great improvement. The shaft runs in ball bearings obtained from an ancient tricycle. The slide-rest still remains too high. The top plate is full ½-in. thick, but I am afraid to take it down, as I find that when a tool is screwed down the slide does not work so easily as when there is no tool in, and I am afraid of making it any worse. I was much interested in the tool-holder, which appeared in the *M.E.* about three weeks ago, but I am afraid that with my slide-rest it is quite impossible. Northcote, in his book on 'Lathes and Turning,' is very down on amateur-made lathes ; but mine has been inspected by a professional and found quite satisfactory. My only regret is that it is now finished, and consequently I do not know what to do." We feel that practical letters of this kind in which our readers discuss their workshop difficulties and the means they have adopted to overcome them are always of interest, and we should be pleased to see more of them. Our regular "Practical Letters" column is always open for such correspondence, and we hope that full advantage of this section of our paper will be taken by our readers during the coming winter months for the discussion of matters of mutual interest. We are somewhat struck by our correspondent's last remark, but we presume he does not wish us to take it too seriously. There are surely enough models described in our pages to enable him to keep his lathe going as hard as even he could wish.

Answers to Correspondents.

M. W. B. (Atherstone).—If you can take a photograph of the lathe, we should be pleased to have it. Glad to hear you have been so successful.

J. N. F. S. (Newcastle-on-Tyne).—(1) There are several good books on the slide rule. See "The Slide Rule," by C. N. Pickworth, price 2s. 2d. post free from this office. (2) Yes. The 84 was a printer's error. It should have been 24. (3) We will try and obtain some further particulars of water motor and dynamo.

H. T. (Aston Manor).—You are not sufficiently precise Give fuller details, and comply with our rules.

A. L. (Hailsworth).—See some text-book on applied mechanics.

Notices.

The Editor invites correspondence and original contributions on all amateur mechanical and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected or not, and all MSS. should be accompanied by a stamped addressed envelope for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

This journal will be sent post free to any address for 13s. per annum, payable in advance. Remittances should be made by Postal Order.

Advertisement rates may be had on application to the Advertisement Manager.

HOW TO ADDRESS LETTERS.

All correspondence relating to the literary portion of the paper, and all new apparatus and price lists, &c., for review, to be addressed to THE EDITOR, "The Model Engineer," 26—29, Poppin's Court, Fleet Street, London, E.C.

All correspondence relating to advertisements and deposits to be addressed to THE ADVERTISEMENT MANAGER, "The Model Engineer, 26—29, Poppin's Court, Fleet Street, London, E.C.

All subscriptions and correspondence relating to sales of the paper and books to be addressed to Percival Marshall & Co., 26—29, Poppin's Court, Fleet Street, London, E.C.

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Contents.

[*The asterisk* (*) *denotes that the subject is illustrated.*]

THE
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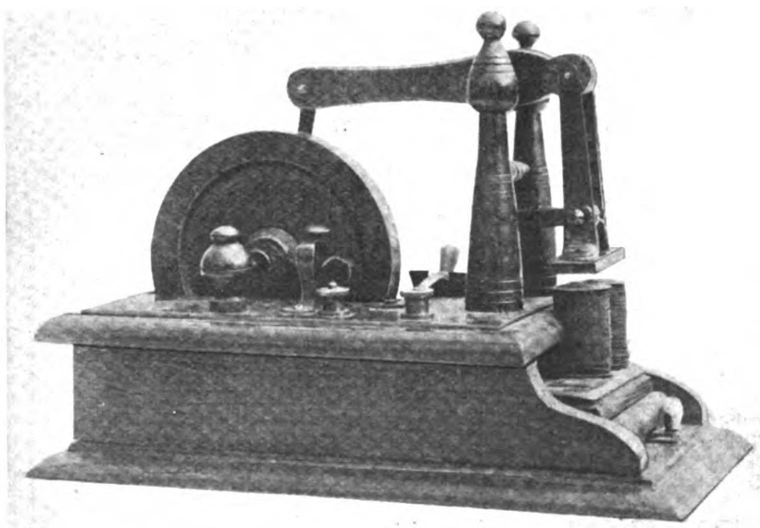
And Electrician.
A JOURNAL OF PRACTICAL MECHANICS AND ELECTRICITY.

EDITED BY PERCIVAL MARSHALL, A.I.Mech.E

Vol. XIII. No. 234. OCTOBER 19, 1905. PUBLISHED WEEKLY.

A Model Electric Beam Engine.

By C. M. Walter.



Mr. C. M. Walter's Model Electric Beam Engine.

THE photograph herewith shown is that of a model electric beam engine which was made by my father and myself a few years ago. The idea I got from the *M.E.* Handbook No. 8, entitled "Simple Electrical Working Models." The wooden parts—consisting of the bed, flywheel, beam, beam supports, and bearing pedestals—are all made of oak, the flywheel beam supports and bearing pedestals being turned on the lathe. After finishing the model, another eccentric set exactly opposite to the one already on was attached to the shaft, so that by moving a lever, which is attached to the brush, the brush is moved from one eccentric to the other, and in this way the engine is reversed. The beam is balanced so as to prevent the engine stopping on dead centres, and if, when running in one direction, it is suddenly reversed after coming to rest, it invariably starts in the opposite direction without any assistance whatever. I may add that the engine was almost entirely built up from work shop odds and ends, the ivory handles on the switch and reversing levers being turned from a broken billiard ball, and the oak for the woodwork being supplied by an old gate post; the only parts requiring to be purchased being the wire for winding the magnet bobbins, and two brass terminals. The engine, when worked from a small 4-volt accumulator, attains a speed of 1,500 to 2,000 revolutions per minute, and is, I think, well worth the trouble of making.

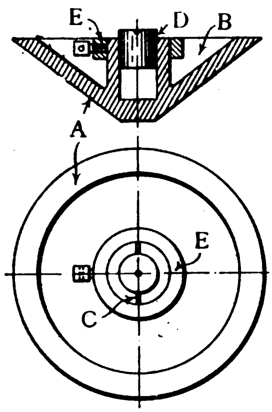
Workshop Notes and Notions.

*[Readers are invited to contribute short practical items for this column, based on their own workshop experience. Accepted contributions will be paid for on publication, if desired, according to merit. All matter intended for this column should be marked "*WORKSHOP*" on the envelope.]*

A Centre Bridge Piece.

By E. FITZGERALD.

Very often it is necessary to scribe a line round a hole, such as the hitch line for the studs in a cylinder flange. The usual way is to fit a bridge of hard wood, and mark the centre on this. In the sketch herewith a centre is shown that will answer the place of the wood bridges used.



SECTION AND PLAN OF A CENTRE BRIDGE PIECE.

The cone A is turned from $1\frac{1}{2}$ ins. mild steel rod, and recessed at B (section). A $\frac{1}{4}$-in. hole is drilled in the central piece, and is split with a metal saw, as shown in plan at C. A piece of $\frac{1}{4}$-in. rod $\frac{1}{4}$ in. long is square-centred and fitted to the central hole, as shown at D (section). The square centre is used for the centre of the desired circle. Of course, the centre of the $\frac{1}{4}$-rod should be true with the cone. A ring (E) will be necessary to keep the piece D in any desired position. If a larger cone is needed, it should be cast iron, as cutting it from a steel rod will be rather hard work on a foot lathe.

A Finely Adjusted Marking Gauge.

By JOHN HEYES.

The following is a description of a marking gauge with a fine adjustment. A steel rod 5-16ths in.

FIG. 1.

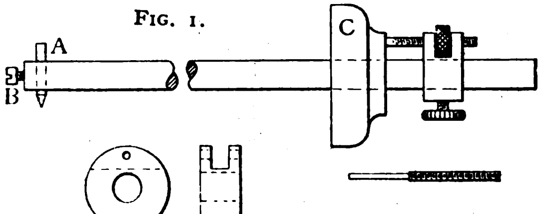


FIG. 2. FIG. 3.

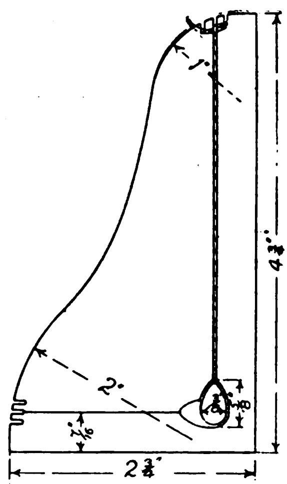
DETAILS OF A FINELY ADJUSTED MARKING GAUGE.

diameter has a 1-16th-in. hole drilled at one end, as shown. This marker is secured with a set-screw B. A piece of brass $1\frac{1}{2}$ ins. diameter, $\frac{3}{8}$ in. thick, is turned to shape (shown C), and a hole drilled through centre to allow it to be just a sliding fit on rod. A disc of brass is then filed out to shape (shown in Fig. 2), and a hole drilled (to fit the rod on which it has to slide) through the centre; the hole for the set-screw must also be drilled and tapped. The sliding block and the fixed block (Fig. 2) must be put on the rod tight together, and a hole somewhat smaller than the adjusting screw D drilled right through them both, to be afterwards enlarged through Fig. 2 to allow for adjustment, the adjusting screw to be of the shape shown in Fig. 3, the thinner part to pass through the sliding block, and riveted and soldered in a countersunk hole in face of sliding block. A knurled nut to fit screw, and also fit nicely in slit of Fig. 2, must be made. Procure a set-screw with a large knurled head for the fixed block, and the result will be an inexpensive and useful tool.

How to Make a Plumb Square.

By M. J. BOALER.

Procure a piece of saw-blade or steel plate, and mark it out and cut with a chisel to the dimensions shown in the sketch herewith. The holes for the plumb-bob being drilled and filed out to just clear the same. Now get the outside edges perfectly square with one another. If the other two squares have been made as described, by putting all three on a straight-edge alternately in pairs, the slight variation from the true square can be easily rectified



A PLUMB SQUARE.

by noticing when the edges touch one another, being very careful to file the metal off where it is required. To complete the plumb square, make three little notches (as shown) with a saw, to fix the string with. Scribe a line through the middle notch quite parallel to the edge of the square, and treat the other edge in the same way. The square may then be used both ways, which will be found handy in confined places. The plumb-bob may be made of lead by making a mould of plaster of Paris with a pattern larger than the finished size. A piece of straight bright rod being placed in the mould so as to pass as nearly as possible through the centre of the casting. The size of the hole should be just large enough to admit the string to be used. The pattern should be a cylindrical piece about 4 ins. long, so that it can be turned in the lathe, using the hole in the casting as the centre. This ensures the hole being in the centre, and the plumb hanging vertical. Or the plumb-bob may be made of some other metal—iron or brass—just as suits the convenience of the maker. This instrument will be found very handy in getting pieces of machinery vertical where the level cannot be used.

A Pocket Slide Gauge and Vernier.

By "Split Pin."

The design shown in Figs. 1, 2 and 3 is for an inside, outside, and height sliding gauge, and is intended as a suitable size for a pocket tool. The body piece shown in Fig. 2 is cut out to form from

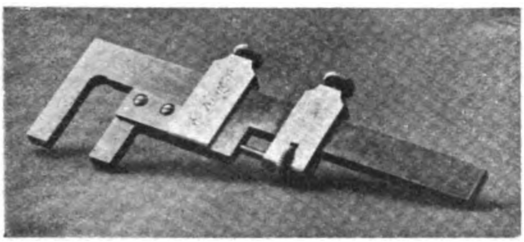


Fig. 1.—The Complete Slide Gauge and Vernier.

cast steel. Fig. 1 shows the finished tool when assembled. In Fig. 2 is shown the sliding and the back saddle, with the vernier plate secured to it by the two small screws. These saddles, when built up, should be a nice sliding fit on body-piece. The two small gibs shown in Fig. 2, and an enlarged view in Fig. 3, fit in the saddles, and slide along top

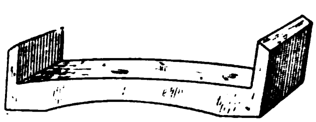


Fig. 3.—Jib for Slide Gauge.

of bar, and act as a spring to keep the saddles rigid when being adjusted to different positions by means of the knurled nut and the screw, after which they are firmly secured by the knurled-headed pins on top. The gibs should be made from hardening steel, and tempered. The centre part of the sliding surface is filed away, which ensures them bedding only at the two ends. The two jaws of the gauge must be hardened, and ground parallel, and of even thickness. The outside end of main bar must be ground right along, as this forms the base of gauge when used for taking heights. If the tool is completed as a vernier, the main bar and the vernier plate must be graduated.

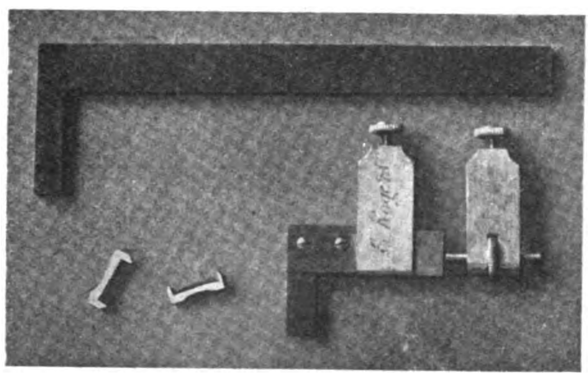
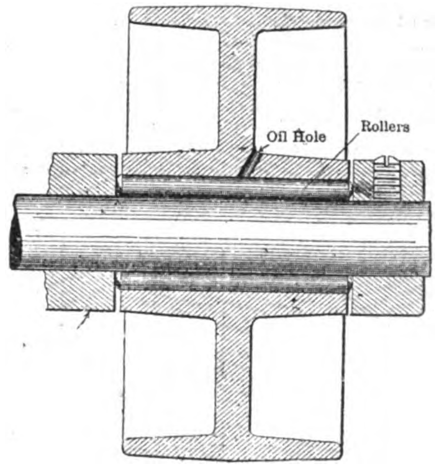


Fig. 2.—Details of Slide Gauge.

Roller Bearing Loose Pulleys.

By F. C. Mason.

By accident, chiefly, I solved the loose-pulley problem four years ago. I was designing a wood planer or sticker. I had to have tight and loose pulleys; the pressure on the bearing, I would say, was about 50 lbs., and the speed of the pulley about 7,000. The bearing was 1 in. diameter by 4 ins. long. It was where all the dust would settle on it most of the time. For an experiment I made the



Section through a Roller Bearing Loose Pulley.

loose pulley like the sketch, which is practically self-explanatory. This pulley has done constant service for the past four years, and is as good as ever. After having used this scheme two years, every time we have had trouble with a loose pulley, we have converted it into a roller-bearing pulley. I have never found a pulley with the hub so small that I could not bore it to take a roller ¼ in. diameter. I prefer to make them ⅜ in. if the hub is large enough to stand it. I make the rollers of drill rod with the ends slightly rounded. I can convert a standard pulley in this way more cheaply than I coud re-babbitt and re-bore it.—*American Machinist.*

A Small Pelton Water Wheel.

By G. Trevor Williams.

In building this model I had two objects in view—first, to produce a machine capable of giving out a moderate amount of power; and, second, to do so at a minimum of expense. On the whole I consider that I succeeded tolerably well, as the total cost only amounted to about a shilling, and the power developed appeared considerable, though I have not yet had time to measure it.

Figs. 1 and 2 show the general arrangement. The wheel and shaft were the only parts purchased. The wheel, which is of cast iron, I picked up for 6d. at an old iron stall. The shaft is of cast steel. The bearings are of brass tubing; driven a tight fit into the wooden casing and strengthening piece; they are oiled through thin brass tubes (not shown in the drawings). The casing is of wood, and is fixed with screws so that it can be easily opened. It has two coats of waterproof enamel inside, as have also the wheel and cups. Outside it is stained and varnished, and covered round the top and ends with thin copper sheeting.

The cups, of which there are twelve, at first presented some difficulty, as I did not wish to go to the expense of castings, besides not having proper tools to machine them. Eventually I cut them out of thick sheet tin to the shape and dimensions of Fig. 3. On bending these pieces at the dotted lines and soldering up they made quite strong and serviceable cups. Four holes were drilled in the curved side of each cup, and they were then riveted to the wheel.

The nozzles I use are of hard-drawn glass. They are quite a success, and I can assure other amateurs who find the proper metal nozzles too awkward to make, that if they try glass ones they will find that they are able, after very little practice, to turn out a satisfactory article. A good way to fix them, and yet allow of easy removal, is rather hard to find, but my method of using a large cork, though somewhat crude, is nevertheless quite practicable.

The method of making these nozzles is as follows:—Procure a piece of hard combustion tubing of a suitable size and length for two nozzles (in my case, $\frac{7}{8}$ in. by about 8 ins.). Heat this, gently at first, for 1 to 2 ins. of the middle in a large Bunsen or blow-lamp flame; revolve it continuously, and when almost red hot, remove quickly from the flame, and draw out with a long steady pull. The two nozzles should then be cut off by marking with a sharp three-cornered file, and breaking between the fingers. The tube will be found to break off quite nice and round. The nozzles are then complete.

The knack of getting the required angle of taper comes only by practice, but the following hint will act as a guide to individual experiments. To get a small angle of taper, heat more of the tube and draw out slowly; for a greater angle, heat less of the tube and draw out sharply.

These nozzles are, of course, very easily broken, but they are also very easily made, and as it is simplest to make two at once, there is always one to fall back on in an emergency. Different sizes and shapes can be drawn by the same method, so that an interesting field of investigation to determine the most efficient shape under varying conditions is open to any one willing to go to a little trouble. I have not yet been able to test the model, but I shall do so before long.

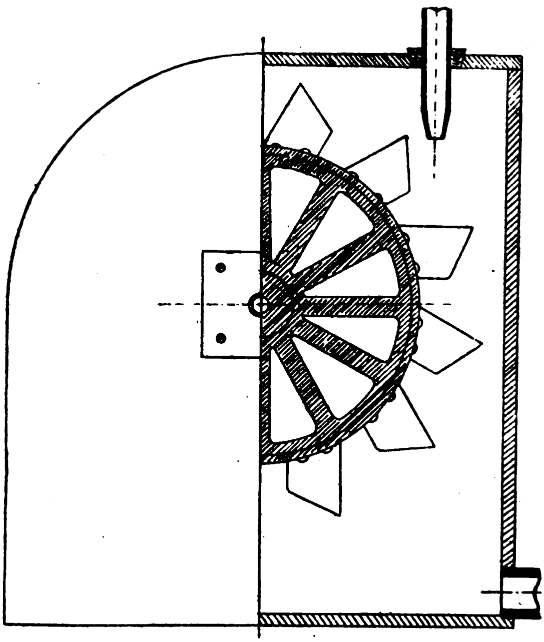


Fig. 1.—Part Longitudinal Section.

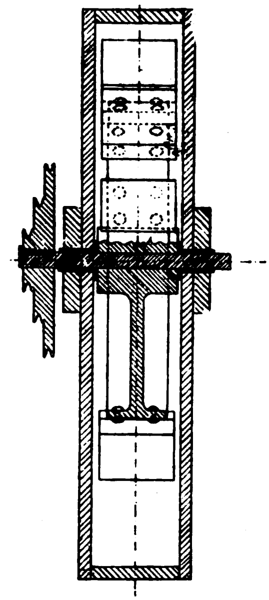


Fig. 2.—Cross-section.

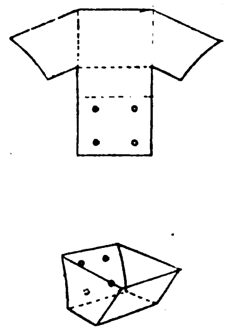


Fig. 3.—Detail of Bucket.

A SMALL PELTON WATER WHEEL.

The Latest in Engineering.

A New Monorail. — In a recent issue of *l'Industrie Electrique* there is a most interesting account of some experiments undertaken during the autumn and continued last spring on an electrical letter and parcel post tube, designed to do for the country what a pneumatic post does for towns. The speed is to be 156 miles an hour, and the least radius of curvature in the track is to be about 1,640 ft. The experiments have been conducted in a circular tube track built of timber of this radius, and the possibility of such high speed was fully demonstrated. The vehicle is 28·8 ft. long, by 3·5 ft. wide, and is divided into five compartments, of which the middle one is for letters and parcels, those next to it contain the motors, and the end compartments, which are parabolic in contour, are given up to the braking and lubricating apparatus. There is only one running rail, with a guide rail opposite to it gripped by two rollers. The plane of the rails is inclined to the vertical according to the curvature of the track, so that the pressure may always be normal to the running rail. This, of course, implies a constant speed, which is secured by the use of polyphase induction motors. Since no conductor travels with the car it is important that the speed be maintained automatically and that the braking arrangement should be also automatic. The one follows from the use of the induction motors, and from the fact that the main resistance is air pressure, which is a function of the speed; the other is arranged for by a wind resistance brake which is brought into operation by the cutting of a wire when the car passes a knife fixed in the tunnel. Of course, the current is cut off when it is desired to stop the car. The voltage is 1,000 at a periodicity of 40. Current is collected from three wires stretched on insulators and kept tight by springs. It was found that the speed rose in five minutes to its maximum, and in the same time the car came to rest on current being cut off; but the period of acceleration could be greatly reduced by diminishing the periodicity at its beginning, and that of retardation by the use of the brakes. Forced lubrication is effected by oil pumps driven by a continuous current motor, which takes its current from a set of accumulators. Unlike Mr. Behr's monorail, this one does not profess to carry passengers; it is more mechanical in its design, since the angle of the rails is tilted according to the curvature of the track, and, running in a tube, it is not liable to the danger of cattle straying on to the track. The motor is curiously constructed with the rotor outside the stator, and the power is transmitted by belts to the driving wheels. The experiments have been carried out by the Société des Chemins de Fer Electro-Postaux.

Either-Side Brakes. — The need of a simple and effective either-side brake for railway wagons has long been generally recognised by the great railway companies, and quite recently Colonel Yorke, of the Board of Trade, and representative officials from the various trunk-line railways, witnessed trials at Liverpool of several devices, none of which, however, fully met the difficulty of exercising gradual pressure on the brake blocks. A Darlington engineer (Mr. J. Noble, of Brook Terrace) has just provisionally protected a brake which, whilst complying with all the Railway Clearing House conditions, differs in action from the majority of brakes, inasmuch as the brake-block pressure may be gradual, and to relieve that pressure it is not necessary to take the brake entirely off, as is the case in most either-side brakes. The new mechanism is readily affixed to existing wagons, is safe and easily operated, and the major portion of the existing brake rigging is retained. The operation of hand levers is the same as in all existing independent brakes. By simply lowering and raising the hand-lever block pressure is controlled; whilst to bring the vehicle to a standstill the lever is pressed down hard, and automatically remains in that position until released. The hand levers, when in the "off" position, are supported so as to resist direct downward pressure; but when slightly lifted, and then depressed, the brake is applied with any desired degree of force, and remains in position. The brake levers are arranged either "cross corners" or "right-hand both sides," and do not in any way interfere with the working of bottom doors. One special feature of this brake is that it is especially adapted for braking not only the ordinary 10-ton wagons, but also the 20-ton and 30-ton high-capacity steel wagons. The inventor is now perfecting a working model—quarter size—on which to demonstrate the efficiency of the brake to persons interested.

A Turbine Locomotive.—According to the *Daily Telegraph*, Mr. Hugh Reid, the managing director of the North British Locomotive Company, has patented a self-contained electric locomotive in the form of a miniature central station on wheels which will generate its own current by means of a boiler and a condensing Parsons turbine; it is somewhat on the plan of Heilmann's experiment, with the difference that the latter used Willans high-speed engines in the place of a turbine. In addition, Mr. Reid proposes to use an air-cooled condenser of somewhat novel design.

Submarine Signalling.—Some interesting experiments in submarine signalling were made recently in connection with the outward-bound Cunard steamer *Lucania*. The Mersey Docks and Harbour Board have had the north-west lightship in Liverpool Bay fitted with a submarine bell, which was sounded when the *Lucania* approached. The bell was heard distinctly on the navigating bridge of the *Lucania* when she was 9½ knots from the light-vessel. The achievement was considered highly satisfactory, inasmuch as the *Lucania* approached the light-vessel almost bow on and at a high rate of speed. Had she been slowed down, or if the bell had been abeam, or somewhere nearly abeam, the vibrations from the bell would probably have been audible by means of the special apparatus with which the *Lucania* is fitted 12 or 15 knots away. In view of the success of the installation on board the *Lucania*, other Cunard steamers are being equipped with the submarine signalling apparatus, the *Saxonia* having been already fitted.

Model Railways.

No. XV.—A Beginner's Model Railway.

By Rev. T. B. Parley.

In writing this short account of my model railway, I wish to make it quite clear that, as I am a mere tyro at mechanical work, and have had no mechanical training whatever, it is evidently quite possible for anyone with a decided taste for railways and locomotives, and who is not afraid of worrying over details, to construct such a model that will bear a respectable resemblance to the real thing.

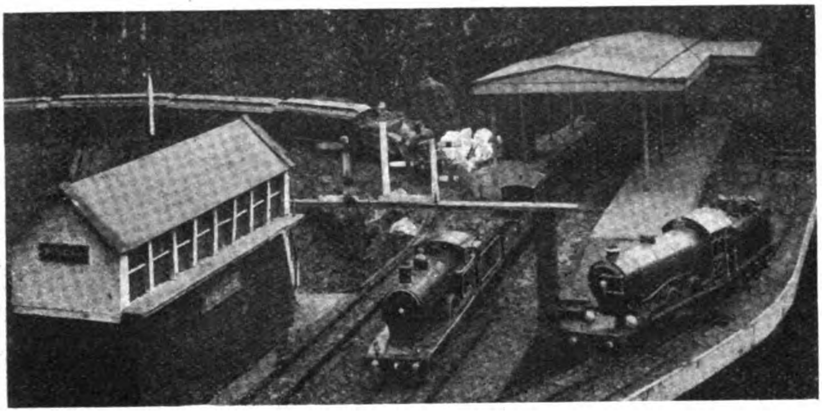


Fig. 1.—View of Signal Box and Station.

I was fortunate in having a strip of kitchen garden that would allow an elliptical railway of 42 ft. extreme length. The ground, however, sloped down very considerably, and so the earth which I removed from the high part formed the embankment of the lower side, over a foundation of broken bricks, oyster shells, and general rubbish.

There was an old broken-down summer-house, through which the line had to be taken, and so, with the help of a mason, who knocked appropriately shaped openings in the two walls, a tunnel was very successfully contrived, which had the great advantage of not being underground, as, in case of disaster, the top could be taken off and the rolling-stock got at.

The track on the straight portions of the line was at first constructed of the ordinary hollow tin rails soldered to tin sleepers, and the tin sleepers fixed to continuous boards about 5 ins. wide. The gauge of the railway was 2½ ins., this being a convenient size.

Fig. 2.—The Model N.E.R. "Atlantic". Loco.

The continuous boards were nailed at intervals to strong uprights driven into the earth; but, of course, in spite of their being painted (lead or slate colour), in time the tin rails rusted right through, and would not bear the weight of the engines. So I took them all up, and procured at an ironmonger's, strip iron, ½ in. by 3-32nds in.; cut this into convenient lengths, and soldered angles of copper 9 ins. apart, and nailed them down to the continuous boarding. This answered very well, and stood the wet and damp excellently, and only required, every now and then, a little filing on the surface to smooth the track.

The semi-circular ends of the track I laid on square blocks of wood, soaked in tar, 6 ins. by 6 ins. by 4 ins.; these, well bedded in the earth, stood the strain of the rails, being bent round to the necessary curvature, and never gave way in the least degree.

It was particularly easy making the points and crossings in the strip iron; the only tiring work consisted of filing the points, so that they pressed perfectly true against the stock rail. I perhaps should add that I *did* get rather tired of soldering the chairs on, as they were fairly numerous in a line 106 ft. round, with many points and crossings.

The terminus was approached by a branch from the main line, and originally possessed two passenger roads and one side road for engines getting up steam. The photograph (Fig. 1) shows the simple construction. The large cabin at "King's Cross" was made of a suitably shaped wooden box. The roof was tin.

"York" station was on the curve at the other end of the ellipse, and simply consisted of pieces of broomstick cut into equal lengths, driven into the ground, and a simple roof fixed over—similar to "King's Cross." The roof was a little more difficult to do, as the station was built on the curve.

There was also "Grantham" on one of the straight pieces: that is shown in the photograph (Fig. 2), with the N.E.R. "Atlantic" No. 532 standing there (this is not quite the place for such an engine, but one must not be too particular).

"Abbott's Ripton" was a small wayside station, with a cabin and siding.

The original engines consisted of two "Black

Princes" (L. & N.W.R.). These ran very well on the tin rails (whilst new), but being only small engines, one could not expect much power; and so I began to wonder whether it was possible for

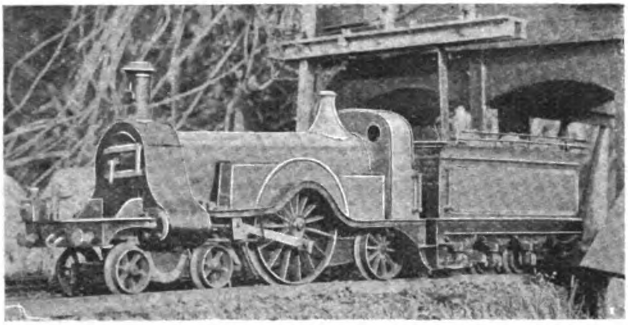


FIG. 3.—MODEL G.N.R. LOCOMOTIVE.

one who had had no mechanical training to produce a loco that looked like a loco, and not a heterogeneous collection of wheels, cranks, and pipes.

My choice for a start was, of course, one of Mr. Stirling's 8-ft. bogie engine (G.N.R.); and so I set to work on No. 1007. I made my drawings, procured two cylinders, and a pair of driving wheels 4 ins. diameter. Being absolutely a first attempt, there were some things I could not do, as I had not the tools. A friend very kindly fixed the wheels on the axles, and fixed the boiler up for me, etc.

The frames consisted of 1-16th-in. brass sheet, and I drilled these out—and a tedious job it was; I never did it again, but chiselled them out. I fixed the cylinders in (¾ in. by 1½-in. stroke), cut the connecting-rods out of brass.

The foot plates were of thin copper, fixed to the main frames by angles riveted on. The boiler was a plain piece of seamless copper tubing, 2 ins. diameter, with five ¼-in. copper water tubes let into the bottom of the boiler, the down-comer forming the firebox end, and fitting in nicely between the frames.

I soldered two plates of thin copper—one on each side of boiler to confine the flames from the five-wick lamp, which was hung underneath. The smokebox was also of copper, soldered up, and looked very realistic.

The most difficult job was getting the boiler low enough down to give the true G.N. effect. I worried here and there, and cut a bit here and cut a bit there, until I got it right down, so that the eccentric just cleared the outside water tubes. The cab fittings consisted of one of Stevens' regulators and two cocks. The bogie splashers I had to fix on the inside frames, and they moved, of course, with the bogie. The real way would have been impossible on such a small radius curve, as the front of the engine swings right over the bogie wheels.

The safety-valve cover is of wood, and is just placed over a cheap form of safety-valve and water-filler combined. The tender is built on a wooden foundation, and has two 4-wheel bogies. It contains a tank for the methylated spirit, which runs through a thin rubber pipe, controlled by a tap, to the lamp. I fixed a piece of fine glass tubing into the lamp, and thus can see at once the height of the spirit. The engine, which is shown at Fig. 3, ran at a great rate on her trial trip, and keeps in very good order, and will pull two or three carriages round the line once.

The next engine I set to work on was the N.E.R. "Atlantic" type No. 532 (the first of her class). The model is shown in Figs. 2 and 4. Here, of course, with small driving wheels, we had abundant boiler capacity. The wheels of this engine were taken from the old "Black Prince," which came in very handy. The cylinders are 1 in. by 1¾ ins. stroke, fed by a boiler 3¼ ins. in diameter, 9 ins. long, with three water tubes, fired by a lamp underneath.

If I ever rebuild this engine, I shall have a Smithies' boiler, as the present one takes about fifteen minutes to get up to 40 lbs. pressure, and then does not last very long. However, she pulls my four E.C.J.S. corridor carriages shown in the illustration (Fig. 5), each 26 ins. long, twice round the railway; so I must not grumble. She runs fast with the train, but by herself goes at a terrific speed, and it is a wonder to me how she keeps the rails on the curved ends of the track, which are 7 ft. 6 ins. radius (outer rail raised ½ in.). There are many details in this engine that are made of very homely materials. The dished cylinder cover front ends are made out of the cymbals of a toy tambourine. The chimney—publish it not in Gath—was made out of one of the candle sconces of a Broadwood grand piano. The mouldings of this were so much like the real thing, that the temptation could not be resisted. The flutings, or H section, of the connecting-rods were made out of the homely square skewer soldered on; the lamp out of an old cycle pump, etc. The Westinghouse

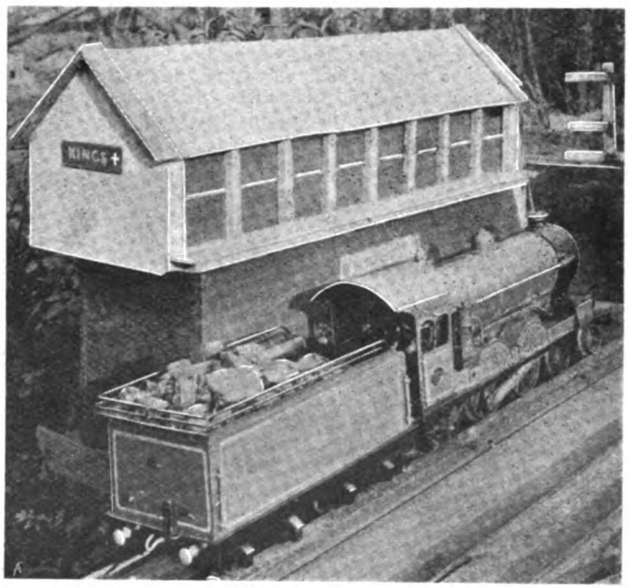


FIG. 4.—ANOTHER VIEW OF THE MODEL N.E.R. LOCOMOTIVE.

pump arrangement seen on the side of firebox consists of two cylinders, into which oil is put; it then flows through the small pipes seen, and lubricates the slide-valve spindles. There is also an oil cup between the splashers fixed to pipe by which the eccentrics are lubricated. The blower pipe is seen also running along the boiler side; this really works by means of a cock in cab, and, of course, although it does not induce the fire, it produces a splendid jet of steam from chimney.

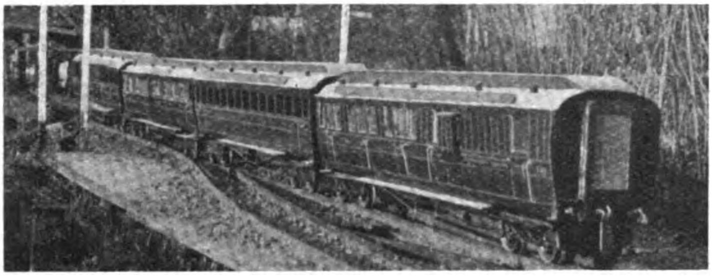


FIG. 5.—MODEL E.C.J.S. CORRIDOR COACHES.

Cab fittings consist of two bib cocks, pressure gauge, blower, regulator (Stevens'), and an arrangement consisting of a cock let into the steam pipe, into which oil is put, which effectively lubricates the cylinders when steam is turned on. The tender is fitted with two four-wheel bogies. It contains the tank from which the spirit flows to the engine lamp. The coal rails consist of ordinary tinned wire soldered on to the coping of tender.

The third engine was an experiment, and is a copy of the L. & N.W.R. new "Precursor" type. There is only one cylinder, geared 3 to 1 to the driving axle. The steam is produced in a Smithies' boiler. The lamp—of four wicks—makes steam very rapidly.

The engine pulls a big load slowly, but soon runs out of steam, but by herself will run a long time, generating about as much steam as she uses. The boiler proper is only 2 ins. diameter, and has three water tubes; so that it is easy to see, that with a larger boiler and two ½ in. by 1-in. cylinders, direct-acting, a very efficient engine could be built.

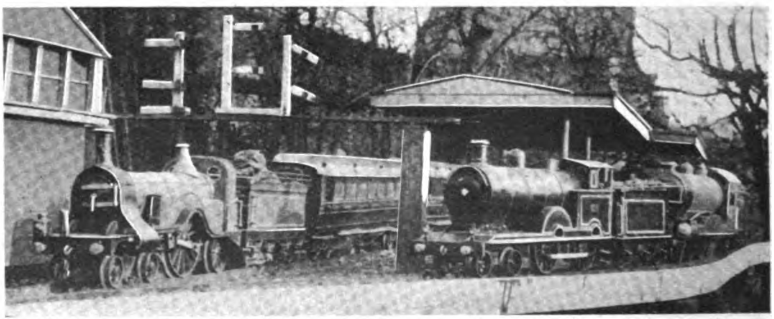


FIG. 6.—THE TERMINUS.

The four corridor carriages (Fig. 5) previously referred to are built almost entirely of cardboard, are 26 ins. long, have clerestory roofs, rubber gangways between carriages, door handles, lamps, buffers, gas reservoirs, and some of the windows have mica for glass. The lining and painting as on the E.C.J.S. stock. The labels over the the cornices are in correct style: "London—Aberdeen (*via* Forth and Tay Bridges)."

The signalling arrangements are very primitive—most of the signals I made to work; the arms being of tin, and worked by stiff wire and balance weight. I did not connect them up with wire, etc., but actuated them by hand when necessary.

If there is anything in this necessarily cursory account of my railway that is not quite clear, I shall be most happy to explain further, and give dimensions; but the photographs will show what can be done by any amateur who has an "eye" for locomotives, and who does not mind worrying out details.

Education of Apprentices.

THE Board of Education have issued a memorandum on the subject of co-operation between employers of labour and school managers, with regard to the instruction of employees or apprentices. The Board desire to secure the assistance and co-operation of employers in encouraging the education of their apprentices, and they take note of several ways in which such assistance can be rendered. These are summarised as follows:—(1) Paying the fees for employees, or offering prizes to those who pass the examinations of the Board of Education, of the City Guilds' Institute, or the Society of Arts. (2) Increasing the wages of apprentices who have passed through an approved course of study, who attend regularly at approved evening classes, or who have passed approved examinations. Or instead of an actual increase in wages, increased efficiency may be recognised by promotion, or by transference from an inferior to a superior department. (3) Making concessions in the matter of working hours, so as to allow all employees the opportunity of attending classes. (4) Providing scholarships, or maintenance and fees, for a few selected and specially qualified students. (5) Taking part in the organisation of technical institutes or schools, and helping such establishments by personal supervision and interest.

DURING the recent German manœuvres a new invention called the microphotoscope, which consists of a map printed on glass and illuminated with a small electric lamp was used in night marches with much success. The apparatus is about the size of an ordinary cigarette case.

Lessons in Workshop Practice.

XXIII.—Practical Notes on Selecting and Using Small Dynamos and Motors.

(*Continued from page* 344.)

By A. W. M

FOR a preliminary test you can connect one wire from the battery to a bared place (A, Fig. 16), and the other battery wire to C and D in turn. It would be well, however, to keep the current flowing in the same direction through the two coils; therefore if A is the positive pole of the battery, and you test coil D first, you should, when testing coil C, join the positive battery wire to C, and B to A. If the machine is of the pattern shown in Fig. 15, a similar method can be adopted: remove the top half of the magnets (see Fig. 17), and apply battery to, say, first, E and D, then F and E; thirdly, F and A; lastly, A and C. When supplied with current in this way, each coil should produce a strong magnet pole at the joint. When the magnet is put together again, and the coils correctly connected up, a current should be sent through them to restore the residual magnetism to its proper direction. The field-magnets of multipolar machines can be tested in a similar manner, one coil at a time; each should produce strong magnetism at its pole, and the poles should be alternately N. and S., a common fault with multipolar magnets being wrong connections between the coils, so that the poles are of wrong polarity (see Fig. 18, which shows a six-pole magnet (A) correctly connected, and B with some of the field coils incorrectly connected). The remedy is to change over the connections of the faulty coils, as

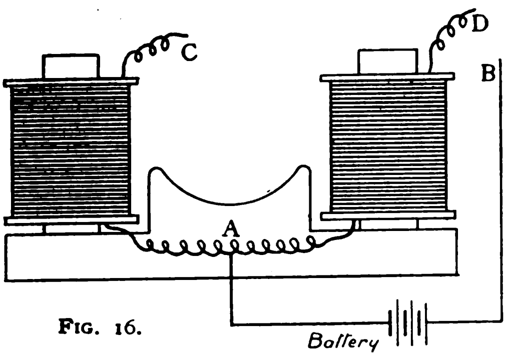


FIG. 16.

previously explained for two-pole magnets. The best way to test if the coils are correctly connected is to refer to a book containing winding diagrams, and compare the coils on the machine with the diagram. A magnetic needle, such as a compass, can be used to test the polarity of the magnet poles; a N. pole would repel the N. end of the needle, and a S. pole would repel the S. end of the needle. The difficulty of using this test is that the dynamo pole is usually so much more powerful than the compass needle, that the latter is overpowered and attracted by either pole, so that unless you find repulsion takes place, the test should be rejected—attraction only is not a reliable test.

If, after proving that the field-magnet is in order, the armature will not run when current is switched on, you will know that the fault will be in the armature or brush gear, provided the connections between brushes and field coils are correct—that is, if the machine is a shunt-wound machine, its field coils have been connected in shunt to the brushes, and not in series with them—a mistake which may occur, especially with small motors. If the machine has been connected in series, and does not start, it may be well to look to this point, and perhaps try it with the field coils connected in shunt to the brushes. As a guide, examine the

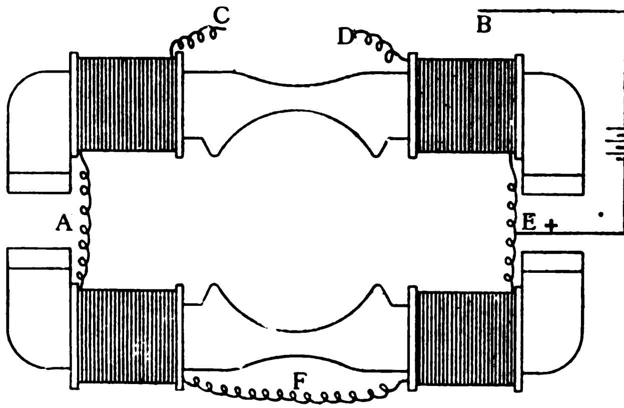


FIG. 17.

sizes of wire on armature and field coils. If the wire on the field-magnet is of much larger size than that on the armature, you may consider that the field coils should be connected in series with the armature.

The position of the brushes is of vital importance. If the machine will not run, the brushes should be shifted round the commutator, and tried in various positions. If they are fixed, and cannot be moved from one position, the commutator may be shifted round on the shaft. Though the actual point of commutation is on a line approximately midway between a pair of poles, the brushes need not be on this line; they will be at a position which is determined by the way in which the armature coils have been connected to the commutator (see previous notes on "How to Wind Armatures," THE MODEL ENGINEER for August 11th, 1904).

Failure to start is sometimes caused by the surface of the armature rubbing against the pole faces. The clearance may be sufficient to permit of the shaft moving easily, except when current is switched on. The magnetic attraction of the pole face may be sufficient to just pull the armature into contact with it, and prevent rotation. Or a similar trouble may occur when the armature runs very near to one corner of the pole, a magnetic pull being concentrated on one of the teeth of the core, and preventing rotation without actual contact between the surfaces. The remedy for both troubles is to enlarge the bore of the magnet at the part where the concentration of magnetism takes place. It may improve the starting and running of the armature to ease away the pole corners, as shown in Fig. 19, especially with armatures having few coils, and cores with large teeth.

Because a motor does not start immediately current is switched on it does not necessarily mean that there is something seriously wrong; it is always advisable to give the spindle a start by hand, and see if it shows any inclination to go. An armature having a commutator with two sections only has a decided dead point, and will not be self-starting if it has stopped on it. A three-section commutator has no dead point; but one with four sections may refuse to start without help. Any armature may stick if the spaces between the commutator sections are rather wide and filled up with insulating material, as one or both brushes may happen to touch only upon this insulating material at the moment of starting, and therefore no currents would flow through the armature coils; a slight movement of the spindle would bring the brush upon one of the metal sections, and the motor would start and run up to speed.

Series Wound Motors will start when current is switched on; if no load is applied to the spindle, the speed will increase, until the internal friction balances the power exerted by the armature, at which point the speed will remain constant. As soon as a load is applied, the speed will fall until the power exerted by the armature balances the load. This class of motor does not therefore run at constant speed with a varying load. When fitted with a smooth cored armature, the speed is liable to rise to a dangerous extent, if no load is applied. With polar and toothed cores and solid field-magnets, the speed becomes checked to some extent, owing

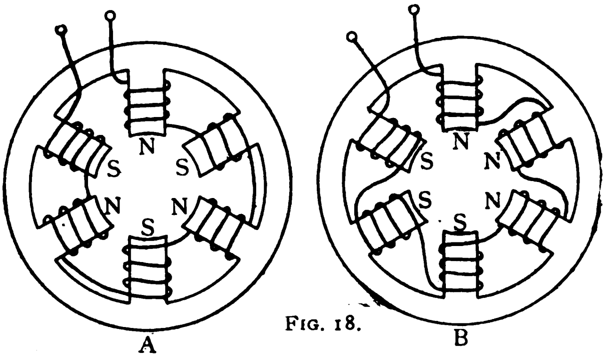


FIG. 18.

to a drag caused by eddy currents in the pole faces, and this danger is largely decreased. A series wound motor starts well under heavy load, especially when the field-magnet has ample amount of iron in it; it is therefore the best type to select for driving boats, cars, and locomotives, or any purpose where the spindle is connected by spur or worm gearing to a constant load, such as a pump, or to a load which increases with the speed, such as a fan or I lower. Motors having only two sections in the commutator should always be series wound. When testing a series wound motor, a load should be applied at starting, and adjusted until the current flowing is that which the motor ought to take at full load. The speed will then be that at which the motor will run at full load.

(*To be continued.*)

Notes on the Treatment of Tool Steel.

By J. M. T.

(*Concluded from page 346.*)

Self- and Air-hardening Steels.—Just a word or two about self- and air-hardening steels. Various metals are added to steel to make it more suitable for certain purposes. Two or 3 per cent. of aluminium added to steel just before pouring into the moulds makes sounder castings, and to make steel harden naturally, *tungsten* and *chromium* are added.

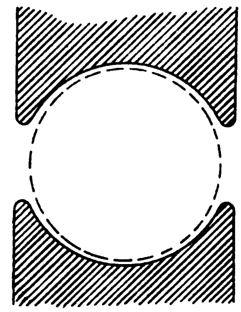


FIG. 19.

There are many others, of course; but I think tungsten and chromium are sufficient for my purpose. These two metals are added in about the proportion of ½ to 1 per cent. chromium to 1 per cent. or more of tungsten; while for very hard duty, such as the first cuts on iron castings, 3 per cent. of chromium and 6 per cent. or more of tungsten are found best.

It appears that variations in carbon make very little difference, steel having ·85 to 2 per cent. of carbon giving practically the same results. After a tool has been made of self-hardening steel, it should be heated to a cherry red, and allowed to cool in the air, but not in a current of air. For self-hardening steel it is best not to hasten the cooling—simply let it cool by the side of the forge.

In forging these steels, it is best to heat them up considerably further than is necessary for ordinary carbon steel. They must also be kept at a red heat, and not hammered if they get below, or the shocks from the hammer will break them.

Tools made from self-hardening steel have been found to do 75 to 100 per cent. more work than ordinary carbon steel tools; but the point that the makers insisted upon was that the steel should not be heated above a clear cherry red colour, or the tool would be spoilt.

Further experiments were made with steel having small percentages of tungsten and chromium, and it was found that if they were heated up to a much higher temperature, and cooled in a strong current of air, they would give far better results than the self-hardening steels. These were called *air-hardening* steels.

The experiments were suggested by the fact that some tools which had been very much overheated, or burnt, as we should say, did better work than tools that had been hardened at a low temperature.

The ordinary cherry red heat, about 1550° F., is the usual heating temperature for both carbon and self-hardening steels; and if the steel is hardened at higher temperatures than this, it will not stand such a high cutting speed, until 1,720° is reached. Some chemical change evidently takes place in the composition of the steels that should make them more durable when cooled from a white heat, as a heat like that would certainly ruin most carbon steels.

The high rate of speed at which the work is run when using these tools causes the chips to come off exceedingly hot: in some cases they must actually be at about 550° F., as they are blue, and the point of the tool is sometimes red hot, and still it keeps its cutting edge.

A lubricant is generally used, I think, to lessen friction and to keep the work and tool comparatively cool; but it is a fact that this steel is stronger when it is nearly *red hot*, and this is the reason why it shows to a far better advantage on roughing cuts than it does on light finishing cuts.

Most of these air-hardening steels are to be slowly heated until they are very nearly white hot, and then cooled down below the critical point, which is perhaps, a dull red; after this point it can cool down slowly in the air. The steel scales very much with the high temperature, and so must be well ground on the cutting edges. It scales because it comes in contact with the air, and if this air can be kept from it, it will not scale. This can be done, to a certain extent, by heating it in a covered crucible in which is placed some anthracite coal, or some cyanide of potassium, or anything that will not burn away at the high temperature, and has no oxydising effect upon the steel. When the steel is at a white heat, it should be instantly placed in oil, nearly at, or quite at, the boiling point.

It will cool down quite quickly enough, and is out of contact with the air. In this way the steel is very little scaled; it is intensely hard, and does not expand very much—only, perhaps, ·001 in. per inch. In grinding self- and air-hardening steel tools, it is best not to colour them, as the heat is very local, and expands only just the surface, and so causes minute cracks which will develop when the tool is subject to strain.

THE FINEST BRIDGE IN IRELAND.—What will be the finest bridge in Ireland is now approaching completion above Dungarvan Station. The total length of the viaduct is to be 1,205 ft., while the rail level is 35 ft. above low water. The bridge has seven spans, one being 110 ft., the opening span intended for navigation having a clear opening of 50 ft. In connection with this span an interesting feature is that it is only the second of its kind that has been built in Great Britain. It is built on the American Scherzer rolling lift system.

NEW ENGINE SHOPS.—Messrs. Cammell, Laird and Company's new engine shops at Birkenhead will be the largest buildings of the kind in the kingdom. They are to be steel structures, and they have been designed by the engineering staff of Sir William Arrol & Co., Ltd., Glasgow. The centre bay will be 1,080 ft. long, 78 ft. wide, and 90 ft. high, and it will have overhead cranes capable of dealing with loads up to 120 tons. The side bays will be 40 ft. and 50 ft. wide respectively The work is to be completed in twelve months.

Marine Engineering and Shipbuilding Notes.

By CHAS S. LAKE.

FIRST TURBINE STEAMER FOR THE THAMES.

MESSRS. DENNY BROS., the well-known shipbuilders, of Dumbarton, on the Clyde, are at present constructing a 20-knot turbine steamer to the order of the General Steam Navigation Company of London. This vessel, which will be the first turbine steamer trading out of the Thames, will be placed on the Ostend or Boulogne service. She will have accommodation for 2,000 passengers, and be 270 ft. in length. Her gross tonnage will be 800, and the speed of which the vessel will be capable is to be slightly over 20 knots per hour as a maximum.

The contract provides that on her trials the ship must show ability to stop dead in her own length when going at a speed of 12 knots, so that her manœuvring qualities will be of a high order.

Passengers by this route between London and the Continent will doubtless welcome the appearance on the service of the new vessel.

NEW P. & O. MAIL STEAMSHIP.

The latest addition to the Peninsular and Oriental S.N. Co.'s fleet of mail steamers is the *Dongola*, built by Messrs. Barclay, Curle & Co., Ltd., of Whiteinch, near Glasgow. The vessel has been specially designed for the Eastern mail service, and has dimensions as follows: Length over all, 490 ft.; extreme breadth, 56 ft. 5 ins.; depth from bottom of keel to top of deck at centre, 36 ft. 8 ins.; and gross registered tonnage, about 8,100 tons. The machinery is estimated to develop 8,000 indicated horse-power on trial, and to give a speed of 16 knots. It consists of two sets of quadruple expansion engines having cylinders 25½ in. (H.-P.), 36½ ins. and 52 ins. (I.-P.), and 74 ins. (L.-P.), with a stroke of 51 ins.

The second intermediate cylinder and the low-pressure cylinder are both steam-jacketed, and flat slide-valves are used for these cylinders, whilst piston valves are employed for distributing steam to the high-pressure and first intermediate cylinders. The twin propellers are three-bladed, with cast-iron bosses and manganese bronze blades. There are six boilers, viz., two double-ended, 20 ft. long, and four single-ended, 11 ft. 6 ins. long, all 14 ft. 8 ins. diameter, with a working pressure of 215 lbs. per sq. in. The total heating surface is 18,700 sq. ft., and the grate area 470 sq. ft. Howden's system of forced draught is used. The *Dongola* has been built to conform to the Board of Trade requirements for a foreign-going steamship, also under the special survey of Lloyd's register, highest class. The British transport service regulations have, in addition, been observed, thus making the vessel available for troops in time of war.

THE GERMAN TURBINE CRUISER "LUEBECK."

A small third-class cruiser, the *Luebeck*, of the German Navy, a sister ship to the *Hamburg*, *Bremen*, and *Berlin*, has been fitted with turbine machinery, and on her trials she has, so it is reported, eclipsed the performances of the *Hamburg*, which, in common with the other vessels mentioned, is provided with reciprocating engines developing 11,000 horse-power. The turbine-engined vessel also had a lower coal consumption than the other ship, so that her radius of action on the same fuel supply would naturally be greater. The length of the vessel is 361 ft., beam 40 ft., and draught 17½ ft., and she carries a crew of 259 men. Each side of the ship has two shafts driven by a high and low-pressure turbine, all four of which can be reversed for steaming astern.

It is reported that the battleship *Dreadnought*, to be built at Portsmouth, will have turbines of 23,000 horse-power.

Thornycroft Twin-Screw 55-ft. Petrol Launch.

The writer has been favoured by Messrs. J. I. Thornycroft, Ltd., of Chiswick, W., and elsewhere, with drawings, photographs, and particulars of the above vessel, which has been designed for sea-going service, as well as for harbour use. She is built of galvanised mild steel throughout, and is 55 ft. long, 9 ft. beam, with a 2-ft. 10-in. draft, and is fully decked, with a roomy cabin aft, while crew accommodation is provided forward. Steering may be effected either from the wheel-house or from the deck, wheels and engine-room telegraph being fitted in duplicate. Four water-tight bulkheads are fitted, the forward one being a collision bulkhead, and eyes for lifting the boat out of the water by means of slings are provided. The propelling machinery consists of two Thornycroft four-cylinder petrol engines, having cylinders 8 ins. bore by 8 ins. stroke, and developing about 115 b.h.-p. each. The engines are quite independent of each other, and coupled to the propeller shaft by means of multiple disc clutches. Reversing is effected by reversible propellers, which are also independent of each other, so that it is possible to go ahead with one, and astern with the other, making the boat very quick in manœuvring. The propellers are of entirely novel construction, the mechanism for reversing the blades being carried into the vessel through the propeller shaft brackets. This obviates the necessity for having a long hollow shaft, as is usually the case. The starting of the main engines is effected by means of compressed air, stored in a pressure reservoir, which is charged by a Brotherhood compressor driven by a single-cylinder 6 b.h.-p. Thornycroft petrol engine. The carburettors are placed on deck, and not in the engine room, as would usually be the case. This is to prevent loose petrol from collecting in the engine room. Another precaution to minimise the chance of fire is a device extending beyond the carburettor, to prevent any back-fires into the latter. The petrol tank filling pipe is carried to the deck, where it terminates in a screw cap surrounded by an angular tray, which is provided with a drain pipe, so that any petrol which may be spilt in filling the tanks is at once carried overboard. The petrol gauge, which is a horizontal dial, for indicating the quantity of petrol in the tanks, is brought just below the deck, where it is seen through a "light." Sufficient petrol is carried for a run of 200 miles at full speed, which is 16 knots per hour. Two, bilge pumps of the semi-rotary type are fitted, driven from the main engine by a clutch, so that either, independently, may be brought into action. The exhaust from the engine is carried through a silencer placed in the uptake or funnel.

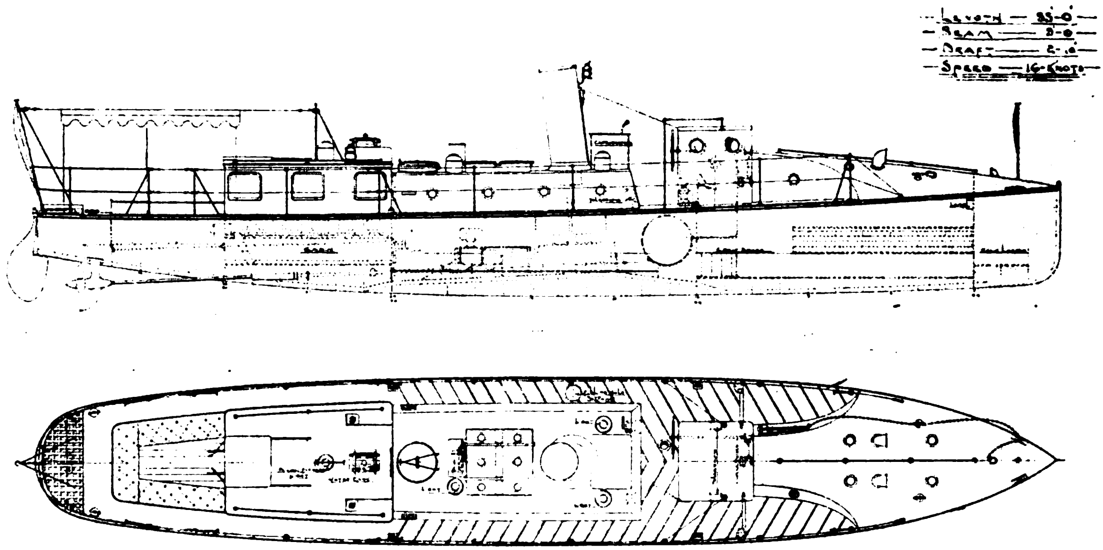
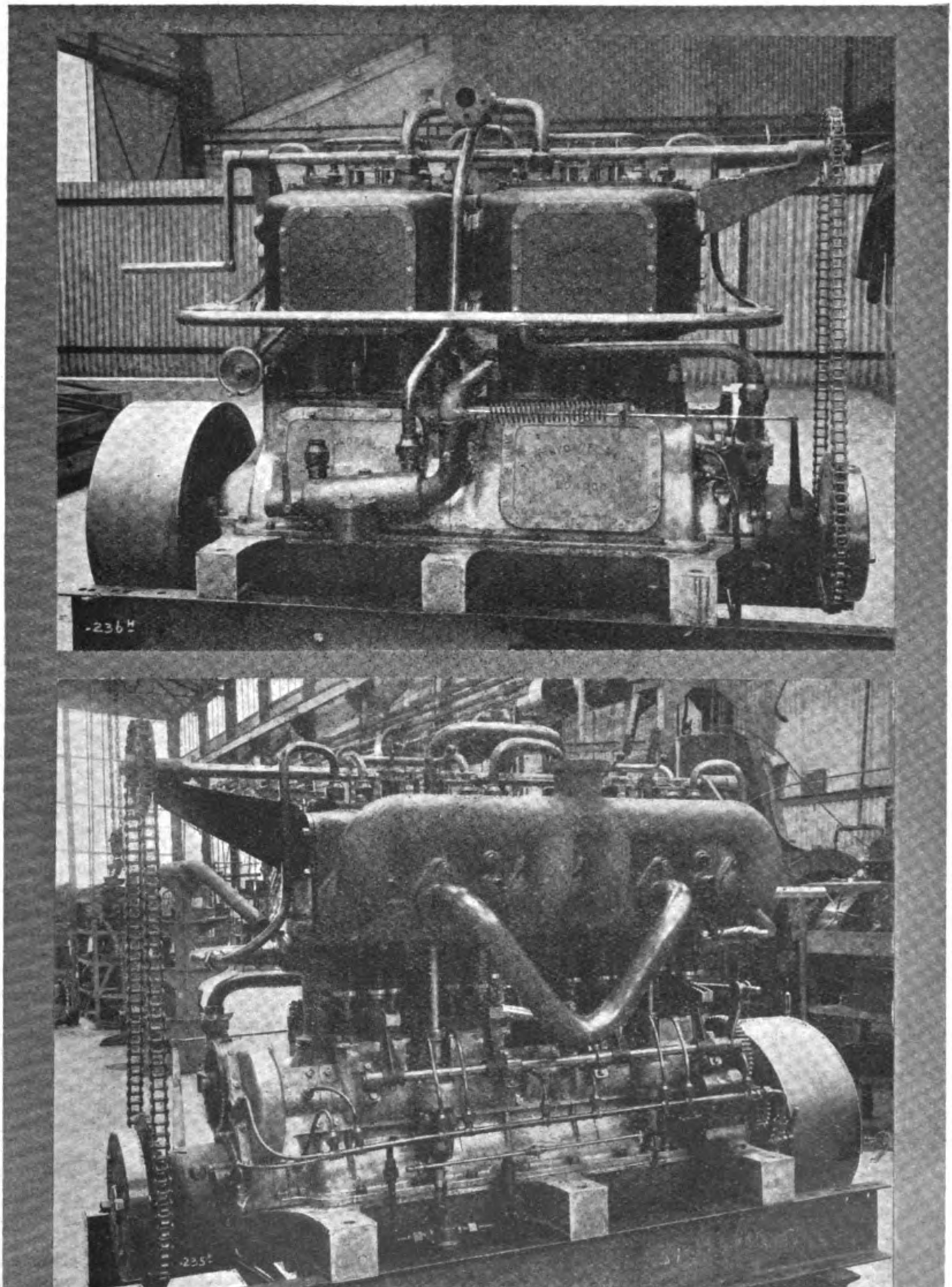


Fig. 1.—Plan and Sectional Elevation of Thornycroft 55-ft. Petrol Launch.

New Ships for the Russian Navy.

According to the *Daily Chronicle*, there is a probability that British firms may obtain huge contracts from Russia for the building of a new navy, to replace that destroyed in the war with Japan. It is stated that the Tsar and his advisers have come to the conclusion that Great Britain alone has the



FIGS. 2 AND 3.—THORNYCROFT 4-CYLINDER PETROL LAUNCH ENGINE.

resources for building a fleet in the shortest space of time, and at the most reasonable cost. It is reported that a representative of the Russian Government is now in London discussing terms with the leading shipbuilding firms, and the *Sheffield Daily Telegraph* is confident that the orders will be placed in this country. British shipyards, says that journal, can build more expeditiously than any in the world, and most of them can take orders for complete ships—hulls, armour, engines, and guns. Everything essential to an efficient warship can be made in Britain, and the builders will even undertake to send the vessels home. A well-known naval architect is of opinion that Russia will require sixteen battleships, and at least eight armoured cruisers, and twenty destroyers. For a fleet of this size something like £33,250,000 would have to be spent, and four years would be taken in accomplishing the task.

High-Speed Engines.

By H. Muncaster.

(*Continued from page* 183.)

THE question of governing a steam engine is one that requires consideration on two distinct lines. First, the regulation of the speed to within a given limit of variation from the normal speed; and, secondly, the economical use of the steam under varying conditions of load.

To ensure the first requirement, the governor must be sensitive to any slight variation of speed, both when the rate is increasing and when it is

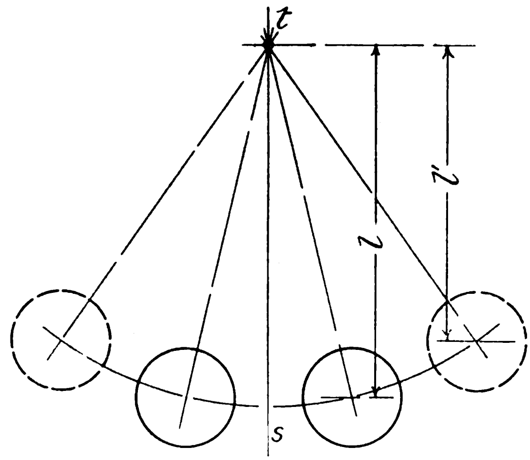


FIG. 23.

decreasing. It is necessary in the latter case that some excess of power over that required to keep the engine to the normal speed must be at the disposal of the governor. Care should be taken to ensure the governor acting promptly when the speed is decreasing, as there is a possibility of constructing a governor which will act when a given speed is exceeded, but which will not return to its first position until the speed has fallen considerably below the normal. There is also the liability of a properly designed and sensitive governor being prevented by friction in the joints and the throttle valve from acting promptly, so that the speed of the engine may be irregular. A governor will on this account require to be sufficiently powerful to ensure its overcoming easily the resistance due to the causes mentioned.

The old-fashioned pendulum governor is not suited for sensitive governing. Some of the examples met with by the writer are of enormous size; in one case the balls were 15 ins. in diameter, although the force required to operate the throttle

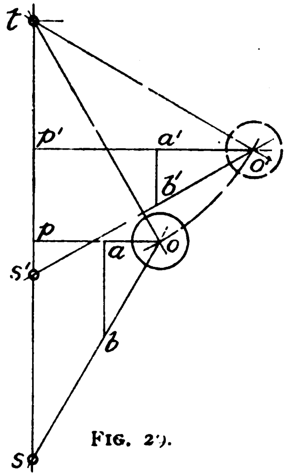


FIG. 29.

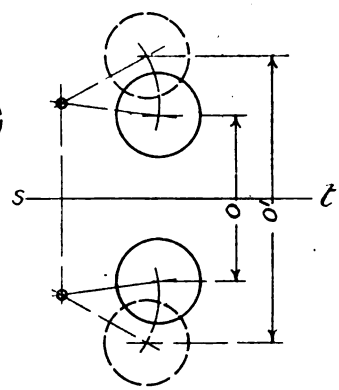


FIG. 30.

valve was not very great. The formula for calculating the length of arms is as follows:—

$$l = \left(\frac{187 \cdot 5}{n}\right)^2 \qquad (6)$$

$$n = \frac{18\ \cdot 5}{\sqrt{l}} \qquad (7)$$

Where l = vertical distance from point of suspension to centre of gravity of arm (approximately centre of ball), n = number of revolutions.

It will be seen that we have to depend upon the falling of a ball whose vertical distance from a given point is inversely as the square of the number of revolutions. Referring to the diagram (Fig. 23), if l makes a revolution in a given time, $\sqrt{l} \times n = \sqrt{l'} \times n'$.

As this form for various reasons is not suited to small work, we have not given any practical examples.

We give two examples of governors of the centrifugal type, either of which will be suited to the engine already illustrated, provided a suitable valve be fitted, the centrifugal force being balanced by a weight in the case of the governor shown in Figs. 24 to 26, and by a spring in that shown in Figs. 27 and 28.

The centrifugal force varies in proportion to the distance of the ball from the centre of the spindle if the number of revolutions be constant: if the distance remain the same, the centrifugal force varies in proportion to the square of the number of revolutions. If the lift of the weight were constant for a given "spread" of the balls, the governor would not work satisfactorily, as the balls, after lifting, would not again resume their original position until the speed were sufficiently reduced to bring the centrifugal force of the balls *at the* *increased distance* to less than would be necessary to support the weight. In this way a very considerable variation of speed would take place.

In the type of governor, of which Fig. 24 may be taken as an example, the weight required to balance the centrifugal force decreases as the balls rise, on account of the direction of the arms becoming more oblique to the action of the gravity of the weight.

Let (Fig. 29) *s t* represent the spindle of the governor; *o* the lowest position of the ball; if *a o* illustrated, an increase of speed will be necessary to maintain the weight when the balls are in the position *o'* which will give a centrifugal force at $o =$

$$\frac{a\,b \times a'\,o'}{a'\,b'}$$

The speed required will be

$$n = \sqrt{\frac{o\,t \times a\,b \times a'\,o'}{o'\,t' \times a'\,b' \times a\,o}}$$

Where n = the number of revolutions at *o*.

FIG. 26.

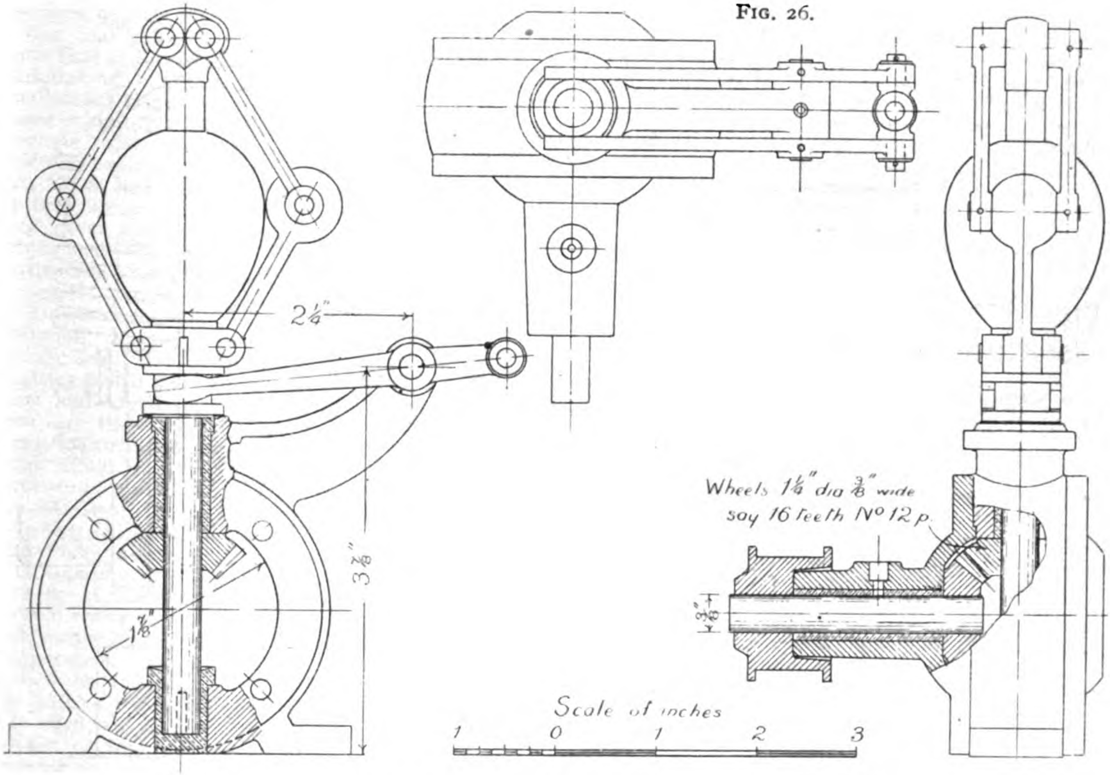


FIG. 24. FIG. 25.

A DESIGN OF GOVERNOR FOR HIGH-SPEED STEAM ENGINE.

be equal to the centrifugal force at a given number of revolutions, $\frac{a\,o}{o\,p}$ will be constant for any position of *o*.

In the diagram, $\frac{a\,o}{o\,p} = \frac{a'\,o'}{o'\,p'}$. Let *a b* (the resultant of the forces *a o* and *o b*) represent the weight w, to be applied at *s*, necessary to balance the centrifugal force; $\frac{a\,b}{t\,s}$ will be constant for any position of *o*.

There will therefore be, when the speed again becomes normal, an amount of weight available to bring back the governor from a new position against an increase of centrifugal force due to the greater distance of the balls from the centre of rotation. This amount is $= (a\,b) - (a'\,b')$.

When w is constant, as in the case of the governor

In practice the distance that is allowed for the lift of the weight would be limited, so as to make *s s'* small in proportion to *s t*, the throttle valve being so arranged that the engine will be under control by the governor working within these limits, the speed at *o'* to exceed the speed at *o* by a small percentage, say, a total variation of 5 per cent. only.

The governor illustrated is intended to stand on the top of the steam chest in such a way that the belt driving on the pulley shown will engage on the shaft just outside the eccentric, and the lever as shown reaching over to connect to the throttle valve.

A very neat form of governor for high-speed engines is shown in detail in Figs. 27 and 28. In this case it is placed directly in line with the main shaft, which may either be turned down to suit, or a gudgeon of a smaller diameter fitted into a hole drilled into the end of the shaft.

The arms are fitted into a mushroom-shaped disc forming the extreme end of the shaft. A spring is fitted at each side of the shaft to engage each ball having the necessary tension to balance the centrifugal force at the given speed. After the springs are in place, a small washer and a cotter through each pin will serve to keep them in place. This must not be overlooked, as otherwise the centrifugal force will throw off the springs.

At any given speed the centrifugal force will be proportional to the distance o, Fig. 30. If the spring be such that the tension at o' be proportional to the tension at o in the ratio $\frac{o'}{o}$, the governor will not return to its original position after spreading until the speed had fallen below the normal. If the tension of the spring at $o = t$, the tension at o' should $= \frac{t\,o'}{o} \times s$.

Where s = the amount necessary to overcome all the friction incidental to gearing, valve, etc., at the given maximum speed, he smaller the amount of s consistent with reliable working the more sensitive will be the governing. To ensure good governing, it is necessary to reduce the friction of joints, valves, etc., to a minimum.

We have spoken of the normal as if it were a given fixed speed. It will, however, be seen that the speed depends upon the load on the engine. If the load be removed and consequently less steam be required, the governor will assume a position giving a slightly increased speed. While the power available is in excess of the load, the governor will not be in the lowest position; the speed required will be such as to maintain the governors in a position midway between the extremes o and o'.

The details of this type of governor will be readily understood by referring to the sketches shown in Figs. 27 and 28, suitable for the size of engine illustrated in previous papers.

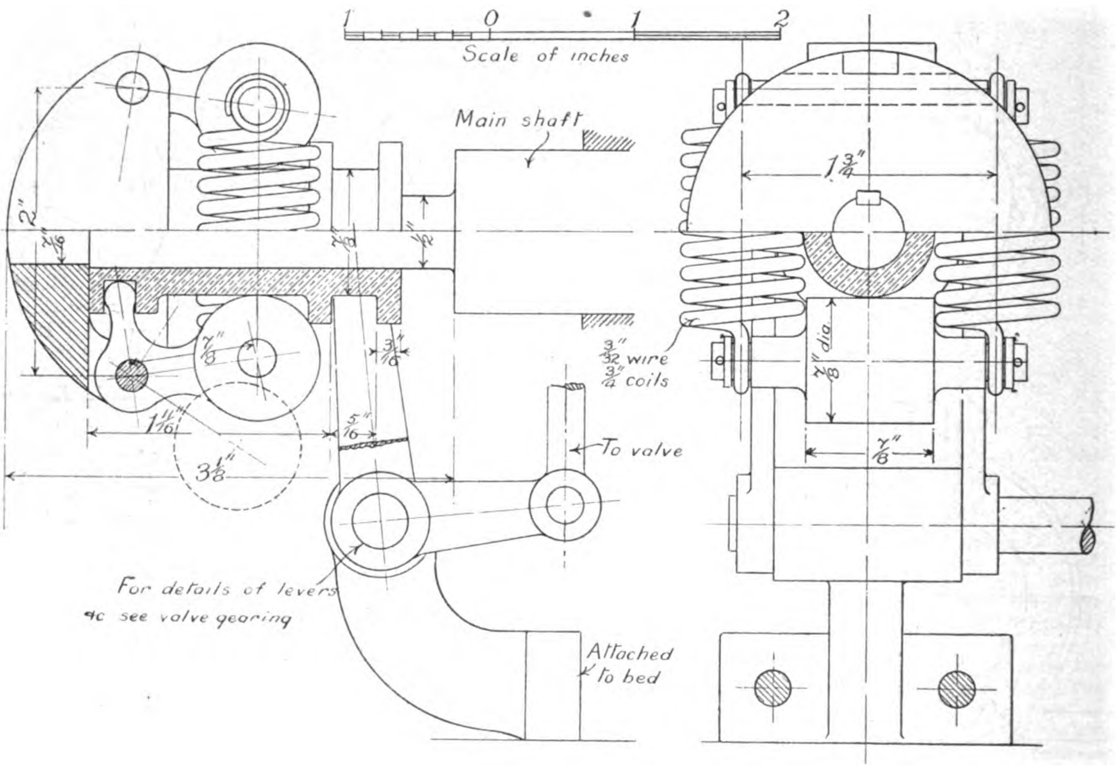


FIG. 27. FIG. 28.

AN ALTERNATE DESIGN OF GOVERNOR FOR HIGH-SPEED STEAM ENGINE.

(*To be continued.*)

MR. JOHN E. RAWORTH, A.I.E.E., informs us that he has opened an office at Queen Anne's Chambers, Westminster, where he intends to practise as a patent agent and consulting engineer.

GEAR WHEELS are now constructed with renewable rims, and possess several advantages over the solid steel wheel. The rims, which are made in halves and bolted on the hub of the wheel, can be manufactured from the finest quality of steel. It is claimed that the renovation of a worn or damaged wheel by the attachment of a new rim can be effected at less expense than the purchase of an entire new wheel of inferior material.

Aluminium Alloys.

M. H. PECHEUX has contributed to the *Comptes Rendus* from time to time the results of his investigations into the alloys of aluminium with soft metals, and the following constitutes a brief summary of his observations :—

Lead.—When aluminium is melted and lead is added in proportion greater than 10 per cent., the metals separate on cooling into three layers—lead, aluminium, and between them an alloy containing from 90 to 97 per cent. of aluminium. The alloys with 93, 95, and 98 per cent. have densities of 2·745, 2·674, and 2·600 respectively, and melting points near that of aluminium. Their colour is like that of aluminium, but they are less lustrous. All are malleable, easily cut, softer than aluminium, and have a granular fracture. On re-melting, they become somewhat richer in lead, through a tendency to liquation. They do not oxidise in moist air, nor at their melting points. They are attacked in the cold by hydrochloric and by strong sulphuric acid, with evolution of hydrogen, and by strong nitric acid when hot; strong solution of potassium hydroxide also attacks them. They are without action on distilled water, whether cold or hot.

Zinc.—Well-defined alloys were obtained, corresponding to the formulæ Zn_3Al, Zn_2Al, $ZnAl$, $ZnAl_2$, $ZnAl_3$, $ZnAl_4$, $ZnAl_6$, $ZnAl_{10}$, $ZnAl_{12}$. Their melting points and densities all lie between those of zinc and aluminium, and those containing most zinc are the hardest. They are all dissolved by cold hydrochloric acid and by hot dilute nitric acid. Cold concentrated nitric acid attacks the first three, and cold dilute acid the first five. The Zn_2Al, $ZnAl_6$, $ZnAl_{10}$, and $ZnAl_{12}$ are only slightly affected by cold potassium hydroxide solution; the others are strongly attacked, potassium zincate and aluminate probably being formed.

Tin.—A filed rod of tin-aluminium alloy plunged in cold water gives off for some minutes bubbles of gas, composed of hydrogen and oxygen in explosive proportions. An unfiled rod, or a filed rod of either aluminium or tin, is without action, though the unfiled rod of alloy will act on boiling water. The filed rod of alloy, in faintly acid solution of copper or zinc sulphate, becomes covered with a deposit of copper or zinc, whilst bubbles of oxygen are given off. M. Pecheux believes that the metals are truly alloyed only at the surface, and that filing lays bare an almost infinitely numerous series of junctions of the two metals, whch, heated by the filing, act as thermocouples.

Bismuth.—By the method used for lead, bismuth alloys were obtained containing 75, 85, 88, and 94 per cent. of aluminium, with densities 2·86, 2·79, 2·78, and 2·74 respectively. They were sonorous, brittle, fine-grained, and homogeneous, silver-white, and with melting points between those of their constituents, but nearer that of aluminium. They are not oxidised in air at the temperature of casting, but are rapidly attacked by acids, concentrated or dilute, and by potassium hydroxide solution. The filed alloys behave like those of tin, but still more markedly.

Magnesium.—These were obtained with 66, 68, 73, 77, and 85 per cent. of aluminium, and densities 2·24, 2·27, 2·32, 2·37, 2·47. They are brittle, with large granular fracture, silver-white, file well, take a good polish, and have melting-points near that of aluminium. Being viscous when melted, they are difficult to cast, and when slowly cooled, form a grey spongy mass which cannot be re-melted. They do not oxidise in air at the ordinary temperatures, but burn readily at a bright red heat. They are attacked violently by acids and by potassium hydroxide solution, decompose hydrogen peroxide, and slowly decompose water even in the cold.

Tin, Bismuth, and Magnesium.—The action of water on these alloys just referred to has been recently demonstrated on a larger scale, 5 to 6 cubic centimetres of hydrogen having been obtained in 20 minutes from 2 cubic centimetres of the filed tin alloy. The bismuth alloy yielded more hydrogen than the tin alloy, and the magnesium alloy more than the bismuth alloy. The oxygen of the decomposed water unites with the aluminium. Larger quantities of hydrogen are obtained from copper sulphate solution, apart from the decomposition of this solution by precipitation of copper at the expense of the metal alloyed with the aluminium. The alloys of aluminium with zinc and lead do not decompose pure water, but do decompose the water of copper sulphate solution, and, more slowly, that of zinc sulphate solution.—*Engineering.*

The Society of Model Engineers.

[*Reports of meetings should be sent to the offices of* THE MODEL ENGINEER *without delay, and will be inserted in any particular issue if received a clear nine days before its usual date of publication.*]

London.

FUTURE MEETINGS.—The next meeting will be held on Monday, October 23rd, at the Holborn Town Hall, Gray's Inn Road, at 7 p.m., when a Rummage Sale of models, tools, materials, and appliances will take place on the same lines as those previously held.

The Annual General Meeting of the Society will be held on Thursday, November 16th, at the same time and place. Any members wishing to move an alteration of any of the rules of the Society, or to make any suggestion as to the working of the Society, are requested to notify the Secretary thereof not less than seven days before such meeting, so that the subject may be properly discussed.

Secretaries of provincial societies affiliated to the London Society are requested to send copies of accounts and reports, with list of members, on or before October 31st, for inclusion in the Annual Report, to be laid before the members at the Annual General Meeting.—HERBERT G. RIDDLE, Hon. Sec., 37, Minard Road, Hither Green, S.E.

RADIUM RESULTS.—The work of the last three years in Germany and France is estimated by Professor Currie to have yielded about 1 lb. of radium. America's stock of radium salt, reduced to the strength known as one million, would half fill a lady's thimble.

A RECORD CRANE.—The world's largest and most powerful crane is at present in use on the North Pier, Tynemouth. It will lift 40 tons, and is utilised for laying the foundation blocks at the end of the pier. The crane has been built by Messrs. Cowans, Sheldon & Co., Ltd., of Carlisle, and is to be sent to Cape Town after the work at Tynemouth has been completed.

Practical Letters from our Readers.

[*The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a* nom-de-plume *if desired, but the full name and address of the sender* MUST *invariably be attached, though not necessarily intended for publication.*]

Model Railway Design.

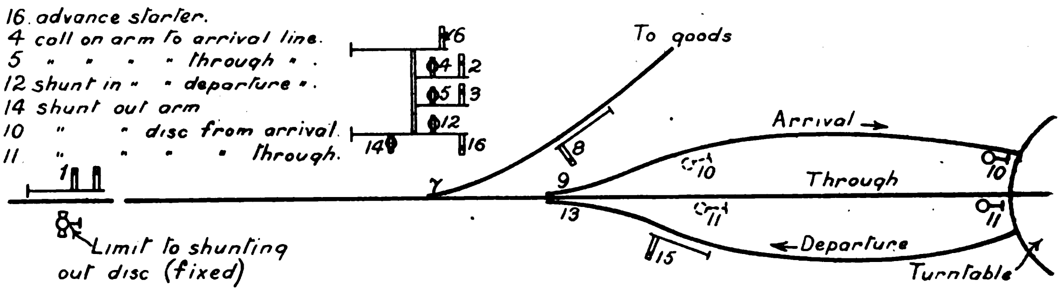
To the Editor of *The Model Engineer*.

Dear Sir,—I read with great interest Mr. Webb's description of his model track, and his ingenious method of electric control. May I, however, point out that, in using his calling-on arms 4 and 5 to govern movements of trains in both directions, he is violating one of the chief rules of railway signalling—namely, that a signal arm can only be read in one direction. The arms 4 and 5 in his sketch are right for shunt-in movements, but for shunt-out movements from the turntable I should fit two small shunt-out arms or discs (10 and 11 in my diagram); 10 thus governs shunt-out movements on the arrival road, and 11 governs similar movements on the through road. These two discs must be supplemented by a shunt-out arm (14) on the gantry. Two shunt-out arms on the gantry are now unnecessary, as we should then be simply telling the driver where he was coming from. To make the installation complete, a shunt-in arm (12) should be provided to govern shunting into the departure line, and an advance started (16) fitted on the gantry. If more convenient for working the electric switches, 10 and 11 could be placed as shown dotted.

The chief additional locking will be:—2 and 4 lock 10; 3 and 5 lock 11; 12 locks 15, 7, 9; back locks 13; 14 locks 16. These are, of course, reciprocal locks; 14 and 16 must also lock all incoming signals, and *vice versa*. The calling-on arms should be fitted with a ring.

The complete locking list would occupy too much space, but I will be very pleased to send Mr. Webb a copy, if he cares to have one. Apologising for length,—Yours truly,

Dryburgh House, Putney, S.W. A. Caldwell Smith.



Model Railway Signalling Diagram.

Lapping Cylinder Liners, etc., in the Lathe.

To the Editor of *The Model Engineer*.

Dear Sir,—In your issue of the 28th ult. I do not think the "Workshop Note" given by "Sand" will be found quite the thing. A lap should always be made of *softer* metal than the metal to be lapped, the action being as follows: The abrasive material sticks into the softer metal, which virtually becomes a grindstone and wears away the harder material.

Type metal, or type metal and lead in various proportions, will be found to give good results for brass, etc., and copper or soft phosphor-bronze for steel, etc.—Yours truly,

V. W. Delves-Broughton, Assoc.M.Inst.C.E.

Armature Reaction and Distortion of Field.

To the Editor of *The Model Engineer*.

Dear Sir,—In your issue of September 28th a letter by Mr. F. J. Kean appears, in which he asserts that in my letter under the above heading a misstatement occurs. If Mr. Kean will look into the matter a little more closely, I think he will be convinced that the statement made is perfectly correct. I advise him to apply the "hand rule" to each conductor in Fig. 3 in my letter, and he will find that the only effect caused by D is a force tending to pull the armature asunder across the line joining the brushes. Mr. Kean also states that since E in Fig. 3 is acting in an opposite direction to R in Fig. 2, it produces no torque. This means that if the field is reversed in a motor no torque is produced. This is evidently incorrect, for it is well known that reversing the field simply reverses the direction of rotation. If Mr. Kean is inclined to doubt this I would advise him to try the experiment. "Where do you think the torque is to come from?" he asks. Surely I have fully explained this. The presence of the armature current produces the necessary field, and the fields are not used except as mere masses of iron. If Mr. Kean will kindly peruse my letter again he will notice that wherever the word "fields" occurs it is simply used as an abbreviation for field-magnets.—Yours truly,

Abbey Wood. A. G. Warren.

A Simple High Resistance.

To the Editor of *The Model Engineer*.

Dear Sir,—In the carrying out of certain electrical measurements a resistance of the order of a megohm is sometimes needful, but its use is often prohibited by its cost. As a cheap substitute for the usual high resistance coil a streak of lead drawn on the ground surface of a glass plate has for some time been suggested, but the idea has been found to be impracticable owing to the great variation in the resistance of the streak and its consequent unreliability, due, it is thought, to the want of permanence in the adherence of the particles of lead to the roughened surface of the glass. More recently, however, it has been discovered that a pointed aluminium rod may be used to mark letters, graduations, etc., on glass vessels, all that is necessary

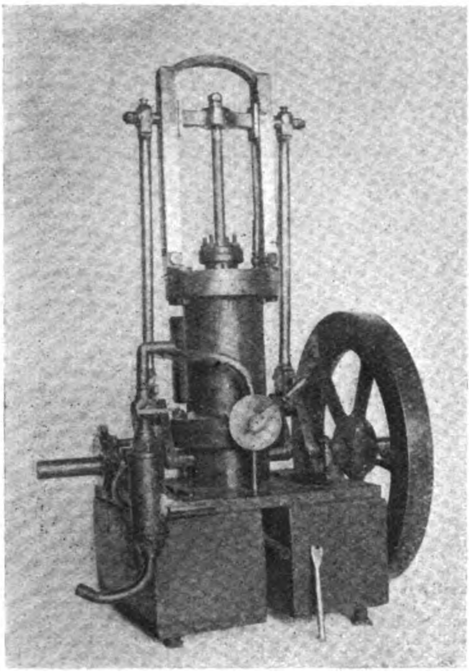


FIG. 1.—FRONT VIEW OF A MODEL OLD TYPE VERTICAL STEAM ENGINE.

to do so being to wet the glass and press firmly with the rod while drawing.

Consequently, to obtain a serviceable high resistance at small cost, it is only necessary to draw an aluminium streak on the polished surface of a glass plate; patches of aluminium at the extremities serving for attaching connecting wires. But since the operation of soldering aluminium is well known to be attended with some difficulty, it has been proposed in this case to eliminate it by depositing copper on the aluminium patches and soldering the wires on to the copper deposit—a much easier undertaking.—Yours truly, SERIES WOUND.

A Model Old Type Vertical Engine.

TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—I enclose two photographs of a rather old-fashioned type of vertical engine which came into my possession some time ago, thinking they may be of interest to your readers. The valve gear is worked by a rocking shaft off the same eccentric as the feed pump. I am sorry I cannot give the dimensions of the engine, as it is not now in my possession.—Yours truly,

Bristol. T. H. BIRDSALL.

Queries and Replies.

[Attention is especially directed to the first condition given below and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-hand corner of the envelope "Query Department." No other matters but those relating to the Queries should be enclosed in the same envelope.

Queries on subjects within the scope of this journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed. (4) Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of Replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor,* THE MODEL ENGINEER, *26—29, Poppin's Court, Fleet Street, London, E.C.]*

The following are selected from the Queries which have been replied to recently:—

[14,687] **Small Dynamo Winding.** H. B. (Cumberland) writes: I am making a dynamo (Fig. 12 in "Small Dynamos and Motors"), 150 watts, 30 volts, 5 amps.; armature 3 ins. diameter, 3 ins. long. Kindly state how many slots you recommend, and what diameter should tunnel be bored to? I enclose a sketch of wrought-iron cores, 1½ ins. diameter, 3½ ins. long (not reproduced). Are these sizes correct? As I have about 4 lbs. or 5 lbs. of No. 22 wire, please state if it would be possible to use this up; and, if so,

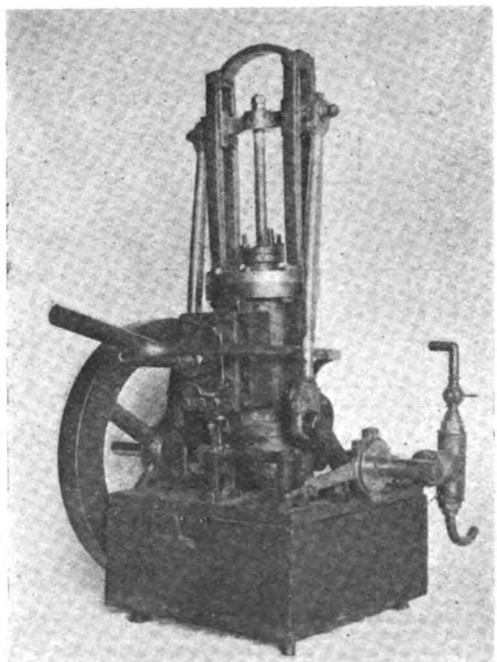


FIG. 2.—REAR VIEW.

please give me the correct weight required for both armature and field-magnet cores; if not, give weight and gauge that will do. Will this machine light three 16 c.-p. lamps?

Armature to have sixteen slots (as Fig. 31, page 30), wound either with sixteen coils—two in each slot, or eight coils—one in each slot. The larger number is to be preferred; bore the tunnel to 3 3-32nds in. diameter. The teeth should run as close to the pole face as practicable. The cores are correct, except that you have done wrong to turn a shoulder at each end 1¾ ins. diameter: this has reduced the area of contact between the yoke and the core; you should have kept to 1¼ ins. diameter right up to the yoke. It would have also been better to have kept to the construction shown in our handbook, and not reduced the core to ¾ in. diameter for the purpose of putting nuts on. However, you can try the machine with these cores, and see what result you obtain. You can use your No. 22 for the field coils; but it is scarcely thick enough for the armature; 5 lbs. will be all wanted for the field-magnet. Use No. 20 gauge for the armature. Will light about five 8 c.-p. lamps. We doubt if you will be able to get 30-volt 16 c.-p. lamps.

[14,555] **Small Gas Engine.** T. L. C. (Edgbaston) writes: Will you please answer me the following questions? (1) What size cylinder, and how thick, would be required for ½ h.-p. gas engine? I have read THE MODEL ENGINEER Handbook on Gas and Oil Engines, but it does not give dimensions of engines. (2) Would it have to be water-cooled? (3) Could I run it off an ordinary gas-jet connection? (4) What sized flywheel should I want?

(1) Stroke of about 3½ to 4 ins. Diameter of cylinder 2¾ ins. (2) Yes, preferably, if it is to be used for real work. (3) Yes, if burner was taken off. (4) Weight about 16 lbs.; diameter, 1 ft. 3 ins.

[14,001] **Capacity of Condensers.** F. A. N. (Worcester) writes: (1) Kindly say how many sheets of tinfoil would be required to form a condenser of one micro-farad capacity? (2) What size should the sheets be for ordinary telegraph purposes? (3) How should a telegraph condenser be built up? You have been good enough to answer several questions, for which I am much obliged. I trust you will excuse this additional enquiry.

(1 and 2) The capacity of a condenser varies directly as the area of the tinfoil surfaces and the specific inductive capacity of the material separating them; it varies inversely as the distance between them. You will see from this that the kind of insulation used between the sheets and its thickness will affect the size of the condenser for a given capacity. Thin paper soaked in paraffin wax is generally used as the insulator for telegraph condensers, and with this material you will get (approximately) one micro-farad, if the area of each set of tinfoil sheets is made equal to 615 sq. ft. total. It does not matter

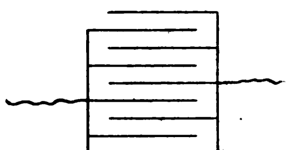


FIG. 1.

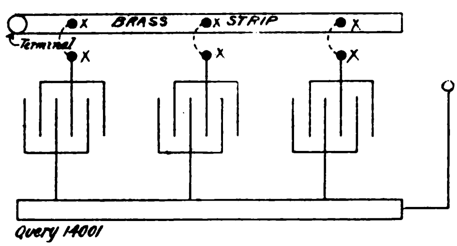


FIG. 2.

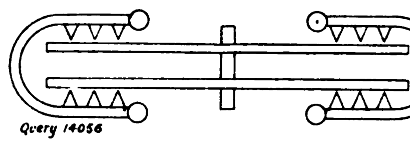
how you make it up, the individual sheets can be of any convenient size. You will do well, however, to make the condenser in sections so that you can vary the capacity according to the line and as required: the capacity of telegraph lines varies from time to time. We advise you to study a book on telegraphy, such as "Telegraphy," by Preece & Sievewright, price 6s. 4d., post free, which contains a great deal of good information on the subject. Telegraph condensers are often made with a capacity adjustable from ½ to 10 micro-farads. (3) When making the condenser two sheets of paper should be used between each pair of tinfoil sheets, so as to stop up any very small holes which may exist in any sheet; they are made as Fig. 1. The sketch above shows a method of making an adjustable condenser in sections so that you can cut in or out any number, and thus vary the capacity. The terminals in Fig. 2 are connected as shown by dotted lines to increase the capacity.

[14,527] **Water Motor to Drive Dynamo.** H. B. (Knutsford) writes: (1) What size motor would I require to drive the 40-watt dynamo described in your Handbook No. 10, page 17 (Fig. 5)? (2) What size pulley would I require on the water motor? (3) What size pulley would I require on armature of the dynamo? The ordinary house water supply is to be used.

(1) You require about ¼ h.-p. to drive this dynamo at full output. If worked under full output, it would take less power, according to the load. (2 and 3) Must be determined by trial, according to the speed at which the motor happened to run. House water pressure varies very much according to the locality. You must experiment with different sizes of jet, if you do not happen to get matters just right at first trial. A small water motor should run at 1,000 revolutions per minute at least, to be of much use. See THE MODEL ENGINEER for September 3rd, 1903 (page 222).

[14,056] **Wimshurst Machine.** H. C. W. (Nuneaton) writes: I have just completed a Wimshurst machine, but cannot get it to work at all. If you could give me a rough sketch of how the various parts act I should be very much obliged. If you could give me any idea of where I have gone wrong, I should be very pleased, as it is my third attempt.

We advise you to study the various descriptions of Wimshurst



WIMSHURST MACHINE COLLECTORS.

machines which have appeared in the last few volumes of THE MODEL ENGINEER, also to get a copy of "Influence Machines," by Gray, price 5s. 3d., post free. As far as we can see from your sketch, you seem to be trying to collect the charge from one plate only; the collecting points must embrace the two plates, as shown above; they do not touch the plates, but are to be as near to them as practicable. All sharp edges and points must be avoided, except at the collecting points, as they will cause the charge to leak away as fast as it is generated. Perhaps the machine requires a preliminary charge from a rubbed stick of sealing wax or ebonite to start it; try it in a warm, dry room. One of the discharger balls should be smaller than the other, and they should be interchangeable, so that you can try them on either hand.

[14,750] **Boiler and Engine.** H. E. H. A. (Sheffield) writes: (1) Will a horizontal steam engine (1-in. bore by 2-in. stroke) be of sufficient power to drive a dynamo of 10 volts, 12 c.-p. (50-watt machine) at a speed of 3,000 r.p.m.? At what speed would the engine be required to run? (2) Also, what size boiler would be suitable for this size engine?

(1) No; an engine with a cylinder 1 in. by 2 ins. will not be found sufficiently powerful for the work of driving a 50-watt (12 c.-p.) machine. You will require a much larger engine—say, a 1½ by 1½ high-speed horizontal, or 1½ by 1½ vertical. Stuart Turner, of Shiplake, Henley-on-Thames, supplies engines of this size; also castings. (2) You should provide a boiler having at least 650 sq. ins. of heating surface. The vertical boiler on page 31 of "Model Boiler-Making" would make a suitable generator.

[14,792] **Change Wheels for Lathe.** H. G. (Leytonstone) writes: I should be greatly obliged if you would kindly give me a formula by which I could find the change wheels for a machine, the leading screw of which is 2½ to the inch.

$$\frac{\text{Pitch of leading screw}}{\text{Pitch of screw to be cut}} = \frac{\text{wheel on mandrel}}{\text{wheel on leading screw}}.$$

Your leading screw being 2½ to the inch, the above would read, supposing you wished to cut eight threads per inch:—

$$\frac{2\tfrac{1}{2}}{8} = \frac{25}{80}$$

i.e., mandrel wheel would have twenty-five teeth, and wheel on leading screw eighty.

[14,692] **Series-Wound Motor for Electric Loco.** W. B. (Twickenham) writes: I am making a motor which I want to use on a model tube loco, and I should be obliged if you would tell me how to wind same. I want machine to be series wound, with a working pressure of 20 volts, and the questions I wish to ask are: (1) What size wire to wind field-magnet? I want to get as much power as possible. (2) What kind of armature to use, and wire to wind same? (3) How many amps. will it take at 20 volts? (4) What power may I expect from same, with good workmanship? Armature tunnel is 2 9-16ths ins. by 2½ ins. long.

(1) Use No. 20 S.W.G. on armature, and No. 17 on field. (2) Cogged drum. (3) About 4. (4) About 80 watts.

[14,758] **Lighting Plant for Workshops.** A. E. J. (Sedgeley) writes: We have in our workshop a 25 b.h.-p. gas engine. Whereas it only takes about 12 b.h.-p. to drive our machine, the other 12 or 13 b.h.-p. must be running to waste. We have been thinking whether it would be economical, in order to use this extra power, to put down a small dynamo to supply the shops with electric light, instead of gas. We should require about six really good lights, similar to those used for street lighting. Should be grateful to you if you would tell us what size dynamo we should require, voltage, etc., and what would be the probable cost of such an one, and the upkeep of the same. The engine above travels at 150 revolutions per minute with a 3-ft. driving wheel.

If you have about 12 h.-p. to spare, you could light up the shops quite readily with a 7 kilowatt dynamo (shunt-wound). An output of 70 or 80 volts at 8 or 10 amps. would be a convenient one. If arcs are to be used, a voltage of about 55 would be best. They would then be run in parallel from the dynamo. Any of our advertisers would quote you for a suitable machine.

[14,639] **Old Gas Engine.** "WEETLY" (Burley-in-Wharfedale. writes: I have a 1 or 1½ h.-p. gas engine (picked up cheap), but I do not understand its principle, and, in any case, I should like to fire it with a spark plug. It is upright, and has a slide with several square and small round holes and sinkings; also a box with a lot of iron plates in. Can you recommend a book in which I can thoroughly read it up, and suggest a way of firing it with plug? It is in very little worked condition, but has been laid some years aside, well greased. I want to use it for charging; also for driving a hay-chopper.

Your engine is evidently an old vertical one, with slide and flame ignition, and we doubt if it will be possible to convert it to anything more modern in the way of ignition and valves. Even if possible, it would cost nearly as much as a new engine of same power. The box of plates is the air-box, through which air is drawn in to mix with the charge of gas. If you understand the principle of spark ignition, you might be able to devise some means of fitting a spark plug yourself in the cylinder end. See Grover's book on "Gas and Oil Engines," post free 5s. 4d., or our handbook by W. C. Runciman, post free 7d.

[14,693] **Electro-magnet for Exerting a Given Pull.** J. A. H. (Aberdare) writes: There is a magnetising coil in use at a colliery lamp room for unlocking lamps. The bobbin was of the following dimensions:—Length of iron core, 7 ins.; diameter of core, ¾ in.; distance between flanges of bobbin, 6½ ins.; size of wire (insulated with double cotton), 10 S.W.G.; resistance of wire, ·187 ohm; current required to exert desired pull, 32 amps.; voltage, 6 volts; No. of amp.-turns, 11450, approximate). The end of magnet core has to attract a piece of round iron (which is the lock of the lamp) of the following dimensions, through an air space of 5-16ths in.:—Lock (round iron), ¼ in. by 1 in. and ¼ in. by ¾ in., spring holding the lock in position when lamp is locked, 4 lbs. pull. It is required to obtain a pull on magnet core sufficient to draw an armature down through a 5-16ths-in. space. I have given the above explanation so as to make it as clear as I possibly can. Now, I wish to wind another bobbin of 16, 18, or 20 (double cotton-covered), so as to exert an equal pull to that of the magnetising coil now in use; but instead of using 32 amps. at 6 volts, I wish to use a lower amperage (about 12 amps.) at a higher voltage, if necessary. Please let me know if it is possible.

Use a thinner wire and more of it. Provided the amp.-turns are the same, the pull will be approximately the same through a given distance; other conditions remaining altered. As you have 11,450 amp.-turns in the first case, when using 32 amps., you would need $\frac{11450}{32}$ *actual* turns of wire, and with 12 amps. flowing you would need $\frac{11450}{12}$ actual turns to get the same effect. The resistance of the new winding would have to be higher, so as to allow only the 12 amps. to flow.

[12,617] **Telegraphic Instruments and Connections.** W. M. (Garston) writes: Could you kindly send me a diagram of connections for a telegraphic circuit? Stations about 100 yds. apart, each having a telegraphic instrument, bell, push, switch, and one battery of two Leclanché cells, with either two or three line wires, so that bells can be run from opposite ends only, and always ready for signalling, and also with putting switch on it, disconnects bell circuit and connects instruments ready for working. The telegraph instruments are of the type shown in *M.E.* handbook—"Electrical Working Models." I have tried to get an earth return for bells, but can get no result with two Leclanchés.

We give you a diagram of method of connecting call bells. They are simply interposed in the circuit of one of the line wires, and each fitted with a two-way switch. The method of using them is as follows: Normally the switches are set in circuit on contacts A; suppose you wish to ring up the operator at the distant station, you set your own switch to contact B, thus throwing the bell out of circuit. You then press either of the contact keys of the instrument and send a current which will pass through the distant bell and ring it. The operator, as soon as he hears the bell, will set his own bell switch to B, and cut it off, thus restoring the line to working condition S, and then signal to you by the telegraph that he is ready to take your message. When you have finished, the switches of each bell are set again to A ready for another call. If you use earth as a return you must connect your wires to large plates of sheet metal, and sink them in damp ground to get good connection, and you may have to provide increased battery power. A water-pipe makes a good earth, if you can get a good contact to it.

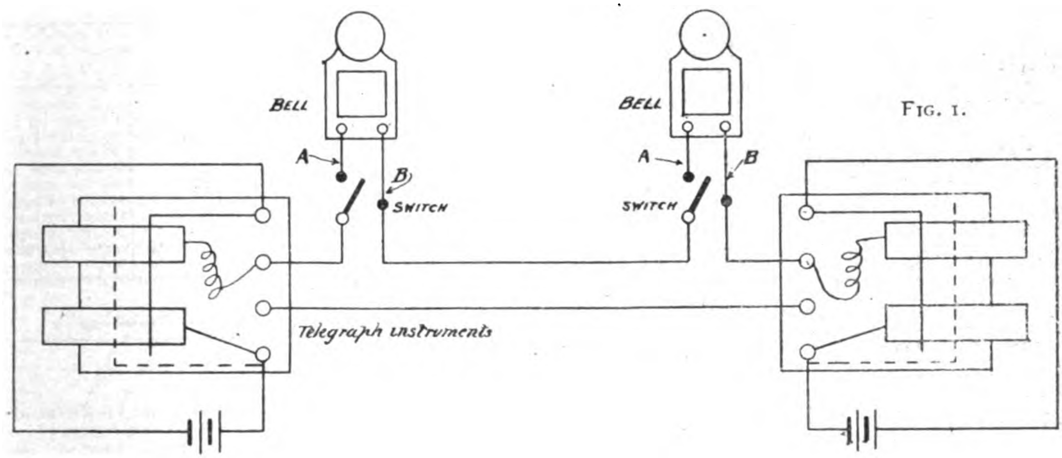


FIG. 1.

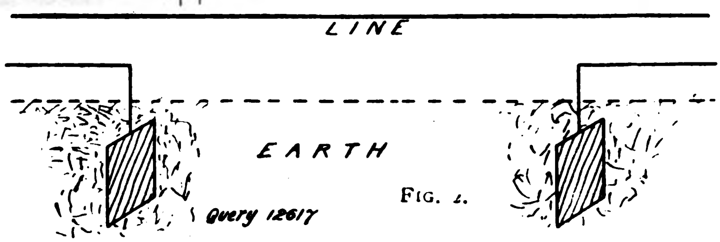


FIG. 2.

DIAGRAMS OF CONNECTIONS FOR TELEGRAPH INSTRUMENTS.

[14,734] **Winding for 8-watt Motor for Electric Loco.** C. F. W. (Oldham) writes: Will you kindly answer me the following questions? I am making THE MODEL ENGINEER Electric Locomotive, described at the beginning of this year. Mine is to be half-size—*i.e.*, taking the coloured plate as a full-size drawing. Can you tell me the windings for armatures and field-magnets of motors? I want the motors to work in parallel from four quart bichromate cells (8 volts), taking, at full load, about 1 amp. each motor. I should like the engine to travel from between two to three miles per hour. Can you also tell me which way to connect each motor—shunt or series?

Wind field-magnet coils with No. 24 gauge s.c.c. copper wire, and armatures with No. 30 gauge single silk-covered copper wire; about 1 oz. will be wanted for each field, and ½ oz. or so for each armature; get on as much as you can in the space. Motors should be connected with the field coil in series with the armature.

[14,743] **Winding for Small Series Motor.** T. H. (Stockport) writes: I enclose sketch for a small electro-motor, and should be glad if you will answer me the following questions:—(1) Gauge and amount of wire for field-magnet in series? (2) Gauge and amount of wire for Siemens H armature (cast iron), 1 in. diameter? (3) Address of firm where a *soft* casting can be obtained? (4) Would it do in malleable iron? The motor is to be driven from three bichromate cells.

(1 and 2) Armature, No. 24 gauge D.S.C. copper wire, about 1 oz.; field-magnet, No. 22 gauge s.c.c. copper wire, about 1½ ozs.; but get on as much as you can in each case. (3) Try Avery, of Tunbridge Wells; or some other of our advertisers. (4) Malleable cast iron, or good soft cast iron can be used; but we consider you would do better to avoid malleable cast iron, as it usually takes a long time to obtain a casting—several weeks—and is not so clean. There is not much advantage in it.

[14,455] **Measuring Resistances.** A. R. L. (Croydon) writes: I am clearing out my experimental apparatus, and wish to start building models proper (electrical). I want to get rid of about 16 lbs. of mercury from a pump (broken up), and lead grids, paste and scrap lead generally; also brass scrap and tinfoil and block tin. (1) Can you let me know a London firm who would buy the mercury and other metals too; but it is the mercury I find most difficulty in disposing of? (2) What is the resistance of an accumulator? Is it the E.M.F. in volts, multiplied by the charging current in amperes (*i.e.*, to give ohms)? *e.g.*, 4-volt accumulator giving just 4 volts being charged at 2 amps. rate would have a resistance of 8 ohms. and therefore need 16 volts to drive the 2 amps. through. It seems too much, yet that is what I have been told.

(1) *Re* mercury, try an advertisement in THE MODEL ENGINEER, "Sale and Exchange Column." (2) Your idea is incorrect. The resistance of an accumulator is very low, and is difficult to measure, as it is a variable quantity, and of so small a figure. There are various methods of measuring the resistance of an accumulator. The following is given by Prof. Ayrton in his book, "Practical Electricity": B is the accumulator, A an amperemeter, R a resistance, the value of which need not be known; V is a voltmeter. The volts at the terminals of the accumulator are first measured when no current is being taken from it; the amperemeter and resistance are then connected, and the value of the resistance is adjusted until a readable indication is given by the amperemeter; the volts at the terminals of the accumulator are again measured with this current flowing. Calling the volts on open circuit E and the volts when the current is flowing V, then internal resistance of accumulator $= \frac{E - V}{A}$ A being the current in amperes. Other methods are given in "The Storage Battery," by Treadwell. When using the method given above, the various values must be arranged to suit the size and voltage of the accumulator; for instance, a small pocket accumulator should only have, say, ¼ to 1 amp. taken from it, whilst a large cell might have 10 to 20 amps. or more taken from it, according to size. The method is an application of Ohm's law $\left(R = \frac{E}{C}\right)$, and gives a resistance at the particular instant of making the measurement.

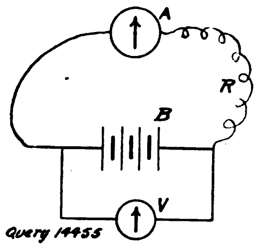
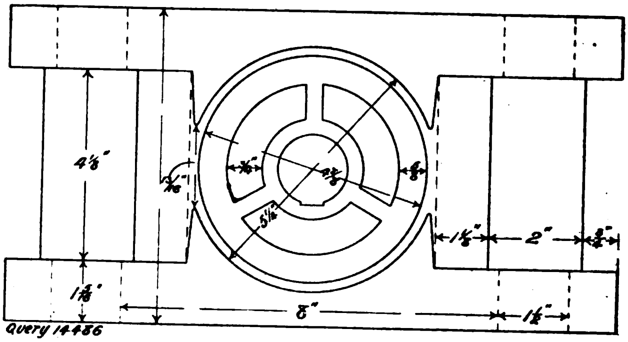


DIAGRAM OF CONNECTIONS FOR MEASURING INTERNAL RESISTANCES.

[14,740] **Power for Driving Small Lathe.** "NELLAT" (St. Leonard's-on-Sea) writes: Will you kindly advise? I have a lathe for light metal work, and want to instal power to drive it. Afraid, as workshop is only 7 by 6 by 3 by 6, not room for gas engine—so thinking of getting motor or dynamo, or both. Would also wish to charge motor cycle accumulator occasionally. Lathe never works for longer than about one to one-and-a-half hours at a time. (1) What power motor should I want? (2) Would dynamo driven by accumulator be same as motor? (3) What voltage accumulator needed to drive (*a*) motor, (*b*) dynamo? Or could I get a petrol motor to do the work (electric ignition all fitted), as I understand them?

An electric motor would be the best means for you to employ for driving your lathe; it takes small amount of space, gives off no fumes or noise, as with a gas or petrol engine, and is always ready for starting up at any moment. For light work and a light running lathe, a ½ b.h.-p. motor would be sufficient; but as your current supply is, we presume, alternating current, and you wish to drive a dynamo as well for charging accumulators, it would, perhaps, be well to have a ½ b.h.-p. motor, so as to have a reserve of power. However, if you do not intend to use dynamo and lathe at the same time, a ¼ or ⅛ b.h.-p. motor should do very well, as unless you contemplate charging a number of accumulators at once, a very small dynamo would suffice. It would be impracticable to use a motor driven by accumulators to run your lathe, unless you have exceptional facilities for having a fairly large battery charged.

[14,486] **Windings for 500-watt Manchester Dynamo.** C. A. S. (Bermondsey) writes: I have bought a plain ring armature and a 56 segment commutator on spindle. I wish to wind it for 85 volts. The measurements of the armature are as follows: Diameter outside, 4½ ins.; diameter inside, 3¼ ins.; length, 5¼ ins. (1) What size S.W.G. and weight of wire will I require for the armature and field-magnet? (2) Are my measurements (enclosed) correct for field-magnet? (3) What would be the output of a machine this size, say, at 2,000 r.p.m.? (4) What horse-power would I require to drive it at full load? (5) Has the commutator too many segments?



MANCHESTER TYPE DYNAMO.

(1) Wind armature with No. 20 gauge D.C.C. copper wire, each coil to have three layers of wire, five turns per layer; a quantity of about 4½ lbs. will be required. Wind field-magnet with about 5 lbs. No. 23 gauge s.c.c. copper wire on each core, both coils to be connected in series with each other and in shunt to the brushes. (2) Yes; measurements will do. (3) About 85 volts 6 amps.; the voltage can be adjusted within limits by running at a higher or lower speed. (4) About 1½ h.-p., allowing for loss in driving belt. (5) No; except that as your supporting spider has three arms, the total number of coils should divide into three portions. To do this the commutator should have fifty-four segments to suit fifty-four coils; we advise you to wind fifty-four coils, and either rebuild the commutator with two segments less, or to suppress two by soldering them to a neighbouring segment each; you would then have two thick bars. With so large a number it would probably not cause trouble; they should not be exactly opposite.

[14,783] **Adjustable Brushes for Dynamo.** R. P. (Springburn) writes: Would you kindly reply to the following query? In a compound-wound dynamo which is made to generate in either direction, the brushes are fixed, and at a certain speed the machine gives a certain output. Now, if I replace the fixed brushes by brushes that will have a forward or backward lead, according to the direction of rotation, should I be able to get more current from the same machine, or, better still, should I minimise the risk of breakdown of the armature when overloading?

You would probably get slightly more current, and the armature would also run cooler than before. It is much better to have a means of adjusting position of brushes.

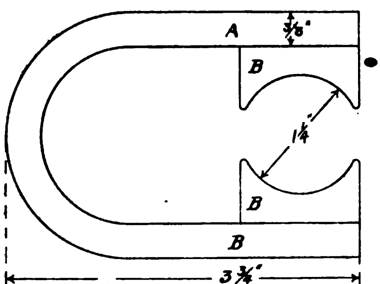
[14,787] **500-watt Dynamo Windings.** E. G. W. (New Hirst) writes: Will you kindly advise me on the following? I am about to construct a 500-watt Manchester type dynamo, say, 50 volts 10 amps. I have a pair of carbon brushes. (1) Will the said brushes do if suitable holders are made for them? (2) What diameter and length should the armature be? Also what number, depth, and width of slots will be required? (3) What dimensions for field cores, yokes, and pole-pieces; or will the 500-watt scale in handbook do, with cogged ring armature? (4) Should cores of field-magnets be cast or wrought iron? (5) How much, and what gauge wire will be required for armature and field-magnets? Also how many turns in each slot of armature? (6) What size shaft will armature take?

(1) Yes. (2) As shown in Fig. 35, page 31, of handbook. (3) As shown in handbook. (4) Perfectly wrought. (5) See table of windings, page 50. (6) $\frac{3}{8}$ in.

[14,753] **2-in. Spark Coil.** A. L. (London. N.E.) writes: I shall be much obliged if you will give me information on the following:—A 2-in. spark coil I have gives a 1-in. spark, with three dry cells in series, with ordinary contact-breaker; but when I use six dry cells in series, with a well-made mercury break, I only get a $\frac{1}{2}$-in. spark. Will you tell me what is wrong with the break? I notice that after it has worked for about five minutes the methylated spirit in the break cup gets quite black, and the mercury at the bottom goes into very small balls; also, there is a loud metallic noise in the break cup. Would you suggest paraffin instead of spirits? I should be grateful for any suggestions you could give me for improving it.

Try a more suitable battery, such as four bichromate cells in series, of at least quart size each. All mercury breaks require some attention as regards the mercury: it requires straining from time to time to clean it. You could certainly try paraffin oil, instead of spirit—you may find it work better. Your mercury may not be very good—it may contain impurities; perhaps also the quantity is not sufficient. Try working the coil from a different set of cells to those which supply current to the break magnet or motor. We presume you have put the hammer break out of action. The easiest way is to place a piece of cardboard between its contacts, and then screw them together. The mercury break is then to be connected in place of the hammer break.

[13,736] **Petrol Engines; Magneto Machine.** J. A. (Leeds) writes: Having received much valuable information by reading your paper, I have been tempted to do a little work at home, and will be obliged if you will answer me the following questions: *Re* Petrol Motor. (1) When the piston is descending, it has to overcome the resistance of the air. Should there be any outlet for the air in the crank chamber? (2) Do the fly-wheels serve the purpose of oil-throwers and automatically oil the bearings, or if a bath of oil was put in the bottom of crank chamber, would this take place? I have a permanent magnet, A, as sketch; B B, soft iron pole pieces. Magnet weighs $1\frac{1}{2}$ lbs., and will lift 6 lbs.; armature, $1\frac{1}{4}$ by $1\frac{3}{8}$ ins. diameter; shuttle, H type, wound with No. 34 wire. (1) Is magnet at full strength? (2) Can I get $\frac{1}{2}$ amp. at 5 volts? (3) What speed will it require? (4) If winding is not suitable, what winding would you



MAGNETO MACHINE.

recommend, and at what speed? (5) If I put two slip rings on, can I get an alternating current, and would it work a $\frac{1}{2}$-in. spark coil without trembler?

Re Petrol Motor. (1) Refer to our handbook on "Petrol Motors," price 1s. 2d., post free. (2) See our handbook on "Gas and Oil Engines," price 7d., post free. *Re Magneto Machine.* (1) Probably magnets vary considerably, and lift from four to twenty times their own weight in the highest quality. (2) Very doubtful; wire is too fine a gauge. (3) About 3,000 to 4,000 revs. p.m.; voltage will vary as the speed; you can ascertain the exact amount by trial with a voltmeter. (4) No. 26 gauge s.s.c. copper wire. (5) You can get an alternating current, but not of sufficient quantity to work a $\frac{1}{2}$-in. spark coil used as a transformer without a contact breaker to be of any use; further, we doubt if an alternating current would be of any use for spark ignition purposes (if that is what you want it for), unless you can ensure the spark occurring at the right moment. You will see that you may have your alternating current at zero just when it should give the spark; it would not do for reliability unless you can evolve a safe method of use by experiment.

[14,757] **Apprenticeship.** R. H. (Plymouth) writes: Having been a subscriber to your paper for over two years, I have noticed at different times the useful advice you have given to would-be apprentices. As I should like to be an apprentice in the engineering line—either motor or locomotive—will you kindly answer the following queries:—(1) What would be the premium required to enter a good locomotive or motor works? (2) Are there as good openings in the motor line as there are in the locomotive line? (3) Can you give me the names and addresses of one or two good firms of motor builders? (4) What is the age limit at which apprentices are usually taken?

(1) Very difficult to say. Premiums for ordinary apprentices are usually about £50; some works take them without premium. (2) There should be very good openings in the motor line, as it will be undoubtedly a very large industry. We are inclined to advise you to try and enter a motor works. (3) Messrs. D. Napier & Son, Acton, London, W.; Messrs. Alldays & Onions, Ltd., Birmingham; Messrs. Singer & Co., Ltd., Coventry; Messrs. The Wolseley Tool and Motor Car Co., Ltd., Adderley Park, Birmingham; Messrs. The Brush Electrical Engineering Co., Ltd., Falcon Works, Loughborough, Leicestershire. Obtain a copy of the *Autocar* Journal, published by Messrs. Iliffe & Son, Coventry; you will find other names in it. There are also other motor journals. (4) Sixteen years.

The "Fortis" Vice Competition.

The "Fortis" Electrical and Engineering Company, of Coventry, have kindly placed at our disposal three of their vices, value 18s. 6d., 10s., and 5s. 6d. respectively, to be awarded as prizes in a competition. We accordingly have pleasure in offering these useful prizes for the best three articles sent on "An Amateur's Vice Bench." What is required is a working drawing of a bench suitable for amateur use, with a short accompanying article describing its construction and fittings (tools not included). The prizes will be awarded to the designs which in the opinion of the Editor of THE MODEL ENGINEER are best suited to the requirements of the average reader of this journal. All entries should be sent to the Editor of the *M.E.*, and should be marked "Fortis Vice Competitions." The latest date for sending in will be December 1st, 1905.

The News of the Trade.

[*The Editor will be pleased to receive for review under this heading samples and particulars of new tools, apparatus, and materials for amateur use. It must be understood that these reviews are free expressions of Editorial opinion, no payment of any kind being required or accepted. The Editor reserves the right to criticise or commend according to the merits of the goods submitted, or to abstain from inserting a review in any case where the goods are not of sufficient interest to his readers.*]

• *Reviews distinguished by the asterisk have been based on actual Editorial inspection of the goods noticed.*

*Drilling Machine for Small Work.

The small drill turn which The Charles Cohen Tool Co. are now supplying will be found very useful to most model makers, and one has been sent to us for inspection. The machine is 3 ins. long by $1\frac{1}{2}$ ins. in height, and is made entirely of steel; has a 3-speed pulley and two American 4-split chucks, which will hold the finest drill. It will drill accurately, the arbor running in a 1-in. long bearing. It can be fixed in a vice for use with a bow, or can be run from a pulley, either driven by hand or from a foot-wheel, and if fixed to the slide-rest of a lathe the most delicate drilling can be accomplished. A set of six hardened and tempered drills are supplied with the machine, and extra drills of various sizes can be had. Prices can be obtained of the above firm, whose address is 34, Barbican, London, E.C.

New Catalogues and Lists.

The Edison & Swan United Electric Light Co., Ltd., 36 and 37, Queen Street, Cheapside, London, have sent us Section VI of the new catalogue of artistic electric light fittings and accessories, illustrating their plain and ornamental pendants, electroliers, standards, lanterns, brackets, shopwindow fittings, bronzes, etc.

The Manchester Electrical Supply Stores, 11 Stretford Road, Hulme, Manchester.—The illustrated price list of electrical sundries supplied by this firm has been sent to us, and includes batteries and charging materials, wires, electrical indicators, alarm clocks, bells, volt and ampere meters, small electro-motors, dynamos, coils, and electric lighting and other accessories. The list will be sent post free to any reader upon receipt of two penny stamps.

The Editor's Page.

THE following note from a Bombay reader serves to show that our Natal correspondent, whose letter we recently published, is not alone in his wish to be able to purchase supplies through a recognised expert buying department. "I think that the suggestion made by your correspondent on page 168 of your issue of August 17th last, regarding a special buyer at home, who would undertake to purchase materials, tools, fittings, etc., for residents abroad, an excellent one. Although a letter takes only a fortnight to reach England from India, and *vice versâ*, I have experienced the greatest difficulty in obtaining things I have required from time to time. A model engineer is always greatly handicapped in India, as nothing in the way of tools, materials, etc., necessary for model engineering, is obtainable out here, and with the treatment one sometimes receives from home firms, the pursuit of this hobby is well nigh hopeless. I for one would therefore gladly avail myself of the services of such a buyer, who could be relied upon, and am quite prepared to pay a commission which might be, say, 10 per cent. on orders under 20s., and 5 per cent. on orders over that amount."

* * *

We have also received the following letter on the same subject from a reader in St. Helena :—"I have read with great interest your Natal correspondent's letter *re* 'goods sent out to the Colonies being of inferior quality,' and heartily endorse his idea of a special buyer, who would procure goods of a reliable quality for Colonial purchasers. It is a severe disappointment to have to wait, say, three months, and then to find the goods sent out do not come up to the specification. Not only on the point of bad quality do I complain, but also in the case of checking, packing, and laxity in forwarding goods. In the case of castings being ordered, sometimes the most important part is missing ; and in a small Colony like this it is impossible to procure even a small machine screw, rivet, or piece of metal suitable for a substitute. Then as regards packing, anything will do as long as the goods are got off. The result is that the goods, be they heavy, force the case open, and something gets damaged or lost. Small articles that can be sent by Parcel Post are packed in wooden cases and sent 'on freight' through export agents who charge exorbitant rates, whereas the goods if packed in proper parcels would probably cost 3s. in the post. Quite recently I ordered from a well-known electrical firm, some small fittings costing about £2, and distinctly told them to forward by parcel post. After waiting four months they turned up 'on freight,' the forwarding agents charges amounting to 27s. The net weight of goods was 7 lbs., which could easily have come by post. Being an Englishman myself I prefer, if possible, to procure English goods, but I must say that the Americans are by far the best to deal with. Their ways of packing, despatching, and courteous letters induce one to give them further orders. You know exactly what you are buying. Their lists contain full information as to weight of goods, cost of packing, and shipping measurement of same. In conclusion, I sincerely hope you will be able to see your way clear to adopt the suggestion of your Natal correspondent, and I am sure Colonial readers of your valuable paper will thoroughly appreciate it."

* * *

We may say that we are giving this matter our consideration, and hope to be able to devise some scheme which will meet the requirements of our Colonial readers, without being too cumbrous and expensive in its working in proportion to the amounts involved.

Notices.

The Editor invites correspondence and original contributions on all amateur mechanical and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected or not, and all MSS. should be accompanied by a stamped addressed envelope for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

This journal will be sent post free to any address for 13s. per annum, payable in advance. Remittances should be made by Postal Order.

Advertisement rates may be had on application to the Advertisement Manager.

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All correspondence relating to the literary portion of the paper, and all new apparatus and price lists, &c., for review, to be addressed to THE EDITOR, "The Model Engineer," 26—29, Poppin's Court, Fleet Street, London, E.C.

All correspondence relating to advertisements and deposits to be addressed to THE ADVERTISEMENT MANAGER, "The Model Engineer, 26—29, Poppin's Court, Fleet Street, London, E.C.

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Contents.

[*The asterisk* (*) *denotes that the subject is illustrated.*]

THE

Model Engineer

And Electrician.

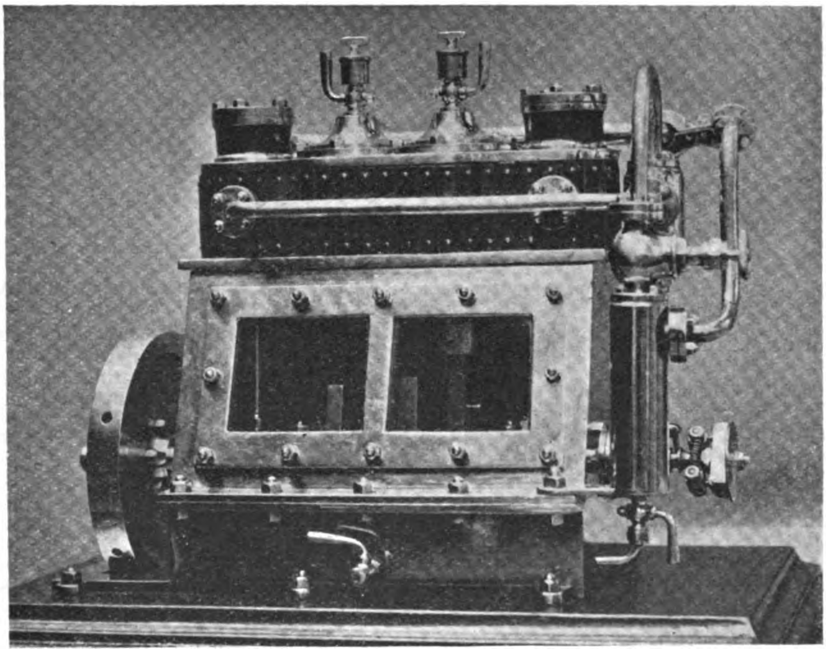
A JOURNAL OF PRACTICAL MECHANICS AND ELECTRICITY.

EDITED BY PERCIVAL MARSHALL, A.I.MECH.E.

VOL. XIII. No. 235. OCTOBER 26, 1905. PUBLISHED WEEKLY.

A Fine Model High-Speed Steam Engine.

By G. BOYES.



MR. G. BOYES' MODEL HIGH-SPEED STEAM ENGINE.

THE photograph herewith is of a model high-speed engine which I have constructed from my own patterns. I may here state that out of seven times shown at industrial exhibitions it has received one special, four first, and two second prizes. The model stands $7\frac{1}{2}$ ins. high on base, and is of polished brass, with exception of crank-shaft, flywheel, and crosshead pins, which are of mild steel. The cylinders, which are single-acting, are 1-in. bore, $1\frac{1}{4}$-in. stroke, and the valve chest $\frac{1}{2}$-in. bore. The cranks are set at 180°, and there are only three webs; this does away with centre bearing and causes less friction. The grease cups, drain cocks, bolts and nuts are all turned and filed from brass wire. The flywheel is 3 ins. diameter and $\frac{3}{8}$ in. thick, and provision is made for coupling direct to a dynamo which I intend to construct. The engine is fitted with shaft governor, of the type fitted to the Belliss and Morcom high-speed engine. The steam pipes are 3-16ths in., and exhaust ¼ in. copper. As will be seen from photograph, cylinders are mahogany lagged, and inspection door fitted with glass, so that you can see working parts. The whole is a compact little model, and runs exceedingly well.

Workshop Notes and Notions.

[Readers are invited to contribute short practical items for this column, based on their own workshop experience. Accepted contributions will be paid for on publication, if desired, according to merit. All matter intended for this column should be marked "Workshop" on the envelope.]

Another Method of Making Wing Valves.

By Wm. Bell.

Having occasion to make some three-wing valves a few years ago, I adopted the following plan,

Fig. 1.

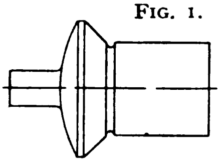
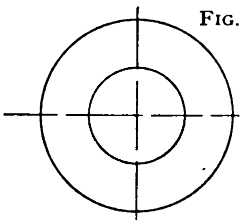


Fig. 2.



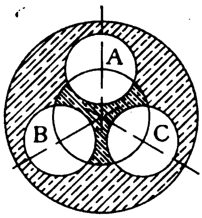


Fig. 3.

A Method of Making Wing Valves.

which may be useful to others:—A piece of brass to size required to fit valve seat was turned as Fig. 1. I then procured a piece of brass, double the diameter of valve just turned, bored hole in centre of same (as Fig. 2), and put this on the valve (an easy fit), keeping flush at bottom; then the ring was divided into three equal parts, as in Fig. 3. Holes (A, B, C) were next drilled to the size required, taking care to put holes to the proper depth, finally pulling off outside ring and leaving valve complete.

Reference Tables.

By "Split-Pin."

The accompanying table of figures is one not often found among the many tables and formulæ conspicuous in mechanical and engineering books. I have no doubt that many readers of this journal, like myself, will find it a useful table of reference. There are other methods, of course, of obtaining the equal divisions of a circle, but with this table the chord is found to a decimal which enables the correct measurement to be taken accurately. The quantities in column headed S are the sines of the half angle obtained by dividing the circle into the number of equal parts given in column marked N; and to find the chord (or the distance between two points on a circle), to divide the circumference into N equal parts, multiply the diameter by S, as shown in example:—Divide 7-in. circle into five equal parts: Find 5 in table, and on same line under S is ·5877; then 7 ins. multiplied by ·5877 =

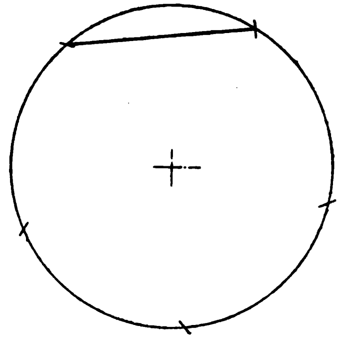


Diagram of a Chord.

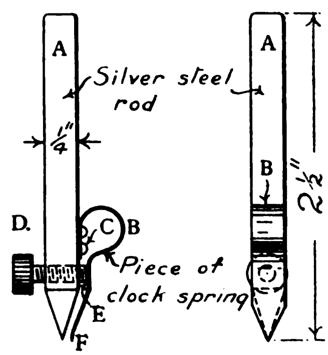
4·113 ins. Set dividers to 4·113 ins. and this will exactly divide the 7-in. circle into five equal parts. The table ranges from 3 to 20.

No. of Divisions.	S.	N.	S.	N.	S.	N.	S.
3	·8660	8	·3826	13	·2393	18	·1736
4	·7071	9	·3420	14	·2225	19	·1646
5	·5877	10	·3090	15	·2079	20	·1564
6	·5000	11	·2817	16	·1950	—	—
7	·4338	12	·2588	17	·1837	—	—

A Spacing Centre Punch.

By "Scribo."

A is a piece of ¼-in. silver steel, 2½ ins. long; ⅜-in. from the end it tapers to a point. B is a piece of good springy clock spring bent to the shape shown, and riveted to A by the rivets C. D is a



A Spacing Centre Punch.

⅛-in. screw, with a milled head; the point marked E is slightly flat so that the end of screw D shall have a good bearing. The point of the spring F comes a little below the point of punch A. Adjust by the screw D to distance required. The spring B should be well tempered.

A Tubular Chime Clock.

By H. Meyrick-Osborn.

THE following is the description of a new and novel design for a set of self-contained tubular chimes. A model has now been working satisfactorily for several months. As will be seen from the plans, the movements are divided into three parts—the fifteen minute chimes (**Figs. 1 and 2**), the hour striker **shown in** Fig. 3, and the clock movement **(Fig. 4)**—each of which is connected with the others by electricity.

The chimes are worked from switch wheels B and D (Fig. 4) contained in the clock movement, two switches being used in order to get a very short electrical circuit. At each of the four quarters electrical contact is made, and the current running through the magnets of the quarter chimes I I (Fig. 2) attracts the bar. The action of the magnets lifts the stop O out of a slot, setting free the fan M, and upon the works revolving the stop runs round in the groove, thereby keeping the opposite end of it from engaging with the fan. As soon as the next slot comes round, the stop falls into it, and allows the opposite end to drop against the fan, thereby stopping the chimes until the next contact is made, when the action is again repeated. The works are revolved by means of a drum and weight.

When the four quarter chimes have been played, the hour movement is set in motion, and strikes the hours; this is accomplished by means of switches X X (Fig. 2). When the chimes have nearly completed the last notes of the hour, the contact is made through these switches. The current runs through magnets in Fig. 3, attracting bar C, which in turn raises stop D out of slotted wheels G and K, and brings stop D to engage point L. The wheel has to revolve nearly once round before it strikes D, and this movement carries the slotted wheel K a little way round, so that directly the current is shut off the stop does not fall into the slot again, and therefore keeps the other stop out of the slotted wheel, G, and by the shutting off of the current it causes the magnet bar to drop, and also the stop D to disengage with L. This allows the works to revolve and the hours to be struck by hammer. When the proper number have been struck, the next slot in the wheel G will be immediately underneath the stop F, and directly the single slotted wheel K has re-revolved until the slot is underneath stop E, when both stops will fall into their respective slots and stop mechanism revolving. The hammer is worked by means of electric magnets, the circuit being completed by a switch-up wheel K.

The fifteen hours' chimes, as will be seen, are played in a similar manner to a musical box—a large drum with pins in it, which in turn raise the hammer levers.

The drum A is a cylinder of sheet brass, 6 ins. long and about 4 ins. in diameter. The ends are centred, and a spindle C soldered into it; B is the drum, which carries the cord of the weight; this measures 2 ins. long and 2½ ins. in diameter. H is a brass wheel turned as in diagram; it is tapped to screw on to spindle C, and carries the pinion G, which engages ratchet wheel F upon weight drum, and the spindle D runs in bearing turned in H. The opposite end of spindle C is threaded with a screw to fit the tapped cog wheel K. E E are the bearings. A plan should be drawn to fit the circumference of the drum, similar to Fig. 10. The black dots shown thereon represent the brass pins, which are soldered into the drum at proper intervals, as indicated at Q (Fig. 2).

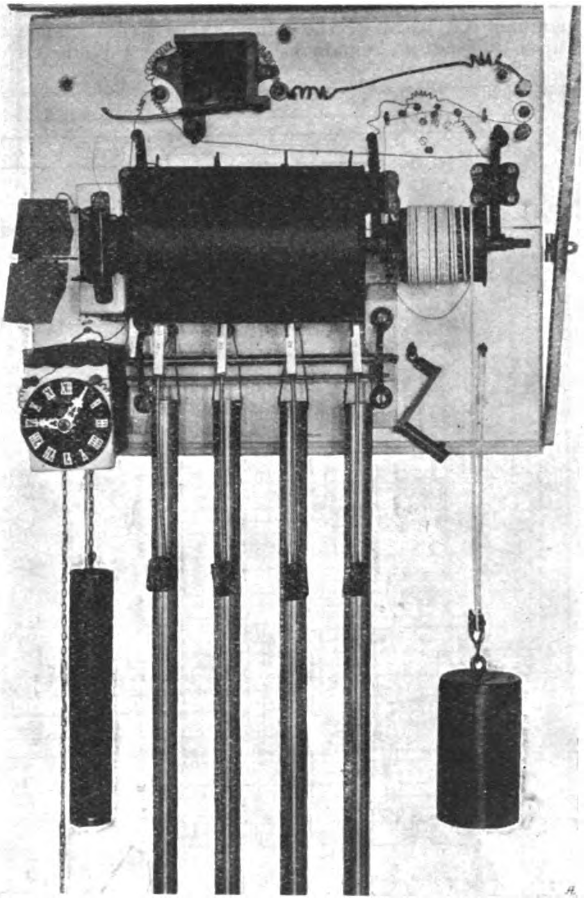


Fig. 1.—Mr. H. Meyrick-Osborn's Tubular Chime Clock.
(*The hour-striking mechanism is not shown.*)

The controlling movement, with starting and stopping lever, is worked by means of cog wheels with a fan. J is the slotted and grooved wheel, with the slots cut at the proper intervals, as in full-sized diagram (Fig. 6). It is turned out of brass, and is soldered to cog wheel K. This wheel has a bearing turned in it to run upon spindle K1 (Fig. 2). The stops O are kept rigid by centre rod, which is of square brass sliding in a square tube. X, X1 are the switches for making circuit to hour hand; X running upon the brass drum, and X1 upon an insulator (V) fixed to side of drum, having a brass segment let into it, similar to Fig. 8.

The Striking Gear.—E' E' are the bearings or brackets; T T is a steel spindle supported by these brackets. The hammer levers are made as in Fig. 5; S is $\frac{1}{4}$ in. square brass, and is drilled to fit with ease without side play upon steel spindle; Y is a brass tube fitting over spindle, which keeps the levers perfectly separated. T1 (Fig. 2) is a steel rod, which keeps the levers from touching tubes when stationary, so when striking there is just sufficient spring in the hammer rod to allow the hammers to strike the tubes, but not to remain in contact, and thereby and made as Fig. 8. M is switch engaging with brass wheel. R is switch, which completes the circuit upon touching brass segment. T is the sound bar, over which gut passes to tube V.

A section of clock, with connections, is shown in Fig. 4. The clock is worked with pendulum and weight, and the only type found to work satisfactorily. T T are terminals for wires to chimes; B and D are the switches made as Fig. 8, and fixed to the cog wheels. A and C are switch brushes; by using two switches a very short contact is made. The size of brass segment on B is only just too short to allow the single segment to connect up twice in

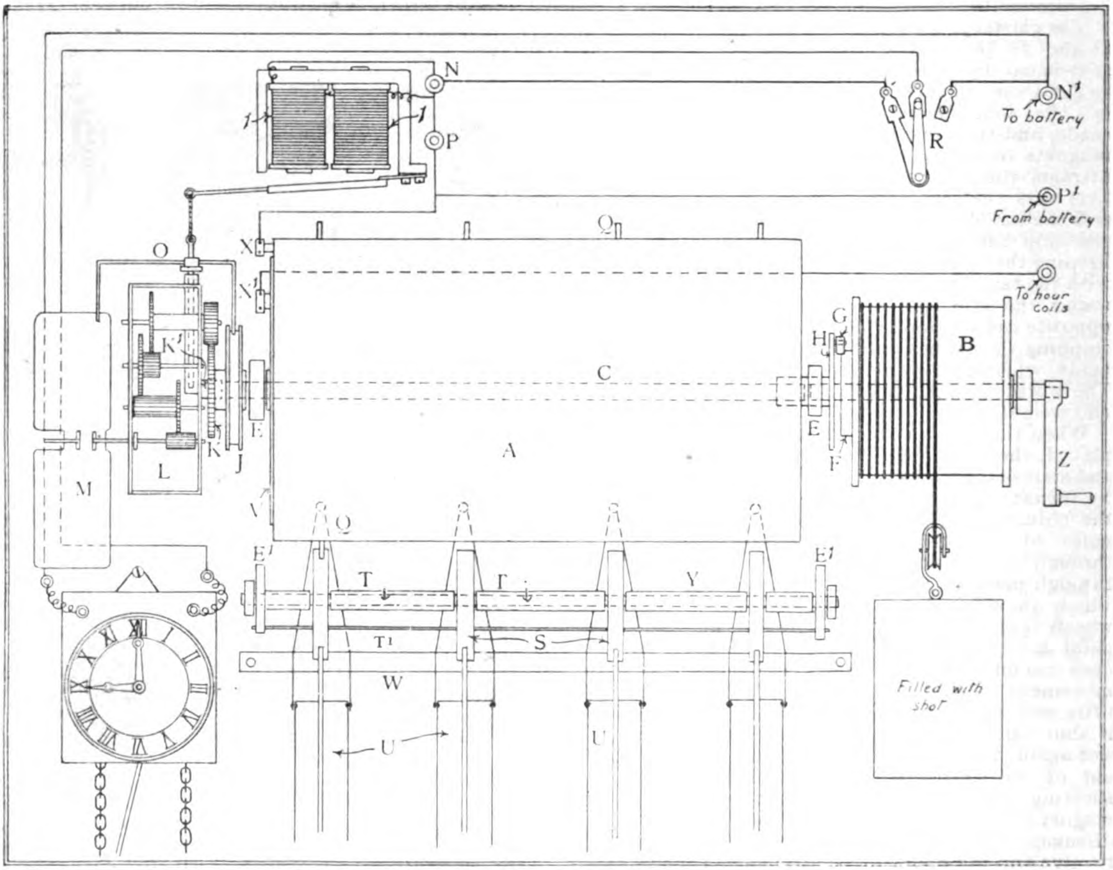


FIG. 2.—ARRANGEMENT AND CONNECTIONS OF THE QUARTER HOUR CHIMES.

deaden the tone. W is a sound bridge (see also Fig. 7), over which the gut of the tubes passes, and keeps the tubes from swinging when struck near the top. R is the three-way switch which allows the chimes to be switched off, to chime at the quarters by connection within clock, to chime at any time, enabling the right quarter to be set for proper time.

Fig. 3 is a diagram of hour-striking mechanism. A is the weight drum, with pinion and ratchet for winding. E, D and F are the stops as before described, D being square, and sliding in square tube to prevent lateral play. H is insulated wheel, with brass segment fixed to wheel K, consecutive revolutions. Switch D has four segments—one for each quarter—and is fixed to the minute hand wheel, which revolves once in each hour. The switch B has one very short switch, as stated above, and is fixed to a quicker cog wheel. When the minute hand is at a quarter, the switch brush C will be upon a brass segment on D, and the electrical connection will be made directly the segment upon B passes the brush A. By the time segment on B passes the brush A again the brush C will be no longer upon segment on D, and therefore no chance of a misconnection. The weight of clock has to be loaded with shot until it keeps correct time and overcomes the friction of brushes upon the wheels. All brushes for switches are made of brass wire turned with a spring in it.

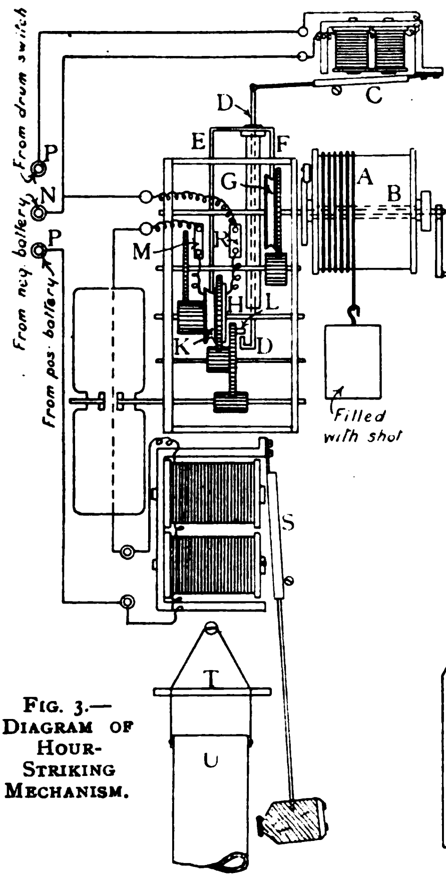


Fig. 3.—Diagram of Hour-Striking Mechanism.

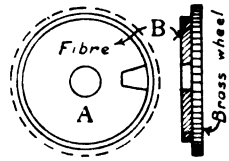


Fig. 8.—Method of Making Switches.

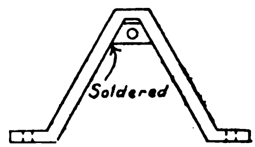


Fig. 9.—Bearings.

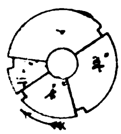


Fig. 6.—Stop Wheel.

Fig. 7.—Wood Sound Bar.

The tubes are made from ¾-in. steel drawn brass tube, and very thin. They are strung with catgut, and give very beautiful tones. Their lengths are respectively 2 ft. 9 ins., 2 ft. 10¾ ins., 3 ft. 1¼ ins., and 4 ft. 2½ ins.

The quarter-hour chiming arrangement is mounted upon a wood base fitted with a glass cover, which can be raised at will to get at the works, and is shown in the photograph (Fig. 1).

This design of clock, although rather bulky in size, the baseboard measuring 12 ins. by 14 ins., is a real novelty. The chimes can be heard at a good distance, and sound well. One of the great features about the design is that the quarters are sounded very slowly, which is not usually the case with small chiming clocks.

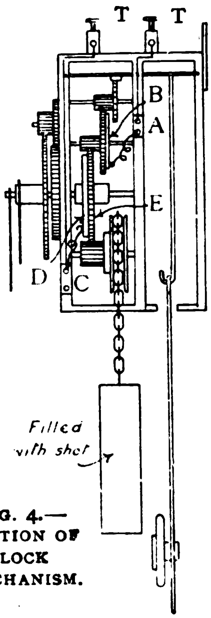


Fig. 4.—Section of Clock Mechanism.

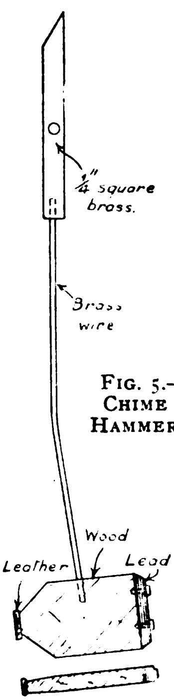


Fig. 5.—Chime Hammer.

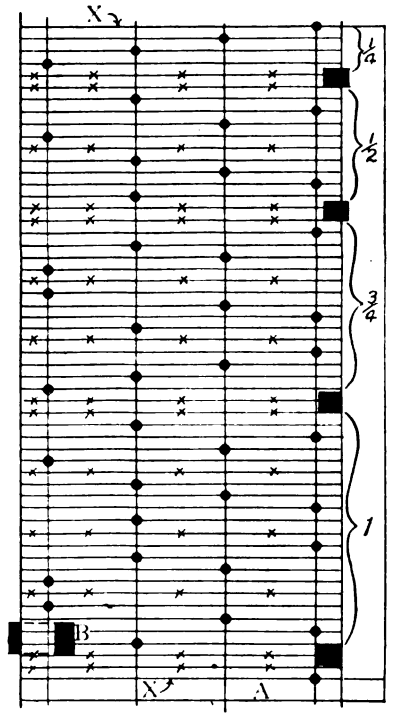


Fig. 10.—Diagram for Marking out the Notes on Drum.

The drawings, etc., are all from the original designs of the writer, and the model built by him from them is the result of three months' spare time.

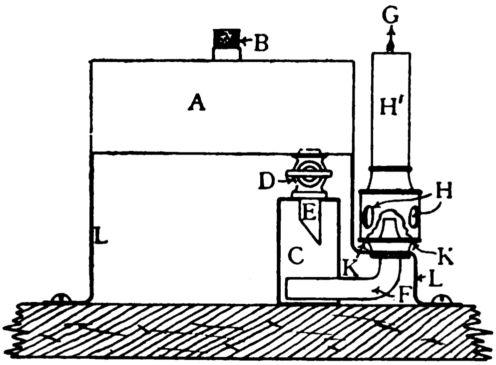
A Simple Spray Carburettor with Automatic Petrol Feed.

By B. H. Bayliss.

THE carburettor here described is suitable for the younger readers of this paper, and for those who are not lucky enough to possess many tools. It is suitable for engines with bores between 1½ ins. and 3 ins.

The spray chamber H' is made from the bottom part of an incandescent burner, called "The Vivid Patent," the only alteration being necessary is the drilling of eight 3-16ths-in. holes; these holes form the standard air inlet, and are situated round the circumference, just under the spray, as indicated at K. The holes already in the sides of the burner are used to admit extra air, as indicated at H.

The float chamber C is made out of an old tin, the size being quite immaterial. There is a short piece of ¼-in. gas pipe at F, which is screwed into the bottom of the burner, where a tapped hole will already be found; it is also soldered into the float chamber C.



A Simple Spray Carburettor.

The petrol tank A is also made from another old tin, and is fitted with a gas tap at D, which must have a ¼-in. hole drilled right through it, otherwise the petrol will not feed satisfactorily. This tap has a short piece of ¼-in. gas pipe screwed into it, as at E, with the other end cut crosswise; this allows the petrol to run more easily. There is a short piece of pipe at B soldered into the tank A, and fitted with a good fitting cork. If this cork is not a good fit, the carburettor will be liable to flood. The action of petrol feeding is the same as that of the water in those drinking fountains used for poultry.

It is necessary that the pipe E should not be a tight fit in the top of the float-chamber C, or the flow of petrol may be retarded. There are two supports at L L, which may be cut out of strong tin or brass sheet, and are soldered on to the tank A. The length of pipe E must be so arranged that the level of the petrol in the spray will be within ⅛ in. of the top. A large piece of rubber tubing will do very well to connect the carburettor to the engine with.

If a good mixture cannot be obtained by altering the apertures, H, the holes in the spray may be enlarged with a needle, or extra air holes drilled in H', according to whether the engine requires more petrol or less. Before filling the tank, see that tap D is turned off. Always have tap D *full on* when engine is working. Remember that when this carburettor is fitted to a gas engine, the previous air inlet of the engine must be stopped up.

The Latest in Engineering.

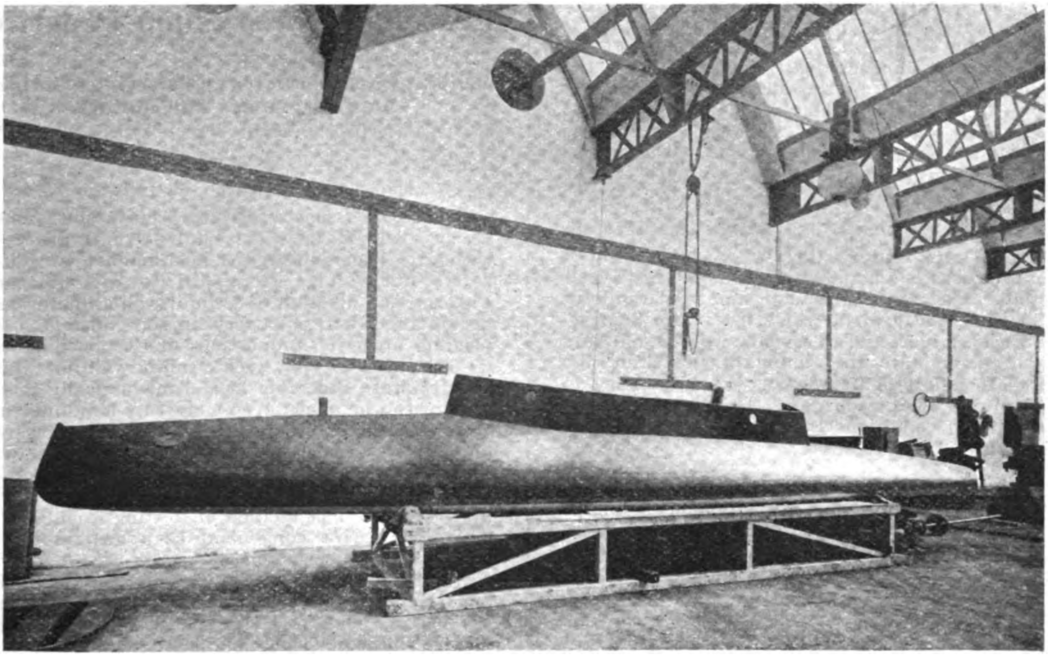
New 100 h.-p. Dietrich Motor Boat.—On the opposite page we reproduce two photographs of a new 100 horse-power Dietrich petrol boat. The photographs are especially interesting as showing the powerful petrol engines that are now being adapted to this type of racing boat. The hull, which measures 10 metres long by 2·20 metres wide, was constructed by Messrs. Deschamp and Blondeau.

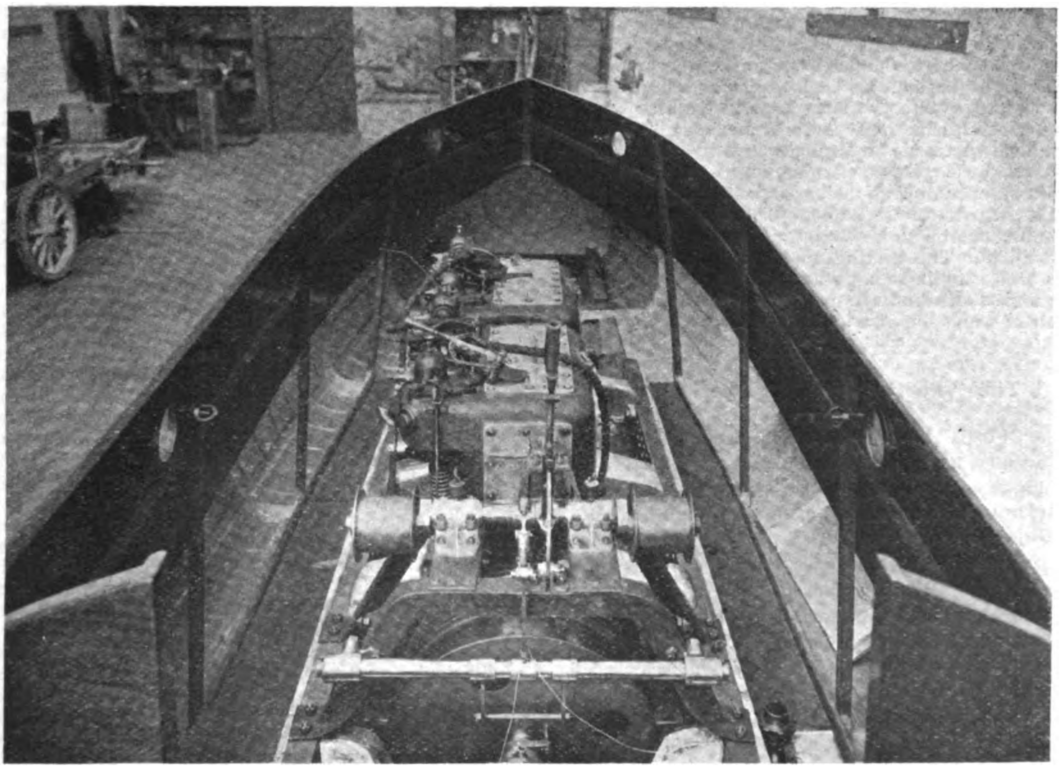
Measuring Turbine Power.—A method of measuring turbine power has been invented by Mr. Johnson, of Messrs. Denny & Brothers, Dumbarton. All that can yet be done is to specify power equivalent to so much horse-power as developed by reciprocity machinery, though the horse-power of the turbine is not capable of exact measurement in the same way. The new instrument measures by electrical means the torsion of the shaft over a certain length. The Admiralty have been recently trying the instrument on a turbine destroyer, and if the results promise well, it may be tried on the *Amethyst*, the turbine third-class cruiser.

Smart Bridge Work.—An expeditious piece of engineering was accomplished at Wood Green recently. It was found, necessary, in consequence of the electric tramways, to substitute a new railway bridge in Station Road. At one o'clock in the morning the Great Eastern Railway sent a gang of men down. They took up the line, removed the old bridge, put in the new bridge weighing no less than fifty tons, and relaid the lines in the small space of three hours.

Oil Engines.—Messrs. T. H. & E. Gardner, of Barton Hall Engine Works, Patricroft, Manchester, have devised a neat and compact apparatus for feeding the liquid fuel to an internal combustion engine. In a casting, or casing, is mounted on a vertical spindle an air-valve. The spindle has a conical upper end, which fits on a seating in a vertical passage, and forms the oil valve. The valve spindle passes across a throttled passage to which the fuel valve delivers the oil. A second passage, or by-pass, for air, deflects downwards at right angles in front of, and returns to, the main passage behind the throttled point. The air valve is placed in the lower passage with one side of the valve open to the atmosphere, so that as the suction of the engine operates the air valve, the fuel valve is simultaneously operated.

New Departure in Pumps.—A new type of direct-acting steam pump which possesses several new features is being placed on the market by Messrs. Frank Pearn & Co., Ltd. One of these consists in the arrangement of admitting steam to





100 H.-P. DIETRICH PETROL MOTOR RACING BOAT.

the cylinder, which is done in a similar manner to a rotative pump—viz., that the main steam port is only slightly opened at the commencement of the stroke, such opening gradually increasing with the travel of the piston ; by this means the steam is not shot on to the piston in the same manner as in most direct-acting pump steam cylinders. It reverses quietly, and closes the water valves without concussion, which is so destructive to most direct-acting types of pump.

A 70-Truck Goods Train.—A goods train of seventy trucks is a new feature on the Great Western line. The train is the 12.5 a.m. from Banbury to Southall, the load of which has, since September 5th, been increased to seventy wagons and van. On the same date the timing of the train was altered to admit of its working from Banbury to Southall and back each day. The working under these altered conditions is understood to be quite satisfactory.

A Heat Distributor.—An appliance, known as Philp's heat distributor, is made of 1-16th-in. sheet-iron, bent into V form and inserted in boiler tubes in order to lengthen the flow of the gas while adding an equal proportion to the velocity. Fast-flowing gases are considered better to give up heat to the surfaces they flow over, and this is said to be one reason why an excessive use of air is not so serious in its results as apparently it should be, for the excess of air is productive of greater velocity of flow, though exactly why this should be so is not clear, unless there is sufficient extra damper opening to permit of this increased velocity being produced by the chimney effect. The new distributor, 4 ft. long, placed in a tube, compels an extra travel of 8 ft. An increase of draught must be possible, it is acknowledged, to permit of this. The change of direction of flow as the gases pass round the ends of the distributor is claimed to mix the gases and promote combustion—a claim which seems quite untenable. The mixing may tend to efficiency, it is true, but it is not due to better combustion. Economies of about 10 per cent. are claimed as a result of using the distributors.—*Electrical Review.*

The "Fortis" Vice Competition.

The "Fortis" Electrical and Engineering Company, of Coventry, have kindly placed at our disposal three of their vices, value 18s. 6d., 10s., and 5s. 6d. respectively, to be awarded as prizes in a competition. We accordingly have pleasure in offering these useful prizes for the best three articles sent on "An Amateur's Vice Bench." What is required is a working drawing of a bench suitable for amateur use, with a short accompanying article describing its construction and fittings (tools not included). The prizes will be awarded to the designs which in the opinion of the Editor of The Model Engineer are best suited to the requirements of the average reader of this journal. All entries should be sent to the Editor of the *M.E.*, and should be marked "Fortis Vice Competition." The latest date for sending in will be December 1st, 1905.

Lessons in Workshop Practice.

XXIII.—Practical Notes on Selecting and Using Small Dynamos and Motors.

(*Continued from page* 370.)

By A. W. M.

Shunt-wound motors do not readily start under heavy load—in fact, may not start at all, even without a load—unless the field-magnet is excited before full voltage is applied to the armature. Fig. 20A is a diagram of a shunt-wound motor connected directly to a battery, in some instances, depending upon the proportions of the machine and its coils, also it's size, such a motor will not start, the armature becoming locked magnetically in the bore of the magnet ; even a start by hand may not cause the motor to run up to speed. If, however, one of the brushes be lifted for a moment away from the commutator, and then allowed to drop on to the sections again, the motor will start and run up to speed. This method of starting would not be good practice or convenient as a general thing ; a proper starting switch should be used, arranged so that current is first sent through the field coils, and then through the armature, or through a resistance so connected that the full voltage is first applied to the field coils and lastly to the armature, the resistance being alternately in series with both the switch transferring it from armature to field at starting, and back again when stopping (see The Model Engineer Handbook No. 14)

If started without load, a shunt-wound motor runs up to a speed which is somewhat higher than full load speed, and which will not be exceeded : there is thus no danger, as with the series motor, of the speed increasing to a rate which is unsafe to the armature winding, *provided the strength of the field magnetism remains constant.* When a load is applied, the speed will fall to an extent which will depend upon the amount of the load and the design of the motor, but this variation is not so great as with a series motor ; in fact, the speed will be approximately constant within a wide range of load, and if the load should be suddenly removed, as might happen, through the failure of a driving belt, would only rise to a comparatively small extent, so that the motor would continue to run without harm. The shunt-wound motor is, therefore, particularly suitable for use when fairly constant speed is required under a widely varying load ; it will also start under a moderately heavy load. To test a shunt-wound motor, you should allow it to run up to full speed without any load on ; then apply a load, and measure the current flowing through both armature and field coils ; increase the load until this current rises to the amount which the motor is designed to take ; the speed will then be that at which the motor will run at full load.

Compound-wound motors are divided into two divisions—one in which the series coils assist the shunt coils and increase the magnetism of the field-magnet with increase of load ; and the other division in which the series coils oppose the shunt coils, and weaken the field-magnet with increase of load. The former method is called cumulative compound winding, its object being to enable a shunt-wound motor to start under a comparatively heavy load, or, in effect, to give to it some of the starting advantage possessed by the series motor, which it does, but, at the same time, it impairs the particular virtue of the shunt motor—namely, that of running at fairly constant speed under varying load. For many purposes, however, exact speed is not necessary, and the cumulative compound winding is very useful for certain kinds of work; there is also the advantage that the motor will be certain to start. To convert a shunt-wound motor to this system, it is only necessary to add a series winding of as much power as may seem desirable. A single layer of series winding on the top of the shunt coils can be tried, the wire being of ample section to carry about one and a half times full load current; the series winding is to be connected so as to add to the magnetism produced by the shunt coils (see Fig. 21).

The second method is called differential compound winding, because the series coils are wound in such a direction that they oppose the action of the shunt coils, and weaken the magnetism of the field-magnet when the load increases, the object being to counteract the drop in speed caused in a shunt-wound motor with increase of load. This winding is not much used, because it diminishes the starting power of the motor, and for the reason that a good simple shunt-wound motor will run sufficiently near to constant speed for all ordinary purposes. In the differential winding the series coils are wound, and connected so that they produce opposite poles to those produced by the shunt winding. The number of series turns must be accurately determined, and may be calculated experimentally in a similar way to the series coils of a compound-wound dynamo, as previously explained, except that the turns are found by decreasing the current in the shunt winding until the motor speed is restored to that at which it ran when no load was applied to the spindle; also, as in the case of a dynamo, the regulation will not be successful, unless the machine has an unsaturated field-magnet and armature. A reference to Fig. 9 will show that the correct method of connecting a compound-wound dynamo would give a differential winding, if the machine was used as a motor, and the incorrect method would give a cumulative compound motor winding.

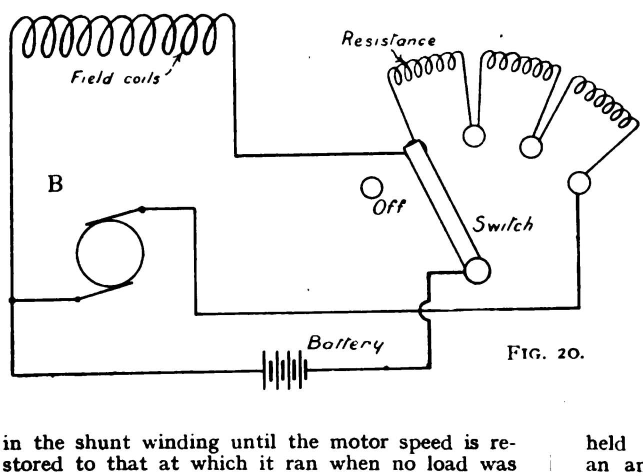


FIG. 20.

Permanent Magnet Motors.—Machines in which the field is produced by means of a permanent magnet—magneto machines, as they are often called—will work as motors, current being supplied to the armature; they start readily, and run at fairly constant speed; it is necessary for the armature to be fitted with a commutator.

Reversing.—All motors having wound armatures can be readily reversed. The rule is to change the direction of current in either the magnet coils or the armature; but not in both. If the current is reversed in both, the motor continues to rotate in the same direction as before. For various reasons it is usual to reverse the direction of the current in

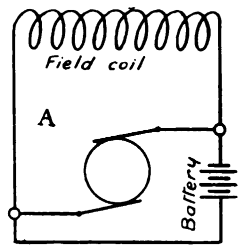


FIG. 20A.

the armature, and not in the field coils, as magneto machines having no winding on the field-magnet, the current is necessarily reversed in the armature to procure reversal of rotation.

The speed of a motor varies according to the voltage of the battery, or other source of current to which it is connected. If the voltage is increased, the speed will rise—if decreased, the speed will fall. This alteration in speed is not necessarily in direct proportion to the alteration in volts: double the volts would not in every case double the speed. A magneto motor does run at a speed which is almost in direct proportion to the volts applied to its armature; a series-wound motor, with constant load, also runs at a speed which is, approximately, in proportion to the volts applied to its terminals. A shunt-wound motor would increase in speed, approximately, in direct proportion to the volts, if its field-magnet was in a state of magnetic saturation at the speed from which the rise was calculated; but as a matter of practice, this condition is not obtained, and the speed will alter to a comparatively small amount, even with considerable variations in voltage, the variation depending upon the design of the machine. It will be smallest with a field-magnet and armature core having ample amount of iron.

The current taken by a motor will vary according to the load applied to the motor spindle. If the spindle was held fast when the current was switched on, an amount of current would flow, which would depend upon the resistance of the motor windings; such a current would be excessive and much greater than that which would flow if the armature was rotating. If the spindle is released, and commences to rotate, the armature at once generates a back pressure in its windings which opposes the voltage applied to its terminals acting exactly the same as resistance. This back pressure is called the counter E.M.F. (electro-motive force) of the motor. As the speed rises, this back pressure increases and reduces the current flowing through the armature coils. If no load is applied to the spindle, the current will decrease in amount until just sufficient is flowing to produce sufficient power to overcome the friction of the bearings and brushes and other small internal losses. If a load is applied to the spindle, the speed will fall, and the current will increase until it reaches an amount sufficient to overcome the load. It will be understood from this that the motor automatically adjusts the amount of current which it will take, according to the amount of work which it is set to do. If you overload a motor, it will take a greater amount of current than its windings will carry, and the wire will become hot; if the overloading is carried far enough, the insulation of the windings will be burnt, and the machine will break down, requiring to be re-wound. Many motors will, however, stand overloading for short periods without harm; a momentary overload will scarcely damage any motor.

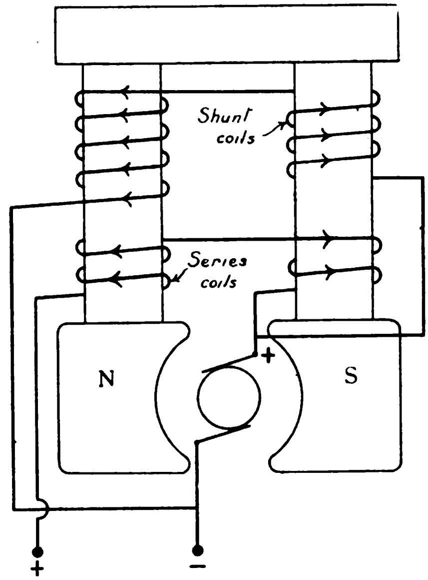


FIG. 21.

A type of machine which has not been, so far, dealt with in these notes is the separately excited dynamo or motor. In this class the field coils are not connected to the brushes, but to some source of current independent of the armature. Any dynamo can be used as a separately excited machine by disconnecting the field coils from the brushes, and connecting them to a battery or other source of current. It is only necessary to arrange that the voltage of the battery, etc., shall not be so great that more current will flow through the field-magnet coils than they can carry without excessive heating. If the armature of such machine be driven by mechanical means, it will generate current, the voltage being, approximately, in proportion to the speed. If instead of being driven it is connected to a battery, or source of electric current, the armature will run at a speed which will be also, approximately, in proportion to the voltage applied to the brushes. The speed of a motor falls if the field is strengthened, and rises if it is weakened. Always make sure that the field-magnet of a motor is excited before current is switched on to the armature at full voltage; in a series wound motor, of course, the magnet is excited by the armature current on its way to the armature.

The following are common faults occurring in an armature :—Short-circuit between one or more pairs of coils, due to accidental pressure or knock; especially at the pulley end does this trouble occur. The coils are liable to be bruised by a blow from a spanner, or by the user taking hold of the windings when removing the pulley. As the top coils suffer more readily, the injury may be located by examination, the coils lifted or spread apart, and some insulation placed between them may repair the damage without the necessity of disconnecting the commutator. A broken wire, either in a coil or the connection with the commutator, will cause a violent spark when the machine is running. The faulty coil can be found by examining the commutator; a burnt place will occur between the two segments to which the coil is attached. A short-circuit between two adjoining bars of the commutator will also short-circuit the coil attached to them, and cause it to burn out. The wires connecting the commutator and the armature sometimes gives trouble by breaking in a mysterious manner whilst the machine is running. The trouble is usually caused by the commutator or armature core being loose on the spindle. If you have any reason to suspect a fault in the armature, but cannot see any signs of it, the only thing to do is to disconnect all the coils and test them separately with a battery and galvanometer. Each coil should be free from leak, either to any other coil or to the spindle; the commutator should also be tested. Each section must be free from any leak, either to any other bar or to the spindle.

If you have a dynamo which will not excite, try it as a motor. If it runs well as a motor, you may be sure that there is no fault of workmanship, and that the trouble is due to design, winding, or method used to test it. If it will not run as a motor, it will certainly not work as a dynamo.

If you have been winding the coils of a dynamo or motor, and using a varnish containing spirit, remember that you can make no reliable test for insulation until the spirit has been dried out. One way of doing this is to send a comparatively heavy current at low voltage through the coils, so that they become hot; but baking in an oven is also a practicable method.

A damaged coil in a hand-wound drum armature can usually be replaced without entirely re-winding all the other coils, cut through the wires of the damaged coil and clear the slot or winding space, then wind on the new coil over the end windings of the other coils, and re-connect it in its proper order. The fragments of the old coil, which may be underneath the end windings can be left in.

(To be continued.)

A MERCURY VAPOUR LAMP.—A new mercury vapour lamp has recently been produced at Jena by Messrs. Schott & Co., making use, for the envelope, of a special glass, very transparent to ultra-violet rays. The light emitted is highly actinic, and very useful for photographic work. With voltages of 110 to 220, and a current of 2 or 4 amps., the lamp gives a light of 800 candles.—*Engineering.*

Notes on Locomotive Practice.

By Chas. S. Lake.

The G.N.R. Compound Locomotive No. 1300.

By the courtesy of Mr. H. A. Ivatt, M.Inst.C.E., chief Locomotive Engineer of the Great Northern Railway, the writer is enabled to contribute to this instalment of the Notes a photograph of engine No. 1300, built by the Vulcan Works Co., Ltd., of Newton-le-Willows, Lancs., for express passenger service on the G.N.Rly. The principal dimensions appeared on page 172 of The Model Engineer for August 24th, when a line drawing of the engine was also given. No. 1300 is now being subjected to a thorough testing of its capabilities in "competition" with the Doncaster built four-cylinder compound No. 292, and a 251 Class engine, with simple cylinders 18¾ ins. by 24 ins., the latter having had its boiler pressure raised from 175 lbs. to 200 lbs. per sq. in., thus placing all three engines on the same footing in that one respect.

There is, of course, a great disparity in the cylinder capacity of the two Doncaster built locomotives when compared with the Vulcan engine, but as the adhesion weight is virtually the same in all three cases, that fact counts for very little.

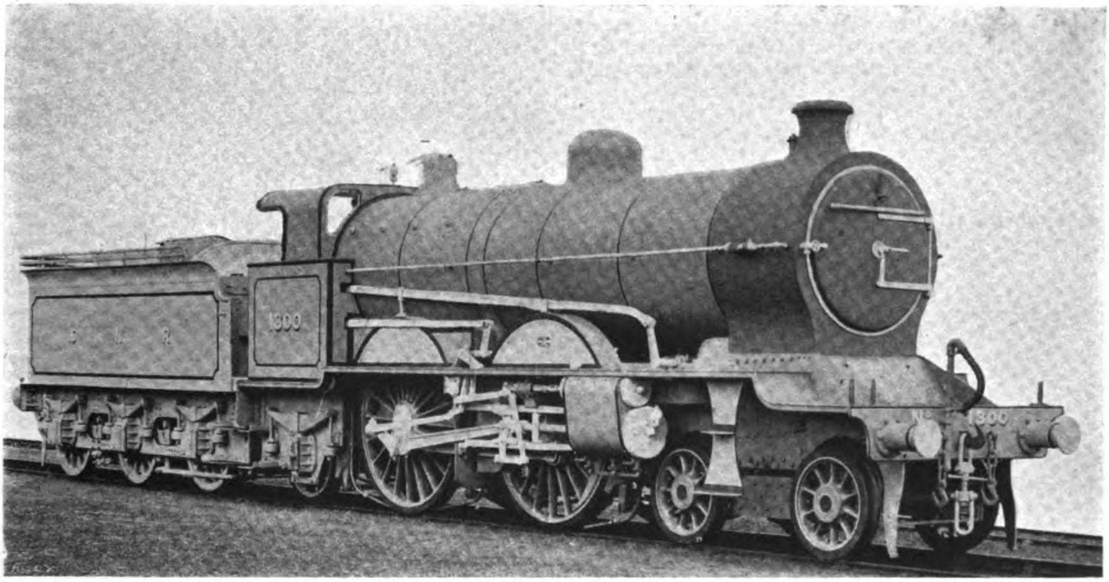


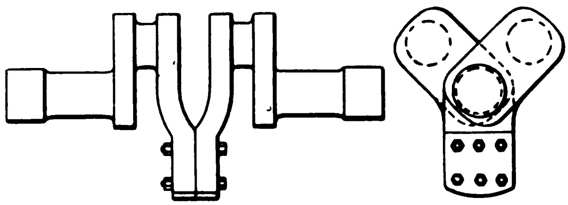
Fig. 1.—Four-cylinder Compound Locomotive, Great Northern Railway.
· (*Built by The Vulcan Foundry Co., Limited.*)

New Locomotives Building at Private Works.

The North British Locomotive Company, Ltd., are just completing at their Hyde Park Works, Glasgow, some "Atlantic" type express passenger locomotives of Mr. Robinson's standard design for the Great Central Railway; whilst at Kitson and Co.'s Works, Leeds, the first series of "Atlantic" type locomotives designed by Mr. D. E. Marsh, Locomotive Superintendent of the London, Brighton & South Coast Railway, are now ready for delivery.

A Novel Design of Locomotive Crank-Axle.

Mr. H. A. Ivatt, of the Great Northern Railway, has recently patented a new form of crank-axle of improved construction, applicable to all types of reciprocating engines, but mainly intended for locomotives. The design is shown in the accompanying drawings, from which it will be seen that the central portion of the axle between the cranks takes the form of a joint or coupling, the axle



ig. 2.—Mr. H. A. Ivatt's Improved Crank Axle.

being either forged or built up in two sections. The cranks are arranged as usual, viz., at an angle to one another of 90°, and may be placed close together, the two inner crank arms being prolonged as shown, and bolted together at the lower portion, which may be adapted for counterbalancing the weight of the two cranks, thus producing a more perfectly balanced axle. The object aimed at in the design is, firstly, that of securing greater flexibility in the axle, thus reducing the risk of fracture owing to rigidity of construction, whilst still keeping the cranks closely adjacent; and, secondly, of obtaining a more perfect balancing of the axle. In addition to these advantages, it is claimed for the innovation that it will facilitate and cheapen the renewal of parts when necessary.

If these objects can be successfully accomplished by such a simple measure as that illustrated, much will have been done to improve the inside cylinder locomotive of the present day, whilst, as before said, the idea may be extended to all types of engines.

New 4-Cylinder Express Locomotives, L. & S.W. Rly.

The above engines have already been referred to in these Notes, and the accompanying photograph (kindly supplied by Mr. D. Drummond, M.Inst.C.E., Chief Mechanical Engineer of the L. & S.W.Rly.) shows the general arrangement of the design. The two inside cylinders drive the crank-axle of the leading coupled wheels, and the outside cylinders drive the middle pair. Walschaerts' gear is employed for the outside cylinders and Stephenson link motion for those between the frames. The boiler is very large, as will be seen from the photograph. It is, however, none too large for supplying four cylinders, equalling in capacity as these do in the aggregate, that of two 22-in. by 24-in. cylinders, using boiler steam, and therefore only expanding down to a moderately high terminal pressure. Mr. Drummond fits a water-tube firebox to these boilers, and places his spark arresting and fuel economising apparatus in the smokebox. He provides 2,727 sq. ft. of heating surface, and uses tubes of moderate length; therefore, it may be confidently expected that the engines will prove successful so far as boiler power is concerned; and if this is so, it may be taken for granted that the rest of the design will be found to be all that can be desired. The cylinders are 16 ins. diameter by 24 ins. stroke, coupled wheels 6 ft. diameter, and the engine weighs (loaded) 73 tons, without tender.

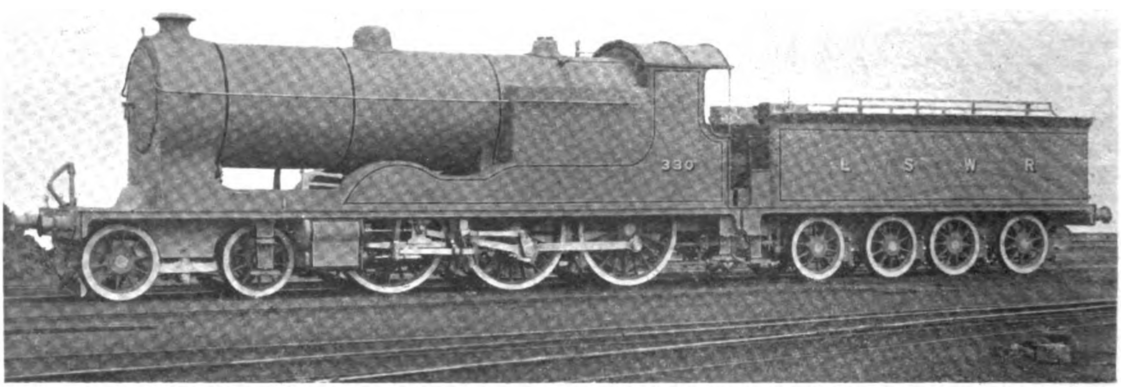


Fig. 3.—New Four-cylinder Express Locomotive, L.S.W.R.

Duplex Goods Tank Locomotive, Northern of France Railway.

Reference to these engines was made on page 256 of The Model Engineer issue for September 14th, when there also appeared an outline drawing with leading dimensions. Mons. du Bosquet, Engineer-in-Chief of the Northern Railway of France, has now been kind enough to provide the writer with a photograph of one of the engines in question, from which a much better idea of the real size and construction of the locomotives may be gathered. Readers are referred to the issue of The Model Engineer mentioned for particulars of the engine.

Locomotive Work on the Great Western Rly.

It is not by any means an unusual experience for travellers on the Great Western Railway to meet with instances of smart locomotive work thereon, and the experiences of a contributor to the correspondence columns of the *Engineer* may be taken as thoroughly representative of what one expects when a passenger by long-distance trains on the famous trunk line to the West. The correspondent in question states that on a recent occasion he was present on a train drawn by engine No. 171 ("Albion," of the "Atlantic" type), which covered the 113¾ miles between Paddington and Bristol in 118½ minutes, encountering a signal check at Tilehurst and Goring, which involved a delay of three minutes. The average net running time, allowing for the checks, worked out at 61·6 miles per hour. The train was worked forward from Bristol by engine No. 187 (of the same type as "Albion") and Exeter, 75½ miles distant, was reached in 85 minutes. By allowing for the reduction of speed round Taunton loop, the speed on this section would be 57·5 m.p.h.

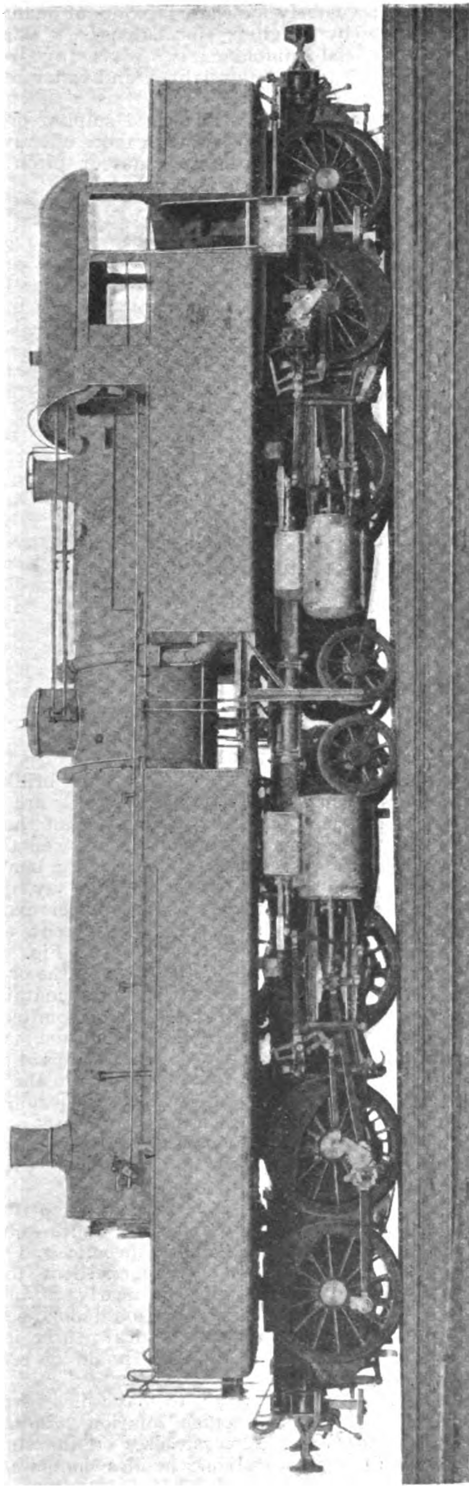


Fig. 4.—Four-cylinder Compound Articulated Goods Locomotive, Northern Railway of France.

Home Electric Lighting.

By Cyril N. Turner.

BEFORE proceeding with the subject in detail, some of the many electrical terms used in the following articles, which may not be known to beginners in the study and practice of electrical science, may be defined in a simple manner.

(1) The *Volt* is the name given to the unit of electro-motive force which may be defined as electrical pressure or difference of potential. The usual abbreviation is V, or when speaking generally of the electro-motive force, E. or E.M.F. For instance, the E.M.F. (electro-motive force) of a certain battery might be expressed as 1½ V. (1½ volts).

(2) The *Ampere* is the name of the unit of electric quantity. The rate of the flow, or "strength" of an electric current is expressed in amperes. The word is often abbreviated to "amp." The quantity of current is also spoken of as the current, the abbreviation of which is "C."

(3) The *Ohm* is the unit of electrical resistance. All conductors offer some resistance to the flow of the current, the amount of this resistance varying with material sectional area and length of the conductor. The abbreviation is ω. When referring to the resistance generally, irrespective of its degree, R is the letter employed. An electro-motive force of 1 *volt* is required to send a current of 1 *ampere* through a conductor whose resistance is 1 *ohm*. This is *Ohm's Law*.

(4) The *Watt* is the name of the unit of power developed in an electrical circuit, and is determined by the product of the current strength and the voltage; ∴ volts × amperes = watts; 746 watts are equivalent to the mechanical unit of power, a horse-power (33,000 ft. pounds of work); 746 watts is, therefore, one electric horse-power (E.H.P.).

(5) *Ampere-hour.*—This term is used chiefly in connection with primary and secondary batteries. The ampere-hour is expressive of the current of 1 amp. flowing for one hour, or its equivalent. For instance, an accumulator may be said to be charged to a capacity of 20 ampere-hours; this means that theoretically it can supply a current of 1 ampere for twenty hours (1 × 20 = 20), or 2 amperes for ten hours (2 × 10 = 20), or 4 amperes for five hours (4 × 5 = 20).

(6) *Watt-hour* is a term used in expressing the total amount of electric power used in a given time. 1,000 watt-hours = 1 watt for 1,000 hours or 500 watts for two hours. To obtain the watt-hours multiply volts × amps. × the number of hours the current is flowing.

(7) A *Board of Trade Unit* of electrical power is equal to 1,000 watt-hours.

Intermittently Lighting by Primary Batteries.

"Intermittent" being anything but a definite word, as regards to time, it may be as well to give the length of time each battery may be relied on to do its specified work, thus making it easier to select the most suitable battery for the work required to be done. The batteries being described in order as to the time they supply current effectively for, and not classified as to their types.

The ordinary Leclanché battery consists of an outer glass vessel containing a solution of sal-ammoniac (ammonium chloride), and a zinc rod.

In the centre of the outer vessel stands a porous pot, containing a carbon plate, around which is packed a mixture of pea-size carbon and oxide of manganese in equal proportions. The carbon forms the positive pole and the zinc the negative (see Fig. 1). The solution should consist of about 4 ozs. of sal-ammoniac to each pint of water. Voltage of cell about 1·40 volts; four of these (2-pint size) cells will light a 4-volt H.E. (high efficiency) or low current consumption lamp brightly for a few seconds at the time—as, for instance, to see the time by at night, and so on. It quickly runs down, owing to the smallness of the elements.

For small intermittent lighting, a battery of good dry cells is very suitable and convenient, and with the larger sizes the light may be used for longer periods; however, the inability to recharge them satisfactorily renders them an expensive luxury for anything more than short intermittent use. It is, however, possible to re-enliven them to a considerable extent (when run down) by making a hole in the pitch sealing of the top and introducing a little sal-ammoniac solution.

The following are brief directions as to the construction of a dry battery. It is a somewhat difficult thing to make a really satisfactory one; the chief things to be remembered are to thoroughly ram down the carbon mixture round the carbon plate, and also not to use *powdered* carbon. The carbon should be of the size between rice and peas. Fig. 2 is the section of the dry battery to be made. The cell should be constructed of zinc about 1-28th-in. thick; the soldering of the joints should be done

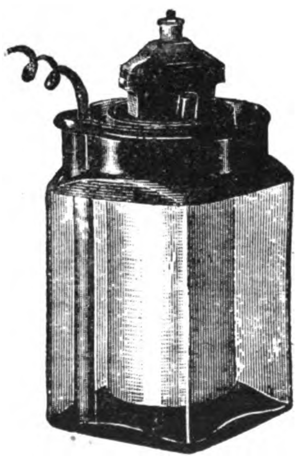


Fig. 1.—Leclanché Cell.

outside, not allowing any to creep inside. The cylinder should be about 6 ins. high by about 3 ins. in diameter. Next solder a zinc bottom to it. Make a paste of—Plaster of Paris, 25 parts (by weight); sal-ammoniac, 10 parts (by weight); water, 55 parts (by weight). Paste this round the inside of the zinc container about $\frac{1}{4}$ in. thick, leaving 1 in. free at the top. Place a piece of paraffined wood or other insulator at the bottom and stand in the centre a carbon plate 7 ins. long by $1\frac{3}{4}$ ins. wide and from $\frac{1}{4}$ in. to $\frac{3}{8}$ in. thick. This is fitted at the top with a terminal. When the paste round the inside of the zinc is set, ram round the carbon very tightly a mixture of—Granulated carbon, 75 parts (by weight); coarsely powdered oxide of manganese, 10 parts (by weight); zinc sulphate, 5 parts (by weight); sal-ammoniac, 15 parts (by weight); glycerine, 2 parts (by weight); and water added to make into a stiff paste.

Now seal the cell with melted sulphur or pitch. The former is said to be much more effective as a seal, but for the ordinary amateur pitch is the easier to use, as well as being cheaper.

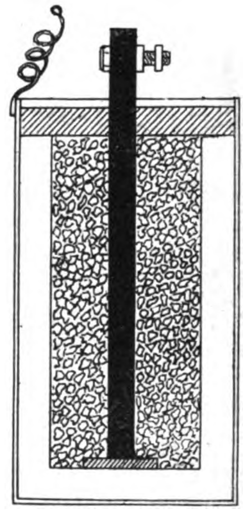


Fig. 2.—Section of Dry Cell.

Three of these will light a 4-volt lamp brilliantly; of course, when connecting up, the cells are put in series—*i.e.*, zinc of one to the carbon of the next, and so on, leaving the zinc of the first cell and the carbon of the last to be connected to the lamp.

When a small light is required for, say, quarter of an hour or so, the carporous Leclanché is excellent, the construction being slightly different to the ordinary pattern Leclanché cell (see Fig. 3). It consists of an outer vessel the same as the ordinary cell (the solution also being the same), containing a perforated carbon cylinder which is mounted on a glass base, which carries a porous tube; around this annular space are packed small lumps of carbon and manganese. The zinc rod stands in the centre of the porous tube, the carbon cell forming the positive pole. This construction prevents polarisation (*i.e.*, the current lessening by chemical formations) to a great degree in comparison with the ordinary type.

It is advisable to have four cells to a 4-volt lamp. The addition of a little dilute sulphuric acid and about 5 per cent. of chromic acid to the sal-ammoniac solution is very excellent for this battery, the E.M.F. rising to nearly 2 volts per cell. As the cell with this solution depolarises very rapidly, large currents may be drawn from it; but in this case, however, the zinc should be removed when the battery is not working.

It is a great mistake to have in Leclanché batteries the sal-ammoniac solution *saturated*, as some recommend. It crystallises on the zinc and prevents chemical action; besides encrusting the zinc, it creeps up and over the sides, and causes electrical leakage.

The proper quantity is 4 ozs. to the pint.

When a small lamp (taking about ½ amp.) is required for, say, an hour a day, a modification of "Bennett's tin-pot cell" is admirable. A splendid modification was arranged by Mr. F. E. Powell, as described in Vol. VIII, pages 344 and 367, of THE MODEL ENGINEER, and for the benefit of those who have not the volume and therefore cannot refer to this able article, the following is an abbreviated description :—Fig. 4 gives section of same ; the container is an ordinary "tin" canister about 6 ins. high by 3 ins. in diameter. It will be seen that a paraffined wood block is used in the centre of both the bottom and top to hold the zinc in position, and also to tack the 30-mesh iron wire gauze to. The space between the tin and this gauze cylinder is packed with iron turnings. The tin forms the positive pole, and the zinc (which, by the way, is an ordinary No. 2 Leclanché zinc) the negative. The best electrolyte (or solution) for general purposes is a solution of caustic potash. Ordinary caustic potash contains about 15 per cent. of its weight of water ; this must be allowed for, it being advisable to ascertain the percentage when purchasing same. The solution should contain 30 to 40 per cent. of its weight of potash.

To make 1 pint of solution, into a pint measure put ½ lb. of caustic potash, add soft water to pint

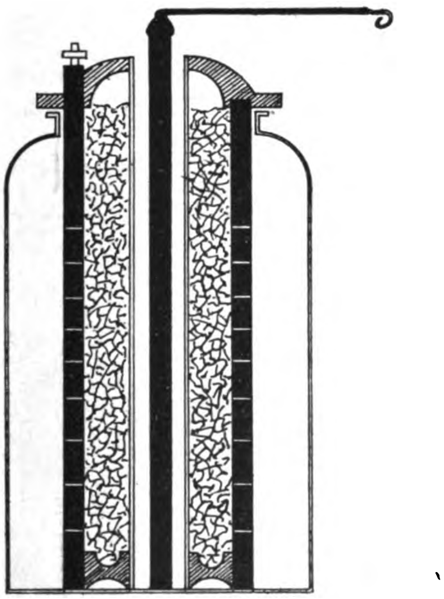


FIG. 3.—SECTION THROUGH LECLANCHÉ CELL.

mark. The potash being 85 per cent. quality, the solution will then contain 35 per cent. of solid substance.

A battery of six of these cells forms a very useful installation, being able to supply, if required, 2 amps. for a short period.

Their capacity is from 50 to 60 amp.-hours ; the voltage of each cell being just over 1 volt. They have practically no local action on open circuit (*i.e.*, when idle).

In view of the fact that the full voltage of the cell is not obtained, owing to the inferior conditions of some "tins" as negative element (although the positive pole), it is sometimes recommended, instead of a tin canister, to have ordinary jars with a piece of sheet iron bent round inside each ; the

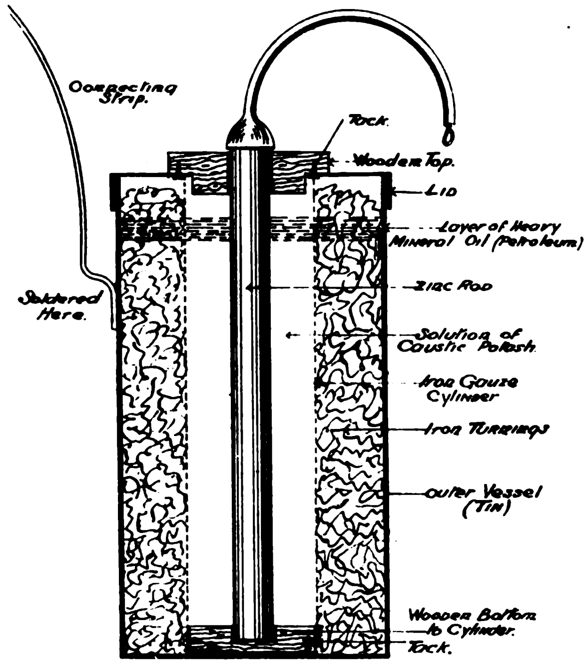


FIG. 4.—SECTION THROUGH TIN-POT CELL.

arrangement of the other parts being the same as shown and described.

Up to the present we have been considering batteries in which there is no local action or open circuit ; but in the following types of batteries it is at least advisable to withdraw the zinc from the solution when the cell is not in use, or waste of solution and zinc will be the result.

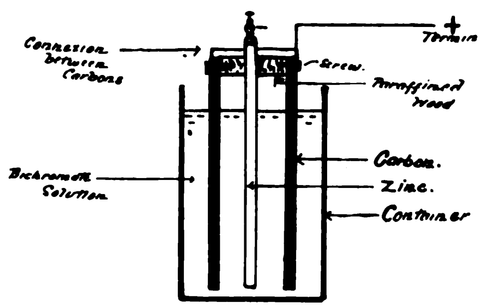
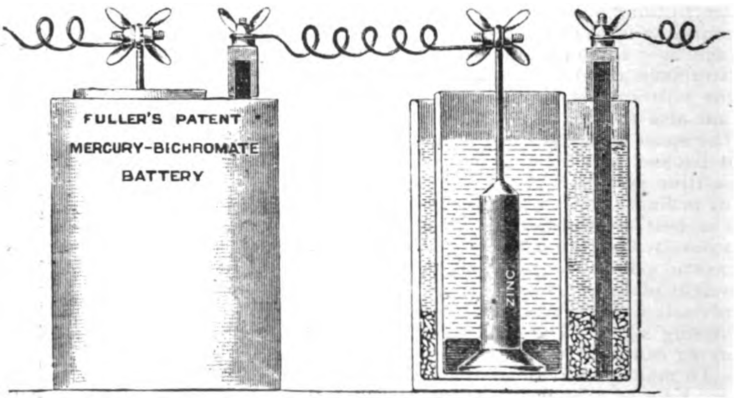


FIG. 5.—SINGLE FLUID BICHROMATE CELL.

Two ½-amp. lamps (or even three for a shorter period) may be lighted for two or three hours at a time by a single fluid bichromate battery (see Fig. 5), in which a zinc is sandwiched between two carbon plates, each plate being about 4 ins. by 2 ins. the solution being 1 pint of water, 3 ozs. of bichromate of potash, and 3 ozs. sulphuric acid.

Dissolve the bichromate in the pint of boiling water, and allow to cool, then add the sulphuric acid to the mixture drop by drop, stirring all the time. The voltage is nearly 2 volts per cell. When, say, three or four of these cells are used in series, it is advisable to fix the zincs and the carbons to one common rod of paraffined wood, by which they may then be lowered together into their respective jars. It is well to arrange the bar so that its movement may be adjusted, by which means the current may be nicely regulated according to how far the elements are dipped into the solution (see Fig. 6).

The double-fluid bichromate cell is exceedingly useful where a current of about 2 or 3 amps. is required throughout an evening, and is, for instance, very handy for lighting a few small lamps for decorative effects, etc. Outer containing jar about 6 ins. high by 5 ins. diameter, porous pot about 7 by 2½, two carbons in outer cell about 7 by 2½. The best pattern zincs for these batteries is undoubtedly the "Fuller" pattern (see Fig. 7), as the zinc is so arranged as to facilitate the mercury (which is put in the porous pot) creeping over the surface of the zinc by capillary attraction, and thus keeping it thoroughly amalgamated. If the cell is required for use fairly often—say, when charging accumulators—the zinc need not be removed between whiles, as, owing to its being kept properly amalgamated, it does not waste away much.



ELEVATION. SECTION.

FIG. 7.—MERCURY-BICHROMATE BATTERY.

The solution for outer cell consists of a saturated solution of bichromate of potash, with a sixth of its bulk of sulphuric acid added. Solution for

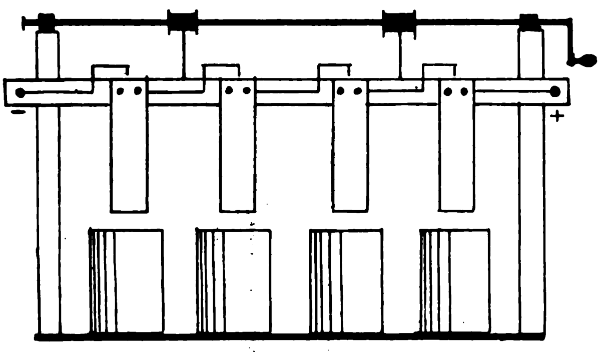


FIG. 6.—ARRANGEMENT FOR LIFTING ZINCS.

porous pot is a mixture of one part of acid to 20 of water. Voltage, nearly 2 volts.

I am much indebted to Mr. J. Caroll, of Stockton-on-Tees for information with regard to the following battery, which he terms the "shunt battery," and which I have found most excellent. Its dimensions, etc., are as follows: Outside jar, about 7 ins. high by 6 ins. diameter—a "half-gallon," or "seven-pound" jam jar (stone ware) will do; porous pot, about 6½ ins. high by 3 ins. diameter; two carbon plates, 7 ins. long by 2 × ½, are bolted together and placed in the porous pot. These plates should stand on a ½-in. layer of small pieces of coke at bottom. Now make a mixture of ½ lb. oxide of manganese and broken coke, which is rammed round the plates to within ½ in. of the top of the porous pot; now pour on top a layer of pitch, leaving a ½-in. hole through which to pour solution.

(To be continued.)

For the Bookshelf.

[Any book reviewed under this heading may be obtained from THE MODEL ENGINEER *Book Department, 26-29, Poppin's Court, Fleet Street, London, E.C., by remitting the published price and the cost of postage.]*

THE MACHINE SHOP COMPANION. By Wallace Bentley, M.I.Mech.E. Halifax: Bentley Publishing Co. Price 1s., postage 1d.

The third edition of this invaluable pocket-book contains tables of diametral pitches, notes on templates, jigs, power required to punch holes in plates, electrically-driven tools, in addition to the fund of information most useful to the fitter, turner, apprentice, and model engineer already comprised within its covers. For the benefit of those who have not seen the book before, we may mention that it provides, in simple form, rules and definitions suitable for every-day workshop use, including notes on arithmetic and the measurement of areas and solids, tables of decimal equivalents of fractions of an inch, speeds of belt pulleys, and notes on rope and toothed gearing, useful information on screw threads, bolts, and nuts, descriptions of the chief machine tools used by engineers, and a chapter on screw-cutting.

TESTING LUBRICANTS.—A machine for testing lubricating oils has been brought out in Germany. The testing part is a short shaft running in a bearing, the pressure upon which may be regulated. The shaft is driven by an electric motor or other means, the speed being adjustable, and the bearing, by an arrangement of electric coils, may be heated up to any required temperature.

Two Useful Petrol Engines.

By W. Snelling.

HAVING made two petrol engines with success, I think a short description of them would be of interest to many *M.E.* readers. The building of the small engine shown in Fig. 1 was quite experimental. It is 1¼-in. bore by 1⅞-in. stroke, and has a water-jacket, which was put on after the engine was tested in the following manner: The cylinder had pieces of ¼-in. square section brass sweated in the required positions; the jacket was then made the necessary size and shape, with riveted joint, and sweated on to the brass strips, and it has turned out a very good job. The ignition is electric, which can be advanced and retarded. The inlet valve is A.O., and the valve boxes were made out of ⅞-in. square bar: but I find horizontal valves do not work very well, and I am altering it

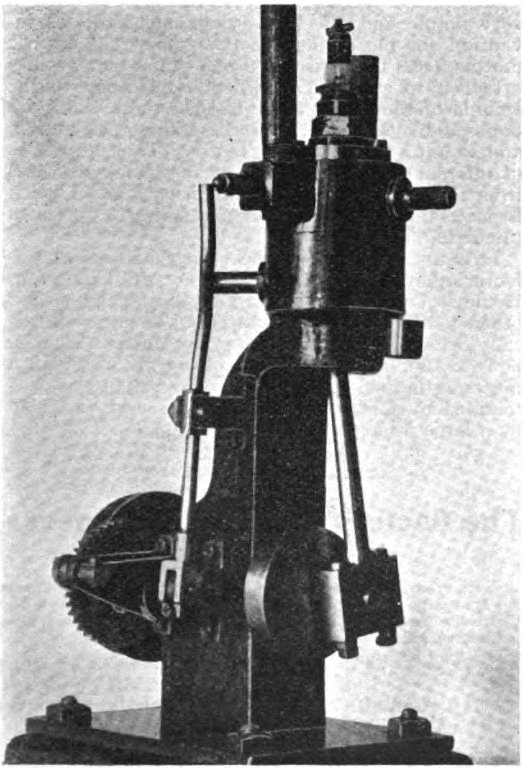


Fig. 1.—A Water-cooled Petrol Engine.

to a vertical valve. The engine bed-plate is mild steel, 5½ ins. by 4½ ins.; the gear wheels were bought ready-made. The shaft is ½ in. diameter, and runs in split gunmetal bearings, adjusted by screws at the side. The disc crank is of cast iron, and the connecting-rod from centre to centre is 4 ins. This was cut from solid steel; also the piston has three spring rings fitted. The exhaust cam and roller are tool steel dead hard, and the side shaft brackets are cut from the solid; the top cylinder cover is tapped for a De Dion thread. The height from the steel bedplate to the top of sparking plug is about 12 ins. The cylinder oil-cup can plainly be seen in the photograph, but the shaft oil-cup is hidden behind the main casting.

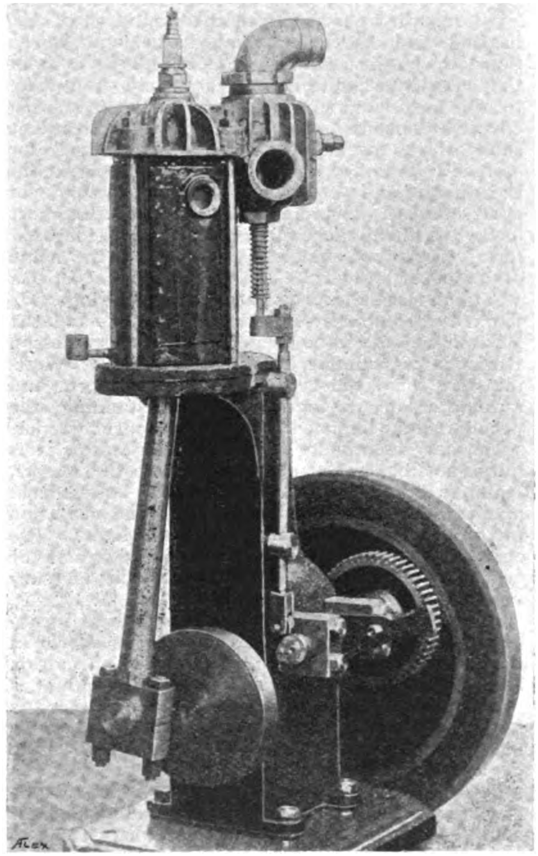


Fig. 2.—An Air-cooled Petrol Engine.

In Fig. 2 is shown another petrol engine which I have made; the cylinder is 2¼-in. bore by 3-in. stroke, and is just the same as the small one, with the exception of the combustion head, in which I have adopted an air-cooled one, and it is owing to the nice working of this I have determined to alter Fig. 1. The patterns for both these engines I have made myself, and all the machine work also; all of which, with the exception of one or two jobs on the head of Fig. 2, were done on a 3½-in. Drummond's lathe, which, I may say, the small engine is now driving. This engine is now driving a "Handy Man" boot-finishing machine.

I should like to say a word to those whom this may spur on to start a small petrol engine. The work must be of the very best, everything must fit perfectly, and unless possessed of a good lathe it is really no use to try; but with a lathe, and perseverance in making a good fit of everything, success is certain. If I have not made anything clear, I shall be pleased to help anyone through the medium of this journal.

The Electrical Exhibition at Olympia.

THIS exhibition, held from September 25th to October 21st, 1905, may to some extent be regarded as a reply to the exhibition of gas heating and lighting appliances held at Earl's Court in January last, and it certainly is a proof that electrical engineers are not tamely submitting to the keen competition of gas without making effective efforts to meet it. Amongst an excellent show of the ordinary commercial appliances for electric light and power, are some developments in the direction of economical lighting which are of great interest and promise. Perhaps the foremost of these is the mercury vapour lamp in the elongated form, introduced some time ago under the name of "Cooper Hewitt," and sold by the British Westinghouse Electric and Manufacturing Co., Ltd., of Norfolk Street, Strand, London, and the Bastian mercury vapour lamp exhibited by Messrs. Rumney & Rumney, 39, Victoria Street, Westminster; this latter is of a very compact form, and automatic in its action. Notwithstanding the peculiar light emitted by the mercury vapour, somewhat resembling that of a glow-worm, it is quite possible to counteract the effect. Messrs. Rumney & Rumney had some of these lamps fitted up in the office on their stand, the sensation produced being that of ordinary daylight. The consumption of electrical energy is stated to be only about ½ watt per candle-power in mercury vapour lamps.

Another advance in the manufacture of incandescent lamps of the ordinary type was shown in the "Osmi" lamp of the General Electric Co., Ltd., London; a metallic filament of osmium is used, with the result that the energy consumed is said to be only 1½ watts per candle; the lamp is made for voltages as low as 4 volts up to 70 to 75 volts, and from 2½ to 32 c.-p.

The "Tantalum" lamp is another ordinary type of incandescent lamp, having a metallic filament composed of tantalum; the consumption is stated to be 2·2 watts per candle-power. Messrs. Siemens Bros. & Co., Ltd., and Messrs. Berry, Skinner and Co., of London, exhibited some of these lamps in operation, showing their economy of current as compared with ordinary incandescent lamps. Two machines exhibited by the Bat Electrical Co., and called by them "Permutators," were at work, changing alternating into continuous current. This machine consists of a kind of induction motor with vertical spindle, upon which is fixed a set of brushes which rotate with the spindle and bear upon a fixed commutator having a large number of segments; sizes from 1½ to 250 kilowatts are made, according to the firm's statement.

Messrs. W. McGeoch & Co., Ltd., and Ozonair, Ltd., exhibited apparatus for generating and distributing ozone, which appears to be coming into use for a variety of purposes, such as purifying air and water, bleaching and maturing various products, etc.

An ingenious device is an electric rifle and target; the rifle is mounted upon a pedestal, so that it can be aimed at any portion of the target, which may be placed at a distance of 12 ft. and upwards; the marksman sights the rifle at the target and pulls the trigger when the exact spot aimed at, and which would have been probably struck by a bullet, is illuminated by means of a small incandescent electric lamp; thus it is possible to get rifle practice without using a projectile. Messrs. Keith, Prowse and Co., Ltd., were exhibiting this novelty, which is arranged on the penny-in-the-slot principle.

Electric pianos of the Harper & Virtuoso systems were playing selections, and the Electrical Engineer Volunteers exhibited some large projector search-lights in operation, as well as some trophies brought back by them from the recent Boer war in which they took part.

The Amalgamated Dry Batteries, Ltd., exhibited an improvement in Leclanché glass cells, the zinc rod being confined to one corner of the cell by means of glass projections inside; also an improved dry battery suitable for export, in which the cell is really in a dry condition when sent out, and, therefore, inoperative, the user pouring in a small quantity of water when required for use.

Mr. W. G. Walker, of Westminster, exhibited a very simple and effective dynamometer of his invention for measuring the horse-power of electric motors, etc. It consists of a pair of flat metal vanes attached to a cross-bar, which is clamped to the spindle of the motor to be tested; these vanes are opposed by the friction of the air as they rotate, and so put a load upon the motor. By using vanes of different sizes and fixing them at varying distances from the spindle, the horse-power at a given speed is ascertained by reference to a series of tables of calculated figures.

Exhibits by many of the large electrical manufacturing firms, such as Messrs. Ferranti, Crompton, Henley's Cable Co., Messrs. Glover, Callender and others; lifts of various patterns; a large electrically-driven planing machine by Messrs. Vickers, Sons & Maxim in operation, driven by means of a reversing motor, completed a show which was surrounded by a blaze of electric light, and attended by a large number of people.

The Society of Model Engineers.

[Reports of meetings should be sent to the offices of THE MODEL ENGINEER *without delay, and will be inserted in any particular issue if received a clear nine days before its usual date of publication.]*

London.

THE Annual General Meeting of the Society will be held on Thursday, November 16th, at the Holborn Town Hall, Gray's Inn Road, at 7 p.m. Any members wishing to move an alteration of any of the rules of the Society, or to make any suggestion as to the working of the Society, are requested to notify the Secretary thereof not less than seven days before such meeting, so that the subject may be properly discussed.

Secretaries of provincial societies affiliated to the London Society are requested to send copies of accounts and reports, with list of members, on or before October 31st, for inclusion in the Annual Report, to be laid before the members at the Annual General Meeting.—HERBERT G. RIDDLE, Hon. Sec., 37, Minard Road, Hither Green, S.E.

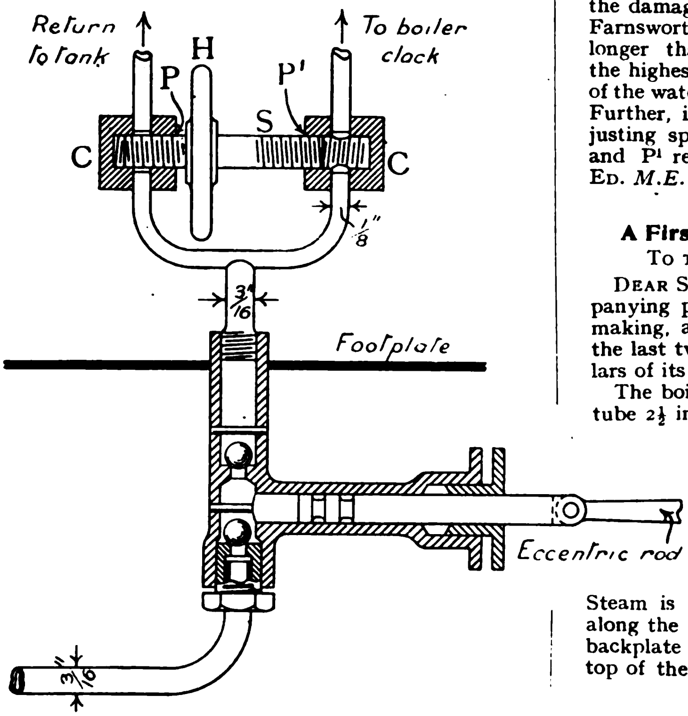
Practical Letters from our Readers.

[The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a nom-de-plume *if desired, but the full name and address of the sender* MUST *invariably be attached, though not necessarily intended for publication.]*

Model Locomotive Feed Pump.

To THE EDITOR OF *The Model Engineer*.

DEAR SIR,—In a back number of THE MODEL ENGINEER, I noticed as I was examining them prior to binding, that in an article on some model compound locomotives the author states that his pump will keep up a constant level of water when the engine is going at full speed, but the water level drops when the locomotive, is running backwards and forwards on a short track. Well, the other day I had an idea which I send herewith.



ARRANGEMENT OF A FEED PUMP FOR A MODEL LOCOMOTIVE.

The pump, which is worked off the crank axle of the locomotive, may be of any design, but is fitted with two pipes at delivery end—one to clack valve of boiler and one return to tank. On each of these a casting (C) is fitted, as in sketch. These castings are bored for pipes, and have also a horizontal hole bored three-fourths of the way through. This is tapped so as to allow the 3/16-in. spindle S (which is threaded to suit) to screw easily in and out, a hand-wheel (H) being fitted for this purpose. The length of S is such that when one end is at centre line of the left-hand pipe, the other end is at that of the right hand.

Thus, when the locomotive is set to run continuously at a high speed, the spindle is run to right (in sketch). This allows a certain amount of water to be sent to the boiler, the opening in pipe being regulated until a constant level is obtained, while the rest returns to tank.

Again, for slow work the opposite would be done. Most water going to boiler. These positions could be found and noted, so that for any kind of work the water level could be kept constant.—Yours truly,

Acton. J. C. FARNSWORTH.

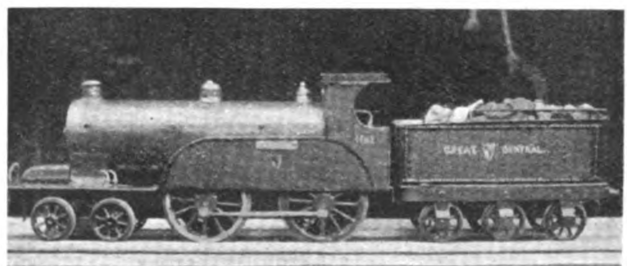
[Our correspondent's suggestion is an ingenious one, but it is usually found that a free main delivery and a single cock on the by-pass pipe back to the tank is sufficiently good for purposes of feed-water adjustment. The latter would certainly prevent the damage to the pipes which might occur in Mr. Farnsworth's arrangement if the spindle S is rather longer than it should be and in mid-position at the highest speeds is unduly restricting the passage of the water in both the delivery and by-pass pipes. Further, it would seem necessary to pack the adjusting spindle at the points we have marked P and P^1 respectively—at P^1 more particularly.—ED. *M.E. & E.*]

A First Attempt at Model Loco Building.

To THE EDITOR OF *The Model Engineer*.

DEAR SIR,—The locomotive shown in the accompanying photograph is my first attempt at model making, and has occupied my leisure time during the last twelve months. I send you a few particulars of its dimensions and construction.

The boiler, which I made from a piece of copper tube 2½ ins. diameter by 10 ins. long, has a firebox 3 ins. long by 2 ins. wide and 2 ins. high, and is connected to smokebox by three ½-in. brass tubes, which are silver soldered in position. The smokebox was formed by letting a disc of brass (1½-in.) into barrel of boiler and a strip of copper riveted at each side, the joints then being silver soldered. Steam is taken from a perforated pipe running along the top of boiler from smokebox end down backplate (inside cab), *via* the regulator, across the top of the firebox, through one of the tubes into smokebox, and thence to cylinder. I may say that the only castings used were those for the wheels, every other portion being built up.



A SIMPLE MODEL LOCOMOTIVE.

The leading dimensions are as follows :—Length of engine, 15 ins. over-all ; length of frames, 14 ins. over-all ; length of tender, 9 ins. over-all ; length of boiler, 10 ins. over-all; the bore of cylinder is ½ in.; stroke, 1 in.; steam ports, 1-16th in. by ⅛ in.; exhaust ports, ⅛ in. by ⅛ in.; valve travel, 5-32nds in.; lap, 1-64th in.; diameter of drivers, 3 ins. on tread; diameter of bogie, 1½ ins. on tread; diameter of tender wheels, 1½ ins.; bore of cylinder, ½-in.; stroke of cylinder, 1-in.—Yours truly, M. ROY CHRISTIAN.

Stockport.

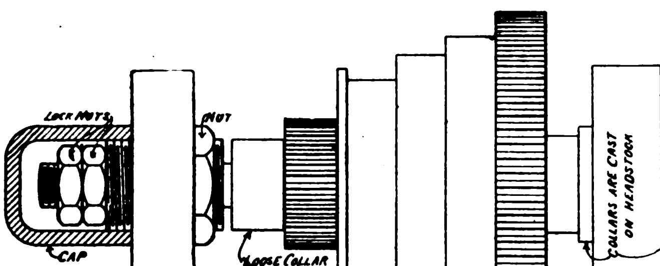
Queries and Replies.

[*Attention is especially directed to the first condition given below and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-hand corner of the envelope "Query Department." No other matters but those relating to the Queries should be enclosed in the same envelope.*

Queries on subjects within the scope of this journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied, wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed. (4) Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of Replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor,* THE MODEL ENGINEER, *26—29, Poppin's Court, Fleet Street, London, E.C.*]

The following are selected from the Queries which have been replied to recently:—

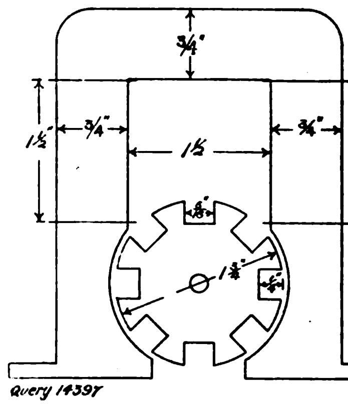
[10,778] **Overhauling Lathe Headstock.** W. F. M. (Torquay) writes: I should be glad of your valued assistance with regard to the following: I have bought a 4½-in. centre lathe (not screw-cutting) at an auction, and am not quite satisfied with the running of the mandrel; it seems to "jamb" sometimes, more especially if I am drilling work in the lathe. The point that puzzles me is that the cone has to take up all the strain, and I cannot see any back centre to prevent the cone being pushed into its seat too far. I have sketched the arrangement of headstock, and shall be glad to know how to adjust it, and how to take mandrel out to inspect it.



A LATHE HEADSTOCK.

There are several varieties of this type of bearing, which is very common on German repetition tools. You will find that what you term the "nut and cup" answers the purpose of a back centre, and in all probability the bearing is bored larger at the front side than at the back, the mandrel having a shoulder turned on it to suit, so by adjusting the bearing in conjunction with the back nuts on mandrel the cone on other end is made to fit as desired. Another kind has a short taper bored inside the bearing, a corresponding taper being turned on the mandrel. The exterior of bearing is also tapered between the threads to fit into headstock, and the bearing split on the underside to take up wear. However, if the two back nuts are taken off, the mandrel and nut and cup taken off the bearing, which may then be taken out, a few light blows on the front side of cone pulley will move it off the feather which holds it on the mandrel. The feather must be removed, when a few blows on end of mandrel, using a copper hammer or piece of hard wood, will drive the mandrel out, and you will ascertain for yourself what kind of bearing it is.

[14,397] **Windings for 60-watt Undertype Machine.** D. J. (Garnant) writes: I should be very pleased if you would enlighten me on the following questions: I have a dynamo or motor, overtype bipolar machine, as per sketch. I have wound the armature with about 5 ozs. of No. 22 D.C.C. wire. (1) What size wire and how much must I put on field-magnet to have an output of 4 amps.? The width of field-magnet being 1¼ ins., height 1½ ins., thickness ⅞ in., round edges. (2) The brushes are two brass strips, ¼ in. wide will that do? (3) When run as a dynamo will it light an 8-c.-p.



UNDERTYPE DYNAMO FIELD-MAGNETS.

lamp? If not, what size lamps will it light? (4) Length of armature 1½ ins., diameter 1½ ins., wound according to the diagram in handbook, "Small Dynamos and Motors." Two coils in each of eight slots, forty turns in each slot—is that right? (5) To regulate the speed what size wire, and how much, and what kind should I have? (6) I have a cylinder (steam) nearly finished, 1¼ by 2¼ ins. Would it be powerful enough to drive the dynamo?

(1) Owing to the small amount of iron in the field-magnet, your dynamo will scarcely give 10 volts, unless at an excessive speed. If you wish to obtain 15 volts you must rewind the armature with wire of a finer gauge and use silk-covered wire so as to get in as many turns as possible. You could try the machine with the present winding, for which a field-magnet winding of about 1 lb. No. 20 gauge s.c.c. copper wire on each core would be suitable; join both coils in series with each other and in shunt to the brushes, run at 3,000 r.p.m., and test with an 8-volt lamp. If not satisfactory, rewind the armature with No. 25 s.s.c. and the field-magnet with No. 23 s.c.c. copper wire, and test with a 15-volt 5-c.-p. lamp. (2) *Re* brushes, we recommend you to solder a strip of fine copper gauze under the brass strips to make a better and softer contact. (3) It may light a 15-volt 8-c.-p. lamp with the finer winding. (4) Winding should have more turns for 15 volts. (5) Do you mean to regulate the speed when used as a motor, or what? Perhaps our Handbook No. 14 will help you. (6) Yes; with a good steam pressure this cylinder would be large enough. The dynamo will require power according to the output which it is giving at any particular moment.

[14,623] **Spring Motors for Dynamo Driving.** G. H. W. (Chiswick) writes: I should be glad if you could inform me of the method of making springs. I wish to construct, if possible, a spring motor, strong enough to drive a small dynamo of about 10 volts 2 amps. Surely it must be possible, if only the spring is large enough. I want to know (1) where the spring steel could be bought, (2) the method of coiling it. I see in this and last week's

issue that spring motors are advertised. Have these any power? Of course, I should like it to run for an hour or two at a time

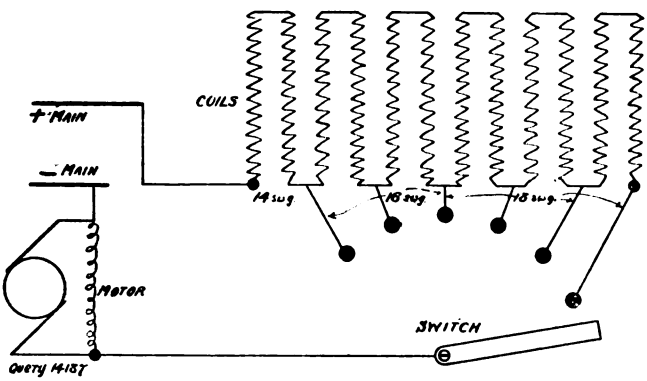
The scheme is impracticable. You would be better advised to drive the dynamo by hand direct. As far as spring motors are concerned, those advertised have considerable power, but not enough to run small dynamo for anything more than a few seconds. You only get out of the motor what power you put in, less losses due to friction; so if you want to drive a dynamo for an hour or two, you would have to wind it up for about the same time.

[14,828] **Small Electric Loco Motor.** B. P. D. (Yarmouth) writes: I should be much obliged if you would answer me the following questions, the motor being mounted direct on wheels, with gearing as shown, and having tripolar armature, 1½ ins. by ¾ in., and permanent field-magnets. (1) Of what steel should the field-magnets be made, and must they be tempered? If so, please give instructions as to hardness, etc. Would spring steel do, and could they be tempered in oil? I wish to make them in six thicknesses of ⅛-in. each, bolted together at points marked A in Fig. 1. (2) Are the field-magnets about the right dimensions, and is there any better arrangement that you could suggest? All the bearings, except the armature bearings, consist of holes drilled through the outer thicknesses of the field-magnet segments, the inner segments being filed away to clear the shafts. (3) What is the best method of magnetising the field-magnets? I wish them to be as powerful as possible. (4) Is the gearing about right? It reduces the speed from 50 revolutions per second to 3·62 revolutions per second. I want the loco to draw fairly heavy loads, without an excessive watt consumption, but to run at a very fair speed when hauling empty trucks—say a speed of about 11 ins. per second. The track wheels are 1 in. diameter. (5) What wire must I use for the armature? I wish to wind it for 4 volts. (6) Could you tell me the cost of running the loco per hour, at full load (not overloaded), from bichromate cells? Also from Daniell cells, and from accumulators? (7) What size bichromate cells should I require to drive it running two in series? Also what size Daniell cells, having four in series? And what size accumulator giving 4 volts?

(1) Wrought iron or soft cast iron. Former preferably. (2) Yes. (3) Use a couple of bichromate cells to start with. (4) Yes. (5) No. 21 S.W.G. (6) A few pence. Depends upon so many unknown factors; it is not possible to say within a few pence. Make a test of a few hours' run. (7) Use two sets of quart cells connected in series or parallel, as the motor may take a fairly heavy current. Accumulator of fully 30 or 35 amp.-hours will be wanted to stand a heavy discharge. Daniell cells are not so suitable.

[14,187] **Resistance for 500-watt Dynamo.** B. A. Q. (Colchester) writes: I have a motor wound for 50 volts 13 amps., and I want to run it off a 200-volt main. I should be much obliged if you would tell me what resistance to put in. How much and what sort? Will you please tell me what is meant by an armature being electrically and mechanically balanced?

You must absorb 150 volts, and if your motor will not always be taking the full current of 13 amps., as is most probably the case, the resistance must be adjustable according to the current flowing at any particular moment. Such a resistance will be somewhat large, as you will dissipate—that is, lose in heating the wire—about



RESISTANCE DIAGRAM FOR 500-WATT DYNAMO.

2,000 watts at full load—a most wasteful proceeding. Make your resistance as follows: 12 lbs. No. 14 gauge, 3 lbs. No. 16 gauge, 2 lbs. No. 18 gauge, bare German silver wire, wound into long coils, and all joined in series in the order of gauges; mount it on insulators or insulated studs, and arrange a switch and contacts so that all the wire is in circuit at starting, and can be cut out as far as the No. 14 gauge, as the load increases and you want speed. The proper thing to do is to re-wind the motor to suit 200 volts. An armature is said to be electrically balanced when all its coils have an equal resistance and are arranged so that they all produce equal effects in every respect. It is mechanically balanced when, if supported upon centres or knife edges, it will remain in any position without rotating when left to itself—that is, if unbalanced, it will tend to turn round, so that one part of the circumference always remains underneath. An electrically unbalanced armature is liable to sparking and heating; if mechanically unbalanced, it vibrates when running, and makes a noise.

[13,091] **Four-pole Dynamo Windings.** H. H. (Chelmsford) writes: A friend of mine is thinking of making up an engine and dynamo from castings which he bought some time ago, but is in trouble as to the winding of the dynamo, and has asked me to undertake this for him. I am therefore writing to you asking the following questions: (1) As to size of wire for a magnet of the following dimensions: Overall size of magnet, 8½ ins. by 3 by 1 in.; laminated poles, 1½ by 2½ ins. (2) Which type of armature is most suitable for

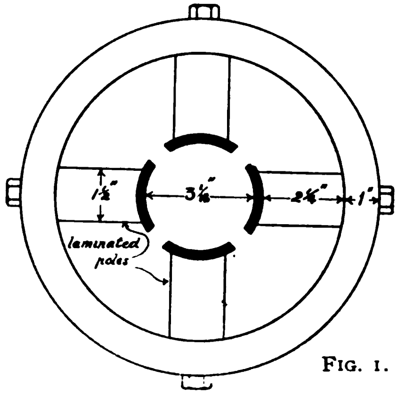


FIG. 1.

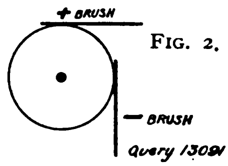


FIG. 2. FOUR-POLE DYNAMO DETAILS.

cell charging, and the size and amount of wire required for same? (3) The output you think we should get out of the finished machine and the revolutions it would have to run at to get the maximum output.

(1 and 2) Drum armature, cogged pattern, having at least sixteen slots, each 5-16ths by 5-16ths in., and sixteen coils, two in each slot, commutator to have sixteen sections with opposite sections connected together so as to use two brushes. A diagram of this winding is given on page 36 of our handbook on "Small Dynamos and Motors," price 6d. The brushes will press on points at right angles to each other. You do not say what volts you want to obtain, but we advise you to wind the armature with No. 24 gauge D.S.C. copper wire; get on as much as you can, ½ lb. should be ample quantity to buy. (3) Your sketch and requirements are too vague for us to give you exact information; but we assume that about 25 volts would suit you; therefore, wind the field-magnet with as much No. 22 gauge S.C.C. copper wire as you can get on, about 12 ozs. per pole will be about the weight; join all coils in series and in shunt to the brushes. You must be careful to connect them so that the magnet poles are alternately N and S. As regards output and speed you should remember that once you have attained the critical speed at which the dynamo will excite itself you can adjust the volts and consequently the output by raising or lowering the speed. The armature with this winding will stand an output of 6 amps., besides the current supplied to the field winding, and we should expect you would get about 25 volts at 1,200 r.p.m. If the voltage rises much higher than 25 volts you should have a new set of field coils to suit the increased voltage. After all, it is not such a big matter to entirely rewind the machine if the output does not suit you: having once acquired some figures by actual trial, it is a fairly easy matter to arrange a new winding to suit the speed you find most suitable. At 6 volts and 25 amps. output the dynamo will take about ¼-h.-p.

[14,745] **Force Pump.** W. H. W. (Belfast) writes: (1) What would be the best size force pump, and number of strokes, for the

4-ft. 6-in. M.T.D. described in your handbook on this subject? (2) Would a force pump take up much power, and (if so) would it be better to have a hand pump?

For a steamer a force pump may be best arranged geared from the crankshaft. The pump should always be large enough for all contingencies, and the regulation effected by means of a by-pass cock on the delivery pipe. A force pump, of course, takes an appreciable amount of power from the engine, but is better than a hand pump for a cruising boat. Most of the racing boats we have seen are not fitted with pumps; the boilers carry a sufficient charge of water to run the allotted time of the test. Probably 5-16ths-in. by ⅜-in. plunger would suffice in your case.

[14,719] **Marine Boiler.** F. E. B. (Portsmouth) writes: I am making a boat of the *Scout* class, expressly for speed. I have an engine (single-cylinder), 1-in. bore, ⅞-in. stroke. (1) What heating surface shall I have on a water-tube boiler to drive said engine 1,000 r.p.m. at 60 lbs. pressure; and also size of safety valve and steam and exhaust pipes? (2) Engine is similar to that on page 45 of "Model Steamer Machinery" Handbook, but differs in the valve having a cylindrical valve ¼ in. diameter, ports 3-32nds by ⅜—is this large enough for said speed? (3) Which is the best and cheapest vapour burner to use for this boiler, and (4) what is the meaning of "pitch" of a propeller? (5) Could two 4-in. propellers produce same speed as one 6-in.—*i.e.*, same pitch at same speed? (6) What must be the total area of blades for 7 miles per hour?

(1) The boiler should have about 450 sq. ins. of heating surface (more or less), according to the design and the firing employed. The safety valve should be ¼ in. diameter; steam pipes, 3-16ths in. outside diameter pipe; exhaust, ¼ in. diameter. (2) The ports are sufficiently large for the speed. (3) The best burner is a benzoline burner of the blowlamp type. (4) For propeller design, see the articles in issues of March 19th and April 2nd, 1903.

[14,782] **Vertical Boiler.** R. A. (London) writes: I am making a vertical boiler 4½ ins. high by 4 ins. in diameter. It has a firebox 1 in. high from bottom of shell of boiler, a single tube, and a separate casing for the lamp. What size engine would this drive (if possible, of the single-acting type, with slide-valve working both cylinders)?

The boiler is only suitable for a 7-16ths-in by ⅜-in., or ½-in. by 1-in. double-acting cylinder. The boiler would be much better if you fitted about six or seven tubes, ⅜ in. outside diameter. The boiler would then drive either of the above engines with considerably more power. A pair of single-acting cylinders (½ by 1) may be used, instead of the one double-acting; but we would prefer the former.

[14,803] **Small Dynamo Failure.** A. T. T. (Darlington) writes: I would be obliged if you would answer me the following questions:—I have purchased (second-hand) a 40-watt dynamo which I cannot make anything out of. I tried it from the treadle of my lathe, with a 6-volt lamp, but it would not light it; but on putting the two wires to my tongue I could feel the electricity, as if from a battery. The dynamo works as a motor at about 6 volts. Could you tell me any reason why it will not work, and also let me know what horse-power it will require to drive it?

Possibly you have not run it at high enough speed—due to belt slipping, etc. Or it may be wound for a low voltage. See our handbook—"Small Dynamos and Motors," 7d. post free. Read it thoroughly, and compare your windings with those recommended in the tables. About ⅛ h.-p. will be required to drive it easily at full load.

[14,804] **Bichromate Cells.** J. C. L. (Penzance) writes: Will you kindly help me in the following? I intend making up several bichromate cells for charging accumulators, etc. (1) Would single-fluid cells suit, as I am going to use large jam jars to take the place of the proper stoneware jar, and I don't think there would be sufficient room for a porous pot? (2) What are the proportions of ingredients for fluid? (3) Would eleven cells light 20-volt lamps? If so, how many, and for how long at a time? (My zincs are round, 1 in. diameter and 6 ins. long.)

(1 and 2) A good method is given in "Electric Batteries," 7d. post free. (3) Yes. Depends upon the candle-power (*i.e.*, size) of the lamps. Reckon 3½ watts per c.-p. Supposing your lamps were 6 c.-p., each would take about 1 amp. at 20 volts. You could take about 2 amps. from a good quart size bichromate for some few hours.

[14,791] **Vertical Boiler.** G. W. (Manchester) writes: I want to make a small vertical boiler to drive a horizontal slide-valve steam engine (1½-in. bore, 2½-in. stroke). As sheet copper comes rather expensive, I was wondering whether some sheet iron, like the sample enclosed, would do. I think it is called Russian iron. (1) Would this kind of iron prevent corrosion, as it seems to be galvanised? (2) Would plate 3-64ths in. thick be sufficient to stand a working pressure of 30 lbs. per square inch? (3) Do you mind giving a rough sketch, with dimensions, of a simple vertical boiler, with position of fittings, to be fired by means of a gas-ring?

The great objection to the iron or steel boiler made of material less than ¼ in. thick is its liability to rapid deterioration. So long as you take reasonable precautions in the matter of storing the generator between the times of actual using, you might make the boiler of the material you sent. The boiler should be kept quite dry, and the inside should be well open to the atmosphere. The corrosion generally takes place at the joints just where the peculiar coating of Russian iron is likely to be damaged, and therefore you could not count on this to lengthen the life of the boiler. Whilst new, and with double-riveting for the longitudinal seam, we think that a pressure of 30 lbs. is quite safe. The boiler must not be more than about 4 or 5 ins. in diameter, unless you use 5-64ths-in. material, when it may be 6 to 7 ins. diameter. For use with a gas-ring, or a Primus stove, the boiler may be made without a water-space firebox. The tubes should be about twelve to twenty in number, according to the size of the barrel of the boiler, and ¼ in. outside diameter. The distance between the tube plates may be 8 to 12 ins., according to the diameter fixed upon.

[13,934] **Small Undertype Dynamo Windings, etc.** S. W. B. (Woolwich) writes: Enclosed is a full-sized sketch of a small dynamo I am building. The field-magnets are of wrought iron, well annealed, 6 ins. high, 1⅛ ins. long, and 1 in. thick at base, the winding space reduced to ⅜ in., and the armature tunnel bored to 2 5-16ths ins. A 1⅛ piece is bolted with four ¼-in. bolts between the two pole-pieces, making the machine 3¼ ins. wide over all. The armature is built up with stampings, 1⅛ ins. long, 2¼ ins. bare diameter, with eight slots ⅜ by ⅜ in., and which I think of winding with about 10 ozs. No. 22 D.C.C. wire, wound in eight sections, as described in your handbook, "Dynamos and Motors," page 34, Fig. 43, and connected

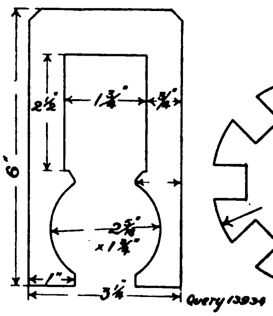


FIG. 1.—UNDERTYPE FIELD-MAGNETS.

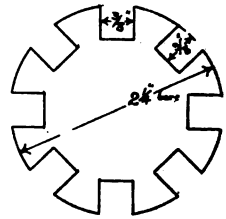


FIG. 2.—ARMATURE STAMPING.

to an eight-part commutator. For the field-magnet winding I propose to use 2 lbs. No. 24 D.C.C. wire. Will you kindly let me know (1) if the wire mentioned is correct in proportion and gauge, (2) at about what speed this machine should be run at, (3) and what output might I reasonably expect from this machine. As this is my first attempt at dynamo building, any little advice will be gratefully received by an old reader of THE MODEL ENGINEER.

(1) The gauges of wire will do, but we should advise No. 23 gauge S.C.C. instead of 24 gauge for the field coils—get on as much as you can on both armature and field coils. (2) Run about 2,500 r.p.m. (3) You should get about 20 volts and 4 amps. You can adjust the volts within limits by running it higher or lower speed. You will find much useful information in our handbook. When the machine is finished, try it as a motor with a few bichromate cells in series; if it runs well as a motor it will show that there is no electrical fault existing; if the field coils are connected in shunt to the brushes, as they should be, then the machine must be driven in the same direction as a dynamo as that in which it runs as a motor. The field-magnet should be well magnetised by means of a strong battery before you try to get it to work as a dynamo; it should be a good machine. As with all small wrought-iron field machines, you may have some trouble to get it to excite.

[14,705] **Engineering Classes.** L. C. (Middlesex) writes: Could you let me know—(1) What it would cost for an electrical engineering education at one of the Engineering Colleges? (2) How long would it take to complete? (3) What colleges you recommend? (4) Are there any examinations that I could sit for to enter any college more cheaply? I am 26 years of age, hold four engineering certificates from the Board of Education, South Kensington, one being a first-class advanced for machine drawing, and have a slight knowledge of practical mechanical engineering. If you think it would be impossible for me to follow the above, could you advise any other course, as I am anxious to improve my position?

(1) At one of the Polytechnics it would come out at approximately £10 to £15 per annum, but much depends upon what subjects you take and the time you spend there. (2) One, two or three years. (3) Any of the Technical Institutes in or around London. The Finsbury Technical College, in Leonard Street, Finsbury, E.C., is good. (4) Whitworth schloarships. Prospectus of these can be had from Eyre & Spottiswoode, Shoe Lane, E.C. We advise you to call at some such Technical College as we refer to and see the Principal. Explain your position and what you

wish to do, and he will, no doubt, advise you what classes to take, and the cost of same.

[14,820] **Small Oil Engine.** M. W. (Stonehouse) writes: Will you kindly answer these few questions for me *re* small oil engine (2½-in. bore, 3½-in. stroke, with automatic inlet valve, no air valve, but exhaust worked with cam)? I want to work it with petroleum oil and the vaporiser. I want to heat with the same lamp as I use for firing. Can you tell me where I could get castings to make up a vaporiser like the one in your handbook on "Oil Engines," Fig. 45, and where can I get iron tube to make ignition tubes about ¼-in. diameter, or does it matter what bore the tubes are for firing? Could I get it hot with a small Swedish benzoline lamp, as we have no gas for Bunsen burner? *Re* vaporiser. Is it necessary to have a force feed to the vaporiser, or will gravity feed do for it? Can you give me dimensions for vaporiser for ½ h.-p., and will it require an air valve (extra on engine) with this kind of vaporiser, or not?

You might write to Capel & Co., of 168, Dalston Lane, N.E., *re* castings for vaporiser. We cannot say definitely that they would supply you, but you could ask them, mentioning our name (and handbook) when writing. Gas barrelling sold at any ironmongers would do for tubes. Use ¼-in. gas barrel. Yes; Swedish lamp would do. Gravity feed would do, but you must keep the oil in the small reservoir at a constant level. You would have to return the overflow to the main oil tank by some means—hand or by pump. An air valve would probably be required unless sufficient were taken in through vaporiser. If you make the diameter of vaporiser about 1¾ ins. inside, and other parts in proportion, you won't be far out. You cannot reduce the size much, on account of tube ignition.

[14,197] **Electric Alarm Bell Connections.** W. C. (Newcastle-on-Tyne) writes: I've fixed up an electric alarm in four rooms, working off the same clock, each bell to ring at different times, by changing the switches and by altering the time of the alarm. I want to ring the same four bells at once off one press. I am working the bells off three Leclanché cells (all the bells have different resistances). I would be very pleased if you could give me some idea how to go about it. The distance from the bells to the press is about 50 yds. away. I am using No. 22 gauge wire for the live wire.

All you require is a circuit to bridge the clock, so that the push takes the place of the clock contact, thus (we reproduce part of your sketch) by closing all the switches the bells will all ring together when the push is closed. As the bells are of different resistances it would be well to try them so arranged that the one with the highest resistance is nearest to the battery, and so on. If they do not work well, then rewind the magnet coils so that they are all of the same

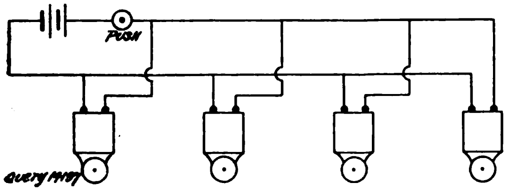
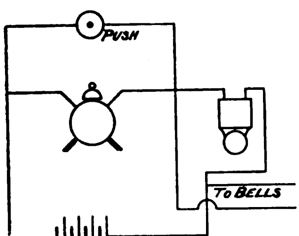


FIG. 1.



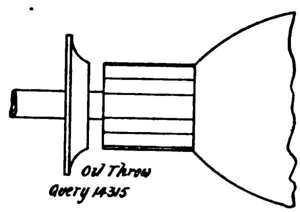
DIAGRAMS OF CONNECTIONS FOR ELECTRIC ALARM BELLS.

FIG. 2.

resistance—preferably equal to the one with the highest resistance, so as to economise current; if necessary, add another cell to the battery. If you do not wish to interfere with the present control of the circuits by means of the switches, then you must have a second battery and set of circuits controlled by the push, all being quite independent of the present clock control. Our remarks *re* winding of magnet coils would still hold good. The present circuits can, of course, be still joined to the same terminals of the bells; it simply means that when you press the push button you ring all the bells, no matter what has happened or is happening in the clock circuits; you should, however, take care to see that the positive wires go to the same terminal on each bell.

[14,315] **Oily Commutator Trouble.** F. S. (Preston) writes: Will you kindly help me in the following trouble? My dynamo (output 30 watts), with drum armature, has given me trouble by oil constantly getting on the commutator. Sketch shows bearing, etc. Would you please tell me a remedy, and if some other form of bearing is best, please state it? (2) Also I have a boat 2 ft. long, 5-in. beam, and 6-in. draught. (3) Would a motor of the "Little Hustler" type drive it? Messrs. Macmillan & Co. have a motor, same output, which they say will drive boat from 2 ft. to 2 ft. 6 ins. I intend to run with 4-volt accumulator, speed no desire. If this motor will not do, please state best from either "Small Dynamos and Motors," or "Small Electric Motors."

(1) Read the articles now appearing in THE MODEL ENGINEER under "Lessons in Workshop Practice." The question of lubrication of bearings is dealt with in the issue for July 6th last. By putting an oil throw on the shaft consisting of a metal disc turned with a bevelled



PLAN OF COMMUTATOR.

edge, the oil will be thrown off at the edge of the disc, and not work on to the commutator—sketch herewith. (2 and 3) We should think you will get satisfactory results with this motor; the best plan would be to let the motor run very fast and gear it to a slower speed propeller, using nicely adjusted belt or spur gearing; reduce in the ratio of about three revolutions of motor to one of propeller, and use large pulleys if belt gearing. If you wish to join propeller direct to motor shaft, then use a small propeller of fine pitch.

[14,756] **Aluminium for Models.** H. B. (Loughboro' Junction) writes: Would you kindly inform me where I can obtain aluminium; also the price of same per pound? What sort of mould should I use for casting fine work? Can it be electroplated, and is it strong enough for making small models?

Aluminium can be obtained from the British Aluminium Co., Ltd., of 9, Victoria Street, Westminster, who will no doubt quote price if you enquire from them. It can be electro-plated, though there is a little trouble in getting a good deposit. Pure aluminium is too soft to be of much use for general purposes, and is very difficult to screw and tap; but there are various alloys consisting of aluminium for the principal part, which are largely used for many kinds of machine building. The company mentioned above make several, each being suitable for certain purposes. They would tell you which they would recommend if you state the purpose for which you intend to use it. They also make castings to customers' patterns. Many ordinary brass founders also now make aluminium alloy castings.

New Catalogues and Lists.

Marshall & Woods, Avenue Works, Park Road, Acton, W., have sent us an illustrated leaflet, giving prices and particulars of the "M.W." motors, which are suitable for those requiring small machines for industrial and experimental purposes. A price list of their motor generators (two machines coupled) is also to hand.

John J. Griffin & Sons, Ltd., 20-26, Sardinia Street, Lincoln's Inn Fields, London, W.C.—The price list we have received from this firm gives particulars of various kinds of thermometers and pyrometers supplied by them for measuring temperatures for all purposes. The list contains prices of slide rules and calculators, a table of thermometric constants, and a conversion table of thermometric scales are also included.

S. M. Stuart Turner, Shiplake, Henley-on-Thames.—The new and complete list which we have received illustrates the well-known high-speed engines, model locomotives, small dynamos and motors, and oil engines supplied by Mr. Turner, and contains prices of castings and finished parts of the above. Amongst others the G.N.R. Locomotive 251, the "Stuart" horizontal engines, and Mr. Greenly's 1904 *M.E.* Locomotive are listed. The list will be sent to readers of this Journal for 4d. post free. The early section of the catalogue, containing prices of down and up comers, boiler ends, a complete list of model locomotive wheels, flywheels, crankshaft and cylinder castings, etc., etc., can be had separately, price one penny.

The Editor's Page.

WE commence in this issue a new series of articles, entitled "Home Electric Lighting," which we think will prove of general interest. While we have in earlier volumes published a considerable amount of information on this subject, there are always readers who are about to make a first acquaintance with the subject, and judging by the queries we have been receiving of late, the new series will be of much assistance to those concerned. We may mention that the author, Mr. Cyril N. Turner, has himself carried out the installation he describes, with very satisfactory results. He will be known to some, at least, of our readers, as the writer of the very practical little handbook on "Acetylene Gas," in THE MODEL ENGINEER series.

* * *

On reviewing Mr. Chas. S. Lake's new book "The World's Locomotives," our contemporary *The Engineer* gave this volume an unusually high measure of praise. To quote two sentences :—"It would be difficult to say too much in praise of this book .... No book on the locomotive so likely to prove useful for reference has previously been produced." From so eminent an authority on engineering practice, this is a striking testimony to the excellence of Mr. Lake's book, and fully confirms the terms in which we commended it to our readers when it first appeared.

* * *

In response to several enquiries we may say that our new book—"A Guide to the Electrical Examinations"—is now ready. It is supplied in paper covers at 1s. net, post free 1s. 2d. ; or in cloth covers 1s. 6d. net, post free 1s. 9d. It may be obtained at the published prices through any of our usual agents.

Answers to Correspondents.

H. F. S. (Ramsgate).—The form of reversing gear contained in your letter is not altogether novel. It is described in "The Model Locomotive." It is a very successful gear for small models ; your setting out, however, would not give the best distribution of steam. Properly arranged, a small amount of lap and lead may be given to the valve, although only one eccentric placed at 90 degs. from the crank pin is used.

J. E. UNDERHILL (Kent).—It is the setting of the valves that determines the direction of the engine. Get our book, "Petrol Motors Simply Explained," price 1s. net, 1s. 2d. post free from this office, and make a working model in cardboard, and you will soon see how it is that the movements of the valves govern the direction of rotation.

C. M. (Leckhampton).—There should be no compression in the power cylinder. There is a slight pressure during the working stroke, of course. The displacer cylinder should not be red-hot.

NAUTILUS II.—1½ ins. diam. Vary the pitch till best results are obtained.

T. H. SYMONDS (Willesden, N.W.).—The sizes of holes suitable for your taps would be 3-16ths in., and proportionately down to ⅛ in.

A. L. R. (Cardiff).—You already have a drawing quarter full size for ½-in. scale model G.N.R. Tank Locomotive in "The Model Locomotive" (see page 57). The cylinders may be 7-16ths by ⅞ in. with valves on top, or a single cylinder ½ in. by 1 in. may be used instead. There is no real necessity for a complicated brake ; devise some means of shutting off the steam from the track.

L. N. (Somerset West).—Messrs. Cotton & Johnson, 14, Gerard Street, Soho, or Christopher & Co., of Clerkenwell Road, E.C., would doubtless do it for you.

C. E. W. (Fairfield).—We do not know where you could get a scale model tramcar. It would probably have to be made for you. There are several cheap working models on the market. Try Messrs. Darton & Co., 142, St. John Street, E.C. ; Messrs. W. J. Bassett-Lowke & Co., Northampton ; or the Clyde Model Dockyard, Argyll Arcade, Glasgow.

Notices.

The Editor invites correspondence and original contributions on all amateur mechanical and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected or not, and all MSS. should be accompanied by a stamped addressed envelope for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

This journal will be sent post free to any address for 13s. per annum, payable in advance. Remittances should be made by Postal Order.

Advertisement rates may be had on application to the Advertisement Manager.

HOW TO ADDRESS LETTERS.

All correspondence relating to the literary portion of the paper, and all new apparatus and price lists, &c., for review, to be addressed to THE EDITOR, "The Model Engineer," 26—29, Poppin's Court, Fleet Street, London, E.C.

All correspondence relating to advertisements and deposits to be addressed to THE ADVERTISEMENT MANAGER, "The Model Engineer, 26—29, Poppin's Court, Fleet Street, London, E.C.

All subscriptions and correspondence relating to sales of the paper and books to be addressed to Percival Marshall & Co., 26—29, Poppin's Court, Fleet Street, London, E.C.

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Contents.

[*The asterisk (*) denotes that the subject is illustrated.*]

THE

Model Engineer

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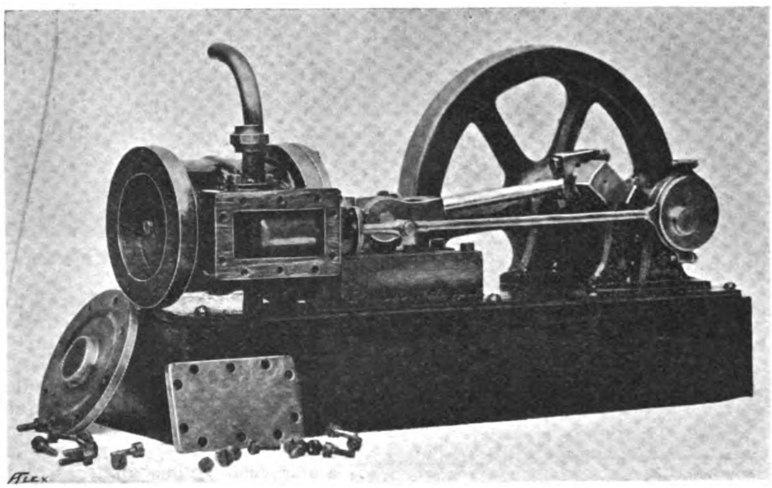
A JOURNAL OF PRACTICAL MECHANICS AND ELECTRICITY.

EDITED BY PERCIVAL MARSHALL, A.I.MECH.E

VOL. XIII. No. 236. NOVEMBER 2, 1905. PUBLISHED WEEKLY.

A 1-6th H.-P. Horizontal Steam Engine.

By F. PULLEN.



MR. F. PULLEN'S SMALL HORIZONTAL STEAM ENGINE.

THE photograph herewith reproduced is of a small engine which I finished about a year ago. The cylinder is of brass, $1\frac{3}{8}$-in. bore, $1\frac{1}{2}$-in. stroke, with 1-16th in. clearance at each end for piston, a very important item in a small engine, where as little steam as possible should be wasted, the steam passages and spaces at the ends of cylinder having to be filled every revolution of engine before any useful work is imparted to the piston, and then it is exhausted along with the main body of steam without having done anything useful. The piston is also of brass, $\frac{3}{8}$-in. thick, with a ring 3-16ths in. wide, cut and sprung into place.

The hole in middle of piston is tapped 3-16ths in., and it is kept from working off the piston-rod by means of a check-nut. I bored the cylinder in a lathe with a double-ended cutter, and afterwards drove it on a mandrel and trued the flanges over the tops and on the sides. The steam ports are $\frac{3}{8}$ in. by $\frac{1}{8}$ in.; exhaust port, $\frac{3}{8}$ in. by $\frac{1}{4}$ in.; the valve travel is 5-16ths in., and steam is cut off at about $\frac{7}{8}$-in. of the full stroke; steam ports open 3-32nds in. to steam, and are full open to exhaust. The valve spindle is $\frac{1}{8}$ in. diameter, the flywheel 5 ins. diameter. The double-webbed crankshaft, which is $\frac{3}{8}$ in. diameter, I turned out of a piece of solid spring steel. It was a very tedious job, but I got through it without a mishap.

All the work, including the pattern-making, was done by myself.

The steam and exhaust pipes are 3-16ths in. and $\frac{1}{4}$ in., respectively. I connected the model to a cock on a large engine at my place of work, and put 60 lbs. per sq. in. on it, and when it started I had to put two 14-lb. weights on to keep it from jumping about. I do not know the exact speed it ran, but it was nothing under 1,000 revolutions per minute. Since the photograph was taken I have abandoned the cheese-headed screws in the cylinder and steam chest flanges, and substituted ordinary studs with nuts. Taking the steam pressure at 60 lbs. per sq. in. and the revolutions at 1,000 per minute, it develops about $\frac{1}{6}$ h.-p.

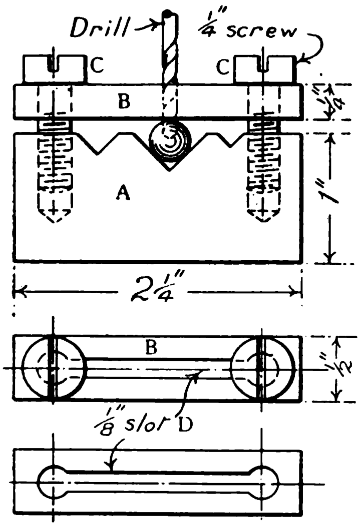
Workshop Notes and Notions.

[Readers are invited to contribute short practical items for this column, based on their own workshop experience. Accepted contributions will be paid for on publication, if desired, according to merit. All matter intended for this column should be marked "WORKSHOP" on the envelope.]

Clamping V-Block for Drilling Machine.

By "SCRIBO."

It is often found when drilling small, short round pieces in the drilling machine that they are very apt to twist, thus throwing the hole out of truth or sideways when using an ordinary V-block. Here is a tool to overcome the difficulty. A V-block shown at A, with three vees to accommodate pieces of different size, and a clamping plate B held down to the work by screws C. The plate B has two $\frac{1}{4}$-in. holes and an $\frac{1}{8}$-in. slot to allow drill to pass to the work. It is also useful for drilling odd size balls, as they can be clamped very easily in the V-block when it would be too much trouble to make a special jig for odd ones. The above size is



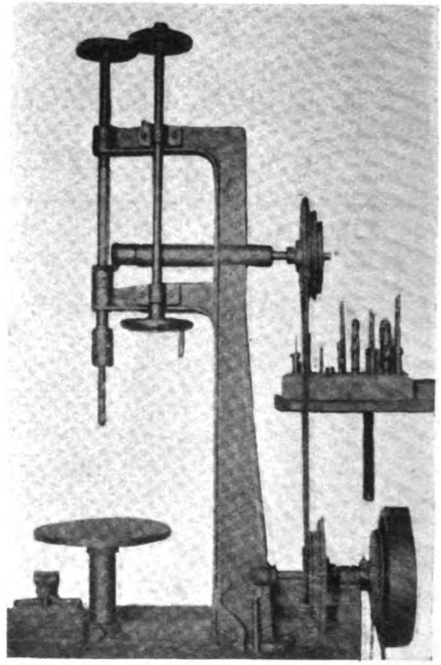
A CLAMPING V-BLOCK FOR DRILLING MACHINE.

a very useful one, and the $\frac{1}{8}$-in. slot D is plenty large enough, as it is only intended for small work.

A Handy Vertical Drill.

By EDWIN R. TURNER.

The following is a description of a vertical drill which I have recently made including all patterns and machining of the various parts, with the exception of splining the drill-spindle and feed-shaft, which a friend kindly did for me on a hand-planer. The drill is designed to fix to an ordinary bench, and is provided with a counter-shaft and three-speed cone, the diameters being 8 ins., 6 ins., and 4 ins. The machine is capable



A HANDY VERTICAL DRILL.

of drilling holes up to $\frac{5}{8}$ in. in cast-iron out of the solid, and will of course ream out holes much larger.

The leading dimensions are:—Total height of machine to top of feed wheels from bench, 3 ft. 7 ins.; diameter of drill spindle, $\frac{7}{8}$ in.; length of drill spindle, 1 ft. 9 ins.; length of feed shaft, 1 ft 9 ins.; diameter of feed shaft, $\frac{5}{8}$ in.; traverse of drill spindle, 6 ins.; will admit 16 ins. diameter and 12 ins. under drill; chuck, $1\frac{1}{2}$ ins. diameter bored for $\frac{1}{2}$-in. shanks; feed hand wheel, $5\frac{1}{4}$ ins. diameter round rim; feed wheels are 60 teeth, 14 pitch; mitre wheels, 2 ins. diameter, $\frac{5}{8}$ in. on face, 22 teeth; table, 10 ins. diameter; table pillar, 2 ins. diameter, 16 ins. long; cross and counter shafts, $\frac{5}{8}$ in. diameter; counter and shaft flywheel, 10 ins. diameter, 2 ins. on face; treadle crank, 2 ins. throw. In addition to the counter-shaft flywheel there is a balance wheel on the treadle shaft weighing 75 lbs. and 26 ins. diameter. Transmission is by belt running on 12-in. pulley on treadle shaft on to a 6-in. pulley on counter shaft. The pulleys are turned from 7-ply board, which does not warp or fly, and as well as being easier to turn, the belt drives much better on them than metal ones.

Metal Scraping and the Production of Flat Surfaces.

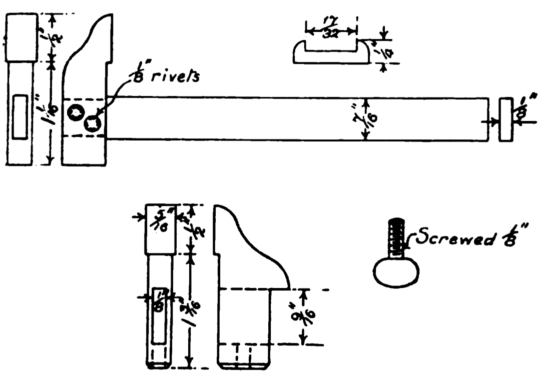
By H. R. B.

In the absence of a surface plate, polished plate glass can be used with a mixture of the finest crocus or rouge, with sweet oil for the ruddle. This answers very well up to the later stages, when a piece of plate-glass finely ground on one side, *used dry* and rubbed over the work, will give the higher places a burnished appearance, similar to those produced by the expensive surface plates. These pieces of ground plate glass are commonly sold by dealers in photographic goods, and can be had a variety of dimensions and shapes up to the whole-plate size. They can be had with a knob on the top, which is very convenient for handling, the smaller sizes only costing a few pence each. It is only intended that these glasses should be used in the later stages, and not with any idea of grinding down the metal surface by friction of the ground glass. Should, however, the ground surface of the glass become loaded with metallic particles, these can effectually be removed with nitric acid and water, equal parts, without detriment to the surface of the glass.

A Caliper Gauge.

By D. Mungall.

The sketches reproduced below are of a heavy caliper gauge, w ich is a very useful addition to any workshop, being very useful for gauging piston rings and such like. The heads are made of softened tool steel, while the stock "cutter" and thumbscrew are made of mild steel. The stock was filed from a forging, care being taken to get the sides square, after which they were scraped up. After the heads had been cut out and filed up, holes were bored for the slots, which were then chipped and filed out. The "cutter" or washer is to keep



Details of a Caliper Gauge.

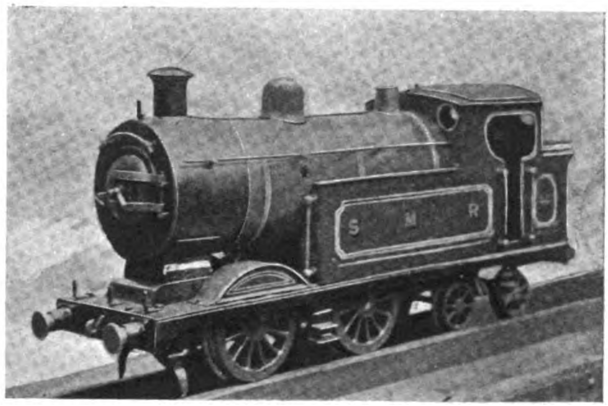
the stock from becoming defaced. At one end of the stock a piece was filed off the sides to leave a shoulder for the head. When finished, it was rubbed up with very soft emery cloth.

Silicon, the most abundant metal in the world, has been comparatively unknown on account of the difficulty of separating it from oxygen, but the electric furnace has now made it obtainable in quantities sufficient to meet any demand. It gives to steel valuable electrical properties; it imparts such hardness as to make some alloys possibly useful as abrasives, whilst the compound known as "calorite" serves, like thermite, for obtaining high temperatures.

A Half-Inch Scale Model Tank Locomotive.

By J. G. Surtees.

The photograph reproduced herewith represents a ½-in. scale model 4-wheeled coupled tank engine something after the style of The Model Engineer locomotive, but with one inside cylinder instead of two.



Mr. J. G. Surtees' Model Locomotive.

As this was my first locomotive, I decided to have one cylinder only, so as to have it as simple as possible, and also to keep the cost low. No castings were used, except the wheels and downcomer.

I first made a rough drawing of engine outline to get the general appearance, size and position of wheels, etc. I then got sufficient 3-32 sheet steel for frames and buffer beams; these, after being cut out, were riveted together by angle brackets. Angle brackets were also riveted outside of frames, to hold footplate, which was screwed to same.

The next job to tackle was the cylinder, which was built up of tube ¾ in. inside diameter; the end flanges and valve face were sweated together, and the covers screwed on; the eccentrics, straps, connecting-rod end and bearings were made from scrap brass. The engine is reversed by the usual link motion connected to the lever in the cab.

Spring buffers are fitted; the sockets are of brass tube, and the heads turned from ¾-in. brass rod. The coupled wheels are 2¾ i s. diameter, and the bogie 1½ ins.; the axles are of silver steel. The boiler (Smithies type) is a piece of 2½ ins. solid drawn copper tube, 9 ins. long, with ends 1-16th in. copper, flanged, riveted and sweated, has five ¼-in. copper tubes sweated into barrel and downcomer; the boiler is lagged with asbestos, and the outer shell is thin steel, 3½ i .s. diameter, which gives the engine a massive appearance; steam is taken from top of boiler by a perforated pipe through the smokebox to cylinder.

The smokebox is 2½ ins. long, the door is hung on two hinges, and secured with crossbar and two handles; it contains a steam-cock, which is controlled by a regulator handle in cab and a steel rod running through a 3-16ths in. tube in boiler. The dome is a dummy, made from tube, and the top turned and sweated on, covering the nut which keeps the boiler and outside shell together.

The side-tanks, cab, and bunker are made of sheet tin; they are all fastened together and secured to footplate by four screws.

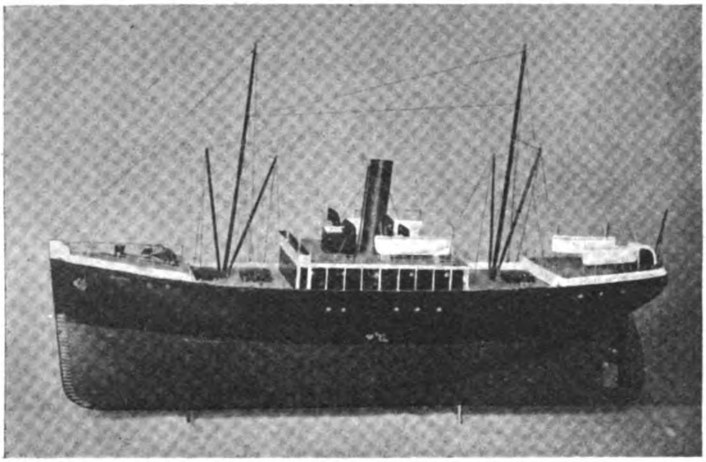
The container for lamp is in the bunker. I first tried methylated spirit, but the cost was alarming, and I did not get as much steam as I do now, with a coiled copper tube burning vaporised paraffin under pressure.

The boiler is fitted with two test-cocks instead of water-gauge, safety valve, and pressure gauge. The engine is 18½ ins. long, 4 ins. wide, and weighs about 11 lbs.

A Model Cargo Steamer.

By Percy Poole.

THE accompanying illustrations represent my model cargo steamer *Cestria*. Although, as will be seen from the dimensions, it is not a large model, I endeavoured to include all the deck fittings that appear in this class of steamer, and finish her as completely as possible. The following are the chief dimensions:—Length, 22½ ins.; breadth, 4½ ins.; depth, 4¼ ins. She is of the dug-out class, and I was fortunate in obtaining a sound piece of Kauri pine, which facilitated this part of the work. All the decks are made of holly—a wood I found very suitable for the purpose. I used mahogany for the deck-house, chart-house, and wheel-house. The funnel and the following deck fittings I made of brass:—Stairways, ventilating cowls, skylight, davits, and anchor crane. The masts and derricks are of lance wood; the boats and remainder of the deck fittings are also of hard woods. I tried several methods for making the ratlines, rails, and stanchions, which I found to be the most difficult job before satisfactorily finishing them. For some of the rigging I used fine copper wire, the rest being done with brown silk cord.



Mr. Percy Poole's Model Cargo Steamer.

The decks and deck-houses are polished, and all the deck fittings are painted white, except the funnel, which is red with black top. The lower part of the hull is painted bright red, and the upper works black. The total weight of the model, as it now stands, is under 3 lbs. Originally, she was built for a working model, equipped with electrical machinery, of which I give the following particulars:—A battery of four No. 1 "Dania" dry cells, and a small "Ajax" motor gave every satisfaction. The motor I inverted, and ran a continuous shaft from the propeller to the armature. Two bearings and a stuffing-box always ensure easy running.

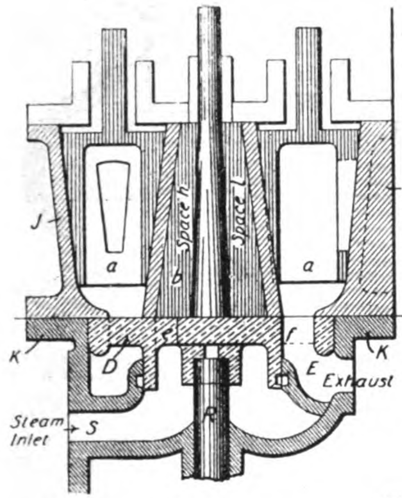
As the polished decks and painted fittings were liable to damage when sailing, I decided to take out the machinery, and finish her as a show model. I may say that this was my first attempt at model steamer making, with a very limited number of tools, and but little opportunity for the work, the making of this model occupied my spare time for a period extending over two years. The work is entirely my own, this journal being the only work consulted on the subject.

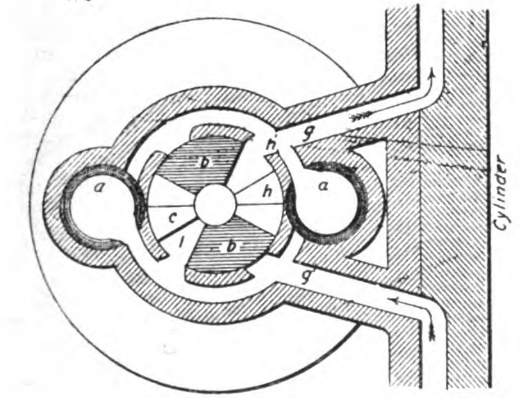
The Latest in Engineering.

Largest Floating Dock.—A new floating dock has just been finished at Tsing-tau, Kiao-chau. Its length is 410 ft., its width over all is 128 ft., and the inside measurement is 98 ft., while the height is 62 ft. It is, therefore, the largest floating dock in existence. It is capable of raising 14,000 tons, or 2,000 tons more than the largest German warship. It consists of five independent pontoons, and two side walls. It is worked by electric power furnished by the central station at Tsing-tau, and the electric lighting permits work to be carried on at night. With its ten pumps in action it is possible to empty the caissons in two hours. The dock will, of course, be available for ships of the mercantile marine as well as for warships.

Petrol Consumption Tests.—Mr. S. F. Edge has recently carried out a series of tests in regard to petrol consumption, with a view to rendering the Napier car most suitable for the tourist trophy. Starting from London he filled up with one gallon of petrol in a special tank made for the purpose, and ran a distance of 25¾ miles on this gallon, the run including the climb up Dashwood Hill. Further runs were made with two persons in the car, and carrying a load of 300 lbs., made up of bags of sand placed in the tonneau; under these conditions distances of 24¾, 26, 25, and 25 11-16ths miles were covered to the gallon. The car used was an 18-h.p. Napier.

A New Rotary Valve.—For a type of rotary steam distribution valve, constructed by Mr. William Mayne, of Mildma, Victoria, no fewer than fifteen advantages over other rotary valves are claimed, of which the following are the more important :—(1) that the cut-off may be varied without altering the lead ; (2) the lead and expansion can be varied at will whilst the engine is running ; (3) that the valve works equally well with 20 lbs. or 200 lbs. pressure of steam ; (4) that the moving part is the rotating disc ; and (5) that in compound engines the maximum pressure of steam for full stroke can be given in the first cylinder. A vertical section through the centre of the valve





A New Rotary Valve.

is shown in the illustration. The valve chest consists essentially of two castings K and J bolted together. The lower part K is circular in form, and contains two separate passages or ports—S the steam inlet and E the exhaust. It also contains the revolving disc D, which controls the supply of steam to the upper or distribution valves, and which are actuated from the crank of the engine by suitable gearing. The latter consists of three circular chests which are in communication with each other. The two outside chests contain two open bottom cocks *a*, through which the exhaust steam passes from the cylinder. There is also a central plug valve *b*, which has two independent longitudinal passages *h* and *l*, which communicate respectively with the two ends of the cylinder. This plug valve is movable, and its position regulates the supply of steam to the cylinder. These three valves *a a* and *b* move in fixed relation to the other, being suitably geared together by means of pinions keyed to their spindles. The winged valve *c* moves quite independently of the others, and its function is to vary the cut-off. Before detailing the course of the steam, it is necessary carefully to note the construction of the rotating disc. It consists of a circular metal disc fitted with a spindle R, operated from the crank-shaft by suitable gearing, and is provided with a porthole *e* and an exhaust slot *f*. As the disc revolves it allows the steam alternately to enter the spaces *h* and *l*—*i.e.*, to enter alternately the ends of the cylinder. The exhaust is similarly actuated. To reverse the engine all that is necessary is to turn the plug-valve *b* through one-sixth of a revolution, and by means of the gearing already referred to the exhaust valve turns through one-third of a revolution. The communication will now be made between (say) *h* and the opposite passage *g'*. The position of the admission and the cut-off point is regulated by the position of the plug *c* which is moved quite independently to the other valves *a a* and *b*. The course of the steam through the valve will now easily be understood. The steam enters the valve at S, and passes through *e* in the rotating disc into the longitudinal space *h* or *l*, depending upon the position of the disc. Suppose the steam passes into *h*, it then passes through the port *h'* into the circular passage *g*, and thence to one end of the cylinder, the exhaust steam leaving the other end through the passage *g'*, passes into *a*, and so through the slot *f* in the disc D to the atmosphere or condenser.—*The Engineer.*

Electrically Driven Fire Engines.—Two fire-engines and a car for carrying accessory appliances, all electrically driven, have recently been put into service by the Vienna fire brigade. The accumulators, sufficient to propel the car for some 28 miles at a speed of 12½ miles per hour, are placed in a compartment in front of the driver's seat over the front wheels. India-rubber tyres are fitted to the wheels, which are 2 ft. 9½ ins. diameter. Each of the front wheels is provided with a 35 h.-p. Lohner-Porsche hub motor, and the controller provides for the following speeds : 5·6, 6·8, 12·5, 17·4, and 22·4 miles per hour.

Smoke-Preventing Device.—A new smoke-preventing device for boiler furnaces has been invented by Mr. J. S. Pearson, of Glasgow. The system consists of discharging a combination of steam, air and producer gas into the furnace. The three elements are combined and discharged through nozzles fitted to short pipe connections. The resulting chemical action releases the hydrogen in the steam, and combines the oxygen with the carbon in the fuel. The decomposition of the supplied gases is thus completed, and by combining with the fuel gases and the resulting new gases thus produced, creates great heating power, emitting heavy smoke. The latter, however, decreases in volume towards the tubes, in which there are only flames, and is completely consumed before it reaches the chimney. The steam pressure does not vary with the stoking or cleaning of the furnace, and no ashes or clinkers are formed. The system can be applied to any type of boiler.—*Scientific American.*

Lessons in Workshop Practice.

(*Continued from page* 394.)

XXIV.—Terminals and Connections for Small Dynamos and Motors.

THE terminals of a dynamo or motor should be placed in such a position that they are easily accessible, and it is essential that they are well insulated from the frame of the machine. A common plan is to mount them upon a block of

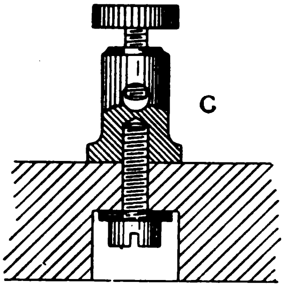
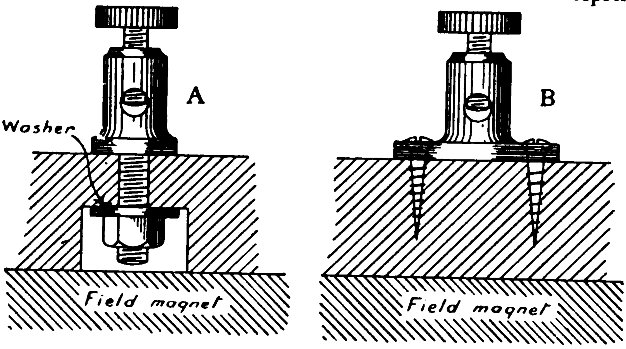
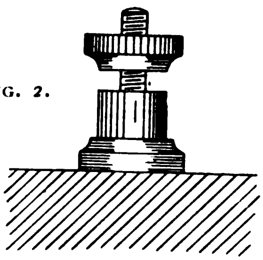


FIG. 1.



wood, or similar material. When this method is adopted, the terminals should not be merely fixed by screwing the shank into the wood (except, perhaps, for very small machines), even when the shank is made in the form of a wood screw, because

FIG. 2.



the clamping screw is liable to stick when tightened up, with the result that when you try to unscrew it to release the wire, the terminal shank either unscrews out of the wood, or the body unscrews from the shank.

Three good methods (A, B, and C) are shown in Fig. 1. When A or C is used, the hole in the wood through which the screw passes should be made large enough to allow it to enter loosely, so that it does not screw in the wood at all. Notice that in each of these the screws are well clear of the metal part of the machine upon which the terminal board is fixed.

Terminals are frequently fixed to the frame of the machine; this makes a firm attachment, and,

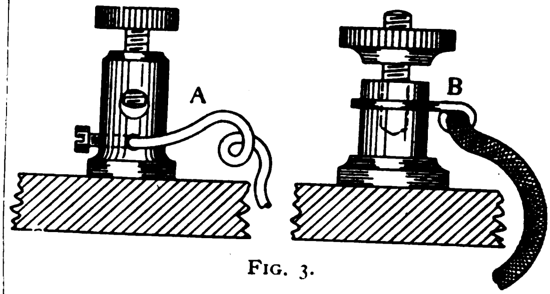


FIG. 3.

when convenient, this method is to be recommended. It is very important, however, to pay attention to the insulation, which should be arranged in the same manner as that adopted for the brush supporting pins (see THE MODEL ENGINEER for April 13th, 1905, page 342). The best pattern of terminal to adopt for very small machines and for those to be used for experimental work is that shown in Fig. 2, as very small wires are more readily clamped than with the pattern shown in Fig. 1. The terminals should be large rather than small, especially as regards the milled head or nut. The connecting wires from the brushes and field coils should be fixed to the terminals in some mechanical way. It is bad practice to merely squeeze the end of the wire between the body of the terminal and the wood. Two methods are shown in Fig. 3. The matter is often complicated by the necessity of connecting more than one wire to each terminal, as well as the wires from the

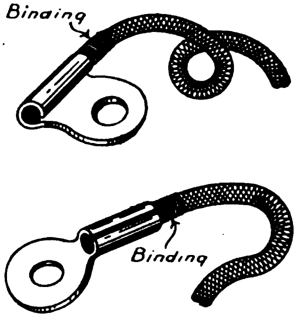


FIG. 4.

outer circuit. A combination of methods A and B can be used to get over this difficulty, or one wire can be connected to the shank of the terminal underneath the board by clamping it under the nut which holds the terminal in place.

Fig. 4 shows two forms of connection piece made out of sheet brass, and soldered to the connecting wires. These attachments are very convenient, especially when the connecting wire is flexible and composed of a number of strands of very fine wire. Such flexible stranded cables are to be obtained of various diameters, with double cotton covering only, or with an additional braided covering. They are very good as connections from brushes to terminals. The following are some of the sizes, with approximate current-carrying capacity :—⅛ in. diameter, 10 amps. ; 3-16ths in. diameter, 20 amps.; ¼-in., 30 amps. The strands should be bared for a sufficient length at the ends to fill the tubular portion of the connection pieces into which they are to be soldered ; the covering can then be bound round with thin twine to prevent stripping. A coat of shellac varnish over the binding makes a good finish. A simple flexible connection can be made by coiling up some ordinary cotton-covered wire like a close coil spring upon a rod (see Fig. 5) ; bare the ends, and make them into loops which can be clamped under the terminal nuts. A coat of shellac varnish over the cotton covering will give

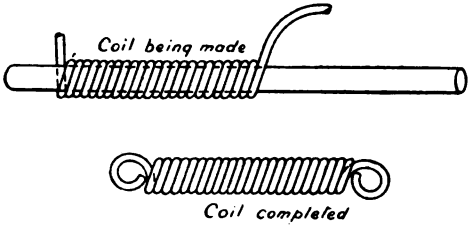


FIG. 5.

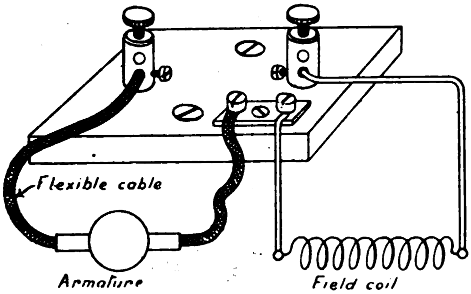


FIG. 6.

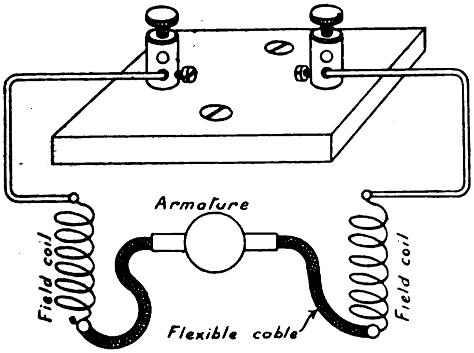


FIG. 7.

a finished appearance. When the current to be conveyed from the brushes is greater than a single cable will carry, two or more cables in parallel may be used. The terminals should also be proportioned to suit the amount of current ; the larger the current, the more important it is that there should be very good contact between the connecting cables and the terminals to which they are attached.

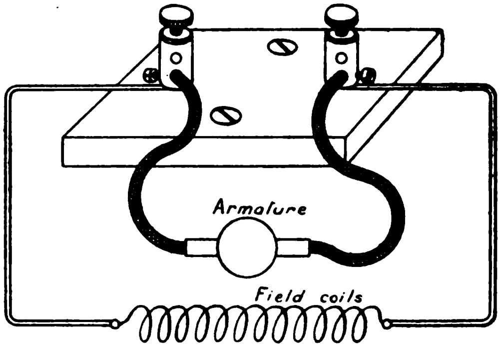


FIG. 8.

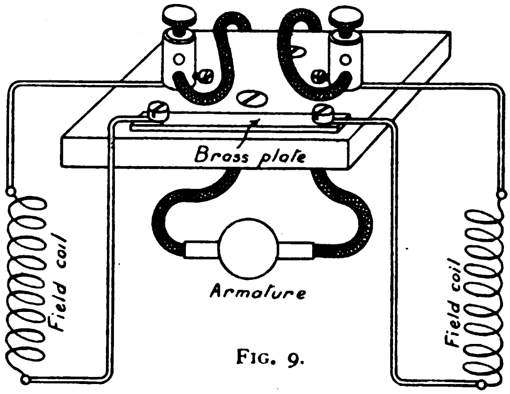


FIG. 9.

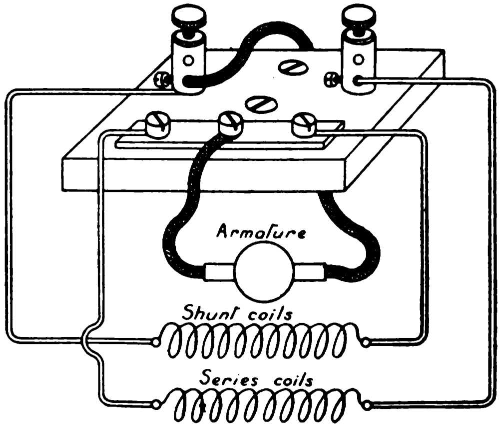


FIG. 10.

Figs. 6 to 12 show various arrangements of terminal boards for different windings. Fig. 6 is for a series wound dynamo or motor, the armature and field leads being connected together by a small brass plate, to which they are attached by means of screws. Fig. 7 is possible when the field coils are in two or more sections. The brushes are connected to the coils through flexible cables, which are practically ends of the windings. Fig. 8 is suitable for shunt-wound machines, and Fig. 9 is an alternative arrangement; the connection between

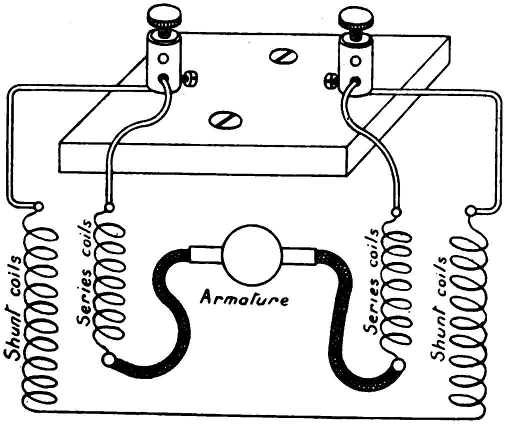


FIG. 11.

the two field coils is made by the brass plate. Such a method enables the coils to be quickly disconnected for purposes of testing or removal. Figs. 10 and 11 are terminal boards arranged for compound

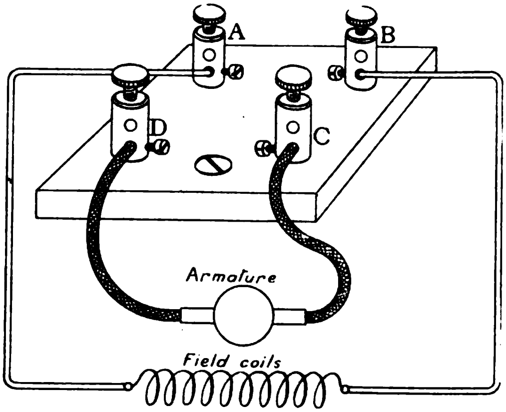


FIG. 12.

winding; the actual arrangements may be taken as of equal value electrically. It is a matter of convenience as to which is adopted. Fig. 12 is an arrangement for motors which are to be connected to

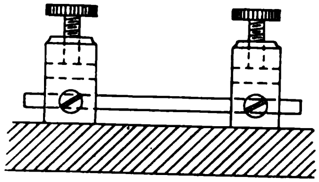


FIG. 13.

a reversing switch, or for dynamos which are to be separately excited. If the terminals are each provided with an extra hole and set-screw, the machine may be readily connected as a series machine by joining terminals A and D or B and C; or as a shunt machine, by joining terminals A to D and B to C, the connection being made by means of copper or brass rods (as in Fig. 13). These illustrations are in the nature of diagrams; proper connection is to be made to the terminals as previously explained.

(*To be continued*)

Model Engineers and Their Work.

III.—Mr. J. Chadwick Taylor.

By HENRY GREENLY.

ALTHOUGH various interesting articles describing examples of Mr. J. C. Taylor's handiwork have from time to time appeared in these pages, no really connected account of his workshop methods has been submitted to the readers of THE MODEL ENGINEER. Considering, therefore, Mr. Taylor's recent successes, the writer ventures to

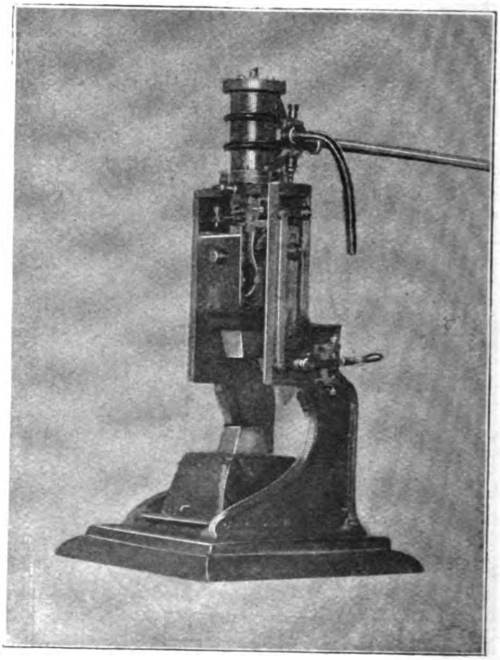


FIG. 1.—MR. J. C. TAYLOR'S MODEL STEAM HAMMER.

think that the following notes gleaned during a visit to Mr. Taylor's workshop may be appreciated by other devotees of the hobby.

The use of the word "methods" in the foregoing paragraph is distinctly intentional. Mr. Taylor is an amateur who *has* a method in all his model-making efforts, and, as the writer has so often noticed, he appears to get through his work with less trouble and fewer mistakes than the perhaps more enthusiastic but hasty brother in the art. Descriptive of this, one thing which greatly interested the writer during the pleasant evening spent with Mr. Taylor was the perusal of his record book. In this volume are written various notes on the purchase of materials, the commencement and progress, testing and completion of the models he has made during the last twenty-five years. For instance, it is recorded of the well-made steam hammer, shown in the accompanying photograph, that it was commenced on October 31st, 1883, and completed in January, 1884, and that the castings were purchased from a well-known firm of model engineers who flourished twenty to thirty years ago. Other and similar notes appear about the mo-e recent models, all of which, if they serve no absolutely utilitarian purpose, are none the less interesting.

At the bench Mr. Taylor is just as thoughtful. If a special tool is required to obtain the best results, it is made and the job in hand not attempted with either insufficient or makeshift appliances. However, in no case does he allow the tool to cost much. This fact is exemplified in the many special tools and jigs the writer saw during his visit.

When it is necessary to split the bearings of a model, an ordinary hacksaw is not used; a much better result being obtained by the appliance shown in Fig. 2. The base for this is an electric fitting wood block, such as can be bought from an electrical dealer very cheaply in dozens, and which will be found useful for many other purposes. The top is fitted with a brass plate, and supports four steel pillars, which are placed in pairs at each end and spaced so that a fine jeweller's hacksaw will just pass between them, in the manner indicated in the sketch. The cover-plate, which is drilled for the pillars at the same time as the plate fixed to the wooden base, keeps the pillars in place. With this simple home-made appliance, and a very thin saw, it is possible to part, say, a connecting-rod "big end" bearing after all other work is done to it, the joint being truly square and so fine that the journal needs hardly any rimering to make it perfectly circular, when it is finally fitted in place. Indeed, if a liner formed by a thin piece of paper is fitted in the joint, the bearing will not require to be touched, and should any wear subsequently take place, the paper may be removed and the bearing restored to its original working fit.

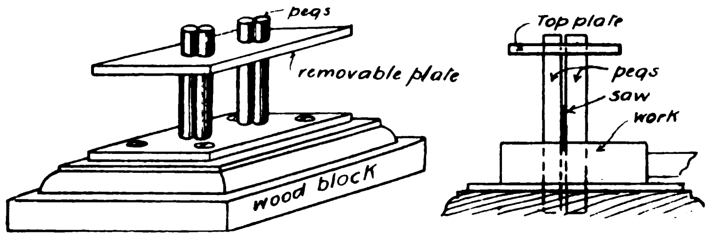


FIG. 2.—A JIG FOR PARTING MODEL BEARING BRASSES.

To bore the bearings of the launch engine which was described in the issue of THE MODEL ENGINEER for October 15th, 1902, and for which Mr. Taylor has been awarded several prizes—notably, a S.M.E. silver medal in 1902—a wooden box, see Fig. 3, which could slide on the bed of lathe, was made, and upon this box the bed of the launch engine was firmly screwed. Previously the caps of the three bearings were fitted and bolted in place, and when the drill had been fixed in the chuck and the bed of the engine adjusted so that the centres of the bearings exactly coincided with the point of the drill and the bearings were truly in line with the mandrel of the lathe, the whole of the three holes were drilled at once, the feed being supplied by the poppet of the loose headstock.

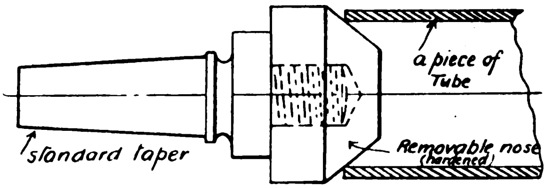


FIG. 4.—CENTRE FOR TURNING TUBES.

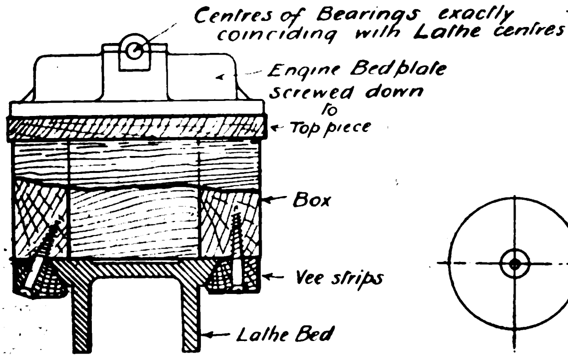


FIG. 3.—HOW MR. TAYLOR BORED THE BEARINGS FOR HIS TWIN-CYLINDER LAUNCH ENGINE.

Mr. Taylor uses a 4½-in. centre Barnes lathe, and since he acquired it has fitted many useful appliances, several of which are depicted in the accompanying sketches. Fig. 4 is a fixed centre for turning tubes and other similar objects, the nose of which is removable and made in several sizes. When making the taper shank, a good fit was obtained by the method of trial and error, turning first pieces of hardwood until the correct taper was found. These pieces of wood were carefully preserved and have done service in many ways since. This useful "tip" has been acted upon by the writer, and he finds that such pieces of wood are extremely handy for drilling awkward castings

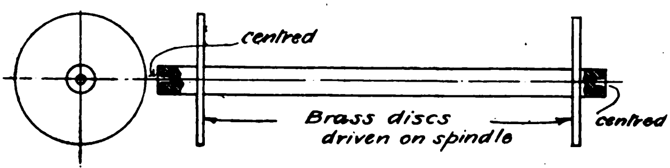


FIG. 5.—LATHE TESTING ARRANGEMENT.

in the lathe, as the ends can be readily shaped to fit the work in hand. These pieces of hardwood are made from the cheap round blind stretchers sold at ironmongers, and can be obtained in several diameters.

The appliance shown in Fig. 5 is employed to test the lathe before attempting to do any parallel turning, and consists of a mandrel which is centred in the ordinary way and has two discs of brass driven on at each end. To use, the mandrel is placed in the lathe and driven by a carrier; a cut is taken off each disc without altering the feed of the cross-slide between the two cuts. If there is any difference in the diameter of the two discs it immediately shows that the line between the two centres is not

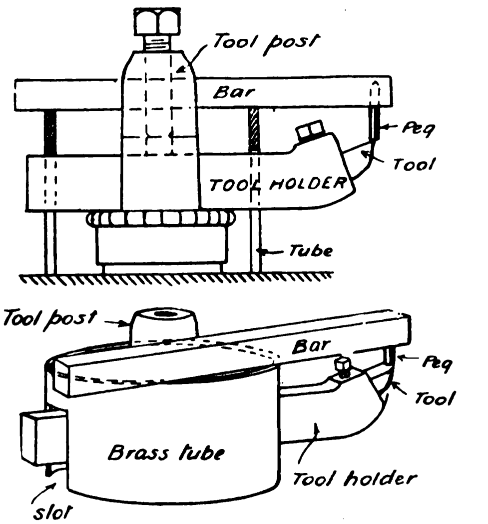


FIG. 6.—TESTING FOR THE HEIGHT OF THE TOOL.

parallel to the bed of the lathe, and that the movable portion of the tailstock or headstock (according to the design of the lathe) needs adjusting.

The sketch (Fig. 6) depicts an ingenious testing appliance by which the proper height of the tool

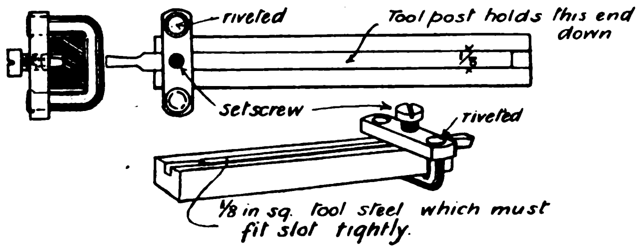


FIG. 7.—LIGHT TOOL-HOLDER FOR THE LATHE.

may be readily and exactly determined without the trouble of running the slide-rest up to one of the centres. The design shown as it stands is not applicable to most English lathe-tool rests, but in a modified form might be adopted in many instances. The sketch (Fig. 6) is self-explanatory.

Model engineers well know the usefulness of light tools under certain circumstances, and as a rule some form of tool-holder is necessary to support the small section of steel usually employed. Mr. Taylor uses the home-made holder shown in Fig. 7, and purchases $\frac{1}{8}$-in. square tool steel for the cutters. Here, again, the sketch explains itself, and requires

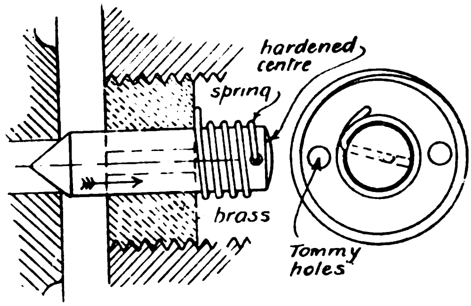


FIG. 8.—A SELF-CENTREING APPLIANCE FOR THE FACEPLATE.

no further description. The only point worth emphasising is the fact that the tool steel should fit the slot as tightly as possible.

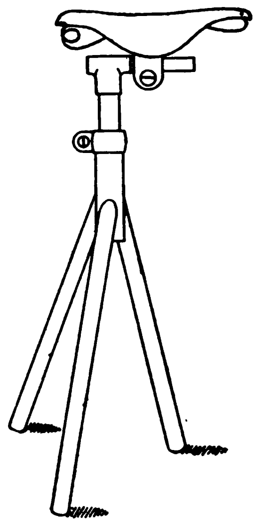


FIG. 9A.—SEAT FOR USE AT THE LATHE.

Another lathe appliance is the self-centreing appliance for the faceplate shown in Fig. 8. With this jig it is possible to place, say, a flywheel on the faceplate exactly true with the hole that may be bored in the centre for the shaft, so that the face and edges may be turned without further adjustment. The appliance consists of a short brass plug which is screwed the same thread as the nose of the mandrel and faceplate. This plug has a steel centre which normally projects some distance out, as shown in the sketch, the spring tending to keep it in this position. To use, the plug is screwed on to the faceplate centre until it is flush (or just a little below the face), and the flywheel or other piece of work to be turned is taken and placed with its centre hole on the steel centre and pressed up against the faceplate. When this is done, the clips holding the work may be put in position and tightened up, and the work will be found to be truly centred on the faceplate. After this, the faceplate may be removed from the nose of the mandrel (if it was there originally), and the plug removed from the back by means of the tommy holes and a suitable two-pin spanner. A similar and just as useful device is shown in Fig. 9.

As Mr. Taylor has to stand all day at his business, he finds it more comfortable to sit at the lathe in the evening, and to enable him to do this, he devised the very simple and convenient seat shown in Fig. 9A. The tubes were brazed up for him at the local cycle maker's. The saddle is an ordinary one, and the height from the ground is adjustable in the usual way by a lug and bolt at the top of the seat-post.

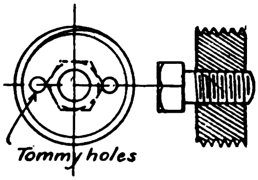


FIG. 9.—A JIG FOR THE FACEPLATE.

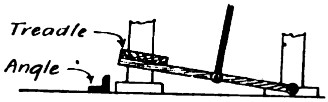


FIG. 10.

To prevent the annoying and somewhat painful experience of getting the foot pinched under the treadle of a lathe—an occurrence which the writer who possesses a lathe with a fixed connecting-rod well remembers—Mr. Taylor has fitted to the floor, just in front of the treadle, a strip of angle iron (see sketch, Fig. 10). Although this would appear to aggravate the state of affairs, it really forms a boundary, and the worker involuntarily keeps his foot from straying over the mark directly he feels it touch the strip of angle.

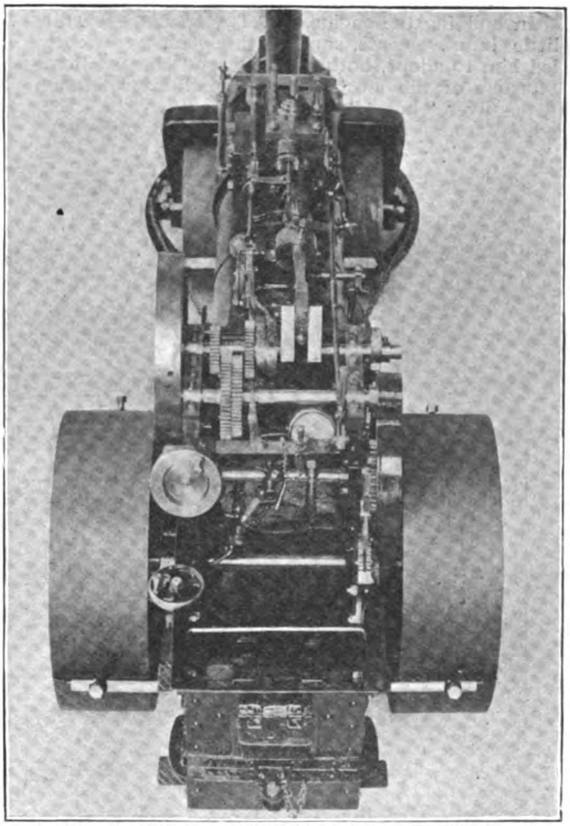


FIG. 12.—TOP VIEW OF MODEL ROAD ROLLER.

One of the most notable events of the evening, was the running of Mr. Taylor's latest completed model, the steam road roller shown in the accompanying photographs.

A similar model, made by Mr. Caparn, was illustrated in THE MODEL ENGINEER some three years ago, and for the most part Mr. Taylor's model is made from castings off the same patterns. The work on this model is excellent, and before the writer visited Mr. Taylor's workshop the engine had not been tried with a view of seeing what could be got out of it in the way of hauling capacity. Steam was therefore raised, and the engine without any difficulty pulled the writer, who was mounted on a pair of roller skates, up and down the linoleum floor of the workshop.

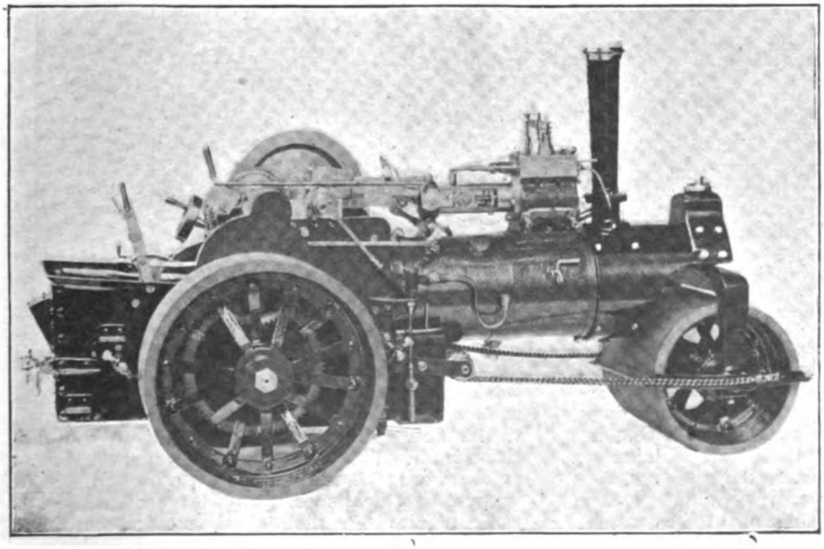


FIG. 11.—MR. J. C. TAYLOR'S MODEL STEAM ROAD ROLLER.

In building the engine, Mr. Taylor made several little improvements, such as his long experience led him to adopt, both in design and construction, but one of the most interesting additions is the little silver "horse" with its label "Invicta," the whole forming the well-known trade-mark of Messrs.

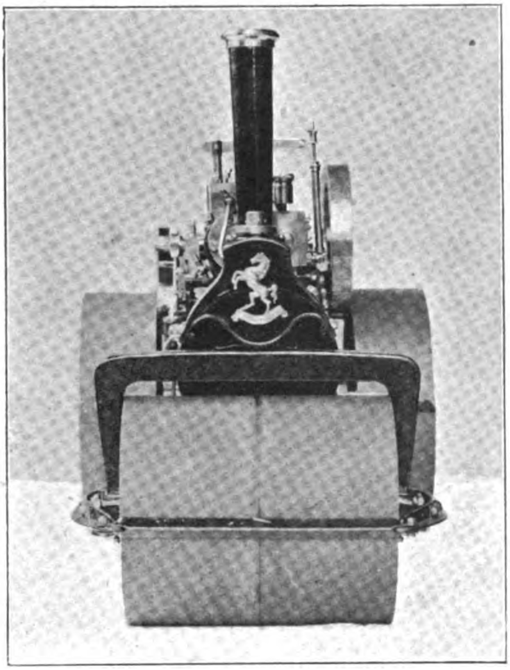


FIG. 13.—THE FRONT VIEW OF THE MODEL ROAD ROLLER.
(Compare with Fig. 14).

Aveling & Porter, Ltd., the large manufacturers of road rollers, of Rochester. This adds a realistic finishing touch to the engine, so much so, that except for the effect of proportion given in the picture of the actual road roller by the surroundings, it would be difficult at a glance to say which was the model and which was the real engine.

In conclusion, it gives the writer much pleasure in expressing his indebtedness to Mr. Taylor for his kind hospitality, and for the information so freely given during the quickly passing hours spent in his most interesting and well-appointed workshop.

CANADIAN TUNNELS.—Preparations are being made for a tunnel underneath the Detroit, near Detroit, the difficulties of ferryage through the winter ice, between Ontario and Michigan, being found more and more troublesome. The Michigan Central Railroad Company contemplates building a tunnel under the Niagara, from Canada to New York State, at a point between Buffalo and Tonawanda. Construction work is expected to be carried on jointly with that of the tunnel at Detroit and by the same company.—*Engineering*.

Electricians in the Navy.

IN view of the large number of enquiries from our readers as to the prospects of electricians in the Royal Navy, we think that the following, which we reprint from our esteemed contemporary, *The Electrical Review*, will be of interest.

The idea of becoming a naval electrician probably appeals to a good many lads who have some knowledge of electricity, and fancy the prospect of going out into the world on board a man-of-war; to not a few of these the uniform is, perhaps, an attraction, with its peaked cap and brass buttons savouring of the full-blown naval officer.

Far be it from us in any way to discourage a feeling of pride in the uniform of either of the services, for it is surely a pardonable form of vanity that brings out such qualities as are needful "for the sake of the cloth."

However, it is but fair to point out to those who may only have seen the shore-going side of life, that there is a good deal beyond the peaked cap and the high-sounding title of electrician, which does not appear on the surface.

To begin with, the title electrician is, perhaps, a little misleading, for it would seem to imply that the holder of it is responsible for, and generally in charge of, the electrical plant on board ship. One might be

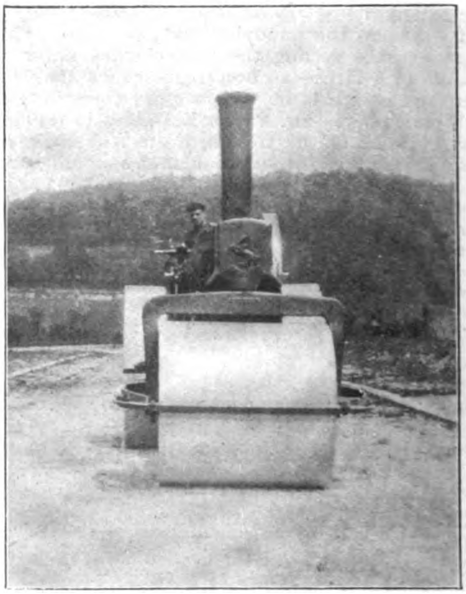


FIG. 14.—AN "AVELING & PORTER" ROAD ROLLER.

led to infer that his opinion on electrical matters would have considerable weight, and that he was, in fact, more or less of a "boss" in his own particular line. Now, as a matter of fact, the electician is not an officer at all in the Naval acceptance of the word; he is a mechanic, pure and simple, supposed to have special knowledge of the sort of work required in the adjustment and repair of electrical instruments. The electrical engineer of the ship is the torpedo officer, whether he be a warrant officer or a lieutenant appointed for these duties; his right-hand man is the torpedo instructor, a man who has entered in the ordinary line and has taken up the torpedo branch in preference to gunnery. The electrician occupies rather the post of instrument maker, though his actual duties in a great measure depend on his special aptitude for certain kinds of work as observed by the torpedo officer. As an example, let us take a battleship or large cruiser, and see in what manner the work is generally divided up, and what duties in particular will be likely to come under the care of the electrician. To do this we must endeavour to place ourselves in the position of the torpedo officer, and see what arrangements are best suited for the disposal of the staff under him. As regards the work that it is his special duty to supervise, it may be divided first of all into two great items: the illumination of the ship and the efficiency of the Whitehead torpedo armament. His staff will probably consist of two electricians, two torpedo instructors, a few permanent ratings in the torpedo branch—some half-dozen or so, and any men that the commander may be able to spare for special work that is in hand, and requires what one might call unskilled labour, such as the cleaning of torpedo tubes and such minor odd jobs. The half-dozen or so permanent "hands" would be called the electric light party and the bulk of them would be employed

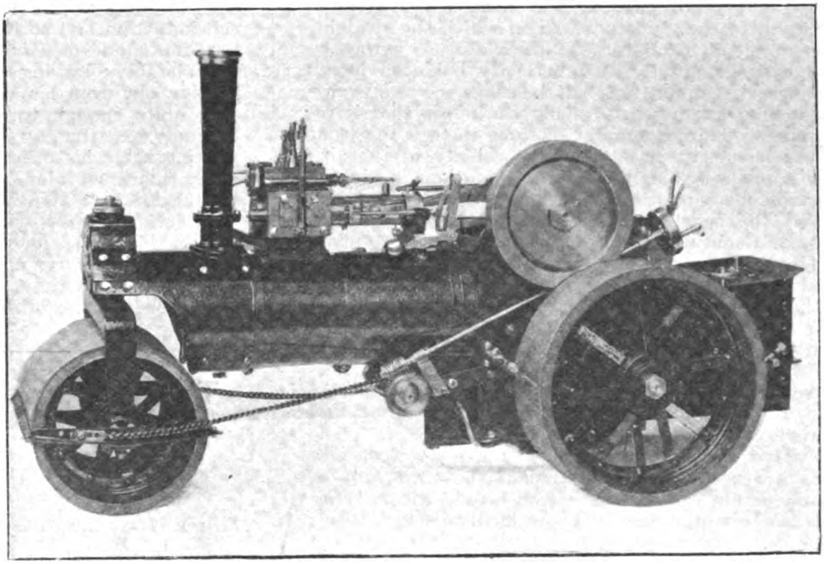


Fig. 15.—Left-hand Side of Model Road Roller.

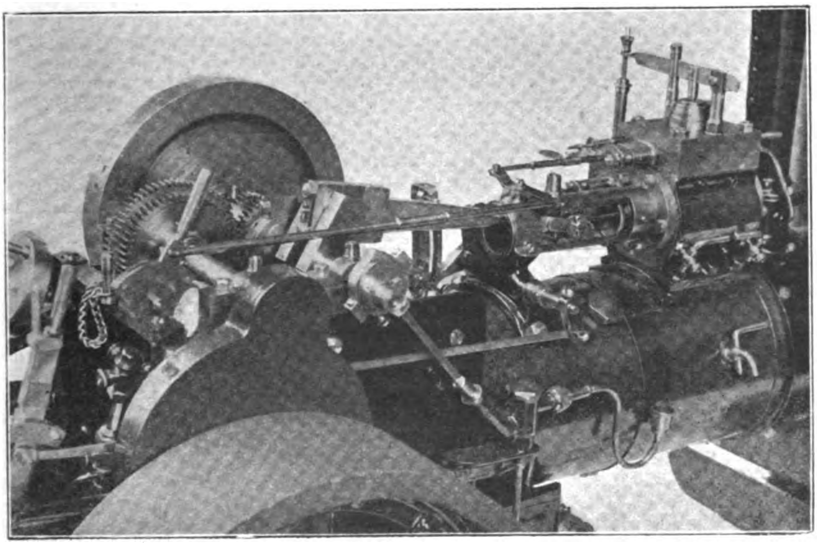


Fig. 16.—Enlarged View of Machinery Portion of Road Roller.

going round chasing earth leaks, repairing circuits, and renewing lamps wherever necessary. A responsible man must be in the neighbourhood of the switchboard, another reliable man should be in charge of the electric light party, a third is required to look after the bells, batteries and telephones. Now all these men have their own little calls upon the electrician's workshop, they go round and gather up the fragments of misapplied ingenuity which follow in the wake of untutored ambition.

There are switches which have suffered from some burly autocrat who did not realise that the current was broken at the sectional box, galvanometers which have had their faces slapped and turned sulky, other instruments which have displayed a marked antipathy to sea-water, and a host of minor fittings with which sea air does not agree. All these things claim the attention of the electrician, and test his skill as an artificer in brass, but they do not, as a rule, require any great technical knowledge. The electrician whose duty it may be to attend to these items has his hands full, and it is always easier to write up the defect book than to write the items off. But, besides electric work, the torpedoes claim a large amount of the torpedo officer's attention; men must be detailed to look after these, and a specially skilled and neat workman must attend to the gyroscopes, upon which the straight-running of each torpedo depends. A gyroscope consists essentially of a perfectly balanced heavy flywheel, running on ball bearings. Now, everyone who has possessed a bicycle knows that it requires a definite amount of force to turn the front wheel when it is set spinning rapidly in the air; it is precisely this force that is made use of in the gyroscope when the little fly-wheel is set revolving, and the resistance to any turning movement is made to act upon valves which control the rudders. This little instrument, which forms an integral part of each torpedo, is exceedingly sensitive, and at the same time it is of the utmost importance that it should be accurate. Who better than the electrician, with his skill in handling delicate instruments, for the job? So it comes about that electrician No. 2 becomes a specialist in the art of gyroscope adjusting to the exclusion of almost any kind of electrical work whatever.

Now, to the man who has taken up electricity as a study, who has studied the theory of it, and perhaps prides himself on his electrical certificates, this may possibly be decidedly disappointing; he had, perhaps, visions of wireless telegraphy, and the large field of investigation that this branch of the subject throws open to the inquiring mind; he had pictured himself in charge of a ship's installation with all its ramifications, the ball systems, telephones, telegraphy, lighting, battery work, dynamo and motor work and all varieties of testing; his certificates are a guarantee of his right to an opinion, and his title would seem to invite it; but he finds himself instead tied down to his lathe, making endless terminals and ebonite bases, carrying out routine orders, and consulted in nothing; there is another in the place that he thought to occupy, and he is not even this person's deputy, for there are torpedo instructors whose official certificates entitle them to a higher place. It may not always be so—in fact it is probable that there will be great changes in the near future—but for the present we would point out the advantages of working up through the regular line where it is a case of ambition, for the torpedo instructor becomes eventually a torpedo officer, and in due course may even get a commission.

The naval electrician is, however, not at all badly placed when once he realises his true position; as an instrument maker no one can touch him; he is master of his craft, and as such will earn the confidence of his officer. Once this is established it is not likely to be forgotten, and he will be looked upon as a man of no small importance.

Electricity is more or less of an innovation in the Navy, and it is daily growing in importance. The electricians, as a body, must remember that the engineers started in much the same way, only with more prejudice against them; within the last few years recognition of their merits has come to them in rapid strides, and there would seem some likelihood of considerable change being effected in the electrical branch. Torpedoes and the electrical plant have little in common; the link was first welded in the adoption of electrically-fired mines, when the torpedo officer was the only individual who was supposed to be sufficiently well acquainted with the fact that electricity can only travel along a metallic circuit, and is held there by the surrounding insulation, through which it cannot pass. In these days of high-frequency currents, specific inductive capacity, self-induction and so forth, he has to know a good deal more, and modify the views of his predecessor considerably; leaving out his executive work, leaving out even his Whitehead torpedoes, he has still quite enough to worry him as an electrical engineer, and the day is probably not far off when, putting aside his other duties, he will assume the latter sobriquet alone. This will be the day for the electrician; and, after all, for those who like the work, the pay, which starts at 5s. a day, is remarkably good for the Navy; the standing is that of a chief petty officer or an artificer; and one may assume, with a fair amount of confidence, that there will be prospects of advancement.

Traction Notes on Road and Rail.

By Chas. S. Lake.

Milnes-Daimler Chassis for Motor Omnibuses.

The drawings (Figs. 1 and 2) show in sectional elevation and plan the design and construction of the 3-ton chassis built by the Milnes-Daimler Co. for motor omnibuses, such as those referred to as run on the Torquay-Paignton service of the G.W. Railway. The same design is fitted to numbers of motor buses on the London streets. The numbered references clearly show the function of each part of the construction. The writer is indebted to the Editor of the *Engineering Review* for permission to reproduce the illustrations appearing herewith.

Motor Omnibuses in London.

Hardly a week passes but that we read of new lines of motor omnibuses being inaugurated in London, or that on such and such a route the horse-drawn vehicles are to be replaced by the more up-to-date motor-driven conveyances.

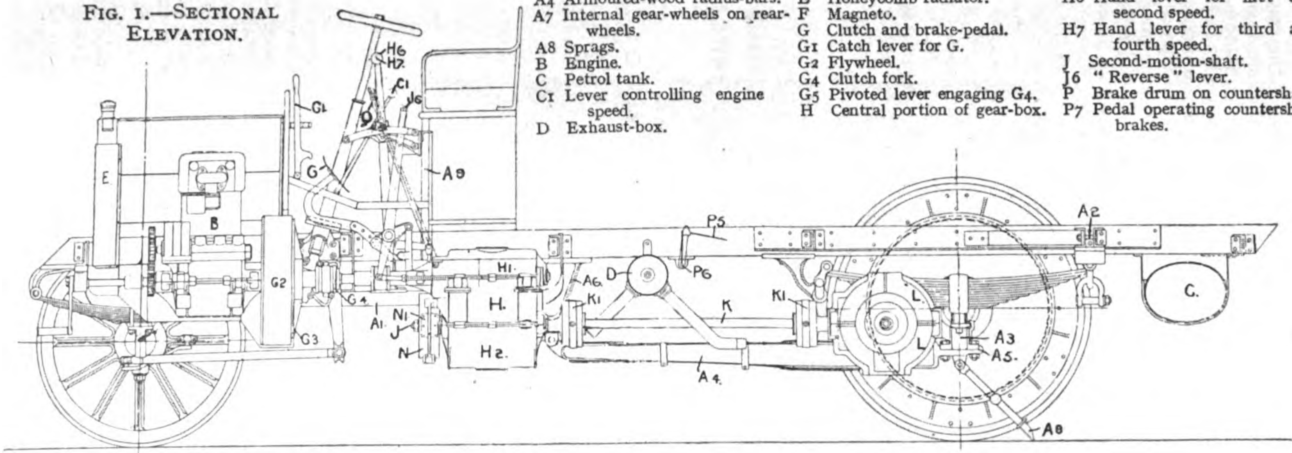
The announcement has recently been made that a large development of the motor omnibus services in the Metropolis may shortly be expected, and the spectacle of drivers and conductors clad in the smartest of smart uniforms is promised in connection with the latest scheme.

The epithet "antiquated," so long applied to the horse-drawn omnibus, has now in truth a wider application than ever it had before, and it is to be hoped that within the shortest possible space of time the companies will abandon their use of such vehicles entirely, with their slow and awkward movements, and substitute the quicker and infinitely more handy motor bus. As much on account of the horses themselves as in the interest of the public, is this to be desired.

"All's Well that Ends Well."

Motor Traction tells, in a recent issue, of an incident which occurred one evening quite lately on one of the "Orion" motor omnibuses plying

FIG. 1.—SECTIONAL ELEVATION.



A4 Armoured-wood radius-bars.
A7 Internal gear-wheels on rear-wheels.
A8 Sprags.
B Engine.
C Petrol tank.
C1 Lever controlling engine speed.
D Exhaust-box.
E Honeycomb radiator.
F Magneto.
G Clutch and brake-pedal.
G1 Catch lever for G.
G2 Flywheel.
G4 Clutch fork.
G5 Pivoted lever engaging G4.
H Central portion of gear-box.
H6 Hand lever for first and second speed.
H7 Hand lever for third and fourth speed.
J Second-motion-shaft.
J6 "Reverse" lever.
P Brake drum on countershaft
P7 Pedal operating countershaft brakes.

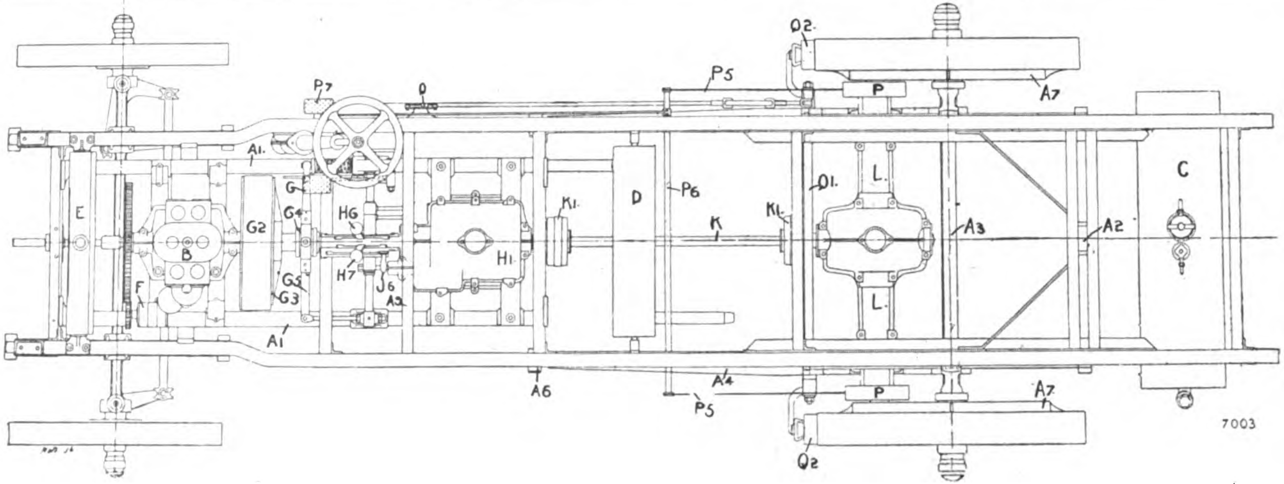


FIG. 2.—GENERAL PLAN.

MILNES-DAIMLER 3-TON CHASSIS FOR MOTOR OMNIBUSES.

between the Law Courts and Cricklewood. Being reminded by the conductor that time was up, the driver, who had been examining the vehicle to see if all was right during its stay outside the Law Courts by the aid of one of the side lamps, hastily finished his look round and drove off to Cricklewood.

On his return to the Courts of Justice someone remarked, "Where is your near side lamp?" "I am bothered if I have not forgetten it," remarked the budding mechanic in his own language (a week or so previously he was still handling his pair of bays). On looking beneath the body of the omnibus he discovered the lamp on the tray beneath the body blackened and sooted, it is true, but safe and sound and still burning. It is doubtful what might have happened had there been any petrol leaking, but it may be assumed that there would have been another testimonial sent to the makers of the fire extinguisher next morning.

FIG. 3.—ONE OF THE G.W.R. MOTOR OMNIBUSES.

THE GREAT WESTERN RAILWAY AND MOTOR SERVICES.

The Great Western Railway is, as most readers are doubtless aware, much to the fore in connection with motor traction, both on road and rail, and the services are not by any means confined to any one district or locality served by the railway. The Company has rail motor cars running on no less than twenty-one sections of the line, both in connection with main and branch line traffic. They are equally forward in respect of road motor services, and they have a number of handsome vehicles similar to that shown in Fig. 3, running between Torquay and Paignton, which may be selected as typical of the class of vehicle and condition of service met with in other districts served by the G.W.R. The omnibus is of the double-deck type, with accommodation for thirty-six passengers. The wheels have solid tyres, double on the driving wheels, and the engine has four cylinders developing 20 h.-p. at 800 revolutions per minute. The cylinders are 105 mm. by 130 mm., which, being converted into English measurement, would represent about 4⅛-in. by 5⅛-in. stroke. The engine governing is effected by throttling, the mixture and the valves are positively actuated. The change speed gears give four speeds forward and one reverse; the flexibility of the motor gives some range between, and it is claimed that any speed from one to twelve miles per hour can thus be obtained—a useful range of speeds for the purpose of road traction. Three brakes are provided acting respectively upon the first intermediate gear shaft, brake blocks on back road wheels and on each differential cross shaft.

The wheelbase is 12 ft. 7 ins. This is an extended length of base, but the fact undoubtedly conduces to steadiness in running and ease of manœuvring.

THE RAILWAY AND MOTOR TRACTION.

Two incidents, if such they may be termed, connecting the railway with the motor trade and motor car service, have recently been widely noticed in the Press. In one case the Great Central

Railway ran a special theatre train from Manchester to London at an inclusive charge, admitting passengers to the Savoy Theatre and providing them with dinner on the outward journey and supper on the return. Those who availed themselves of the opportunity to make a flying visit to the Metropolis, witness a theatrical performance, and afterwards commenced their return journey home again, were also afforded a chance of testing the London Motor Omnibus service, for they were conveyed from Marylebone to the Strand and *vice versa* in a series of "Vanguard" omnibuses, and it is said this formed not the least enjoyable part of the trip.

The Caledonian and L. & N.W. Railways recently dealt with a record train load of Argyll motor cars, which are now being handled at No. 17, Newman Street, Oxford Street, W., by Argylls London, Ltd. (of which concern Mr. E. H. Watson is chairman and managing director). A special train was made up consisting of closed carriage wagons containing the motor cars. It left Glasgow hauled by one of the enlarged "Dunalastair" type of express locomotives, and on arrival at Carlisle the L. and N.W. Railway attached one of their 4—6—0 type locomotives of the new "Experiment" class. The train completed the journey between Glasgow and London in the course of the same day.

A Simple Air Pump for Exhausting Vacuum Tubes.

By N. D. Fourdrinier and "Dynamp."

THE following is a decription of an easily and cheaply made air pump of the Sprengel type. It will produce an exhaustion quite high enough for making vacuum tubes, coherers, and for performing many other experiments requiring a good vacuum. Procure a 32-in. length of glass tubing, $\frac{1}{8}$-in. internal diameter, and about $\frac{1}{4}$-in. external, and to one end fit an angle joint of the shape shown in the figure. The joint may be obtained from any manufacturer of chemical apparatus. The connection between the two tubes should be made by india-rubber tubing of such a diameter as to be a tight fit on the glass. The tubes must be pushed up the rubber junction piece till they nearly touch, and then wire wound tightly round the outside. An enlargement of the junction is shown in Fig. 2.

To the top end of the V-tube is fitted another length of rubber tubing with a pinch cock (Fig. 3) in the middle, into which the spout of a fairly large filter funnel is fixed. The funnel should be of glass, and must be firmly supported at a sufficient height to allow the bottom end of the long tube to clear the table or floor by about a foot. It is important to fix the funnel very firmly, as it has to contain over 2 lbs. of mercury, and if it slipped it might mean the loss of a large part of this. The end (N) of the tube is placed in a small medicine bottle which stands in a cardboard box having a hole in one bottom corner. This box is supported on a stand and is tilted so that any liquid flowing into it would escape through the hole into the jar. Fig. 1 shows the pump after a small quantity of mercury has been allowed to fall.

The most expensive item is the mercury, of which, at least, 3 lbs. are required. If the reader is lucky enough to know anyone who buys it direct from a large firm he may be able to get it at the rate of 2s. per lb.; otherwise it may be obtained from a chemist for 3s. per lb. It is not necessary to use the pure redistilled mercury; this costs more and is practically no better.

To work the pump, the tube to be exhausted is connected by a strong gutta-percha junction piece to the arm of the angle joint. The funnel is then

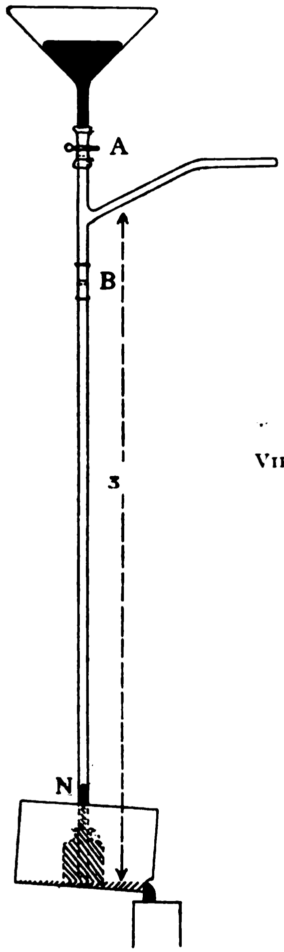


Fig. 1.—General Arrangement.

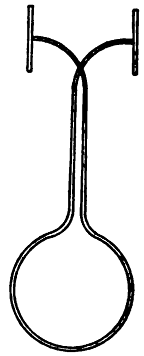


Fig. 3.—Enlarged View of Stopcock A.

Fig. 2.—Enlarged View of Junction B.

Simple Air Pump for Exhausting Vacuum Tubes.

filled with mercury, and the stop-cock opened so as to allow the mercury to flow down the tube. When the funnel is nearly empty, the cock is closed, and the mercury which has collected in the jar is poured back again into the funnel and the same process repeated. It will be noticed that after each fall of mercury the level of that in the tube has risen; this indicates that the pressure of air within the apparatus is decreasing. As the vacuum improves the falling metal produces a sharp click;

this occurs when the column of mercury in the tube is about 29 ins. in height.

When the mercury no longer rises after a funnel-full has been let down, the exhaustion is as complete as it is possible to obtain with this pump. It will be found useful to mark the top of the mercury column by pasting a narrow strip of paper round the outside of the tube, so that when using the pump again one may have a rough guide to the degree of exhaustion. When the barometer is low it will not be possible to obtain as high a column as when the barometer is high. Perhaps the best way of measuring the pressure in the apparatus is to measure the height of the mercury from the bottom of the tube and subtract this from the height of the mercury in a barometer, and this will give the pressure in inches of mercury. For example, if the mercury in the pump stood at 29 ins., and that in the barometer at 30 ins., the pressure in the apparatus would be equal to 1 in. of mercury. It is of the greatest importance not to allow all the mercury to run out of the funnel, as air would then enter the tube and destroy the vacuum. The mercury must be kept perfectly clean and bright, and if it should become dirty it should be squeezed through chamois leather, which will retain most of the scum.

The "Fortis" Vice Competition.

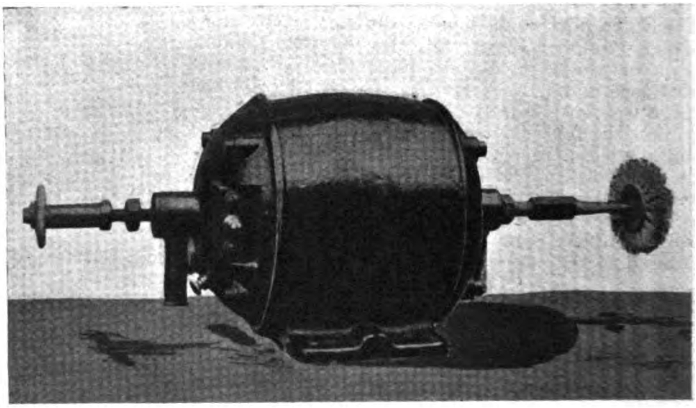
THE "Fortis" Electrical and Engineering Company, of Coventry, have kindly placed at our disposal three of their vices, value 18s. 6d. 10s., and 5s. 6d., respectively, to be awarded as prizes in a competition. We accordingly have pleasure in offering these useful prizes for the best three articles sent on "An Amateur's Vice Bench." What is required is a working drawing of a bench suitable for amateur use, with a short accompanying article describing its costruction and fittings (tools not included). The prizes will be awarded to the designs which in the opinion of the Editor of THE MODEL ENGINEER are best suited to the requirements of the average reader of this journal. All entries should be sent to the Editor of the *M.E.*, and should be marked "Fortis Vice Competition." The latest date for sending in will be Dec. 1st, 1905.

A BOILER EXPLOSION.—A boiler in use in New South Wales stood a hydraulic test without showing any defect, and within three days collapsed along the top of the flue. Fortunately it came down over the crown of the firebox, and at the other end almost simultaneously. The two concussions counteracted one another, and the boiler was not moved six feet. The torn plates were found to be their full thickness (½ in.), no corrosion was visible, but the iron was laminated like the leaves of a book, and was visibly perished when seen across the torn section. This boiler was twenty years old, and its explosion proves the uselessness of a hydraulic test by itself, and the danger of running an old boiler for ever. The hammer would have shown the rotten state of the plates.

A Small Grinding and Polishing Motor.

By J. D.

A SMALL electro-motor totally enclosed, with its shaft extended at each end, and suitably arranged for taking various sizes of emery wheels, scratch brushes, polishing bobs, etc., cannot but prove useful in almost every model-maker's workshop. With that end in view, I decided to construct the small ⅛ h.-p. motor shown in the



A SMALL GRINDING AND POLISHING ELECTRO-MOTOR.

photograph herewith reproduced. The motor is built upon somewhat modern lines; the magnet is of cast iron, and circular in shape, being 7 ins. diameter outside by 5 ins. inside by 5 ins. wide, and is of the two-pole type, with radial inner poles, the bore being 2 51-64ths ins. The length of the cores—which are cast in one piece with the magnet—is 2¾ ins. The ends of the magnet are faced up to a jig to receive the end bearings, which are made male and female, to the same jig, thus ensuring the bearings being perfectly concentric with the bore of the field-magnets. The holes for the setscrews for fixing the bearings are also bored to a template; this ensures the interchangeability of parts. The foot of the motor is cast with the magnet. The end bearings are made of cast iron, and bushed with brass; these also act as covers for enclosing the motor. The armature is of the perforated type, and is built up of charcoal iron discs, 2¾ ins. diameter, perforated with sixteen holes, 21-64ths in. diameter, to a length of 2¾ ins.; into these holes are wound sixteen coils of No. 24 S.W.G. double silk-covered copper wire, which are connected up to a sixteen-part commutator in the usual way.

The commutator is built up of cast copper bars, which are made slightly thicker than are finally required, and then hammered down to nearly the proper size, so that they may be finished off with the file, or on the emery wheel. This method I find very good for small commutators. They were then assembled together, turned and mounted on a gunmetal sleeve, insulated with mica throughout, 1-32nd in. thick between the segments, and 3-64ths in. between the segments and the sleeve.

No binding wires are necessary with perforated armatures, hence the small amount of clearance in this motor. The magnet coils are wound upon a wooden former, and over-wound with cotton tape, afterwards shaped to fit the magnet cores, and then given another layer of tape, and thoroughly impregnated with shellac varnish until they are waterproof. The coils consist of about 600 turns of No. 21 S.W.G. double cotton-covered copper wire, and are connected up in series with the armature.

The brushes are of carbon, and are fixed into brass boxes, which are fitted to, but insulated from, the commutator end bearing, and are pressed up to the commutator by means of small spiral springs. Outside these boxes are the terminals of the armature, as will be readily seen in the photograph. The terminals of the field coils are just below. The lubricators are of brass, and screwed into the under side of the bearing, lubrication being effected by a piece of felt dipping into the oil well, and pressed up to the revolving shaft by a small spiral spring. The ends of the armature shaft are turned taper, so as to enable chucks to be fitted for various classes of work. The chucks shown are for a polishing bob and emery wheel respectively.

The motor described above is suitable for working on a 100- to 110-volt circuit. The rating is ⅛ h.-p., 100 volts ·25 amp., 3,000 revolutions per minute. It may be bolted to the bench, or on the wall or ceiling. I find this motor very useful; for light work, such as tool grinding, finishing light brasswork, etc., it answers its purpose admirably.

The Society of Model Engineers.

[*Reports of meetings should be sent to the offices of* THE MODEL ENGINEER *without delay, and will be inserted in any particular issue if received a clear nine days before its usual date of publication.*]

London.

THE Annual General Meeting of the Sooiety will be held on Thursday, November 16th, at the Holborn Town Hall, Gray's Inn Road, at 7 p.m. Any members wishing to move an alteration of any of the rules of the Society, or to make any suggestion as to the working of the Society, are requested to notify the Secretary thereof not less than seven days before such meeting, so that the subject may be properly discussed.

Secretaries of provincial societies affiliated to the London Society are requested to send copies of accounts and reports, with list of members, on or before October 31st, for inclusion in the Annual Report, to be laid before the members at the Annual General Meeting.—HERBERT G. RIDDLE, Hon. Sec., 37, Minard Road, Hither Green, S.E.

TESTING CABLE BY *x*-RAYS.—Novel use of Roentgen Rays is made by a Berlin company manufacturing submarine cables. The cables are tested by being passed over two eye-pulleys over an *x*-ray tube, the screen above showing any defect more directly and with greater certainty than the resistance tests usually employed.

Practical Letters from our Readers.

[*The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a* nom-de-plume *if desired, but the full name and address of the sender* MUST *invariably be attached, though not necessarily intended for publication.*]

Carbon Terminals.

To the Editor of THE MODEL ENGINEER.

SIR,—Allow me to reply to Mr. Alfred Gain, who criticises my carbon terminals in THE MODEL ENGINEER of Oct. 12th. The terminal he shows is a decidedly inferior method, as it will only clamp on a certain thickness of carbon. To fix on any other size, washers, few or many, must be used, whereas my terminal can be securely fixed on any thickness of carbon, from 1-16th in. to ⅜ in. *without alteration*.

Further, he says: "It would save time, labour, and expense to buy them ready-made."

The "time," at the most, with the terminals I used was only two minutes to take out the wood screw and insert the other, as no fitting was required.

The "labour"—well, I survived it, even though I do not use—cocoa!

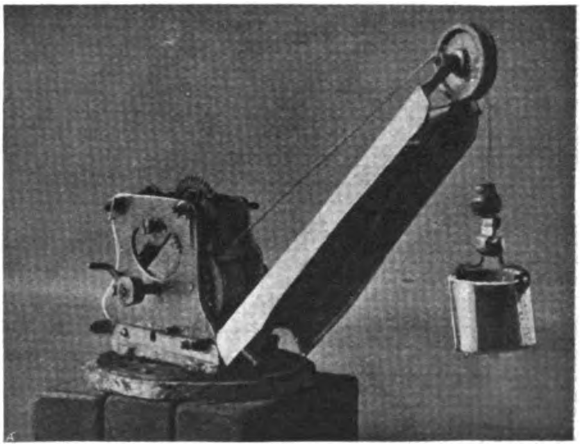
The "cost"—I paid 1½d. each for the terminals, and had a nut to spare worth ½d. A. G.'s terminal cost 2½d., so that there is no difference in cost.

The true amateur fitter does not keep profit and loss accounts, but follows his hobby for the pure love of it, and as a means of recreation, and he only smiles when he reads the effusions of people who can only use a pen!—Yours faithfully, J. A. B.

A Model Crane.

TO THE EDITOR OF *The Model Engineer*.

DEAR SIR,—The little crane shown in the accompanying photograph may interest some beginners in model making; it is, I think, a novel arrangement, being made out of a broken "Bee" clock. The same bearing plates were used, being the same



A SIMPLE MODEL CRANE.

shape in the clock as were required in the crane. I took a joined cog and pinion and filed the cog down to a level with the teeth of the pinion, and put on a steel shaft to work the winding drum. This drum is one taken from the clock, and has a large cog-wheel one end and a small one the other. The teeth of the small one were filed down a bit, and a large cog with the teeth filed off slipped on. The brake works on the spindle of the cog-wheel, which is just seen over the frame. The jib is made of sheet tin bent as shown.—Yours truly,

DOUGLAS TEAGUE.

St. Agnes, Cornwall.

Queries and Replies.

[Attention is especially directed to the first condition given below and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-hand corner of the envelope "Query Department." No other matters but those relating to the Queries should be enclosed in the same envelope.

Queries on subjects within the scope of this journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed. (4 Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of Replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor,* THE MODEL ENGINEER, *26—29, Poppin's Court Fleet Street, London, E.C.]*

The following are selected from the Queries which have been replied to recently:—

[14,791] **Small Starting Resistance for Motor.** C. F. W. (Lewisham) writes: I have a small motor made by myself which is driven by 6 volts (three large bichromate cells). It is utterly unnecessary, but for the sake of appearance and for experiment, I have added a rheostat or starting switch, upon which I should be obliged to receive some advice. First of all, I presume the battery gives at least 3 amps. On putting six yards of No. 24 S.W.G. German silver wire into the circuit, the speed of motor is only slightly reduced. Is this because the resistance of the battery is so much less than that of the motor that the effect of the G.S. wire is only to balance the two? Then I used some fine binding wire (tinned iron), only 9-1000ths-in. diameter (sample enclosed, 34 S.W.G.), and what surprises me is that it does not get warm with several minutes' working. I expected it to fuse. Will you explain this? However, 4½ yds. of this sufficed to bring the motor to a very slow speed, but the space behind the switch is limited—badly designed, I should say—and when wire is in spiral form and soldered in position, etc., I cannot avoid short circuits. Can iron wire or other resistance wire be obtained insulated? If so, can it be obtained in very small quantities, say, a dozen yards, and where purchasable. I think s.c.c. would be sufficient.

The resistance of the tinned iron wire you were using would be approximately 2·2 ohms per yard, whereas that of the 24 S.W.G., G.S. wire would only be ·83 ohm per yard. This, of course, accounts for the different speeds you got in each case. Drop some of our advertisers a line, asking if they can supply insulated iron wire.

[14,813] **Current, Voltage, and Resistance.** G. H. S. (Hunslet) writes: (1) I have in my workshop a 200-volt 5 amps. installation, and have two separate circuits of lights to each circuit, operated from two switches on switchboard. Will the current divide into half, making 2·5 amps. for each circuit; then half again, making 1·25 amps. for each lamp? If so, each lamp would consume 250 watts.

$$\frac{250}{4} = 62\tfrac{1}{2} \text{ c.-p.}$$

Is there any loss to insert a 16 c.-p. lamp in place of the above candle-power? I have a 32 c.-p. inserted on the four lampholders. (2) Do fuses blow out when current rises, or is it the increase of voltage? (3) How do you ascertain the point at which a given lamp will fuse? (4) How do we reckon the point at which a fuse wire may blow off? Do we alter the gauge of the wire or alter the length? Some wiremen put a double fuse in. Is this what should be done? (5) Please show by diagram the wiring from the main cut-out or main fuses—I might say to the switchboard—and fuses and circuits from these. (6) Is the current alternating or continuous for tramway traction? Is the voltage usually high, or is it the current, as the motors are all arranged in parallel. (7) Is there danger in handling the overhead wire from a well-insulated derrick?

(1) The current will divide and flow in definite quantity in each circuit, according to the resistance of the respective circuits. Thus, if you had two circuits, one having two 16 c.-p. lamps in parallel, and the other two 32 c.-p. lamps in parallel, voltage of supply 200, then you would get a flow ·64 amp. in the first case, and 1·28 in the second. The total current flowing would be $·64 + 1·28 = 1·92$ amps. This is the case whether the resistance is in the form of lamps or something else. The current in the above diagram having a choice of two paths, the total resistance between the two mains will be less than that of either single path. It is equal to the sum of the resistances divided into their product. Thus—

$$\frac{620 \times 1240}{620 + 1240} = \frac{870800}{1860} = \text{approximately, 470 ohms.}$$

Thus, the current flowing from main to main is—

$$\frac{200}{470} = ·425 \text{ amp.}$$

(2) Due to increase of current, which is due to one of two things: (*a*) increase in voltage of supply, or (*b*) drop of resistance of circuit. (3) In the first place by trial. It is not usual to go more than 10 per cent. above voltage recommended by manufacturers, though it is quite possible to exceed this considerably for short periods. (4) The greater the cross sectional area a fuse has, the higher its fusing point; or, more strictly speaking, the more current it will carry before reaching its fusing point. (5) Rather vague. (6) Usually continuous. See reply to Query 8,106 in March 5th, 1903, issue for explanations on this point. (7) Possibly.

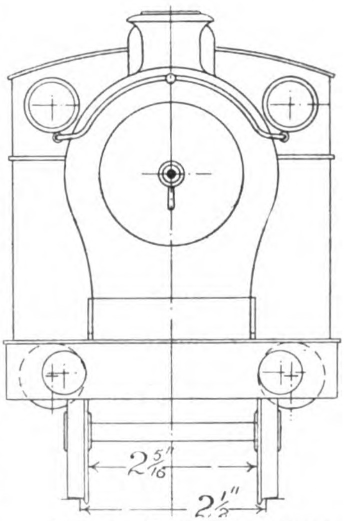


FIG. 1.—FRONT ELEVATION.

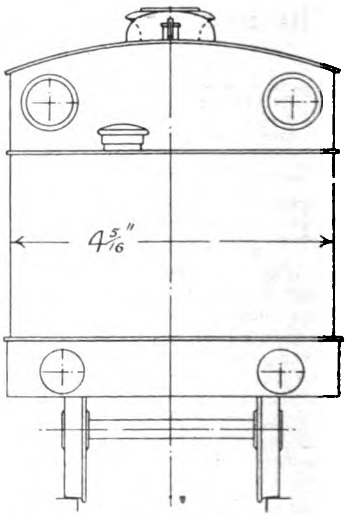


FIG. 2.—REAR ELEVATION.

MODEL L.T.S.R. TYPE TANK LOCOMOTIVE.

[14,857] **Model ½-in. Scale L.T.S.R. Type Tank Locomotive.** A. J. B. (Wandsworth) writes: I am desirous of building a model on the lines of the L.T.S.Rly. passenger tank locomotive, to ½-in. scale. Will you kindly give me some of the

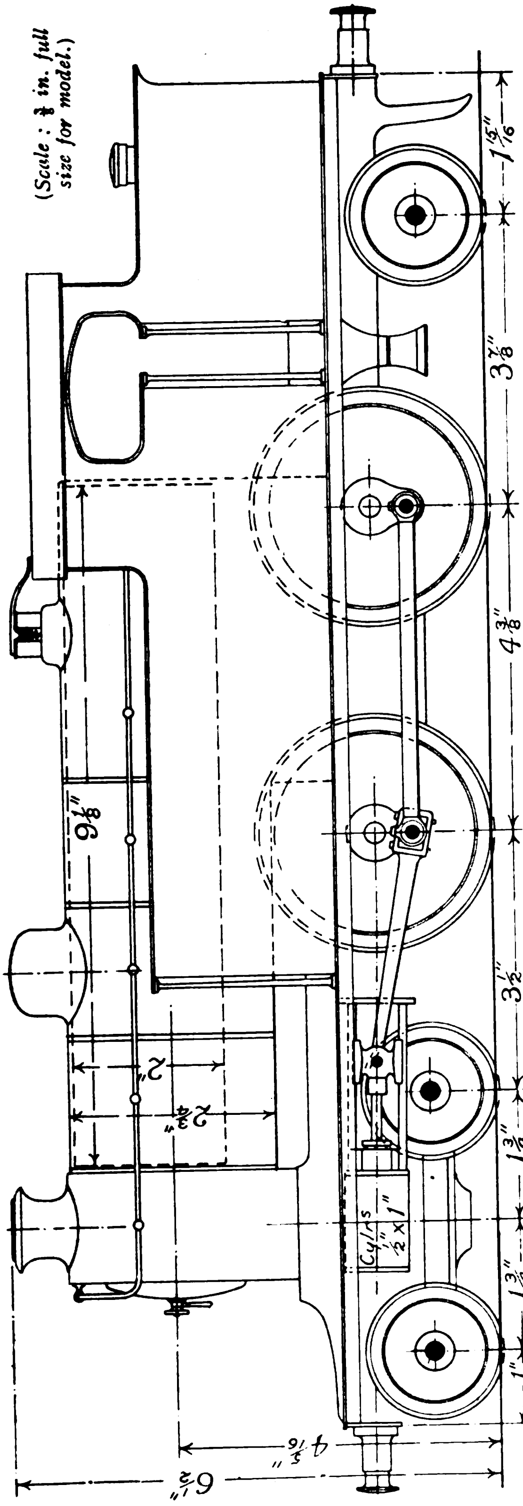


Fig. 3.—Design for a ½-inch Scale Model L.T.S.R. Type Tank Locomotive.

leading dimensions—cylinders, boiler, etc.? I see by "The Model Locomotive" that it is advisable to adopt 2¾ ins. diameter for the outer shell. The L.T.S.R. locomotives, even in the latest class, have smaller boilers than 5 ft. 6 ins. over the lagging. I am desirous of a good *working* model; would like to know whether you would advise me to employ a 2¾-in. outer shell and 2-in. inner barrel for my model. I do not mind the external appearance being altered a little, so long as it is pleasing.

We reproduce herewith a sketch of a model L.T.S.R. type locomotive, altered as regards boiler dimensions. The leading dimensions are given on the drawing. The cylinders may be ½ in. diameter by 1-in. stroke. As you say, the inner barrel may be 2 ins. diameter. It should be fitted by at least three (if not four) water tubes, ¼ in. diameter. The distance between tyres should be 2⅜ ins.; rail gauge 2½ ins. Driving wheels are arranged to be 3 3-16ths ins. diameter. This is slightly smaller than scale, but the alteration is hardly noticeable, and is an advantage. You say nothing about the curves of the track upon which you propose to run it when completed. If they are sharp, then the bogie wheels will have to be reduced in size, so that they may be made to clear the frames and crosshead. The latter would also be better if made after the style of the prototype, with a single bar, instead of the double bar shown. For constructive details, see "The Model Locomotive," price 6s. 4d., post free from this office.

[14,866] **Heating of Field Coils.** J. K. (Pateley Bridge) writes: I have a 3-kilowatt dynamo on my hands, and I wish to make use of same for lighting part of mill and adjoining house, but mainly the latter; half-dozen lights will do for mill, the lighting to be done direct from dynamo for the present. The dynamo has been run lately, and a few lamps lighted. After a few hours' running the fields get hot, though the revolutions were a little under the stated number.

If the fact that the fields get hot after running awhile is your only trouble, you need not worry over the matter. They may safely get as hot as it is comfortable to bear your hand on them; beyond this, it is unwise to go. Perhaps you are overloading machine.

[14,836] **Reflectors for Small Search-Lamp.** E. M. (Sedbergh) writes: I should be glad if you could let me have a sketch of a simple reflector for a searchlight. I want to get the whole thing into a round case 2 ins. by 2½ ins. I should like to make the reflector of tin, polished with quicksilver, if possible. What does a bull's-eye glass do; and should I have to have one for such a lamp? I want to have four or five pea lamps to supply the light. How many ¼-amp. lamps should I be able to light from an ignition accumulator (4-volts), with one positive and one negative in each cell; and what is its amp.-hourage?

A watch glass silvered at the back makes a good reflector for a small light. Any optician would supply you, or any of our electrical advertisers. A "bull's eye" acts in the manner of a parabolic reflector—*i.e.*, it prevents the beams of light from diverging too much. A parabolic reflector is the proper thing to use in a searchlight—it sends the rays out quite parallel. Amp.-hourage of your cells depends upon the plate surface. Reckon 25 amp.-hours per sq. ft. of positive plate surface. (See recent Queries and Replies).

[14,841] **Size and Power of Oil Engines.** O. L. (St. Austell, Cornwall) writes: Would you kindly answer the following questions?—(1) What determines the power of an oil engine? Is it by cylinder capacity? If so, then why are some engines half the size of others, yet of equal power? (2) Does an extra flywheel increase the horse-power? Would the same rule determine power in both the petrol and oil engines?

(1) Yes: and also the speed at which they run. An extra flywheel has no effect upon the *power* of an oil, or, in fact, any engine. (2) Yes. See our handbook on "Gas and Oil Engines," by W. C. Runciman, 7d. post free. It will clear up some of your wrong ideas.

[14,845] **Small Accumulators for Flash Lamp.** J. B. (Norbiton) writes: I should be much obliged if you would advise me concerning the following two questions:—(1) A friend of mine has one of the Ever Ready Co.'s flash lamps, worked by five dry batteries in a leather case of the size shown in the accompanying sketch (not reproduced). Having to pay 2s. 6d. each for refills, he is desirous of fitting it with accumulators, which I could charge with a 10 c.-p. size "Simplex" dynamo, as sold by the U.E.S. Co., of Manchester. Would two ordinary 4-volt flat pocket accumulators be suitable for this purpose? If so, would they go into a case of this size, and about how many hours would they light a 3 c.-p. lamp? If these would not be suitable, what would be the approximate cost of having one made? (2) It occurred to me some time ago, while examining some accumulator plates, that a considerable amount of weight might be saved by using carbon instead of lead grids in which to pack the paste, or that sort of carbon envelopes filled with paste might be used successfully. Do you consider this to be a practicable idea, and, if so, what ought I to do with it?

(1) Provided the accumulator would fit into the available space, it would answer the purpose well enough. You would need some sort of engine to drive dynamo for charging it. Capacity of accumulators, if you used three positive plates and four negative, would be 20 amp.-hours. Or if you turned it into a 4-volt cell, it would be about 10 amp.-hours capacity, but would probably suit your small lamp better. We do not think it is a 3 c.-p. lamp, however. (2) We do not think this would be a great advantage—if any. A plate tending to buckle would soon crack the carbon, and

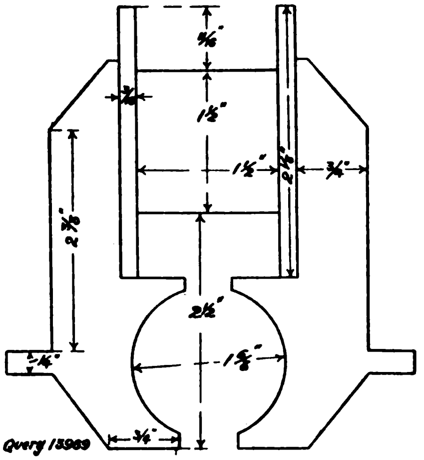
paste would fall out. Besides this, effective area would be reduced and resistance increased.

[14,856] **Motor for Small Fan.** T. B. (London, S.W.) writes: Would you kindly tell me if I can convert a dynamo I have into a motor, suitable for a fan? It has a Siemens' H armature (2 ins. by 1¼ ins.). field coils 4¼ ins. by ½ in., wound with nine layers of wire (No. 24 S.W.G.). Stamped on base of machine is "Volts 8, amp. 1. Rev. 2,500." What I want to know is—(1) What voltage will it take to drive fan? (2) What amperage? (3) What method of connecting up to economise current (at present it is as sketch, not reproduced)? (4) In lieu of accumulators, could constant bichromate battery drive it for an hour at a stretch per day; and how long would the same last (size, 3-lb. jars)? (5) Diameter of fan, as large as possible.

(1) Machine is evidently wound for 8 volts. If you supply it with 10 or 12 volts, it should run well as a motor. (2) About 1½ amps. (3) Connect in shunt, as you show on sketch. (4) Yes. Use about five or six in series, as large as possible. If motor is not extravagant with the current, they should run it for some 10 hours or more. (5) Use an 8-in. or 10-in. fan.

[13,969] **20-watt Motor Windings.** E. W. D. (Chatham) writes: Will you kindly answer the following questions? I am enclosing full-size rough sketch of the dynamo. (1) I have the castings for a 10-c.-p. set dynamo from the Universal Supply Co.; also 10 ozs. of No. 22, which is silk-covered. How much more should I want for the dynamo to develop 40 watts, say 10 volts 4 amps. (if you think that is possible with the machine)? The principal dimensions of the dynamo are shown in the accompanying rough sketch, and the armature stampings, of which there are about sixty, are 1½ ins. in diameter, and about the same length. (2) Is it possible to join wire on the field without affecting the insulation?

(1) We should not expect an output of more than 20 watts from this machine—say 6 volts and about 3 amps. Get on as much of the No. 22 gauge wire as you can for the field-magnet, and use No. 25 gauge s.s.c. copper wire on the armature, which we presume is a drum pattern; if a shuttle pattern, use No. 22 gauge—get on as



UNDERTYPE DYNAMO FIELD-MAGNETS.

much as you can. For 10 volts we should prefer to wind the field with No. 24 gauge wire and the armature with No. 25 gauge if a drum, and No. 23 gauge if a shuttle; run at 3,000 r.p.m. (approx.) (2) Your query is not quite clear. You can certainly make a joint or several joints in the wire of your field coil as long as you cover up the wire again by wrapping tissue paper or thin silk round it; such joints should be soldered. Is this what you mean?

[14,839] **Lighting Switches and Ceiling Roses.** G. W. (Sutton-in-Ashfield) writes: Will you kindly inform me on one or two subjects. I should like to know what precautions to take in connecting a few ceiling roses. I have connected the lamp and holder, and I think it must be at the top they won't light, and yet the other two will light. There are three lamps to the switch, and the middle one won't light, so I think it must be at the top. How many 16 c.-p. lamps would be sufficient for an ordinary switch? There are nine to this one that I am alluding to; so don't you think that is too many? There are only three to the others. There is a little box just above the switch at our place—what is that for?

Possibly a fuse has "blown," due to taking too much current. The little box above the switch is evidently a fuse box. The remedy is—put in a new fuse. Your query is rather vague. We can recommend you to read our shilling manual on "Private House Electric Lighting," 1s. 2d. post free. It will put you right in all these matters. It depends upon the size and make of switches and ceiling roses what number of lamps they will safely carry current for.

[14,799] **Poles of Accumulator.** W. H. P. (Longsight) writes: I have an accumulator which has not been in use for some time, but it is charged at present. The poles, however, are not marked, so when I want to charge it I shall not know how to connect. I have found the pole which evolves hydrogen from acidulated water, both on this and on my dynamo. (1) Do I connect these two in charging or the two unlike together? (2) How many 4-volt lamps may be connected safely in parallel with a 20 amp.-hour 4-volt accumulator, and about how long will they last with one charge?

(1) Yes; connect similar poles together. (2) Depends upon their candle-power, *i.e.*, size. Of the usual small 4-volt lamps, you could run three or four in parallel if they are fairly economical. About four or five hours.

[14,754] **Resistance for Arc Lamp.** S. G. T. (Colwyn Bay) writes: I am making the small arc lamp as described in your January 1st issue, 1904, and want to work it from our electric light mains (220 volts direct). (1) Could you let me know how many yards of German silver wire to use as resistance, with safety? (2) What is the diameter of No. 10 B.W.G. wire? (3) What is the gauge of the enclosed piece of wire?

(1) You will require a large resistance to put in series with the lamp on a 220-volt circuit—35 ohms will be required; about 4½ lbs. No. 18 gauge bare German silver wire. The length will be about 200 yds. It can be coiled up into spring coils, and stretched on insulators. (2) Diameter is ·134 in. (3) The sample of wire which you enclose is No. 22 gauge. We have presumed you refer to the arc lamp described in THE MODEL ENGINEER for January 1st, 1903. There is no issue of January 1st, 1904.

[14,762] **Windings for ¼ h.-p. Motor.** E. M. F. (Lower Broughton) writes: I have an entirely enclosed motor, which is designed to give ¼ b.h.-p. I wish to wind it to work off a 220-volt main as a shunt motor. Could you advise me as to what I shall wind it with—*i.e.*, number of conductors in each slot on armature, and the size of conductor; also the number of turns on each pole, and the size of wire? Following, I give particulars of the motor: Two-pole machine; cast-iron poles and case; armature is built up of laminations; length between end plates is 5 ins., diameter 3 ins.; eighteen slots ½ in. deep by ¼ wide; commutator has eighteen bars; air-gap 1-16th in. The amount of winding space round poles, allowing for insulation, is 1½ ins. by ¾ in.

The proper winding for this armature would be No. 26 gauge wire, if the machine is to give ¼ b.h.-p.; but we doubt if the machine will do this, without undue heating, and therefore we advise you to use No. 28 gauge s.s.c.; get on as much as you can—about 1½ lbs. will be required. Wind two coils in each slot. Wind the field-magnet with about 2 lbs. No. 33 gauge s.c.c. wire on each pole; get on as much as you can in the space, both coils to be joined in series with each other, and in shunt to the brushes. Copper wire should be used for both armature and fields. We should expect this machine to give about ⅛ b.h.-p. at full load.

[14,778] **Old Leclanche Cells.** H. E. K. (Fratton) writes: I am intending to fit up a night-light set, consisting of two 4-volt high-efficiency lamps, which could be switched on for periods of, say, four or five minutes. For this purpose I bought some agglomerate block cells (second-hand). They are as follows: Carbon plate, 4½ ins. long by 2½ ins. by ½ in., surrounded by four agglomerate blocks, each 3 ins. long by 1¼ ins. by ¾ in. Outside these are sacking and rubber bands, and then a piece of sheet zinc, ⅛ in. thick, bent to form a lining to the case, which is ebonite, the whole being sealed with pitch. These are Government cells, and were used for night "sights" on the guns. I have cleaned the zincs, which were very dirty, and charged with sal-ammoniac; but from twelve cells I only get 5 volts, rapidly dropping to about 2 volts (cells in series). The zincs are in fairly good condition, so far as I can see, but I do not quite understand the agglomerate blocks. Should I do away with the blocks altogether, and enclose the carbons in flannel bags, packed with peroxide of manganese and crushed carbon, making them a kind of sac battery. Do you think this would answer? Should the peroxide, etc., be packed tightly in flannel bag, or just loose? I thought I should only require about six cells to work both lamps at once, but the whole twelve will only light one lamp for a few seconds, after which the filament goes dull red. How many cells should you say it would require to light two 4-volt lamps in series (*i.e.*, to give current at 8 volts)?

Your best plan is to turn your cells into sac Leclanchés, and use circular zinc *plates* instead of rods, bent so as to almost completely encircle the sack. The packing of the latter does not need to be *very* tight. Each cell should give about 1·3 or 1·4 volts; but this will drop considerably when too heavy a current is taken from them. Perhaps your lamps are not economical; have you tested them with an ammeter? Make these alterations, and see how you get on. The blocks are evidently very old ones, and useless.

[14,737] **Electric Motor for Loco.** W. S. (Dublin) writes: Would you please advise me further in *re* "electric loco and dynamo"? I have your reply of June 21st, No. 14,278. I have wound dynamo with three layers of No. 18 gauge wire (not having No. 16 to hand), taking off two layers of the shunt wire to

make room, and connecting up to compound, as you advised. To my surprise, I could not get speed out of loco at all with this arrangement. I did not take off the wire, but have re-connected it with the shunt coils, so that the machine is just as it was before, except that it has one extra coil on each magnet. The loco can do a good speed, and has always done so; but I fancied that if motor was wound to suit dynamo voltage, I should get at least the same result with a minimum of power, as I use foot drive. Dynamo is wound for 20 volts 4 amps., and motor for 8 volts, so there seems to me to be a loss of current amounting to about 40 watts, allowing for absorbing of volts in track and friction, etc. Also, she takes nearly full power to start her (Col. Harvey's only taking ½ amp. to start). The friction in loco is about as low as it can be, having pointed steel thrust bearings on motor shaft and 24 to 1 single worm gear (Avery's). There is room on armature shaft for about a ½ in. extra lamination to fill up F.M. tunnel. Your further kind assistance will be a great favour. Would you kindly give me the correct winding for above machine as a compound? It is an overtype Thompson's "Greenwich," 4 amps. 20 volts. Also windings for loco motor to suit above voltage? Motor is Thompson's 2B eight-section drum armature 1½ by 1½, wound at present for 8 volts.

Compound winding ought to give improved results. No 18 gauge wire is, however, too small a gauge; you should use No. 16 or No. 14, a single layer on each coil. By using too fine a gauge for the series coils, and also too many turns, you absorb too many volts in them, and obtain no benefit. See THE MODEL ENGINEER for August 31st last, pages 200 and 201—"Lessons in Workshop Practice." You could make a further trial of your series winding by putting the two sets of coils in parallel with each other. Are you sure you made correct connection? Perhaps you joined up the series coils so that they opposed the shunt coils: this would be fatal. It does not follow because your dynamo is wound to give 20 volts that it is giving this voltage when driving the motor; the volts may drop to 8 or 10 volts, or less. The extra ½ in. of laminations on armature core would be a step in the right direction. It may not, however, make much difference in actual working. If you re-wind the motor to suit higher voltage, it will take less current; but the net result may be just the same as at present, if the dynamo now only gives about 10 volts when at work, as the dynamo would give higher volts with the motor wound with finer wire. It is of little use to refer us to a maker's catalogue; it is necessary to send a dimensioned sketch, with particulars of the present winding, if we are to advise as to gauge of wire for a new winding. You could, however, try wire of, say, two gauges thinner for both armature and field coils. For instance, No. 22 instead of No. 20, and so on. At starting the motor requires heavy current at low volts; the voltage should rise as the speed rises—the current will correspondingly fall. It is, however, not always practicable to ensure these conditions as regards alteration of voltage.

[14,838] **Engine and Boiler Details.** F. W. M. (Coventry) writes: Will you please inform me on the following points. (1) What size boiler should I require for a 1½-in. by 1½-in. high-speed engine? (2) Shall I be right if I make reversing gear as per drawing (not reproduced), which is about actual size and length I should require? (3) Is there any rule governing the length of the link, etc.? (4) What size flywheel would suit?

(1) A vertical centre flue boiler about 16 ins. diameter by 30 ins. high, or a multitubular vertical boiler 14 ins. by 24 ins., with fifteen tubes 1½ ins. diameter, would suit your engine very well. The exhaust steam should be used to induce a draught. (2) The main proportions are all right. For details of design, see "The Model Locomotive," price 6s. net, 6s. 4d. post free from this office. (3) The length of the link between the eccentric rod pins should not be more than quarter to one-third length of eccentric rods. See the above-named book. (4) Flywheel may be about 6 ins. diameter.

[14,689] **Resistance Wire for Shocking Coil.** J. T. H. (Crewe) writes: I have a powerful shocking coil; this I wish to enclose in a cabinet in such a position as to conceal the coil completely, doing away with the sliding tube, and using a resistance switch in an outer position. When working full strength off a battery giving 4·65 volts 18 amps., it is more than three persons can stand. Will you kindly tell me if the enclosed wire will suit for resistance, and what resistance per foot it will offer? In case of wires accidentally getting close together, would No. 40 s.s.c. be better, and what resistance would this offer, or what would you recommend, stating resistance per foot?

The sample of wire you send is No. 40 gauge; its resistance is about 1·3 ohms per yard. We expect you will find it will get too hot with the current required by your coil. However, it can be easily tried. No. 26 gauge German silver wire would probably do; its resistance is, approximately, 1½ ohms per yard. The amount must be found by trial · perhaps 3 or 4 ohms will be enough. The wire could be wound tightly on some incombustible material, such as slate.

[14,761] **Model Searchlight.** A. B. (Welshpool) writes: Would you kindly answer me these questions? I am thinking of making a model searchlight Could you give me any information as to how to start, and where to get the lens from? About what price, and could I use an old carbide gas cycle lamp?

You could obtain suitable lens from any optician's. An acetylene lamp would do well enough for a small affair. For a proper searchlight you should get a parabolic reflector. This sends the rays out in parallel beams, and is much more effective and realistic.

[14,835] **Model Traction Engine.** W. H. K. (Greenwich) writes: I wish to construct a two-cylinder traction engine, the dimensions of my cylinders to be ½-in. bore by 1-in. stroke. My trouble is the boiler. What would you propose its length and diameter should be? Also the number of tubes required and their diameter? Could acetylene gas be used successfully as a means of firing it, if I devised a way of generating the gas?

We would advise you to adopt methylated spirit for fuel. The boiler barrel may be 3 ins. diameter and 6½ ins. long. The firebox may be 3½ ins. long by 3 ins. wide outside. Six ½-in. flue tubes are advised, also a few ¼-in. water tubes in the firebox. We doubt whether you would find acetylene gas a convenient fuel. See issues of April 2nd and 9th, 1903.

The News of the Trade.

[The Editor will be pleased to receive for review under this heading samples and particulars of new tools, apparatus, and materials for amateur use. It must be understood that these reviews are free expressions of Editorial opinion, no payment of any kind being required or accepted. The Editor reserves the right to criticise or commend according to the merits of the goods submitted, or to abstain from inserting a review in any case where the goods are not of sufficient interest to his readers.]

** Reviews distinguished by the asterisk have been based on actual Editorial inspection of the goods noticed.*

*Small Electric Lighting Novelties.

The illustrations we give herewith show a few of the electric lighting specialities for small voltage which Messrs. Armstrong and Co., of Twickenham, have sent to us for inspection. Figs. 1 and 2 show their 4-volt accumulators, curved for the pocket, in

FIG. 1.

FIG. 3.

FIG. 4.

FIG. 2.

FIG. 6.

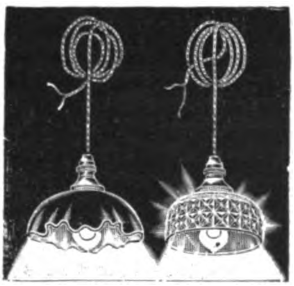


FIG. 5.

MESSRS. ARMSTRONG & CO.'S ELECTRIC LIGHTING NOVELTIES.

ebonite and transparent celluloid cases respectively, fitted with acid-protected terminals; each charge is sufficient for a five-hours' light. Small candle and flame pattern standard lamps are shown in Figs. 3 and 4, each complete with cord and switch. Figs. 5 and 6 represent very neat hanging lamps of low voltage, suitable for night lights; these are supplied with silvered or cut glass shade, or with wire guard. Further particulars and prices can be obtained from the above-mentioned firm.

*A Soldering Flux.

Mr. W. N. Naylor, of 124, Sandhurst Road, Catford, S.E., has submitted to us a sample tin of his new soldering flux, which he claims is free from acid. We find that it satisfactorily answers its purpose, being clean in use and gives off no smell.

The Editor's Page.

A CORRESPONDENT seeing our paragraph of a few weeks back referring to another reader who had obtained a practical position through the knowledge he had gained from our paper and handbooks, writes to say that he also has derived much benefit from the same sources. Although only 21 years of age, he is in charge of electrical plant of over 500 h.-p., and he gives the credit of his progress largely to the *M.E.* We should be interested to hear of other readers who have experienced similar practical benefit from our publications, and in order to promote a little friendly rivalry in the matter, we offer four prizes of 10s. 6d. each for the four best letters on the subject, "How THE MODEL ENGINEER has helped me." The letters should not exceed 350 words in length, and should be written on one side of the paper only. It is, of course, hardly necessary to stipulate that they must be strictly accurate in their statements, and not in any way coloured by the imagination of the writer. All letters intended to compete for these prizes should be addressed to the Editor of THE MODEL ENGINEER, and should be posted not later than November 20th.

* * *

We have lately had one or two instances of letters being sent us for insertion in our "Practical Letters" column which, by reason of their sarcastic and aggressive nature, we have been obliged to consign to the capacious paper basket resting at the side of the editorial table. We always welcome letters of comment or criticism on the contents of our pages, provided such letters are written with courtesy and with reason ; but some of our correspondents are apt to aim rather at exhibiting their own "cleverness" at the expense of some contributor or other correspondent with whom they do not agree, or whom they think they have caught tripping. To err is human, and no contributor would object to being courteously corrected if in error, or to having counter arguments brought against his own views where a contentious point had been raised. Indeed, such corrections and discussions are in a sense complimentary, for they show that his article has been read and his statements or misstatements have been deemed of sufficient importance to warrant public discussion. Correspondence on such lines is, therefore, always appreciated, and will always find a hospitable reception at the hands of THE MODEL ENGINEER. But when any reader does feel moved to take upon himself the *rôle* of critic, he must remember that to secure the attention and consideration he feels his remarks deserve, he must write in the same spirit of good faith and good fellowship as that which prompted the subject of his comments. He may hit hard if he likes, but let him "fight fair."

Answers to Correspondents.

J. H. (Marylebone).—You can get an excellent four-jaw independent chuck from the Liverpool Castings and Tool Supply Company, 5, Church Lane, Liverpool, to suit your 3½-in. centre lathe.

E. W. (Westhoughton).—Probably the bought ones are amalgamated when you get them.

E. M. C. (Aberdeen).—The boiler will prove of ample power, if the exhaust is used to induce a draught.

J. G. (Greenwich).—You will find our handbook, "Model Steam Turbines," of assistance to you. It can be obtained from this office, price 6d., post free 7d.

W. H. (Southsea).—See the "Queries and Replies" in recent issues.

Notices.

The Editor invites correspondence and original contributions on all amateur mechanical and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected or not, and all MSS. should be accompanied by a stamped addressed envelope for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

This journal will be sent post free to any address for 13s. per annum, payable in advance. Remittances should be made by Postal Order.

Advertisement rates may be had on application to the Advertisement Manager.

HOW TO ADDRESS LETTERS.

All correspondence relating to the literary portion of the paper, and all new apparatus and price lists, &c., for review, to be addressed to THE EDITOR, "The Model Engineer," 26—29, Poppin's Court, Fleet Street, London, E.C.

All correspondence relating to advertisements and deposits to be addressed to THE ADVERTISEMENT MANAGER, "The Model Engineer, 26—29, Poppin's Court, Fleet Street, London, E.C.

All subscriptions and correspondence relating to sales of the paper and books to be addressed to Percival Marshall & Co., 26—29, Poppin's Court, Fleet Street, London, E.C.

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Contents.

[The asterisk (*) denotes that the subject is illustrated.]

THE

Model Engineer

And Electrician.

A JOURNAL OF PRACTICAL MECHANICS AND ELECTRICITY.

EDITED BY PERCIVAL MARSHALL, A.I.MECH.E.

VOL. XIII. No. 237. | NOVEMBER 9, 1905. | PUBLISHED WEEKLY.

A Small Rotary Converter.

By D. E. J.

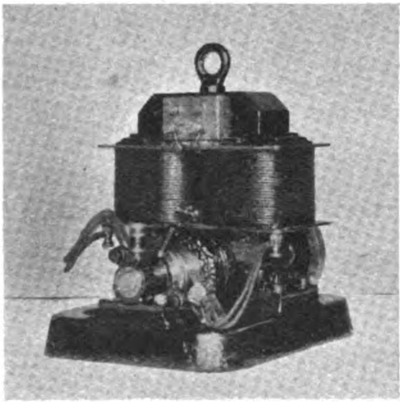


FIG. 1.

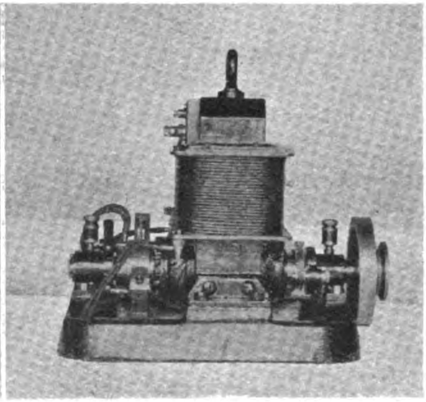


FIG. 2.

A SMALL ROTARY CONVERTER.

A SHORT account of the above model may be interesting to some of the electrical readers of THE MODEL ENGINEER. This model is a long-shunt compound machine with a single armature winding, and made to run off a 50 single-phase supply (in my case a transformer giving a voltage of about 15 when connected to the 200-volt mains). It gives an output at the continuous terminals, without overheating, of 10 amps at 20 volts, running at 3,000 revolutions per minute, and is very useful for charging accumulators.

I first made all the working drawings, designing it to use existing armature stamping, then made all the patterns myself. These took up a lot of my spare time, especially the bedplate, which is of the box-type. Before they went to the foundry they were sand-papered a few times, and then given a final coat of varnish, which gave them a very hard and smooth surface, with the result that I got very smooth castings, quite free from blow-holes. Although in the photograph the bedplate appears rough, it is in reality quite smooth. The armature is 3 ins. diameter by 2½ ins. long, with 16 slots each ½ in. deep bv ¼ in. broad. The winding is a symmetrical one in 16 sections, wound with 17 S.W.G. D.C.C. wire, nine turns in each coil, making a total of 288 conductors all round the armature. It is connected up to a 16-section commutator, 2¼ ins. diameter by ⅞ in. width on the face. The commutator is built up of copper sections insulated with mica and clamped together in the usual way with coned-end washers and a brass sleeve, nut, and washer. The slip rings consist of two gunmetal rings, 1⅝ ins. diameter by ⅜ in. width of face, insulated with fibre, and mounted on a brass sleeve, which is in turn made a good fit like the commutator sleeve, and pinned on the shaft. The brushes on the commutator are made of copper-gauze in adjustable holders, and those on the slip rings are made of carbon, also in adjustable holders. Although carbon has a much larger resistance, and therefore a larger contact surface being required, it was easily obtained by making the carbons cover a fairly large portion of the circumference of the slip-ring. The field-magnets consist of a single casting of cast-iron, shaped and dimensioned like Fig. 4. By this means a large amount of labour in fitting is saved, with practically as good results, and quite equal, if not better, in appearance to one built up of separate pieces. The coils are wound on metal formers with brass flanges (Fig. 5), each coil consisting of 13 layers of 19 S.W.G. D.C.C., about 48 turns per layer connected in shunt, and one layer of about 26 turns of 13 S.W.G. D.C.C. for the series winding. The magnets are mounted, or rather suspended, inside the bedplate by means of brass angle-plates. In this way the centre of the armature is kept low—a great advantage, considering the high speed. The bearings are made of phosphor bronze, and lubricated by means of grease lubricators, which have been all that could be desired, and very clean. The journals are ½-in. diameter, and 1½ ins. long, and the armature being well balanced, both mechanically and electrically, it is quite free from vibration and sparking on top speed and full load. The fly-wheel was a casting turned all over, and polished on the rim. It is very useful when running the machine as a dynamo from the gas engine, but a small pulley takes its place when running as a converter. The terminals are arranged so that the machine can be separately excited when starting up, as it is liable to lose its magnetism if switched in before synchronism has been obtained. The terminals are mounted on slate, which is in turn screwed on to the magnet yoke, as shown in the photograph. Since the photographs were taken, the "alternating" terminals have also been fixed on the opposite side of the magnet yoke. They are made similar to the "continuous" terminals, except in number, there being only two. The only parts that I bought finished were the screws. All the bright parts, such as brush gear, terminals, and coil flanges, are polished and lacquered. The field coils were varnished with shellac, as well as the armature. They were then well dried, and when tested for insulation gave a result of three megohms. Should any reader require further particulars, I should be very pleased to give them. I have not described everything—such as brush gear, commutator, and slip rings—in detail, as I have often seen them described fully in THE MODEL ENGINEER. The machine is enamelled black, and weighs about 70 lbs. altogether.

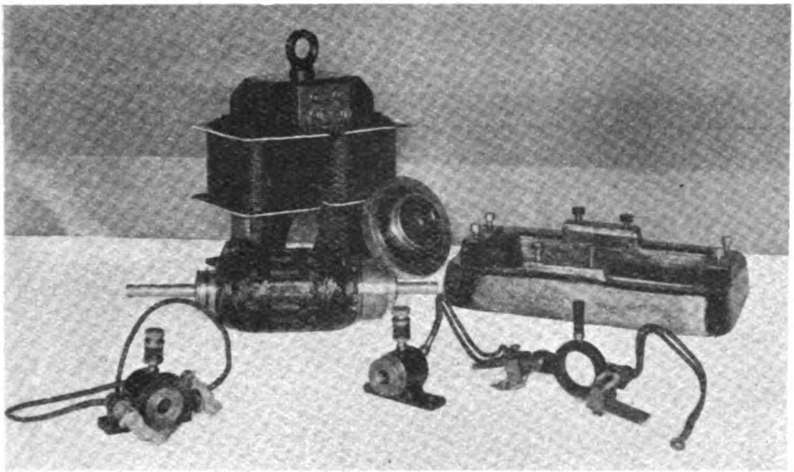


FIG. 3.—THE PARTS OF SMALL ROTARY CONVERTER.

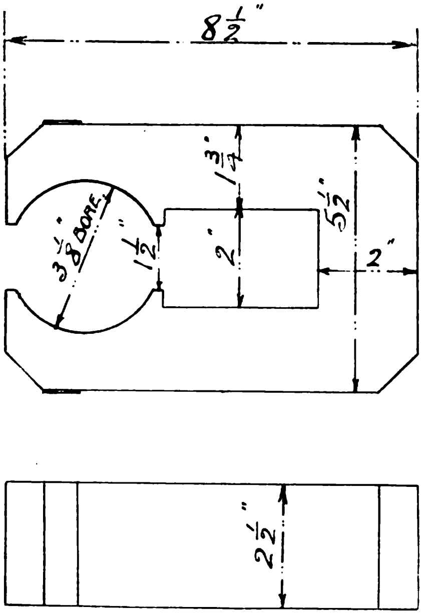


FIG. 4.—FIELD-MAGNETS.

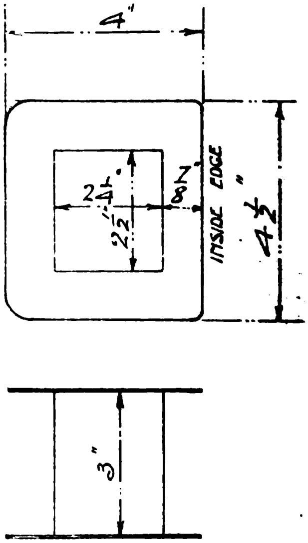


FIG. 5.—METAL FORMERS.

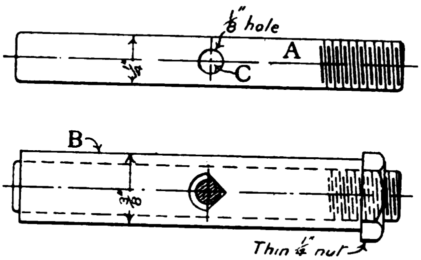
Workshop Notes and Notions.

*[Readers are invited to contribute short practical items for this column, based on their own workshop experience. Accepted contributions will be paid for on publication, if desired, according to merit. All matter intended for this column should be marked "*WORKSHOP*" on the envelope.]*

A Handy Holder for Small Taps.

By "SCRIBO."

A is a piece of ¼-in. mild steel, about 2 ins. long, with a hole (C) drilled in the centre; one end of the



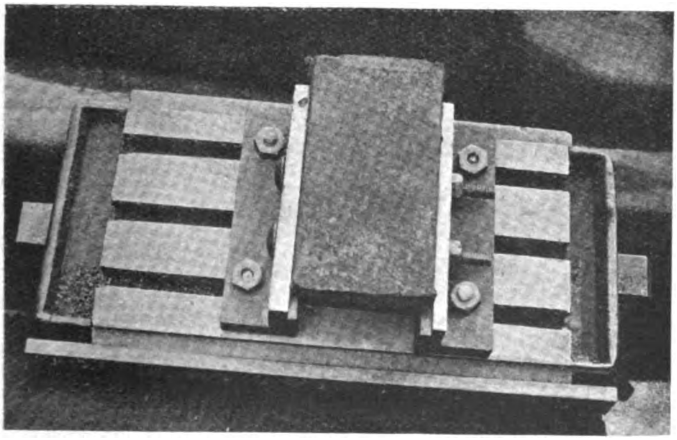
HOLDER FOR SMALL TAPS.

steel is threaded, say, about ½ in. up, ¼ in. Whitworth. B is a piece of ¼-in. inside diameter tube which has also a ⅛-in. hole drilled through at C, one side of which is a V-groove to hold taps, etc., firmly. The tube B should be 1¾ ins. long. A nut goes on the threaded end for tightening up. It is very easily made.

Two Angle-Plates.

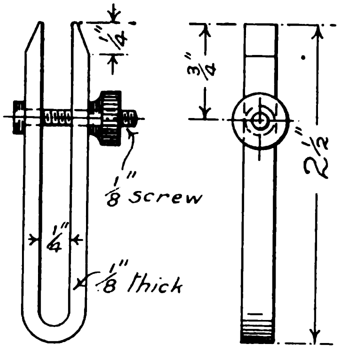
By S.

The accompanying photograph and particulars are of two angle-plates made by the writer to suit a hand-planer. A pattern was first made from yellow pine bradded together in the usual



TWO ANGLE-PLATES.

manner with a suitable allowance for machining, and it was sent to a local foundry and cast in cast iron. The rebates were not cast, but were planed out afterwards. They are 4 ins. long, 1 5-16ths ins. on the sides, and ¾ in. thick, and the rebate is ⅛ in. deep and ¼ in. high. These angle-plates are very useful for planing wide thin plates which lie quite true in the rebate. They are each fastened down on the slotted table of the planer, as shown, by either two ¼-in. bolts with hexagon nuts, which can be got at any hardware shop for a few pence. The angle-plates are drawn together by one or two



A USEFUL HAND VICE.

¼-in. bolts as occasion may require, the lengths of the bolts being determined by the length of work being planed. If any difficulty is experienced in getting these long thin bolts, ¼-in. round iron or mild steel, threaded at each end and ¼-in. hexagon nuts put on can be used instead. If the rebate is too deep for very thin work, it can easily be packed up from the table with true pickings. The two sides, edges, and rebates were very truly planed; great care was taken to get the two rebates on each plate exactly of the same depth and parallel to the face of the planer table.

The holes in the plates are drilled with a 5-16ths in. twist drill, so as to be an easy fit on the ¼-in. bolts, so that they will readily move for adjustment; also they can be used as ordinary angle-plates, the only difference being they have round holes instead of slotted ones. When being planed the plates were fastened by clamps to a slotted angle-plate on the machine table.

The two castings cost about 1s.

I may say, in conclusion, that I have found the above most useful for several purposes, and it is a very useful adjunct to a hand-planer.

A Useful Hand Vice.

By "SCRIBO."

To make this hand vice, procure a piece of good steel, file smooth and bend to shape, bevel off the top to about ¼ in. down, leaving the tips about 1-32nd-in. thick. Drill an ⅛-in. hole ¾ in. from the top and fit a bolt ⅞ in. long with an ordinary nut, or, better still, a knurled head nut. The tips should be case-hardened and the whole finished off bright. This will be found a very useful tool for holding small delicate work, and can be made without the use of a lathe.

An Improved Scribing Block.

By J. A. Taylor.

The scribing block represented by the accompanying detail sketches is an improvement over the ordinary style, and can be made throughout in the lathe. It is a useful size for model makers, the novel feature about it being the method of tightening the crosshead and scriber by one movement of the milled nut. The scriber can be adjusted either up or down, without releasing the crosshead at all. The stand can be made from cast iron or steel, allowance being left on the pattern for finishing to the given size. The pillar must be made from good quality steel, as it is subjected to much wear by the crosshead being moved up and down it. The

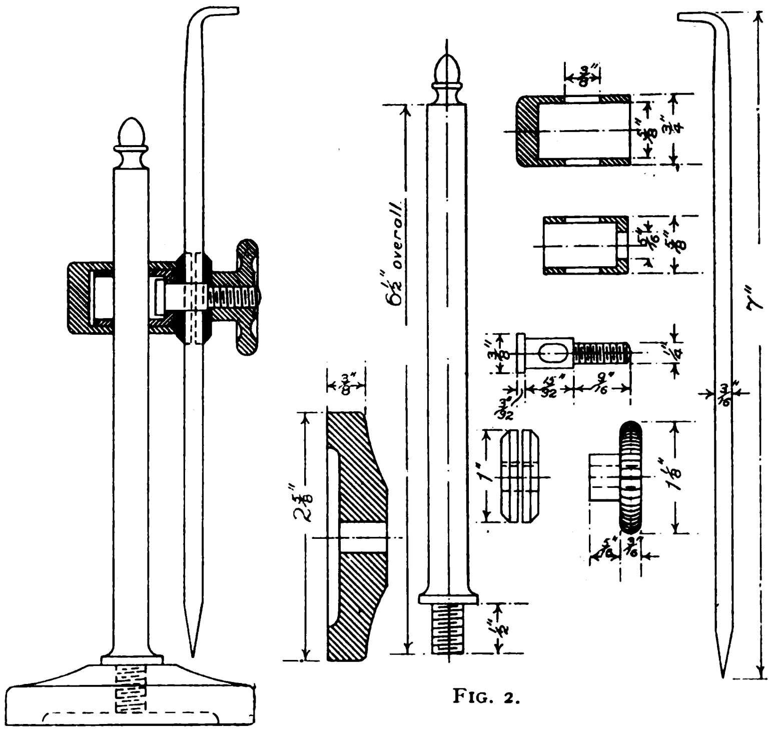


Fig. 1.

Fig. 2.

Arrangement and Details of Scribing Block.

outer shell of crosshead should be made of steel, and hardened to stand the friction of washers rubbing against the edge of shell (see the elevation shown at Fig. 1). It is advisable to make the inner shell from good steel, but it need not be hardened, for it has not to stand as much wear as the outside shell. The bolt may be made from mild steel, and hardened with potash. The washers may also be of mild steel, and hardened in the same way as the bolt. The milled nut can also be made from the same quality of steel, and hardened in the same way as the bolt and washers. A piece of 3-16ths-in. tool steel wire, hardened at both ends, will do for the scriber. In conclusion, I might say, speaking from my own experience, that anyone caring to make a similar tool will be well repaid.

The Latest in Engineering.

The Robert Water-tube Locomotive Boiler.—The water-tube boiler that has achieved such economical results in marine and stationary practice offers an attractive field for experiment on the locomotive. According to *La Genie Civil* a boiler of this type has been built, and for more than a year in successful working on the Algerian lines of the Paris, Lyons & Mediterranean Railway, by M. Robert, the chief engineer. The boiler is of the Yarrow type, though still preserving, in external appearance and method of location on the engine, the ordinary form of boiler.

The boiler is composed of three main parts—the firebox, the body, and the smokebox. The body is formed, or is built, upon two cylindrical reservoirs (A and B in the drawings) attached to each other by three drums for direct connections, as well as by the tubes that serve the purpose of water evaporation and circulation. These (V_2 V_2) are of steel. The upper reservoir holds both water and steam, while the lower one, which ends at the front end of the firebox, is filled with water only.

The firebox extends down to the grates that carry a hollow frame. The crown of the firebox is the upper reservoir A; the front and back walls are of firebrick, and the side walls are formed by the tubes V_1, with expanded joints, and connect the upper reservoir with the hollow ring. The latter is further connected with the two reservoirs by large return pipes R_1 R_2.

The gases of combustion pass between the nests of water tubes that extend from the firebox to the smokebox. In order to avoid an admission of air, steel covering plates have been applied to the sides of the firebox and body of the boiler.

As in the case of the boilers of torpedo boats, the circulation of the water is maintained in such a way that there is an ascending current passing through the tubes immediately surrounding the firebox, and in the principal nests nearest thereto, while the descending current passes through those that are more remote, as well as through the return water tubes R_1 R_2, which are not in contact with the flames. While the circulation is quite rapid, the adherent deposits have a tendency to form in the tubes that are the hottest, though they are easily removed when scale is thus formed, as will be shown later. The principal dimensions are as follows :—

Grate length	72 ins.
„ width	41·34 „
„ area	2·67 sq. ft.

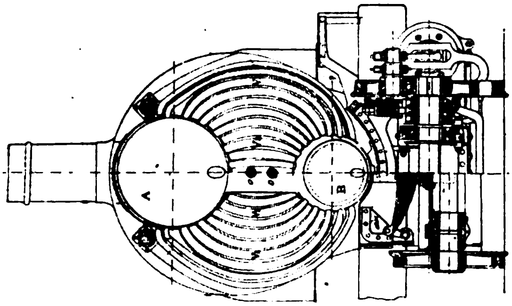


Fig. 2.—Cross-section.

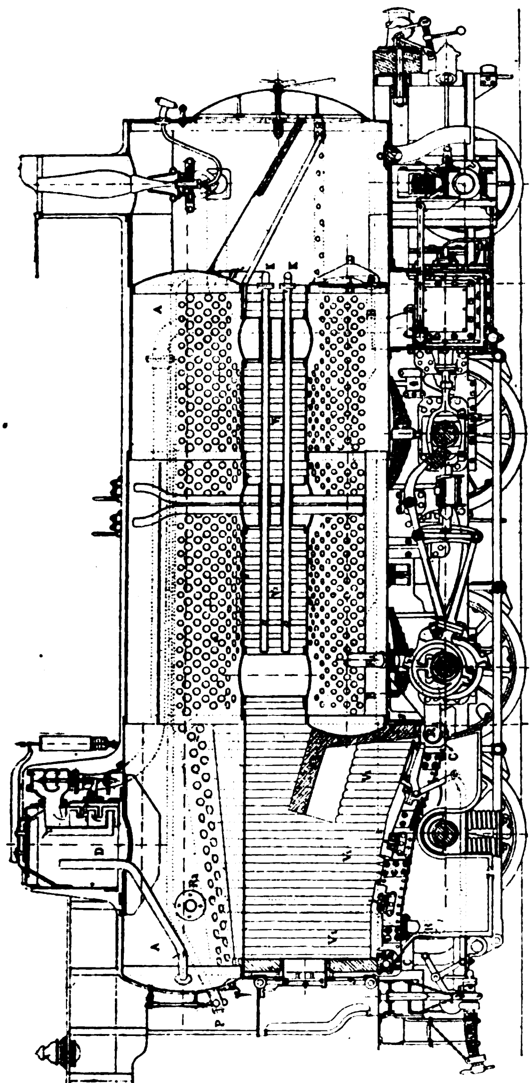


Fig. 1.—Longitudinal Section.

Application of the Robert Water-Tube Locomotive Boiler.

Tubes, 2·6 ins. diameter (number)	556
,, 1·8 ins. ,, (number)	60
,, 2·6 ins. ,, (average length) ..	67 ins.
,, 1·8 ins. ,, (average length) ..	47·8 ,,
Heating surface (firebox)	165·67 sq. ft.
,, ,, (nests of tubes, reservoirs and drums)	1,108·07 ,,
,, ,, (total)............	1,273·74 ,,
Length of nest of tubes	143·7 ins.
Steam pressure per sq. in.	160 lbs.
Total capacity	300 cu. ft.
Volume of water at upper level	248·8 ,,
,, at lower level	206·45 ,,
Difference available for evaporation ..	41·35 ,,
Weight of boiler, empty without attachments	29,700 lbs.
Weight of boiler filled	42,570 ,,
Height, centre of gravity of boiler above the rail	7 ft. 5¾ ins.

The Robert boiler has one advantage over the ordinary locomotive boiler in ease and speed in freeing the scale without taking out or disturbing any part of the structure, as must be done in the case of the standard style. When the boiler is to be washed out, it is first emptied, and then filled with cold water, so as to make it possible to enter

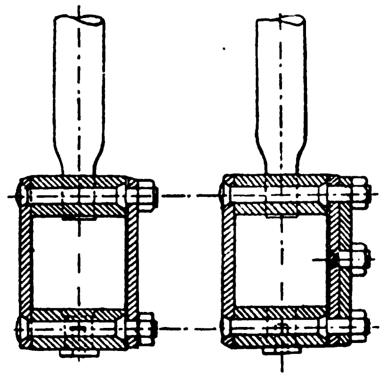


Fig. 3.—Foundation Rings.

the cylindrical reservoirs, which are provided with man-holes. There need be no fear of over-straining or distorting any of the parts by this sudden cooling, as would be the case with boilers fitted with the ordinary fire tubes.

The reservoirs can always be cleaned without using any special apparatus, as they are always accessible. The tubes are cleaned as follows: The workman takes a piece of flexible shafting into the upper reservoir. This carries cutting teeth at one end, and is driven from the shop. The teeth cut away the scale in a few moments, and it falls into the lower reservoir or the hollow frame of the firebox, from either of which it is readily removed. All parts of the boiler can be cleaned in the manner thus indicated, and kept in such a state of cleanliness that the best condition of evaporative efficiency be maintained.

It is also necessary to free the tubes from the soot that may have accumulated upon them. This can be done by the crew even while the engine is on the road, for there are two pipes (*o o*) connected to the steam pipe *k*, and perforated with small holes inclined in the proper direction. By opening a cock and allowing the steam to blow out at these holes, the surfaces of the tubes are scoured and cleansed of the soot, which is blown out at the stack.

The advantages that are claimed in comparison with the ordinary type are :—Less weight for the same amount of heating surface, and the entire avoidance of flat surfaces that must be stayed by bolts or braces ; ease of cleaning ; as no tube joint is exposed to the action of the flames, the liability to leakage from this cause is avoided ; the construction, and especially the work of repairs, being less troublesome than in the case of the ordinary boiler, the time occupied in the making of repairs is shorter, and this lessens the period that the engine is out of service.

The criticism to be made is that, owing to the limited area of the water surface in the upper reservoir, the liberation of the steam is likely to be accompanied by a violent ebullition, with a consequent intrainment of water.

The engine shown has been in freight service for sixteen months. The line has a length of about seventy-four miles, with an undulating profile in which there are some long 2 per cent. grades. The trainloads handled are about 25 per cent. more than those taken by engines with fire-tube boilers having the same heating surface and practically the same grate area, in the same service. The saving in fuel amounts to about 10 per cent., which is due to the better condition of the evaporating surfaces and the improved circulation of the water.

The maintenance of the boiler, up to the present, has been practically nothing, while, in the case of the ordinary locomotives during the same period, it has been necessary to replace a large number of staybolts and tubes as well as tube sheets on account of the bad quality of the water, which contains about 2·8 grains per gallon of solid matter, and in some localities the waters are so hard that this proportion rises to 9·2 grains per gallon.

The salts in solution, with the exception of a small quantity of carbonate of lime, are the sulphates of lime and magnesia, which produce very hard and adherent deposits.

The writer of the article in *Le Genie Civil*, M. F. Barbier, is of the opinion that the experience thus far obtained with the Robert boiler seems to indicate that it marks a notable advance in construction.

A Large Crankshaft.—The largest double-throw crankshaft in the world was recently forged under the 4,000-ton hydraulic press of the Bethlehem Steel Company, South Bethlehem, P. The shaft is one of three ordered by the International Steam Pump Company. It will, when finished, be 27 ft. long. The largest pin diameter is 27 ins. The webs in extreme dimensions will be 64 ins. by 49 ins. and 16⅝ ins. thick. The weight of the ingot was 240,000 lbs.

An Aerial Rowboat.—A late feature of the attempts to navigate the air is an aerial rowboat which has been constructed by Alva L. Reynolds, of Los Angeles, Cal. It is composed of a gas-bag whose equator is much nearer the front of the bag than usual, and a light framework which supports the occupant. It is raised and lowered, propelled forward and backward by the use of a pair of wind-like oars. By the use of weights the bag can be made to raise just ½ lb. less than the weight of the occupant. Then gravity is overcome by the use of the oars. Anyone who understands how to row can operate the aerial rowboat. So far no experienced aeronaut has ridden in the machine, although several hundred people have tried their hand at rowing up and down the park where the machine is being tested. The bag is 37 ft. long and 15 ft. in diameter at the equator. To raise the car and an occupant weighing 150 lbs., 2,500 c. ft. of gas is sufficient. One of the features of the new air boat is that the cost of building a car and bag sufficient to carry one person is about £20. A speed of four to six miles an hour has been attained by good oarsmen. There is always the drawback, characteristic of the ordinary rowboat, that it is difficult to row against the current, or rather against the wind in this case.

A Weighbridge for Heavy Motor Cars has been introduced by Messrs. W. and T. Avery, Ltd., Birmingham. The machine weighs up to 15 tons, and its platform measures 14 ft. by 8 ft. When the car is in position on the bridge the weight on each axle can be read separately, or the weight of the car as a whole.

Marine Engineering and Shipbuilding Notes.

By Chas. S. Lake.

More Submarines for the French Navy.

There are at the present time no fewer than twenty-four submarines of large size under construction for the French Navy. Of these six are of the *Emeraude* class, whilst the remaining eighteen are of a somewhat larger type. The latter vessels are being built at Cherbourg, Rochefort, and Toulon. They will have a length of 167 ft. 8 ins., a beam of 16 ft. 4 ins., and a normal draught of water of 10 ft. 3 ins., the displacement being 398 tons. It is evident that by adopting submarines having such a displacement as this the French Naval authorities regard these vessels as something more than weapons of defence, and we may expect before long to be using the term "submarine cruisers" in truth, and not merely in a conjectural sense. These new French submarines will be almost as large as 30-knot destroyers, and will have main engines, driving twin propellers, and working up to 700 horse-power, giving the vessels a submerged speed of 12 knots. The crew will consist of two officers and 22 men. Each boat will carry seven torpedoes, and the flotilla is expected to be completed for service in eighteen months.

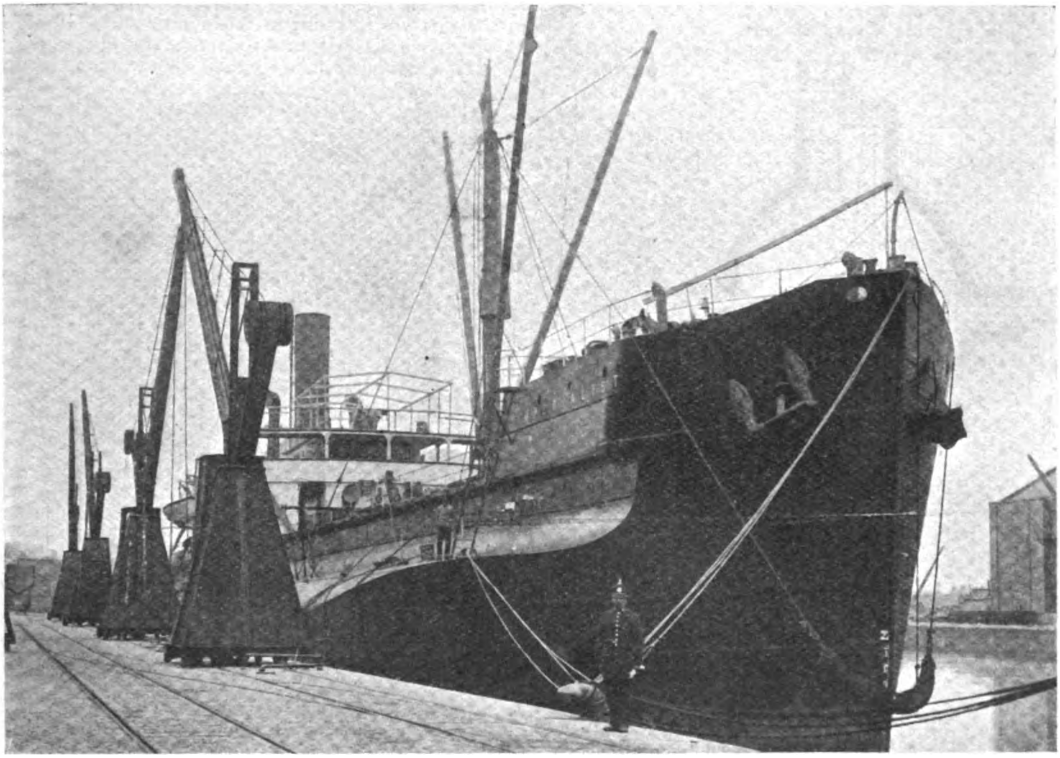
The R.M.S. "Carmania."

The Cunard *Carmania*, which is the largest turbine steamer in the world, and also the first vessel of this description to sail between the United States and Europe, is advertised to leave Liverpool for New York on her maiden voyage on December 2nd. Preparations are being made in the United States to give the vessel a stirring reception. The *Carmania's* passenger accommodation is of the same magnificence as that of the recently introduced

Caronia on the same service, and by the addition of these two great floating hotels the Cunard Company have increased their tonnage during 1905 by 40,000 tons.

A SHIP WITHOUT BEAM.

Paradoxical as such a statement may appear at first sight, it is nevertheless a fact that Messrs. Doxford & Sons, of Sunderland, are at present engaged in the construction of a vessel which will be to all intents and purposes a beamless ship. Messrs. Doxford have invented a new type of boat, in the design of which an application of the cantilever principle is incorporated. Instead of beams crossing the holds, stout stanchions are raised at the sides, and diagonal joists run from the tops of these to the upper decks. The new vessel will have a smaller draught in proportion to dead weight, and will give greater freedom for shipping long and bulky goods, and it is anticipated that the type will achieve equal popularity with that of the turret class of vessel which Messrs. Doxford have done so much to bring to the fore. The turret ships have many advantages, and are especially useful for trading into foreign ports where there is no dock accommodation, in which case the low "harbour" decks at the sides of the ship are advantageously brought into use when loading into lighters alongside. The illustration shows the *Imperialist*, a 7,000-ton steamer, built by Messrs. Doxford & Sons a few years ago, and in which the writer sailed as engineer to India and the Cape.



THE TURRET STEAMER "IMPERIALIST."
(Built by Messrs. Doxford & Sons, Sunderland.)

NEW MOTOR-BOAT SERVICE.

A motor-boat service has recently been inaugurated on the Hamble river, between Southampton, Hamble, Warsash, Swanwick, and Burlesdon. Hitherto communication between these places has been only of the most meagre description, but as the boat rates are very considerably below those of the railway, and the service is more direct, it may be anticipated that the enterprise will be rewarded with successful results.

There are two trips daily in each direction, and residents in the Hamble river districts will find the service convenient for shopping in Southampton. Each boat is 52 ft. in length, and has a beam of 10 ft. 6 ins., and accommodation for 61 passengers is provided.

ADDITIONAL STEAMER FOR THE HEYSHAM ROUTE.

The Midland Railway Company have recently accepted delivery of the twin-screw steamer *Wyvern* for service between Heysham and Ireland. The vessel has been built by Messrs. Ferguson Bros., of Port Glasgow, under Board of Trade and Lloyd's surveys, and she has a No. 3 passenger certificate. The main engines are of the compound surface condensing type, steam being supplied by a large multi-tubular boiler.

A Design for a Model Elektra Turbine.

By Rev. W. Bredin Naylor.

Since reading Mr. Harrison's interesting article on the Elektra turbine, I have been struck with its possibilities for model steamer work, and have tried to design a model, simple of construction and, at the same time, offering a probability of reasonable efficiency. Mr. Harrison has very kindly helped me, and I venture to place the following design before your readers, in the hope that it may interest those who, like myself, find a certain fascination in the steam turbine compared with other motors.

Small models of the De Laval turbine are not very efficient, owing to the difficulty of making the blades close enough to prevent waste of steam, and also to the loss of power in the gearing.

For the main features of the Elektra turbine I may refer my readers to the article in the *M.E.* of May 11th. It will be seen there that the steam, after leaving the nozzle, is made to pass four times through the blades, by means of curved passages in the casing, before finally exhausting. The energy of the steam is thus more completely made use of than can be accomplished in the De Laval type, the result being that the velocity of the wheel is much reduced, and gearing done away with or reduced to more manageable proportions.

Turning to the drawings which accompany this design, Figs. 1 and 2 show the construction. The blades *b* at right angles to the plane of the wheel revolve between two concentric rings (*r r*) containing the steam passages (*p*). These rings, as also the casing ends c^1 and c^2 are castings in magnalium, or other easily worked alloy of aluminium (not in pure aluminium, which is unworkable in the lathe), the wheel (*a*) being brass or gunmetal. The blades are formed on the German toy principle, illustrated in the *M.E.* handbook on Steam Turbines.

For the blades it will be necessary to procure a couple of inches of brass tubing, 2½ ins. diameter, 1-32nd in. thick. A circle of hard wood 1 in. thick, screwed to the faceplate of the lathe, and turned a tight fit for the tubing, will serve as a mandrel; drive the tube on carefully, and true the projecting edge; ¼ in. from the edge scribe a line round the tube, and another at ⅜ in. (*a*, Fig. 3). The first line serves as a guide for drilling the holes to form the blades, and should be scribed as lightly as distinctness will allow; the second line is for parting off after the holes are drilled.

Mark off the first line as accurately as possible into eighths of an inch, and make a slight dot at each intersection, with a sharp-pointed centre punch, to ensure starting the drill truly. A hand-drill and 1-16th-in. drill may now be used to drill the hole round the tube, cleaning away the burred metal from inside; then with sharp, thin-bladed shears cut from the edge to the centre of each hole, as in *a*, Fig. 3, which shows how the ring is marked off and cut, and also two finished blades. The blade ring may now be parted off, and the curving of the blades proceeded with. Those who have a lever press or punching jig might make a pair of dies, as in *b*, Fig. 3. If the curve of the dies be made to the same radius, and sufficient pressure be applied, the blades can be made with some approach to

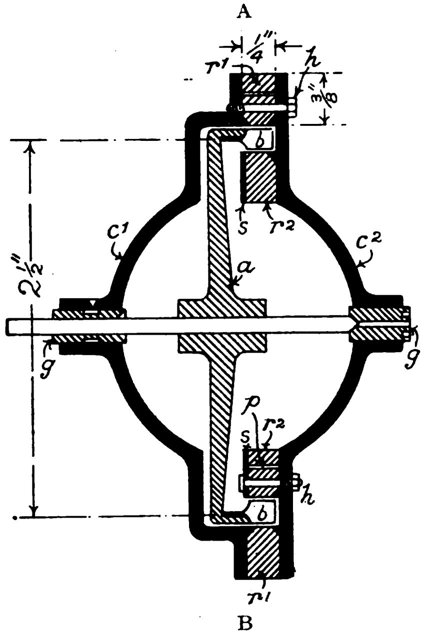


Fig. 1.—Cross-section.

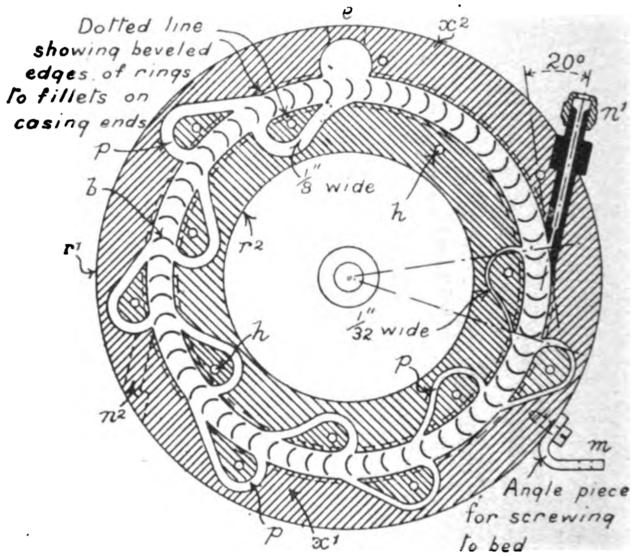


Fig. 2.—Section through A B.

A DESIGN FOR A MODEL ELEKTRA TURBINE.

correct section, and at the same time widened; but a simpler plan may be used. Get a pair of small pliers and cut off the ends of the jaws, leaving them $\frac{3}{8}$ in. long; file one jaw to the desired curve—in this case 5-32nds in.—and rivet a hollowed piece of the same radius to the other jaw. This can now be used to curve the blades uniformly and quickly. Put the ring on one side, and proceed to the wheel (*a*, Fig. 1); chuck and turn it on both faces. The projecting rim should be turned inside, so that the blade ring can be slipped in tightly. The depth of this recess should be such that when the blades are twisted half-round the upper shoulders of the blades fit against the edge of the rim. A blade made from a scrap of sheet brass will serve as a template. Now tin the edge of the blade ring and inside of rim, slip the ring in and sweat it in place, making sure that it is evenly in place all round. The blades are next given a half twist, using a strip of steel with a saw cut in the end to do this; heat the rim again till the solder runs between the edge of the rim and the shoulders of the blades. The edges of the blades, inside and out, will need a slight trimming in the lathe, and plaster-of-Paris should be poured round the blades, and allowed to set hard, otherwise they will most likely be broken off. Chuck the wheel by the boss, and turn away the plaster from the outside cautiously till the blades begin to appear, then exchange the tool for a fine-cut flat file, and bring all the blades to the same level, the outside of the rim being turned to the same diameter. Bind a few turns of copper wire tightly round the outside to keep blades and plaster in place while doing the inner edges; a sharp-pointed boring tool in the slide-rest taking a very light cut will be the safest way to do this. Before taking the wheel from the chuck drill through the boss for the shaft, as shown in the drawings; this is a piece of $\frac{1}{8}$-in. steel rod, pointed at one end, the cone for the other bearing being turned separately, and driven on. A more elaborate shaft can be turned, if preferred, from $\frac{1}{4}$-in. steel rod, with a tapered boss for the wheel, as in the full size turbine, the bearing cone being turned from the solid. Chip away the plaster from between the blades, and the wheel, when in place on the shaft, should run truly, and should be tried between centres for balance; a scrap of solder may be run inside the rim on the lightest side, if any adjustment is needed.

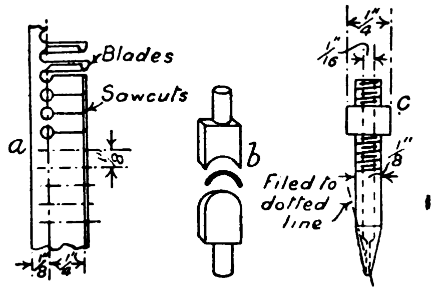
The outer ring (r^1, Figs. 1 and 2) may now be commenced; face evenly on both sides, and turn the outside of ring true; then chuck it by the outside and turn inside until it is 1-16th in. wider than the extreme diameter of the blades, bevelling off the inside edges to fit fillets on casing ends, as shown by the dotted lines on Fig. 2. The inner ring is treated the same way, but only one outer edge is bevelled, a shrouding of thin brass (*s*, Fig. 1) on the inside next the wheel keeping this ring in place.

Before cutting the steam passages (*p p*, Figs. 1 and 2) finish the casing ends, turning the inner faces and triangular fillets to fit the two concentric rings. The centre bosses are drilled $\frac{1}{4}$ in., and tapped for the adjustable gunmetal bearings. Not having a screw-cutting lathe, I used a chaser of 36 threads to the inch to make a tap and die for such bearings. The threads are turned off for $\frac{1}{8}$ in. in the centre of the bearing to make an oil-way; two or three small holes bring the oil to the shaft. Set-screws, or thin lock nuts, are used to tighten up the bearings when adjusted. These bearings can be adjusted till the blades are in their correct position.

Tracings of the steam passages should be made on thin paper, taking care that the end of one passage is diametrically opposite the beginning of the next. On reference to Fig. 2, the passages will be seen to be wider for a short distance at the entrance; this is necessary, owing to the space between the blades, in order to catch all the steam passing through. The passages also grow slightly wider from nozzle to exhaust, the increase in width being under 1-64th in. in each consecutive passage.

Drill the hole through the outer ring for the nozzle at an angle of 20°. The nozzle (*c*, Fig. 3) is $\frac{1}{4}$ in. diameter where it passes through ring, and may be screwed part of its length, or simply pushed into place.

Cut out the tracings with scissors, and paste each portion on its respective ring, taking care that the outer ring corresponds with the nozzle hole. The holes (*h h*) for bolts are to be drilled through the rings first, then through each casing end, clamping the rings to c^1 in their respective positions while drilling. The holes in c^2 are drilled tapping sizes and tapped; also the holes in c^1 for the inner ring bolts. The bolts not only clamp the rings in place, but also, with the aid of the fillets, keep the separate pieces forming the steam passages in their correct



METHOD OF CUTTING BLADES. DIES FOR FORMING BLADES. NOZZLE.

FIG. 3.—MODEL ELEKTRA TURBINE DETAILS.

position. The passages are meant to be cut out with a fretsaw—preferably a machine saw; the small pieces must be carefully marked to ensure replacing exactly.

The first few passages may be widened by filing the detached pieces slightly; as they grow wider, two cuts can be taken with the saw, which should be well lubricated with turpentine.

The nozzle (*c*, Fig. 3) comes last, and as the bore of this depends on the evaporative power of the boiler and the steam pressure, I cannot do better than refer my readers to the tables in the handbook on Model Turbines for sizes. Supposing the nozzle be designed for 30 lbs. pressure at the standard evaporation of 1 cub. in. a minute, drill the nozzle with a 1-32nd-in. drill; then get a strong darning needle, break off an inch or two of the point, and drive it up the nozzle until of the right diameter (as measured by a micrometer); this will also give a slight taper to the nozzle, which will be an advantage. The nozzle should be drilled

1-16th in. from the union end as far as possible, without the drill breaking through the other end.

In this design the steam passes through the blades twelve times before exhausting, but as an alternative two nozzles might be used with advantage, as n^1 and n^2, the exhausts being at x^1, x^2. The passages for n^2 would then duplicate the first five, but the passages would widen more rapidly towards the exhaust.

No design for gear is shown, but I would suggest the use of pulleys with a band of the fine coiled spring used in camera shutters, which is non-slipping, or the fine steel chain found in the winding arrangement of lever watches might be tried running in oil. Do not dismantle your watch, however, for the sake of the experiment—a watchmaker may be able to supply you.

It will be asked what power may be expected from this turbine, and I say frankly I don't know. In a small size such as this, it will be largely a matter of accurate construction and trial. It was designed for a boat between 3 and 4 ft., and it might be possible to drive a small propeller at a high speed without having to use gearing. One thing must be noted—no provision is made for getting rid of condensed water, consequently the steam must be slightly superheated, and the steam pressure should be as high as possible, as I find, from experiments made with small turbines, that any pressure under 30 lbs. is of little use.

I hope some of my readers who have made a study of the subject will criticise this design, as I feel it is open to improvement, and their suggestions might be of assistance to those inclined to spend some of the long winter evenings in building an Elektra turbine.

A Working Model Steam Colliery.

By T. Thomas.

THE photographs reproduced herewith are of my steam-working model colliery (shown complete in Fig. 1), which has taken me 18 years of my spare time to make. The pit frame (or headgear), shown in Fig. 2, is an exact model of the famous Deep Navigation Colliery headgear at Treharris, near Cardiff, where I have worked for 12½ years. The headgear alone took me seven years to make. It is all brass—with the exception of the copper-snapped rivets, of which there are 10,325 in that alone—and stands 3 ft. 6 ins. high, by 3 ft. 6 ins. long over back stays, by 12 ins. wide, and weighs 161 lbs.; the pulleys or sheaves are brass 8½ ins. diameter, with 30 3-16ths in. diameter brass spokes in each. I may here state that the Treharris Deep Navigation pits are the deepest in Wales, 700 to the 4-ft. seam, and the headgear the finest and most massive in the country, made by the De Burgh Engineering Company, Manchester. The sheaves or pulleys on top are 21 ft. diameter in the tread, and weigh 10 tons each, and are all steel. My model winding engine (Fig. 3) is double-acting, with cylinders 1½ ins. bore, 3 ins. stroke, with link reversing motion. The winding drums are only 1½ ins. diameter, so as to get as many revolutions as possible, as the pit is only 4 ft. 6 ins. deep, and are fixed one each side of the brake-wheel, whereas if I made the winding drum in proportion to the engine, she would bring the bond up on two revolutions, which would not

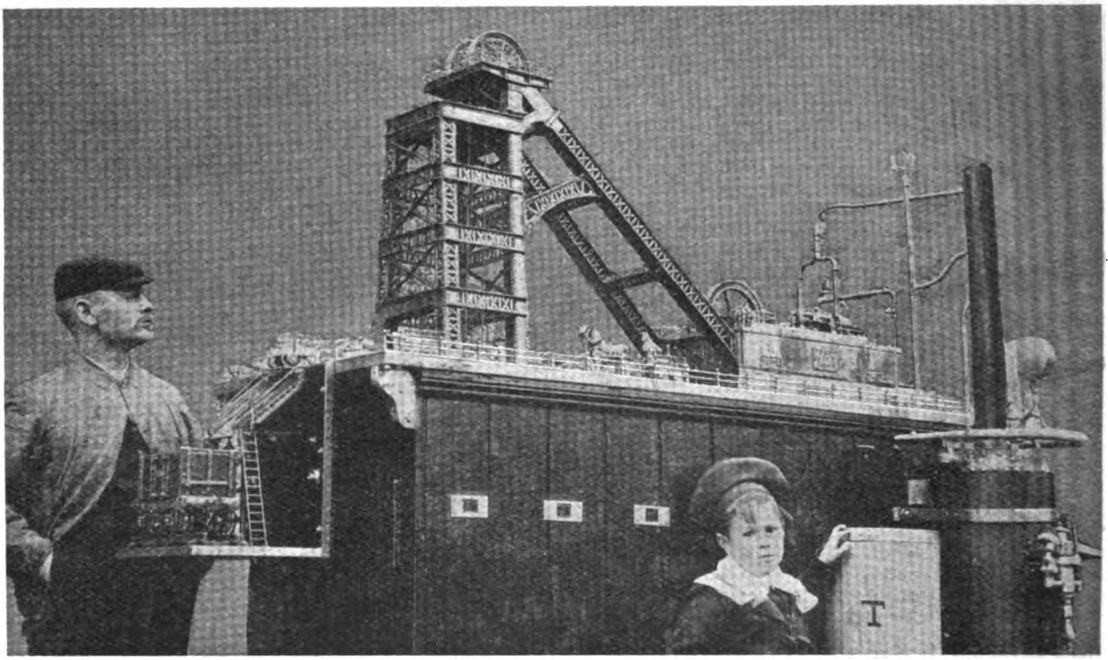


Fig. 1.—Mr. T. Thomas and his Model Steam Colliery.

FIG. 2.—PIT HEAD FRAME AND GEAR.

screening bars to screen the small from the large coal. The model 10-ton railway wagon shown in the same photograph is made of brass and wood, with side and end doors, spring buffers and spring coupling, also leaf springs and brake arrangement. There are 188 brass bolts and nuts in it, and 150 copper snapped rivets. The coal trams (Fig. 4) are brass-riveted, with 50 copper rivets in each. The keps or fangs upon which the cages rest when they are at the top of pit are made of steel, with coupling boxes to adjust to length (the arrangement is shown at Fig. 7); little banksmen 4 ins. high work the levers by a secret arrangement. The vertical steam boiler (Fig. 6) made by Thos. Goodhand, New Brompton, Kent, is of the best Weardale steel, with water space around fire-box, with one 3-in. central flue, and stands 2 ft. 6 ins. high by 12 ins. diameter. It is a capital steamer; it speaks for itself, inasmuch as it has driven a double $1\frac{1}{2}$ ins. by 3 ins. engine four years with no trouble whatever. I made all fittings myself, with the exception of the steam and water gauge. The feed-pump is worked by hand, and is saddled on to the boiler

look effective; she also has an indicator worked off the crank-pin by a drag-link, to show to the engineman the exact positions of the cages in the pit. The engine is driven by a little man 6 ins. high, as seen in photograph. He has the reversing bar in his left and the throttle valve lever in his right hand, and the foot-brake is worked by his left foot, and works in conjunction with the throttle valve. There are 165 hexagon nuts and bolts in the engine alone, and she weighs 2 cwts.

The pit cages are brass, with over 200 copper snapped rivets in each cage, and have frog-gear scotches; the winding rope is $\frac{1}{4}$-in. diameter. Walker's (of Wigan) patent detaching hooks are in use on each rope end (as seen in photograph, Fig. 4), in case of overwinding, and although I have put her to overwind hundreds of times before thousands of people, neither of the hooks have failed once. The cages are guided in the pit by four 3-16ths in. diameter steel ropes, fixed at bottom of pit, and tightened on top by 5-16ths in. eye-bolts. The screen (Fig. 5) is also made of brass, with

with $1\frac{1}{2}$ ins. angle iron. Each little model man on the colliery has an improved Clanny lamp made of brass, each one composed of 18 parts. There are dozens of other parts belonging to the colliery not spoken of here, nor shown in photographs. The model colliery in working order stands

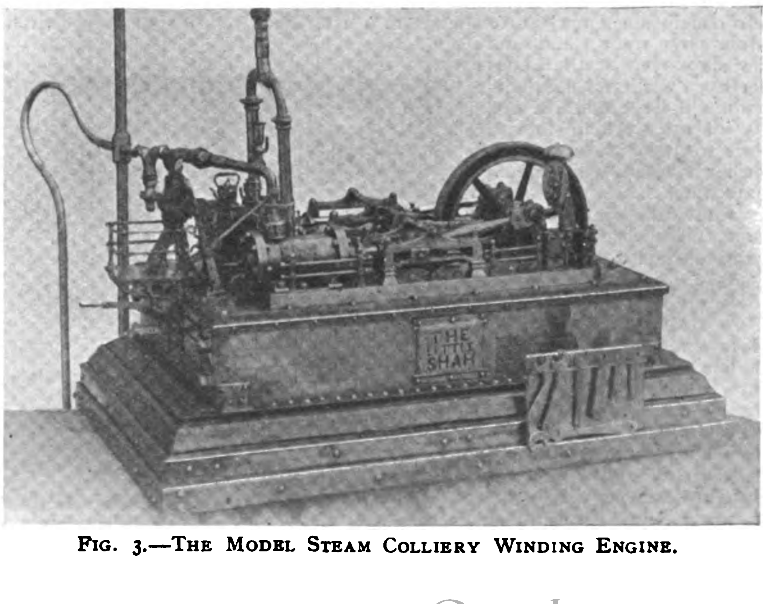


FIG. 3.—THE MODEL STEAM COLLIERY WINDING ENGINE.

7 ft. 6 ins. high, 8 ft. 6 ins. long, by 4 ft. wide, and weighs 12 cwts. I have been as brief as possible in the description of my models, but must say I have been a reader of THE MODEL ENGINEER since the commencement, from which I have many times derived valuable help and information, especially when I have read and seen the photographs of other people's work, they have considerably encouraged me.

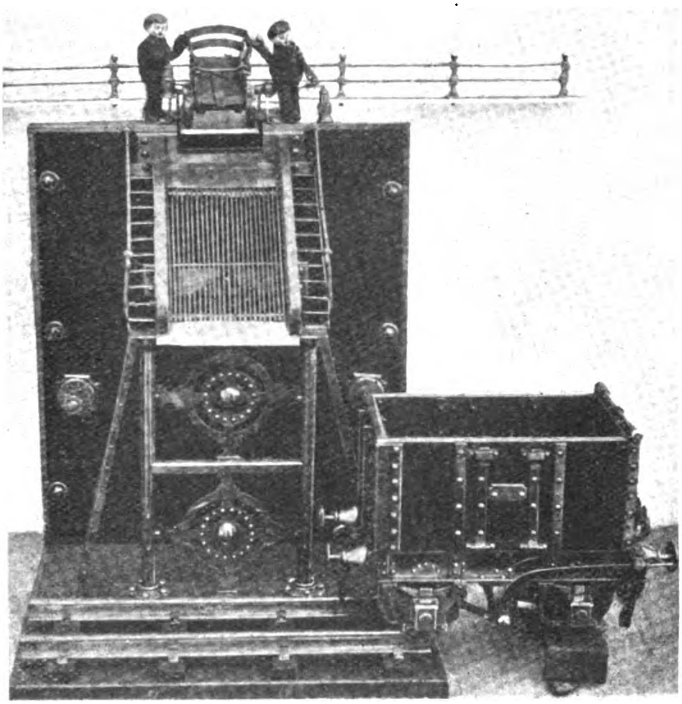


FIG. 5.—MODEL COAL SCREEN AND WAGON.

In conclusion, I may state that I am a fitter and turner by trade, and am now employed at the Lewis Merthyr Collieries, Senghenydd. I have not lost one day of my work in the 18 years to make these models, neither have I ever had much spare time. The model can be seen any time at my home, near Cardiff, by appointment.

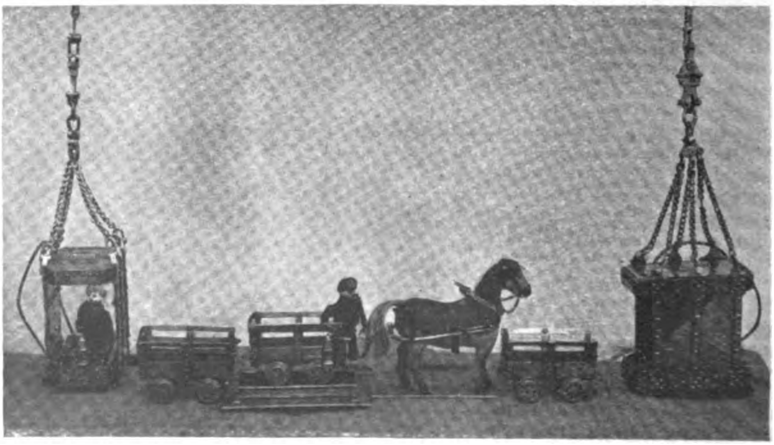


FIG. 4.—THE COLLIERY CAGES AND COAL TRAMS.

"ACID METAL," often called "lead bronze," stands well the corrosive action of mine water, and is therefore suitable for parts of machinery employed underground. This alloy consists of 75 per cent. of copper, 15 per cent. of lead, 9·9 per cent. of tin, and 0·1 per cent. of phosphorus.

Home Electric Lighting.

By CYRIL N. TURNER.

(*Continued from page* 400.)

ANOTHER carbon plate will now be required about the same size, with terminal attached. Wrap this carbon over with good brown paper, and fasten with string or india-rubber bands (the brown paper prevents the carbon from making contact with the zinc, as it stands with the zinc in the outer cell). The zinc can be a piece cut from thin sheet zinc—say, 1-32nd in. thick, as sold by ironmongers, or obtainable at any builder's yard, and should measure about 11 ins. by 7½ ins., and should have a terminal fitted (Fig. 8 plainly shows the arrangement). It will be noticed that the carbon in the outer cell is connected to the carbons in the porous pot, thus greatly reducing the unusual resistance of the battery. Solution for porous pot is made as follows:—2 ozs. bichromate of potash, ½ oz. oxide of manganese, 4 ozs. of boiling water (to dissolve the crystals); then add very slowly 4 ozs. of sulphuric acid, and stir well while doing so; then add ½ oz. permanganate of potash. When cool, add another 4 ozs. of sulphuric acid slowly while stirring. This mixture should be made in a strong jar out of doors, or in an empty fireplace, to allow the fumes to escape. There are no fumes given off from the battery while working. Solution for outer jar, 6 ozs. of common salt, and fill up with water.

Mr. Caroll does not advise amalgamating the zinc. This cell is capable of giving 3 amps. at nearly 3 volts pressure for 10 hours, which is equal to 30 amp.-hours. If a 2-volt lamp is used with

5 yds. of No. 28 iron wire as a resistance, one cell will keep it alight for thirty hours. Mr. Caroll says: "The object of the shunt carbon plate is to

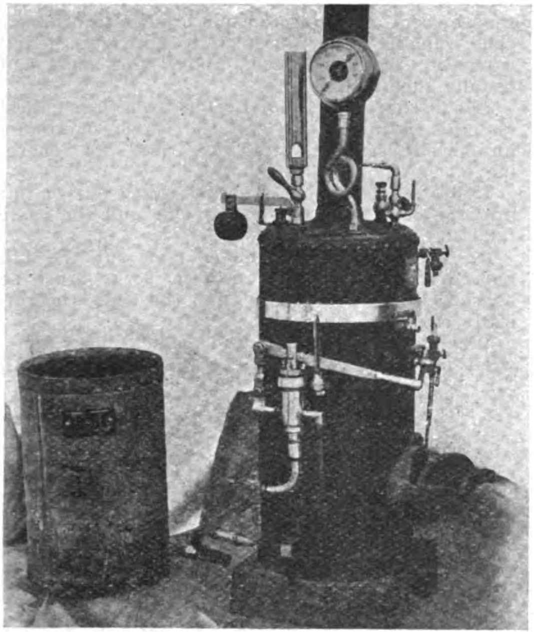


FIG. 6.—MR. T. THOMAS'S MODEL VERTICAL BOILER.

absorb the oxygen out of the spaces of matter, and shunt it round to the carbon in the porous cell, thus lowering the resistance of the cell." There are many ways to couple up the shunt for different work.

"three-wire" system. The shunt plate *certainly* does lower the resistance of the cell.

This shunt system may be used with good effect in the case of nearly every double-fluid cell. Mr. Caroll has designed this cell from his original theory that electricity is carbonised oxygen.

For other batteries and more detail as to construction, I should advise the reader to refer to that excellent little handbook "Electric Batteries" (No. 5 of THE MODEL ENGINEER Series).

General Hints.—Carbons may be lead-capped very easily indeed in the following way:—Carve out in a piece of chalk (or make a mould in plaster-of-Paris) a groove about ½ in. wide by ¾ in. deep and ½ in. longer than the width of the carbon. Now drill two holes in the carbon about ⅜ in. from the top, and stand this top in the centre of the groove, and pour in molten lead, which will run into the holes in the carbon plate forming a perfect "key." For large batteries it is very handy to cast one top to three carbons in a half-circle, so as to fit round the cell, thus leaving one common terminal. It is advisable to vaseline the carbons just below the lead to prevent the solutions from creeping up the plate and corroding the terminals. The 7-lb. stone-ware jam jars make excellent battery jars; but when choosing them, see that none of the glaze is chipped; also get the kind with wide necks or, better still, parallel ones with no necks at all.

Where small broken carbon is required use broken arc-lamp carbon, or "retort scurf," which is obtainable at the gas works; coke is not so good, and must be avoided when harder carbon is obtainable. Coke must on no account be used for the carbon mixture for dry batteries, as having hard carbon is one of *the* chief factors of success.

THE CONSTRUCTION AND MAINTENANCE OF ACCUMULATORS.

In electrical installations the addition of accumulators is an immense advantage, and, in fact, cannot be very well dispensed with, as, if the

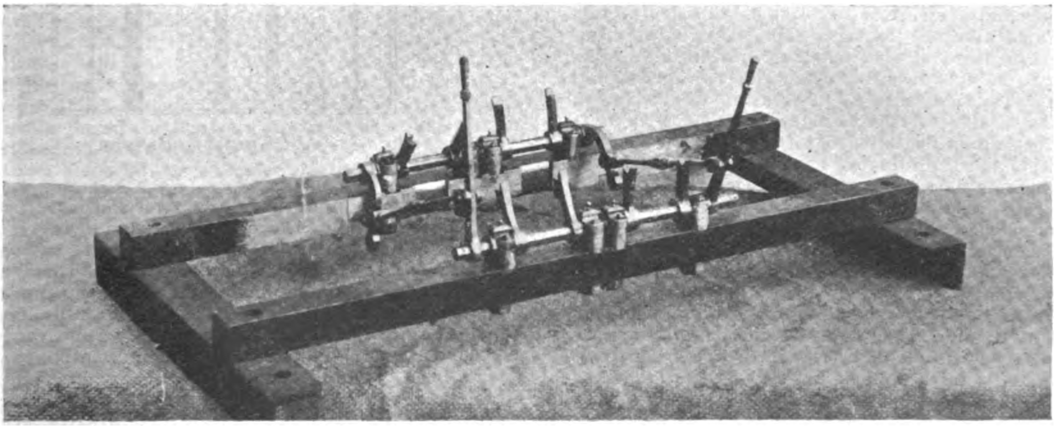


FIG. 7.—ARRANGEMENT OF FANGS FOR HOLDING AND RELEASING THE CAGES AT TOP OF PIT.

Lamps may be lit in circuit direct as ordinary batteries, or bells or lamp may be worked through the shunt, coupling up this way: three wires consisting of two positives and one negative—almost a

lights are required intermittently, as is usually the case, it is obvious that a dynamo or powerful primary battery cannot be always in readiness to supply current at the mere turn of a switch; so it will readily be seen that accumulators are eminently suitable for this purpose.

An accumulator is an appliance where to all appearances electricity is stored up—in fact, they are sometimes called storage cells—but such is not actually the case. The principle of an ordinary Faure type accumulator is as follows:—

While the accumulator is being charged (*i.e.*, the current from some source is being sent into it) the elements undergo certain chemical changes, the positive plate gradually forms into peroxide, and the negative into fairly divided spongy lead of a very porous nature. When the two terminals of the cell are connected for discharge, current flows in the opposite direction, for the reason that the two elements while they are so connected try to gradually re-form themselves into their original state.

The capacity of an accumulator, as before stated, is expressed in ampere-hours (see page 397). This capacity is controlled by the size and number of the plates in the cell, and when calculating this capacity the surface offered by both sides of the positive plates are taken into consideration, if both sides are active—that is, where a negative plate is in parallel with it. Thus it will be seen that it is advisable to always have one more negative plate than there are positives, so as to utilise both sides of the first and last positive. In amateur-made accumulators not more than 16 amp.-hours per square foot of positive surface should be calculated upon in designing the plates; but experienced makers obtain from 30 to 40 amp.-hours per sq. ft. No matter what size or number of plates an accumulator cell contains, it has never more than 2 volts normal pressure; so it is evident that to obtain more voltage several cells must be connected in series—*i.e.*, the positive terminals of one cell to the negative of the next cell, and so on.

Rate of Charge.—The voltage of charging current must be 25 per cent. higher than the total voltage of the cells to be charged (taking each cell as having the normal pressure of 2 volts), or, in other words, we must allow 2½ volts per cell. This is the minimum pressure of the charging current allowable, and it is not desirable that the voltage should greatly exceed this. The reason of having a higher E.M.F. of the charging current than that of the cells is the fact that the cells have a back E.M.F., and so unless we have a higher pressure in the ingoing current to overcome this back E.M.F., the cells will discharge back to the dynamo or source of supply.

A very usual rate of the charging current in amperes for an ordinary lighting cell is one-tenth of their capacity; for instance, an accumulator of 100 amp.-hours would take comfortably a charging rate of 10 amps. Of course, an accumulator may be charged with less than a tenth of its capacity, but this takes a longer time to effect.

To illustrate a case in point! Some large accumulators of 420 amp.-hours' capacity, and, therefore, entitled to 42 amps., charged up splendidly at the rate of only 15 amps., although, of course, it took longer; but it will usually be found that the ten per cent. rate of charging is the best to maintain accumulators in good condition. This rate must not be mixed up with those cells which are specially designed for heavy discharges and discharges having thick plates, or very many medium ones, but only the same capacity being allowed for as the ordinary type. Small cells of 50 amp.-hours' capacity and under have a higher rate of charge than this. The ten per cent. charging formula applies to ordinary cells, ranging from about 50 to 400 amp.-hours' capacity; the larger cells above this have not usually such a high rate.

The discharging rate of a cell is from the smallest amount required up to the same maximum number of amperes that are used for charging.

If too much current is either taken out or put into the cells the paste will buckle and the paste fall out.

An accumulator will never give out the full amount of current sent into it, so it must be charged for a little longer than the time theoretically required.

When a cell gasses well, and the acid turns somewhat milky, it is said to be fully charged. An

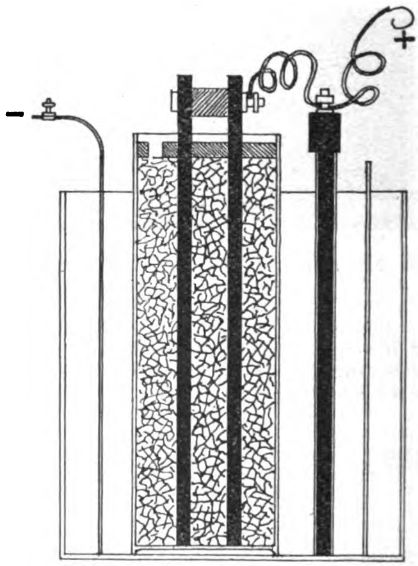


Fig. 8.—A "Shunt" Battery.

accumulator cannot be really overcharged to its detriment through the correct current being sent into the cell for too long a period. It is even advisable about once a month to give them an "overcharge" for a short time—*i.e.*, continue to charge from half to one hour after the cells have all gassed up well and have a milky appearance. This cleans the plates and prevents sulphate of lead from forming, which would have the effect of insulating the plates to a certain degree, thus impairing the capacity of the cell greatly; this fault is commonly called "sulphating." When plates have once begun to sulphate it is a difficult matter to remove it, and the old proverb, "Prevention is better than cure," must be taken to heart. The addition of a little caustic soda or carbonate of soda is sometimes recommended, which to an extent prevents sulphating; but one need never be troubled with it if the cells are kept charged well. If for any reason the cells are not to be used for a while they should be charged up before leaving, and just a short charge given them every two or three weeks. Should the cells have to be stored away, or through any other reason should the acid require to be removed, it is advisable for the cell to be discharged to about 1·8 volts, when the acid may be syphoned out by means of an indiarubber tube, after which it should be rinsed out with water. In a battery of accumulators where the cells are fully charged an inspection should be made while they are still being charged. Should a cell appear to be gassing less than the others (or not at all), a strong light should be held at the side of the glass cell so that it shines between the plates; it will then be a very easy matter, by looking down, to see if any paste has fallen between any two plates; if so, it should be immediately dislodged by the help of a thin strip of glass or paraffined wood. The paste, by thus bridging any two plates, forms an internal short-circuit, which, if not removed at once, may permanently injure the cell. Short-circuiting and too heavy discharges cause the paste to fall out and the plates to buckle. The bottom of the plates should always stand off the bottom of the containing box, so that any sediment will sink to the bottom, and thus fall clear of the plates. It would otherwise cause an internal "short."

For stationary work glass cells should be used, as it is an immense advantage to be able to see easily as to what condition the plates are in, and how they are progressing during a charge.

The sulphuric acid solution when first filling should be of 1·175 specific gravity; when diluting the acid it must be added to the water, and *not vice versa*, as otherwise the acid will spray violently, which would be very dangerous to the person, and detrimental to the clothes.

When any acid does splash, a timely application of strong ammonia to the place will prevent further action, as it neutralises the effect of the acid. A strong solution of common washing soda has the same effect. The water used should be either distilled or boiled. The action by diffusion of the strong acid in water creates heat. The cells should on no account be filled with the solution before it has cooled. The acid should be mixed in a strong glazed earthenware crock, or, as a makeshift, an ordinary wooden lard pail, obtainable at any grocer's for 2d. or so, answers the purpose well, although the acid soon gets through and attacks the metal bands round it.

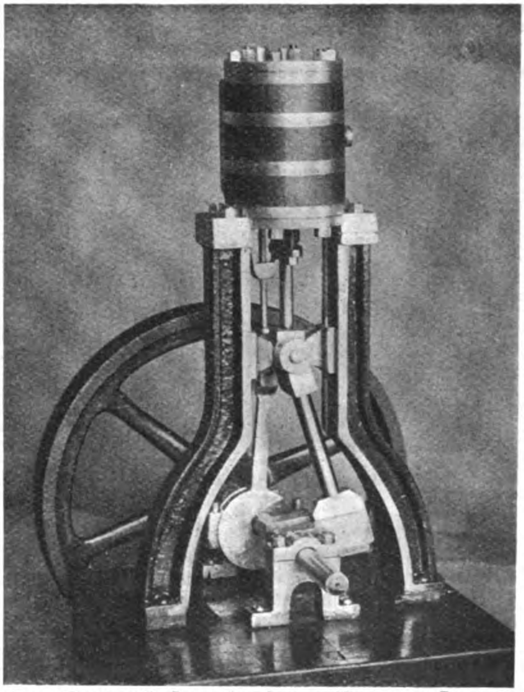
An easy and good way of filling the cells is to get an ordinary funnel from a tinman's and coat it with wax or tallow by heating the funnel and rubbing a candle over it. An indiarubber tube is slipped over its end. This tube is put down to the bottom of the cell to be filled, and the diluted acid is poured down through the funnel and rises in the cell from the bottom. By this means the filling is very gentle, and there is not the risk of disturbing any of the paste on the plates, as there would be if the solution were poured into the cell direct from a jug. When the accumulator is fully charged the specific gravity of the acid should rise to 1·200 or more, after a full charge the voltage of each cell may be about 2·2 to 2·3. However, after about an hour's discharge it drops to 2 volts, which it steadily maintains until nearly the end of the discharge. When the cells only register 1·8 volts each the discharge must be stopped, and the recharging begun as soon as convenient.

(To be continued.)

A Model Vertical Steam Engine.

By Henry J. Croft.

The model vertical steam engine here illustrated is my third attempt at model making. The crankshaft and castings of columns were given me. I bought castings of bearings and forked end of connecting rod and fly-wheel; the remainder is built up from scraps, including all bolts and nuts. Since it was photographed I have added link-reversing gear, which makes it a more interesting model. The cylinder is built from solid drawn brass



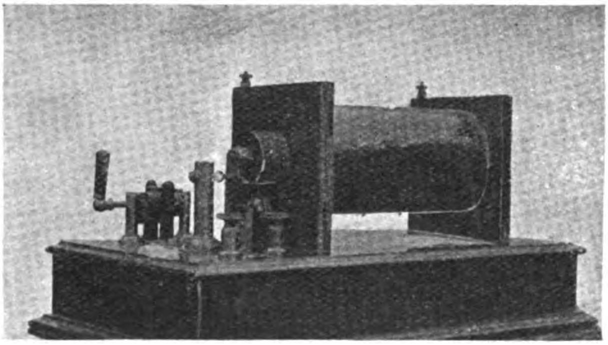
Mr. Henry J. Croft's Model Vertical Steam Engine.

tube $\frac{1}{8}$ in. thick, flanges and valve face bolted and sweated on, and is lagged with mahogany, with brass bands. Piston and rod, crosshead and valve and rod are Muntz metal; eccentric sheaves are turned from solid; eccentric straps and rods are from sheet steel 3-16ths in. thick. Connecting-rod and reversing-rod are parts of cotton spindles (which, by the way, are very useful in many ways). The following are the principal dimensions: Cylinder, 2-in. stroke, 1-in. diameter; valve travel, $\frac{1}{2}$-in.; shaft, $\frac{3}{8}$ in.; crosshead, $1\frac{3}{8}$ ins. wide; fly-wheel 7 ins. diameter, $\frac{3}{4}$ in. on face; total height $12\frac{1}{4}$ ins. There are 72 nuts and bolts altogether. I have tried it under steam from a small boiler, and with 10 lbs. of steam she ran over 700 revolutions per minute, running light.

A 4-in. Spark Coil.

By Geo. F. Tanner.

The accompanying photograph shows a 4-in. spark coil constructed by the writer. I may say the coil has proved a great success, and although designed to produce a 4-in. spark, a much longer spark, it is believed, could be obtained by using suitable battery power. A 3-in. spark is produced by a 4-volt portable E.P.S. accumulator, and this, used with a modern Righi or Oudin oscillator, is sufficient for most wireless experiments. It has been constructed in the orthodox fashion, except as regards the number of sections; these are rather more than usual, there being 70 sections. The writer is much in favour of using as large a number of sections as possible, with a view to reducing the leakage due to arcing between points where a sufficient difference of potential exists. By using a large number of sections it is apprehended the following advantages will accrue:—(1) The difference of potential between adjacent points is kept low; (2) the insulation between points is



Mr. G. F. Tanner's 4-in. Spark Coil.

improved; (3) Points between which there is a considerable P.D. are not near enough to favour internal arcing. The less internal leakage there is in a coil the more efficient it is; and, although it is impossible to eliminate this altogether, yet in a good coil it should be small. The principal dimensions of the coil are as follows:—

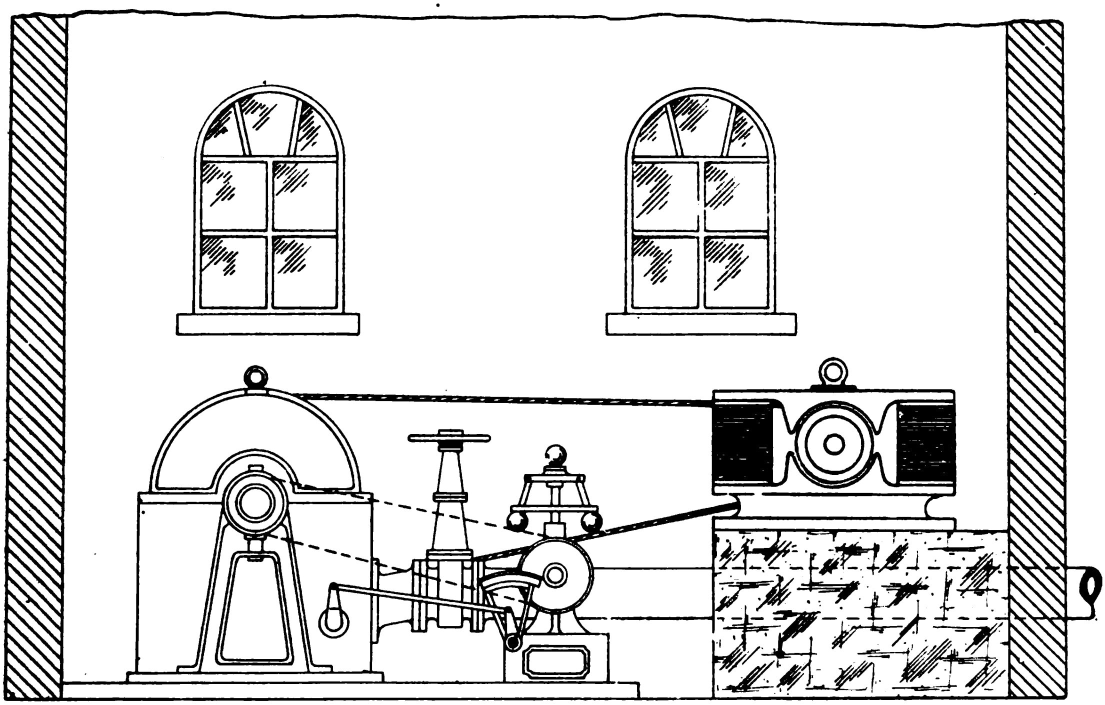
(1) Central iron core, 1 in. by 9 ins.
(2) Red fibre tube, 1·75 ins. by ·125 in. by 10·6 ins.
(3) Available length between ebonite cheeks, 8 ins.; total diameter of coil, 4 ins.
(4) Ebonite cheeks, 5 ins. by 5 ins. by ·5 in.
(5) Condenser, 72 sheets tinfoil 10 ins. by 6 ins.
(6) Base, 10 ins. by 14·5 ins. by 3 ins.

For the primary winding two layers No. 14 cotton-covered wire are wound. The secondary consists of from 3¼ lbs. to 3½ lbs. No. 36 single-cotton-covered wire wound in 70 sections each, 1 in. wide, two best pieces of white copying driers being placed between each, and the joint tucked between. These driers were also used in the construction of the condenser, the whole of the condenser being compressed whilst warm in an ordinary copying press. Paraffin wax was used for insulating. Each joint in the secondary was removed a few degrees of arc away from its neighbour after being insulated with silk, the ends being brought up through holes drilled in the ebonite cheeks to the terminals. To prevent the possibility of sparking round the tube from the secondary to the primary or hammer head, the tube is carried some distance outside the cheeks, and on the vacant end an ebonite plug is screwed in, and at the hammer end a ring of ebonite is screwed, so that the hammer head is just free to vibrate inside. The hammer is of the ordinary Nieff pattern. The utmost care will require to be taken during the construction of the secondary to avoid sections being placed in opposition, and this applies with special force where the number of sections is large. To obviate difficulty in this connection the ends of a section might be marked by differently coloured silk before any section is removed from the winder, then different colours only should be joined together. A commutator of the ordinary barrel type has been added for convenience, and other smaller details can be gathered from the photograph.

An Electric Generating Plant.

By J. R. G.

The following particulars of a well-arranged electric plant, driven by water-power, may be of special and instructive interest to readers of The Model Engineer. It tends to point out the superior qualifications of a plant thus driven, in place of steam in this particular case. This installation is situated amidst splendid scenery in the rural district of Cragg Vale, within a few miles of Hebden Bridge, Yorkshire. The locality is one where manufacturing in the heavy woollen and cotton trade flourished twenty or thirty years ago, and at that time enjoyed its full share of prosperity. Since then, owing to severe competition and the better means of rival firms near town and rail in despatching their finished goods, these outlying districts were soon left behind, and deserted by both trade and inhabitants. The particular mill where this installation is fixed is well known in the district as "Turvin Mill," situated towards the top of Cragg Vale, Heythomroyd being the nearest station, about three miles distant. The mill in its old days was driven by means of two old water-wheels, the waste overflow water from the first wheel drove the second wheel. These two were backed up by an old-fashioned jet condensing steam engine, steam being supplied by a low-pressure Cornish boiler. The No. 2 water-wheel and engine were still there a short time ago, but were not in use. Three years ago, after having stood idle and deserted for over twenty years, "Turvin Mill" was taken over by a manufacturer of ability and with some up-to-date ideas, who commenced to remodel the power and lighting methods with which this article mainly deals. He purchased the old water rights, in which were embraced a constant supply of compensation water from some higher level reservoirs in the district, and made a storage reserve on his own behalf at a height of 165 ft. above the power-house, this giving him a water-pressure of about 70 lbs. per square inch. The installation proper consists of a Pelton water-wheel enclosed in an iron case and fixed over the tail-race. The wheel runs at a speed of 320 revolutions per minute, and upon the shaft is mounted a rope pulley 4 ft. in diameter, grooved for 7/8 in. ropes, by means of which the power is transmitted to drive a compound wound Manchester type dynamo, generating electric current of 330 amps at a pressure of 110 volts (see sketch of arrangement). The power house is situated in the lowest position in the valley practical with the necessary tail-race clearance. The water is led down from storage supply to power-house by means of a line of 14-in. bore cast iron pipes, which convey a good supply of water for all power at present required. The water can be passed on to wheel through one or two nozzles according to load on dynamo. The speed of wheel is controlled by a belt-driven governor which actuates slides passing over nozzle-ends. The system of governing is excellent, the voltage of dynamo being very constant. The electric current generated is transmitted underground by means of a lead-covered and steel-armoured concentric cable of 37-12 capacity to the mill on the hill-top about 200 yards distant. The current is then used for both lighting and power purposes, the principal power generator being a 4-pole shunt wound motor capable of giving 30 b.h.-p. used for driving weaving and other machines in connection with same. There are some smaller motors and about 100 16-candle power incandescent lamps. The whole of this power is generated with a small amount of attention in comparison with the old method of generating power. The coal for steam-raising had alone to be carted three miles, all on a rising gradient, several attempts to find coal near at hand having proved unsuccessful. I have no doubt there are many similar plants in such out-of-way places which would be interesting to hear about. I may say, in conclusion, that when I saw the above-mentioned installation a short time ago, "Turvin Mill" was again enjoying another spell of prosperity; the place being in full employment day and night.



General Arrangement of a Small Electric Generating Plant.

Blowing Wells, sometimes known as breathing wells, are now being investigated by the United States Geological Survey. They have already examined many wells that emit currents of air with more or less force, sometimes accompanied with a whistling sound audible for a long distance. The best-known examples of this type of well are found throughout Nebraska. The force of the air current in one of the Louisiana wells is sufficient to keep a man's hat suspended above it. The cause of such phenomena is mainly due to change in atmospheric pressure or to changes in temperature.

Wire Drawing.—Because the wear upon the hardest steel dies precludes the possibility of a uniform wire diameter from beginning to end of the drawing, diamonds are now extensively used for dies, especially for small wire up to about 1-40th in. in diameter. The diamonds used for this work weigh four to five carats each and cost about £3 to £4 per carat. With these dies it is said to be quite practicable to draw platinum wire down to a diameter of 0·0005 in.

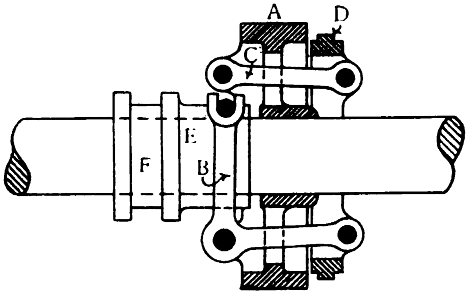
Practical Letters from our Readers.

[The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a nom-de-plume *if desired, but the full name and address of the sender* MUST *invariably be attached, though not necessarily intended for publication.]*

Single Eccentric Reversing Gear.

TO THE EDITOR OF *The Model Engineer.*

SIR,—Having seen different methods which have recently appeared in THE MODEL ENGINEER. for reversing with single eccentric, I venture to send you another form of gear, which appeared through an old number of the *Mechanical World,*



A SINGLE ECCENTRIC REVERSING GEAR.

dated 1895, if the same may prove of any interest to your readers.

The above illustration is a sectional view of the arrangement. Referring to the sketch, A is a wheel keyed on the crank-shaft (which in this case serves as the governor-pulley, having four lugs cast on, and receiving pins forming fulcrums for the bell-crank lever B, and the distance-link C, both of which have pin-centres of exactly equal length. D is the eccentric having similar lugs, and receiving pins which attach it to the other end of the bell-crank and distance-link. E is the sleeve connected to the bell-crank lever, and is moved along the shaft by a hand-lever oper .ting a forked clutch in F. The eccentric is shifted from full forward to full backward gear without altering the lead, and its movement is such that in any position it remains parallel to centre line of engine and at right angles to the crank-shaft.

The above gear is the patent of Messrs. Mann and Charlesworth, Engineers, Leeds, which at the above date they were fitting to the road tractions built by this firm.—Yours truly, R. A. PEAKE.

Shropshire.

Lapping Cylinder Liners in the Lathe.

TO THE EDITOR OF *The Model Engineer.*

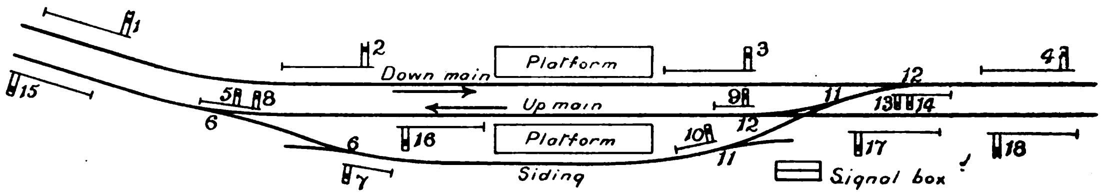
DEAR SIR,—In reply to the letter in October 19th issue by Mr. V. W. Delves Broughton, his method of using a lap of softer material than the liner is practical enough for large jobs, such as ring gauges, which require very little taken off to get the exact size, and this is generally done by hand; but this paper THE MODEL ENGINEER generally deals with model work, and the job I applied my method to was a hard phosphor bronze piston valve liner, ⅜ in. inside diameter. To make a lead lap with a steel centre, this size would take a considerable time, whereas any thoughtful model maker will have a stock of steel wire in his workshop. I have tried using a softer material for the lap, and I find that the pull of the belt, or cord, and the motion of the liner soon wears the lap hollow in the middle, and thus you get a liner larger at the outside than the middle; but a hard steel lap will not wear at all, or very little, and so keeps the liner perfectly parallel. To finish off, you can use the steel lap dry to burnish the inside of the liner, and after this I think you will have a better finished job than you would have with a lead lap.—Yours truly,

Newcastle-on-Tyne. J. T.

Model Railway Design.

TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—With reference to the above, described in your issue of the 12th inst., there are two errors —viz., the signal "siding to down line" is reverse way, and the "up home" is marked on the siding signal. Herewith I send a complete practicable signalling scheme for "Midlands" station



1, Down Main Distant Signal; 2, Down Main Home Signal; 3, Down Main Starting Signal; 4, Down Main Advance Signal; 5, Signal Up Main to Siding; 6, Points Up Main and Siding; 7, Signal Siding to Up Main; 8, Signal Set Back on Up to Down Main; 9, Signal Up to Down Main; 10, Signal Siding to Down Main; 11, Points Down Main and Siding; 12, Points Main Cross-Over; 13, Signal Down Main to Siding; 14, Signal Down Main to Up Main; 15, Up Main Advance Signal; 16, Up Main Starting Signal; 17, Up Main Home Signal; 18, Up Main Distant Signal.

PLAN OF SIGNALLING ARRANGEMENT FOR MODEL RAILWAY STATION.

"B." You will observe I have added a slip connection, which forms a direct connection between the main lines; also two trap points in the siding to protect main line through working. This scheme only deals with station "B," and embodies all Board of Trade requirements.—Yours faithfully,

"SIGNALLING."

TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—I thank Mr. Caldwell Smith for his letter, and I agree I have violated one of the chief signalling rules in real practice by using the calling-on arm for shunting in both directions.

In the real practice of signalling such a plan of using the arm for shunting over a road in both directions might be mistaken by a driver, and an accident result; but with my system of electric control this is quite impossible. The electric current being switched in permits the passage of the train, and the having a signal guarding the road, and lowering on the current being switched in, is only to be representative of the real practice, and is not required for actually controlling the trains; in fact, signal posts with arms could be done without, but then, of course, it would spoil the realistic appearance of the railway, and this I am strongly against; and I advocate full signalling of the track, as in the real practice, and as shown by Mr. Smith.

The signals left out in my drawing (page 307, September 28th issue), do not affect the safe and right control by electric signal, and as our track is only about 60 ft. long and for experimental work, they were left out to save work. I omitted to point this out in my first letter.

Our main-line track will be correctly signalled as representative of the real track.

It is absolutely necessary to have the points and signals correctly inter-locked in the box, but I did not deal with this part in my first letter, as I did not consider it came in, the subject I was dealing with, and space also would not permit.

I suggest that the advance-starter signal be placed nearly opposite the distant signal, instead of on the gantry, for the following reason:—In my letter of September 28th I suggested a switch in main cable be placed in each signal-box, and then a system of block signalling could be adopted. If this block section extended from one box to the other, before shunting could take place at either end the permission of signalman in next box would be needed to switch in main cable.

If signalman in box B switched in current to permit shunting at A after A had done some shunting, he might despatch a train to B, when B had only given his permission for shunting, and not for a train to enter his section. Such a possibility would be dangerous even in model practice, and to obviate same the block section should extend between the distant signal of each box only, the third rail between the distant signal on one side of station and advance starter signal on the other side of station being supplied by a separate main cable to that supplying third rail in block section. The advance starter signal should be controlled by the home box and the box in section in advance, thus: A wire attached to the third rail in block section is connected to a solenoid working weight bar connected to arm of advance starter signal, the return wire being attached to running rail. The arm of advance starter signal is also worked by wire from "home box." Supposing it is required to send a train from home box, signalman rings up advance box, and if line is clear, advance box replies accordingly, switches in third rail in block section, and sets his signals in his station section. Now the action of switching in third rail in his block section supplies current to the solenoid working weight arm on advance starter signal post, and this is pulled down; but the signal arm does not fall, because it is still held up by the weight arm worked from home box. On home box pulling over his lever, however,

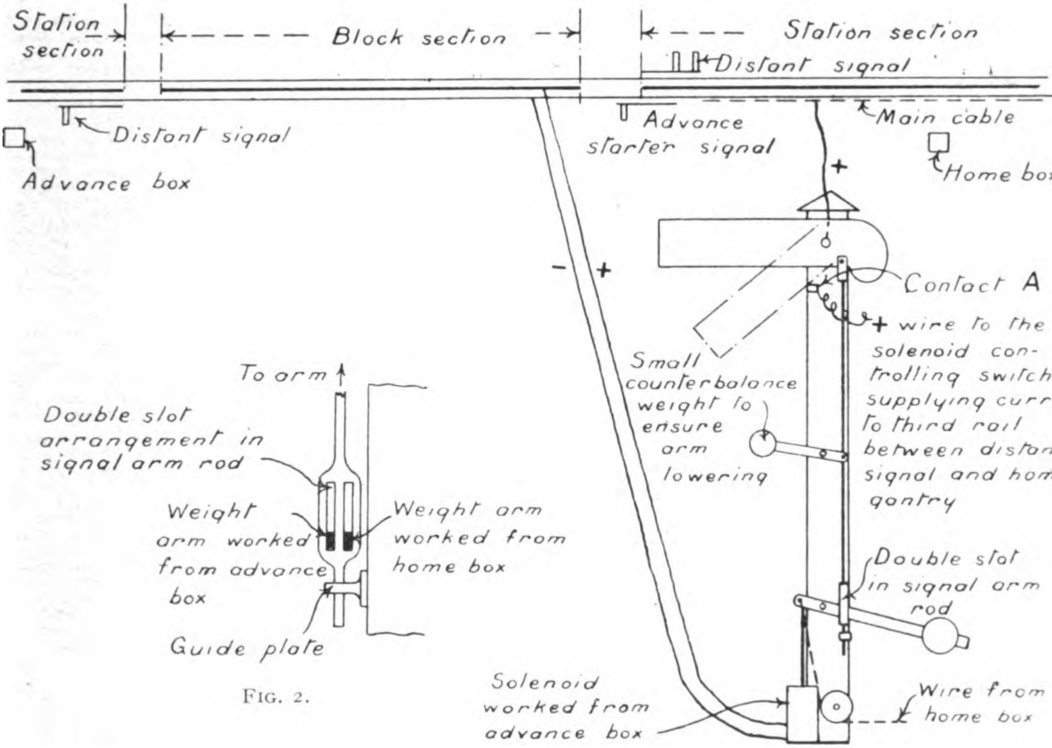


FIG. 2.

FIG. 1.—DIAGRAM OF ADVANCE STARTING SIGNAL AND CONNECTIONS FOR A MODEL RAILWAY.

and so raising his weight bar, the arm lowers, and in so doing touches the contact A (see drawing), and completes the circuit, supplying current to solenoid working the switch supplying current to third rail between home gantry and advance starter signal. Directly either signalman withdraws his permission the arm flies up to danger, and the circuit to switch being also broken, the current in third rail is cut out. The advance starter signal protects the line behind it by placing it where shown on drawing. I thank Mr. Smith for his offer of complete locking list, and should be very pleased to have same.—Truly yours, WILLIAM E. WEBB.

Harlesden, N.W.

The Society of Model Engineers.

[Reports of meetings should be sent to the offices of THE MODEL ENGINEER *without delay, and will be inserted in any particular issue if received a clear nine days before its usual date of publication.]*

London.

THE usually monthly meeting of the Society was held at the Holborn Town Hall, Gray's Inn Road, on Monday, October 23rd, the chair being taken by Mr. D. Corse Glen at eight o'clock, and about seventy members and visitors being present. The minutes having been read and approved, three gentlemen were elected members, and Messrs. J. C. Taylor and S. L. Solomon were appointed auditors for auditing the accounts for the past year. The Chairman also announced that better accommodation had been obtained at the Holborn Town Hall for the storage of the track and other apparatus belonging to the Society, and during the evening the members of the Track Committee shifted the goods to the new premises.

A very varied assortment of articles were brought by members for inclusion in the Rummage Sale, the whole comprising 52 lots. The quality of the goods was considerably in advance of former occasions, and practically the whole were disposed of by the Hon. Sec., acting as auctioneer, to the satisfaction of both buyers and sellers. The Treasurer and Messrs. Greenly and Hildersley rendered the auctioneer much assistance in the speedy disposal of the goods. The only exhibit apart from those in the Rummage Sale was Mr. Blankenburg's *M.E.* loco, which was shown under steam on the track, its performance showing good workmanship.

The meeting terminated at 10.15 p.m.

FUTURE MEETINGS.—It is particularly requested, in view of the special business to be transacted, that all members who are within reasonable distance of London will make a point of being present at the Annual General Meeting, to be held on Thursday, November 16th, at the Holborn Town Hall. It is also requested that members will exhibit specimens of their work freely on that occasion.—HERBERT G. RIDDLE, Hon. Sec., 37, Minard Road, Hither Green, S.E.

POROUS CASTINGS.—To make a porous casting air and water-tight, prepare a saturated solution of copper sulphate, mix with it an equal quantity of commercial nitric acid. Dip the casting into the solution, or pour it over the casting on all sides, and let stand for a few hours.

Queries and Replies.

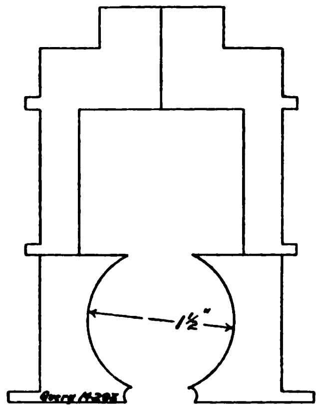
[Attention is especially directed to the first condition given below and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-hand corner of the envelope "Query Department." No other matters but those relating to the Queries should be enclosed in the same envelope.

Queries on subjects within the scope of this journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied, wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed. (4) Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of Replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor,* THE MODEL ENGINEER, *26—29, Poppin's Court, Fleet Street, London, E.C.]*

The following are selected from the Queries which have been replied to recently:—

[14,298] **15-watt Dynamo.** T. R. B. (Warfield) writes: Will you please be kind enough to answer the following query: I have bought a casting of undertype dynamo said to be 40-watts. I enclose a scale sketch. Can you tell me how much wire it will want and what size to get 10 volts, and as many amperes as possible? Armature, 8-slot drum, fields connected in shunt.

We doubt if you will get more than about 15 watts out of this dynamo, except at an excessively high speed, which is not desirable. Wind the armature with No. 25 or 26 gauge s.s.c. copper wire, eight coils round, two in each slot, connected to an 8-section commutator; wind field-magnet with No. 24 gauge s.c.c. copper wire, about 6 ozs. on each core, both coils connected in series with each



FIELD-MAGNETS FOR 15-WATT DYNAMO.

other and in shunt to the brushes. Get as much wire as you can on to the armature, about 3 ozs. will be the weight required; wind the field coils to a depth of ¼ in., run at a speed of 3,000 to 3,500 r.p.m.; test it with a 10-volt 1-c.-p. lamp. If it lights this well, then try others of larger candle-power until you reach the utmost output; the volts can be adjusted by running at higher or lower speed.

[14,777] **Secondary for "Powerful Shocking Coil" in Handbook No. 11.** W. T. (Dorchester) writes: I have been reading "Induction Coils for Amateurs" published by you, and note in Chapter 3 "How to Make a Powerful Shocking Coil," that you recommend 4 or 5 ozs. of D.C.C. copper wire for the primary winding; but you do not say how much is required for the secondary winding. I am rather anxious to "try my hand" at this coil, but, being my first attempt in anything electrical, I shall be greatly obliged if you will inform me (1) How much wire (by weight) will be required for the secondary winding? (2) Whether single cotton-covered or double cotton-covered is recommended? You also state that each layer of the secondary winding is to be covered by a layer of thin waxed paper. (3) Does this mean paper that has been dipped in paraffin wax?

(1) Wind until the bobbin is nearly full. (2) About ¼ lb. of No. 36 will do. D.C.C. (3) Yes.

[14,327] **X-Ray Screens.** A. St. A. (Glasgow) writes: I should be very much obliged if you would kindly answer the following questions:—(1) How can I make an efficient *x*-ray screen with calcium tungstate? I once made one by mixing with gum, but it was useless. (2) When will your new book on *x*-rays be out? (3) Can you tell me how Dr. Bodie, the public hypnotist, manages to pass a 6-in. spark into his arm? Is he using high frequency or induction coil current? (4) What is the best book on experiments with induction coils?

(1) Paint a sheet of clean cardboard with gum water, or, better still, with a solution of celluloid in amyl acetate. While still wet dust the calcium tungstate over out of a muslin bag, and leave to dry. Adopt any method of mounting or framing which you find convenient. *Note.*—If amyl acetate is used you must be quick, or the solution will dry, amyl acetate being very volatile. Remember that both celluloid and amyl acetate are very highly inflammable. (2) We hope early next year. (3) Dr. Bodie, we believe, uses ordinary high frequency discharges, such as are described in the series of articles by Mr. R. P. Howgrave-Graham in THE MODEL ENGINEER. Mr. Howgrave-Graham will shortly describe how a 6-in. spark can be taken to the body. (4) "The Induction Coil in Practical Work," by Lewis Wright.

[14,680] **"Simplex" Dynamo Failure.** C. W. (Peterboro') writes: I have made a dynamo of the "Simplex" pattern, from castings supplied by a firm that advertises in the *M.E.*, and I wish to ask you a few questions concerning it. It has a Siemens H-armature, wound with No. 24 s.c.c. wire, and field is wound with No. 22 s.c.c. It gives a good shock when driven at its proper speed (3,000 per minute), and also sparks at brushes. When I put a 2-volt lamp on it gave a red glow. I then put a 4-volt motor on, and it made it spark at motor brushes, but would not work it. A 4-volt lamp was then connected, and it lit that, as well as a 6-volt lamp; and when the 2-volt was tried again, it gave a good white light. It now fails to light a lamp at all, but still gives a good shock and sparks well. Any advice will be of great service, as this is my first attempt, and I do not want it to be a failure.

Perhaps all your lamps are burnt out; that is, you have unintentionally fused the filaments. The dynamo seems to be in order; perhaps you have the brushes either out of position or not making good contact. An ordinary shunt-wound dynamo does not do well when supplying current to a motor, unless the motor is very much smaller than the dynamo. Read the articles which have appeared in THE MODEL ENGINEER under "Lessons in Workshop Practice" during the last few issues; they refer to testing and using small dynamos. Try giving your motor armature a spin round by hand when the dynamo is trying to run it.

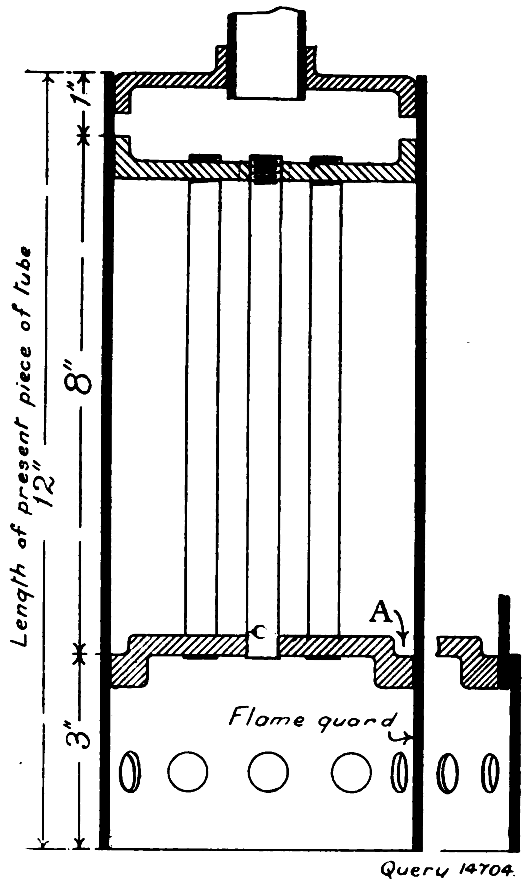
[14,749] **Cells for Small Electric Lamps.** J. H. (Thornaby-on-Tees) writes: I am thinking of fitting up a 4-volt 1¼ c.-p. lamp in my bedroom, and should like your advice on the matter. As I do not want to go to any more expense than I can help, I have thought of using three Leclanché cells in series if they will light one of the Universal Electric Supply Co.'s 4-volt 1¼ c.-p. loop pea lamps of high efficiency, but what do you recommend? I shall want to use it for half-an-hour at once, so I think they will want to be quart size cells. Could you tell me what gauge insulated wire would carry the current for this purpose from the battery you recommend; also would ordinary bell switches do? Could you also tell me what gauge insulated wire will carry the current safely from a four-cell Leclanché battery charging a 4-volt pocket accumulator, and also if a bell switch will do for closing the circuit?

Leclanché cells are not suitable for lighting a lamp, except for momentary lighting, such as a watch night-light. We advise you to try a battery made of cells such as described in THE MODEL ENGINEER for April 9th and 16th, 1903, or constant bichromate pattern, as described in Chapter IV of our Handbook No. 5. Ordinary bell switches can be used also for accumulator circuit. Wire should not be smaller than No. 22 gauge; this gauge will do, or any larger gauge; also same gauge wire for accumulator circuit.

[14,674] **Induction Coil Windings.** S. W. (Bradford Moor) writes: I should be much obliged if you would please enlighten me by answering the following:—(1) For the primary winding of the 6-in. spark coil in your MODEL ENGINEER Series No. 11, it gives 2 lbs. of No. 12 D.C.C. and in answer to my question as to how many layers this required, you answered and advised me to put three layers. Now the core is 1⅛ ins., and the *inside diameter* of the ebonite tube is 1⅜ ins., which leaves ⅛ in. all round the core for the primary. Is it possible to get three layers in ⅛ in. space, and if not what shall I do? (2) Is it quite necessary to have 100 sections in the secondary winding, and would it make any difference to have an odd number of sections—say, for instance, 97 sections? (3) If No. 36 single silk-covered wire is used for the secondary winding, is paraffin wax insulation necessary?

(1) No; you will require ⅜ in. space all round to get in three layers. As you have the ebonite tube, we advise you to wind two layers only on the core as a primary winding, and see how the coil works. You may get just as good results; it may mean that the coil will take more current. Induction coils are peculiar things; experts differ as to whether two or three layers are best for the primary, but you can safely try two. (2) No, the exact number of sections does not matter in the least. (3) It is absolutely necessary to soak the secondary wire in paraffin wax, as per the instructions given in our Handbook for the construction of a 4-in. spark coil, or as per some of the excellent directions given in back numbers of THE MODEL ENGINEER by several correspondents.

[14,704] **Model Boiler.** F. B. B. (Liverpool) writes: I have a piece of copper tube, 12 ins. long by 5 ins. diameter, which I should like to make into a vertical boiler. (1) How many tubes and size? (2) If fired with a gas-ring, how far should bottom of boiler be from gas-ring? (3) Would it be better with a firebox if same burner is used? (4) Would it keep a ⅝ in. by ⅝ in. high-speed engine going in order to drive a 10-watt dynamo? (5) At present the tube is in the form of a horizontal boiler with a 2-in. furnace tube and ½-in. cross tubes, and is fired with an "Etna" blowlamp, which keeps up 30 lbs. pressure with engine going full. Would the vertical do the same?



SECTION THROUGH MODEL VERTICAL BOILER.

(1) About fifteen tubes, ½-in. diameter outside. (2) About 2½ ins. between the top of the gas-ring and the bottom of the firebox. The same distance will suffice for a Primus burner stove. (3) A firebox is unnecessary, but if the ends of the boiler are cast, you may allow a space (A) for the mud to settle in, as shown in the sketch. The flame guard may be out of the solid tube, as indicated, or a separate structure. In the latter case, a greater length of tubes and range of water may be obtained. (4) The heating surface will amount to about 200 sq. ins. (gross), and the boiler should be capable of evaporating about 1·5 to 2·0 cubic ins. of water per minute. This amount of steam should (theoretically) run an engine with a cylinder ⅝ in. by ⅝ in. at a speed of 500 to 600 r.p.m., and with a pressure of 50 lbs. at the stop valve. However, this performance will not be obtained unless the steam is thoroughly dry and the pipes lagged. To reduce cylinder and steam-pipe condensation, the steam may be superheated by a coil in the firebox. Without reckoning electrical losses, the mechanical efficiency of both the engine and the belt drive to the dynamo, which would

reduce the total efficiency to about 35 or 40 per cent., the engine would produce about 30 watts: 40 per cent. of 30 watts is—

$$\frac{40 \times 30}{100} = \frac{1200}{100} = 12 \text{ watts.}$$

Therefore, with reasonable good workmanship, you ought to find the engine and boiler quite capable of driving a 10-watt dynamo. We note the pressure maintained by the present boiler, but presume that there is no load on the engine. There is a vast difference between running an engine light and loading it by driving a dynamo or other machine. When running light, the pressure of the steam in the cylinder will be much less than when the engine is doing useful work. We have no doubt that the above described boiler will do much better than the horizontal one, if it is properly fired.

[14,825] **Trunk Pistons; Condensing.** J. P. L. (Paisley) writes: Would you also give me your valuable assistance with the following? (1) Is there any objection to using trunk pistons in a model? (2) Is there any advantage in condensing the steam from a ¾-in. bore by ½-in. stroke, double-cylinder engine, using a water-tube boiler? (3) Approximate pressure for above engine in a 2-ft. 6-in. boat to give best results?

(1) The chief objection to trunk pistons in a model double-acting engine is the large amount of friction absorbed at the packed cylinder cover-gland. (2) No, unless you can maintain a vacuum by means of other power than that developed by the engine. The engine should be a compound to get any benefit from the condensing. (3) The pressure will be what you can get the boiler to maintain—25 to 30 lbs. would prove quite high enough for all practical purposes.

[14,860] **Locomotive Boiler.** A. D. P. (Dalston) writes: I should be very pleased if you will answer the following questions for me. (1) What size boiler should I require (copper) for a locomotive, with cylinders 1¼ by 2¼ stroke, four-coupled driving wheels 8 ins. diameter, 5 ins. between flanges? (2) Which would give the best results, a vaporising burner or ordinary fire for a loco boiler, with firebox 5 ins. long, 2½ ins. wide by 4½ ins. high, and four ⅝-in. bore water tubes across firebox, six ½-in. bore fire tubes through boiler 10 ins. long; diameter of boiler 4 ins.? If vaporiser is the best, will you give me a sketch showing how to make it, the spirit (methylated, petrol, or paraffin) supply to come from tender?

(1) The driving wheels are very large for an inch scale model, and therefore we would advise you to increase the *scale* of the design slightly, so that the boiler may be placed higher, and the maximum diameter obtained. The boiler may be 4¾ ins. diameter, the boiler centre being the scale equivalent of 8 ft. 9 ins. above rail level. You ought to be able to get in at least twelve to fourteen tubes, ⅜ in. outside diameter. The barrel should be about 11½ ins. diameter, this dimension varying according to the design of the locomotive. (2) An ordinary fire of good half-burnt coal or briquettes would work as well as anything—that is, if the water tubes do not come in the way too much. However, if the engine is not over-cylindered, you should find that two 2½ ins. "Primus" silent paraffin burners work excellently. Methylated spirit is out of the question. A petrol or benzoline burner could be designed for the work, but would require a certain amount of experimenting with to obtain the best results.

[14,870] **H.-P. of Engine for 2,000-watt Dynamo.** E. B. (Wolverhampton) writes: I should be pleased if you would tell me what h.-p. engine I should require to drive a Kapp type dynamo of 2,000 watts at 100 volts 20 amps., at full load. Dynamo has plain drum armature.

About 4 h.-p. Certainly *not less* than 3½ h.-p.

[14,903] **Cooling Petrol Motor Cylinder.** T. A. (Stockbridge) writes: I am thinking of rigging-up a cycle motor to drive a dynamo. I do not want to use a fan for cooling, but thought of covering the fins with flannel, and keeping it moist with a continual drip of water. I have looked through all my back numbers, but do not see anything on the subject. Do you think it would answer?

This would not be a very convenient or practical method to adopt. The flannel would gradually get burnt on the inside, and become carbonised. The steam generated would also be a nuisance.

[14,904] **Solenoid for Lifting Small Weights.** S. G. C. (Sheffield) writes: In connection with some experimental work I require a small inexpensive means of lifting a small weight (4 ozs. to 6 ozs.) a distance of ⅜ in. for one second or so at a time. Can I do so by means of a solenoid worked from a battery (Leclanché for preference)? If it can be done, I shall be grateful for dimensions of parts, diameter of wire, length, and all other particulars. If it is not possible to do all I want, how near can I get?

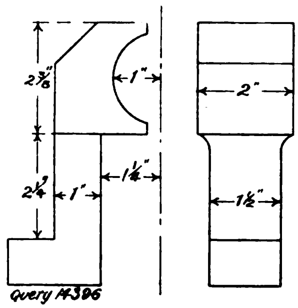
Leclanchés are hardly suitable; use bichromate. A solenoid would do this. Make core about ⅜-in. diameter and work it in a bobbin of about 1½ ins. diameter. Wind with about 100 yards of No. 24 S.W.G. wire. Apply 8 volts pressure for good large bichromate cells. Some experimenting may be necessary, and careful adjustment required.

[14,808] **Spark Coil.** A. W. M. (Plumstead) writes: I shall feel obliged to you if you will kindly give me your assistance in reconstructing my coil (primary, ¾ lb. No. 14 D.C.C.; secondary, 2¼ lbs. No. 34 s.c.c., 54 sections; core, 8 ins. long, 1 in. thick; condenser, 60 sheets tinfoil). I first intended building a 4-in., and purchased the materials as per your Handbook on "Induction Coils"; but when winding primary I could not get on more than ¾ lb. of wire, instead of the 1¼ lbs., as required for a coil giving this length of spark. I therefore let it go at this, and wound the secondary with 2¼ lbs. of No. 36 s.c.c. in 54 sections, as suggested by Mr. Pike in the *M.E.* of November 26th, 1903, thinking, perhaps, I should get at least 2 ins. of spark, but with two accumulators giving 8 volts, I can only get 1-in. I have also tried a bichromate battery of 12 volts, but failed to get any longer spark. If you will kindly answer these few questions below, it would assist me greatly and possibly lead to better results. (1) Will this quantity of primary wire do for a 2-in. coil, or would a finer kind be better? If a finer one is more suitable, will you kindly state gauge and quantity? (2) Have I too many sections on secondary (54)? If so, what would be a more suitable number? I have tested these for leakage, but find no signs, and the galvanometer deflects well when testing for continuancy. (3) How does the core compare with the quantity of primary wire? It is 8 ins. long, 1 in. thick, composed of 22-in. soft iron wire. If I have to use smaller gauge of wire, will this core do? Also please say the number of turns, there are now 138. (4) The condenser is composed of 60 sheets of tinfoil, interleaved as instructed. Is this quantity enough or too many? (5) When using mercury interrupter there is a sound as of sparks passing, but none show outside the coil. Would this point to a leak? (6) When using the coil I found it was allowing over 3 amps. to pass. Is this not excessive, and likely to damage accumulators?

(1) You might try a finer gauge on primary, but we do not think it will give better results. (2) No. Are you sure some of them do not oppose one another? (3) Core is of correct proportions. (4) Correct; but you might vary its size and note results. (5) No. Run the apparatus in a dark room, and watch for sparks. You can often detect a leakage like that. (6) Not at all for this size of coil. Add more accumulators in parallel if you take too heavy a current from them.

[14,396] **Winding for Small Overtype Dynamo.** D. B. C. (Todmorden) writes: I am thinking of buying the field-magnets for a small dynamo, and want to use a 12-slot armature if possible. Could you tell me what gauge of wire and weight would do for same, so that I could light a small lamp or run a motor for a model tramcar? I give a sketch of the field-magnets.

Wind armature with No. 23 gauge D.S.C. copper wire, get on as much as you can, about 6 ozs. will be wanted; wind field-magnet



FIELD-MAGNET FOR OVERTYPE DYNAMO.

with No. 22 gauge s.c.c. copper wire to a depth of ⅜ in., say about 1 lb wire on each core, join both coils in series with each other and in shunt to the brushes, run at about 2,800 r.p.m., and test with a 10-volt lamp; the volts can be adjusted by running at a higher or lower speed. For particulars of connections, method of winding armature, etc., see our Handbook No. 10.

[14,661] **Winding Armatures for 4-pole Dynamos.** E. W. B. (Birmingham) writes: I have the castings of a 4-pole armoured dynamo and the stampings for the laminated cog armature, but the laminations have 28 slots in them. I was reading a book on winding armatures for 4-pole dynamos, and the author said that 28 cogs were not the combination for this type, but should be either 26 or 30. Is this correct? Can you tell me which publication I can purchase which will deal with the type of dynamo I mention?

The relation between the number of slots in an armature and the number of poles in the field-magnet of a dynamo is determined by the type of winding to be employed. There are considerations to be regarded when designing large machines which would not need to be held when dealing with very small machines, so that unless you wish to go thoroughly into the matter, you would find the system illustrated on page 36 of our Handbook No. 10, Fig. 49, suitable for a small dynamo with 28 slots; the winding would be from slot 1 to slot 8, and then continue right round the armature, using 28 coils wound two in each slot, connected to a 28-section commutator, which should be cross-connected to opposite sections, as in the diagram if two brushes are to be used; or if this is not done, you would require to use four brushes and cross connect opposite brushes. A good book on the subject is that by Messrs. Hawkins and Wallis.

[14,798] **Watts per candle-power.** J. O. S. (Limerick) writes: I would be thankful for an answer to the following queries:— (1) *Re* Query 13,561, March 9th, 1905. Reckoning 3·5 watts per c.-p., 200 by 16 by 3·5 equals 11,200 watts; reckoning ·64 amp. per 100 volts, 16 c.-p. lamp equals 12,800 watts. How does this occur, and which is right? (2) Is it right to reckon 3·5 watts per c.-p. for all voltages? If not, what is right for different voltages? (3) I have a house wired for 130 volts' supply—will the same wiring do if the voltage is changed to 100?

(1) This is merely a slight variation of the estimated current a lamp takes. (2) It is always safe to reckon 3·5 watts per c.-p. (3) Provided a margin has been left for using the same (130-volt) wires for heavier current.

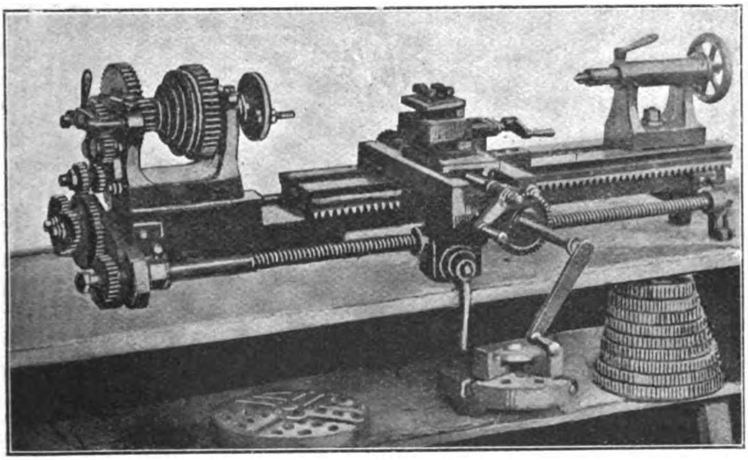
The News of the Trade.

[*The Editor will be pleased to receive for review under this heading samples and particulars of new tools, apparatus, and material for amateur use. It must be understood that these reviews are free expressions of Editorial opinion, no payment of any kind being required or accepted. The Editor reserves the right to criticise or commend according to the merits of the goods submitted, or to abstain from inserting a review in any case where the goods are not of sufficient interest to his readers.*]

• *Reviews distinguished by the asterisk have been based on actual Editorial inspection of the goods noticed.*

Lathes for Amateurs.

We illustrate herewith an amateur's 4-in. centre bench lathe made by Mr. G. Hallas, Shaftesbury Street, Alloa, N.B. The capacity of this tool is a piece of work 22 ins. long, 8 ins. diameter, or 11 ins. diameter in the gap. It is fitted with sliding and surfacing motions, independently of the lead-screw, which is only used for screw-cutting. Both headstocks and slide-rest have adjustments for turning tapers. Castings of this lathe are also supplied, and any part can be machined if required. Mr. Hallas also makes a 3 by 4 gas engine, suitable for driving the above lathe, which is supplied either in castings or made up. A list of prices will be sent on receipt of a stamp.



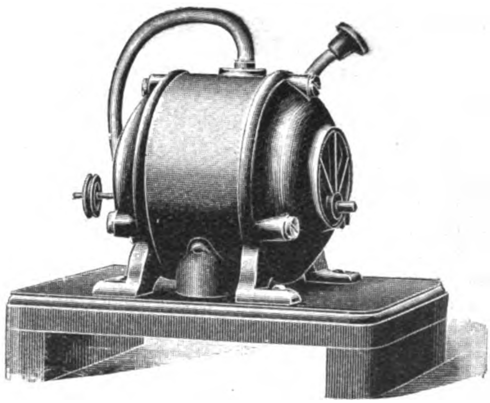
Mr. G. Hallas' Amateur's Bench Lathe.

"Railroadiana."

Under the above title Mr. Edward Baker, of 14 and 16, John Bright Street, Birmingham, has issued a most interesting 84-page catalogue of books, pamphlets, maps, guides, and time tables, connected with railways and railway history. All our readers who make a hobby of collecting railway and engineering literature will find this list well worth perusal, many of the works included being rare and of great historical interest. Mr. Baker has marked all the items at reasonable figures, and we have no doubt that many who see this list will be tempted to add one or more volumes therefrom to their collection. The price of the list is 3d., and its number (232) should be mentioned when ordering.

New Water Motor.

The illustration given herewith represents the new water motor which The Universal Electric Supply Co., of 60, Brook Street, C.-on-M., Manchester, are selling. The motor is specially made to drive small models, and is supplied complete, coupled with a rubber tube and jointing cup which fits on to any domestic water tap. By turning on the tap it revolves at a very high speed, taking very little water, and will light their Novelty dynamo brilliantly, if coupled to same. It is a perfect model of the Pelton wheel.



The Universal Electric Supply Co.'s New Water Motor.

A Business Transfer.

The Model Engineers' Co-operative Society, of 51, Summer Row, Birmingham, has been taken over by Carson & Co., engineers for light work, and will be carried on by them at the above address as well as their own work. The principal of the new firm is Mr. James Carson, an engineer of many years' experience, ex-member of the Council of Civil Engineers, Ireland, who will give his personal attention to design, details, and the general production of high-class work.

New Catalogues and Lists.

Messrs. W. J. Bassett-Lowke and Co., Kingswell Street, Northampton.—This firm are issuing their new season's catalogue in sections, the first of which (Section A) we have just received. This in itself is a substantial list of 140 pages, and is devoted to stationary engines, steamboats, racing yachts, locomotives, coaches, rails, points, accessories, and electrical goods. Among the new introductions we notice a series of model machine tools, some improved designs in model torpedo boats and destroyers, Great Eastern, South-Western, and American express locos, new patterns in rolling stock and permanent way, a L.N.W. self-contained electric loco, and a number of other attractive novelties. The locomotive section is very strong, and a very large assortment of both steam and clockwork models are illustrated. Owners of indoor miniature railways will find considerable interest in the list, which will be sent post free for 4d.

The Audley Engineering Co., Newport, Salop.—We have received a leaflet giving prices for various sizes of the Audley parallel vice, suitable for model makers; also the Audley machine vice for parallel or angular work.

The Editor's Page.

AT the recent Edinburgh and Midlothian Industrial Exhibition there was a very good entry in the section devoted to mechanical and electrical appliances and engineering models, and the competition for the prizes offered was very keen. Our own contribution to the prize-list, in the shape of a MODEL ENGINEER Silver Medal, was the object of much friendly rivalry, and two very strong bids for this distinction were made by Mr. J. A. Lind, of Joppa, N.B., and Mr. A. J. D. Harris, of Enfield Lock respectively, the former showing a working model of a clever electrical advertising device, and the latter a beautifully-made model of a horizontal undertype engine after the design published some time back in this journal. Both these exhibits appear to have possessed exceptional merit in the opinion of the judges, and we have thought well to give a Silver Medal to each. We hope to be able to give full particulars of both models at an early date.

* * *

While on the subject of exhibitions, we may give space to a complaint we have lately received from a reader who entered his model for competition at an exhibition where open classes were arranged. He states that his model was returned to him with some parts missing, some parts damaged, and the whole smothered in dust. Some of the accessories had been packed loose in the case, so that they had knocked against the enamelled portions of the model, and had so damaged its appearance. Further than this, he had evidence that his model, while on show in the exhibition, had been exposed to the careless and ignorant handling of any passer-by who cared to meddle with it. An experience of this kind is, of course, a very unsatisfactory and annoying occurrence, and we can fully sympathise with our correspondent when he says that it is hardly worth while exposing valuable models to such risks. At the same time, we are inclined to think that the case we have quoted is a somewhat exceptional one, as we know of a number of cases where similar models have been sent for exhibition and have been returned to their owners intact and in perfect condition. In any case, exhibitions of this kind do a large amount of good in promoting the art of model-making, and it would be a great pity that such happenings should be allowed to mar their prospects of securing good entries. The matter is one in which a number of our readers are interested, and we should be glad to have the experiences of others in this connection, either as organisers of such competitions or as exhibitors. Possibly some suggestions on packing and forwarding exhibition models, or on other points, may be forthcoming which may be of assistance in minimising or eliminating any future troubles of the kind referred to.

In our last issue we announced a prize competition for the best letters on the subject "How THE MODEL ENGINEER has Helped Me." Will those who have not seen the announcement please refer to page 432 for particulars? We shall look forward to a very interesting batch of communications.

Answers to Correspondents.

A. E. M. (Karachi).—Many thanks for your useful note, which we shall be pleased to insert.

W. H (Leytonstone).—Sorry we cannot use your contribution. The information has been published many times over.

P. S. B. (Clacton).—The article which appeare in our issues for May 14th and 21st, 1903 (Vol. VIII), "How to Photograph a Model," will repay you for reading.

A. M. (New Cross, S.E.).—Please adhere to the conditions of our Queries and Replies Department.

G. T. (Brockley).—The locomotive engravings you require can be obtained from this office for 3d. each, post free.

Notices.

The Editor invites correspondence and original contributions on all amateur mechanical and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected or not, and all MSS. should be accompanied by a stamped addressed envelope for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

This journal will be sent post free to any address for 13s. per annum, payable in advance. Remittances should be made by Postal Order.

HOW TO ADDRESS LETTERS.

All correspondence relating to the literary portion of the paper, and all new apparatus and price lists, &c., for review, to be addressed to THE EDITOR, "The Model Engineer," 26—29, Poppin's Court, Fleet Street, London, E.C.

All correspondence relating to advertisements and deposits to be addressed to THE ADVERTISEMENT MANAGER, "The Model Engineer, 26—29, Poppin's Court, Fleet Street, London, E.C.

All subscriptions and correspondence relating to sales of the paper and books to be addressed to Percival Marshall & Co., 26—29, Poppin's Court, Fleet Street, London, E.C.

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Contents.

[*The asterisk* (*) *denotes that the subject is illustrated.*]

THE

Model Engineer

And Electrician.

A JOURNAL OF PRACTICAL MECHANICS AND ELECTRICITY.

EDITED BY PERCIVAL MARSHALL, A.I.MECH.E.

VOL. XIII. No. 238. NOVEMBER 16, 1905. PUBLISHED WEEKLY.

A Watchmaker's Ingenuity.

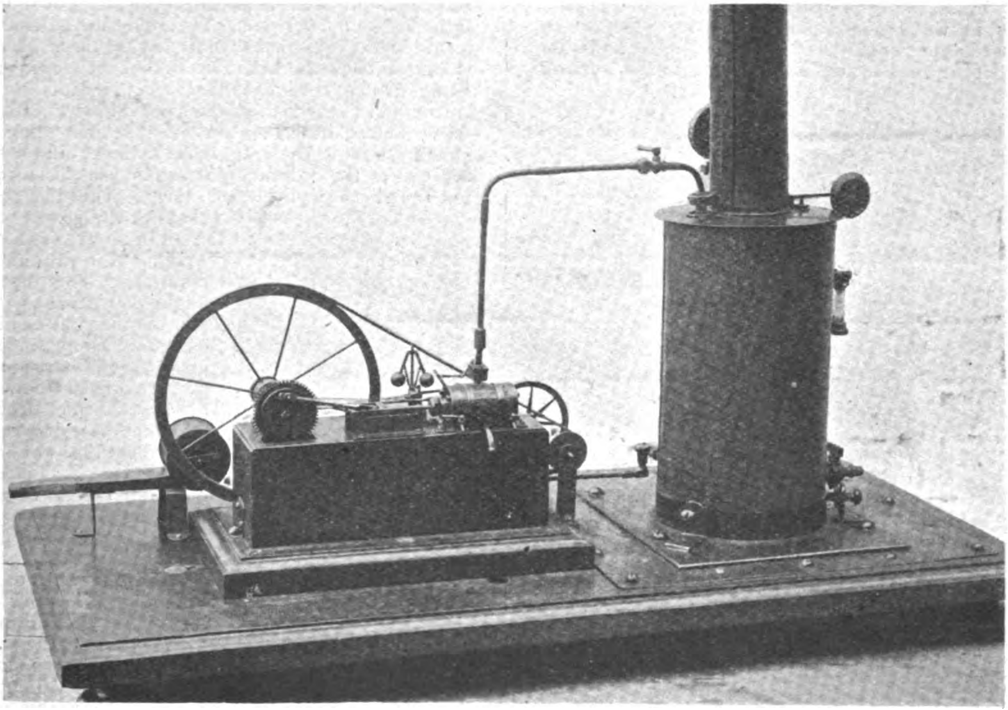


FIG. 1.—MR. CHARLES C. GOODMAN'S INGENIOUS MODELS.

THE model horizontal steam engine with vertical boiler, illustrated herewith, was built by Mr. Charles C. Goodman, watch and clock-maker, of Chalfont St. Giles, Bucks, nearly forty years ago. It possesses unusual interest inasmuch as nearly every part of which it is comprised has seen service in some totally different capacity to that for which it is employed in the model; and the most ingenious use has been made by the builder of a variety of miscellaneous articles, none of which were even remotely connected originally with the purpose to which they are now put. In the year 1868, the task of overhauling the clock in the tower of the Parish Church at Chalfont St. Giles was placed in Mr. Goodman's hands. At that time, the clock had only a single hand, but this was removed in the course of the renewals, and the customary arrangement, having separate hands for denoting the hours and minutes, was substituted in its place. As a result of this change, the wheel which had been used for carrying the single hand of the clock was dispensed with, and, together with several other parts, came into Mr. Goodman's possession, being converted by him into a flywheel for his model then building, after having done service as part of the clock since 1710—a period of 158 years. The teeth were stripped off to form a smooth flange surface, and in place of the original rough brass arms, four in number, eight spokes, made from pieces of 1-16th-in. diameter steel wire used in connection with clock-making, were introduced. A brass castor, which had belonged to an old-fashioned mahogany table, was pressed into service to form the boss of the flywheel, a suitable keyway being cut for securing it to the shaft. The cylinder consists of a piece of brass tubing, with flanges soldered on at the ends and then turned up in the lathe. It is lagged on the outside first with a layer of felt and brown paper, and finally with strips of wood cut from a cigar box, the whole being secured by two copper bands about 3-16ths-in. wide.

The double guides were cut out of a piece of sheet brass about 1-10th-in. thick, flanged outwards at the bottom, and secured by screws to the baseplate, which is also of brass, held down on a platform formed of a solid oak block resting upon a mahogany bedplate. The connecting-rod, which measures 2¼ ins. between centres, was made from the back of an antiquated pocket knife of large proportions. It was filed into shape and has flat sides, whilst being rounded off at top and bottom. The big-end is fashioned out of the solid piece of metal, and has nothing in the way of bearing brasses or means of adjustment.

The crank is of the disc type, and was originally one of the "ounce" pennies coined in George III's time, the last of which disappeared from currency many years ago. This penny-piece, or disc, is pinned to a wheel from a grandfather's clock which had seen over 100 years' service at the date of the model being completed, viz., in 1869. At the time, Mr. Goodman thought he might possibly be able to drive another wheel or some easily moved mechanism from this clock wheel attached to the crank, but the idea was never carried into effect.

The main shaft consists of a piece of ¼-in. diameter steel rod, used in connection with the work of clock-making, and the eccentric is formed of solid brass taken from an old clock, the strap being also of brass in two halves, held top and bottom by small screws. The eccentric-rod is a piece of steel wire of the same size as that used for the spokes of the flywheel, the valve spindle being brass wire, and the valve itself of solid brass filed into the required shape. The piston in the cylinder was originally a drill stock or ferrule used in the watch-making trade for drilling with bow and gut, and afterwards turned down in the lathe to the proper size. The governor is driven off a pulley on the main shaft by a piece of violin string, and for the balls two bullets were used, holes being drilled through them for the arms to pass through. Levers connect the governor with a throttle valve placed in a box, on the pipe just above the steam chest at the side of the cylinder and a stair-rod eye of the ordinary pattern is used for supporting the rod carrying these levers, whilst a second eye is employed as a bracket for the governor.

A disc is attached to the main shaft on the outside of the flywheel for driving a feed pump in connection with the boiler supply. This disc was originally attached to the pointer of an old-fashioned barometer long since disused. The barrel of the pump, which is about ¼-in. bore, was formed from the cartridge case of a repeating rifle, and the pump valves were fashioned out of odd pieces of metal filed into the required shape.

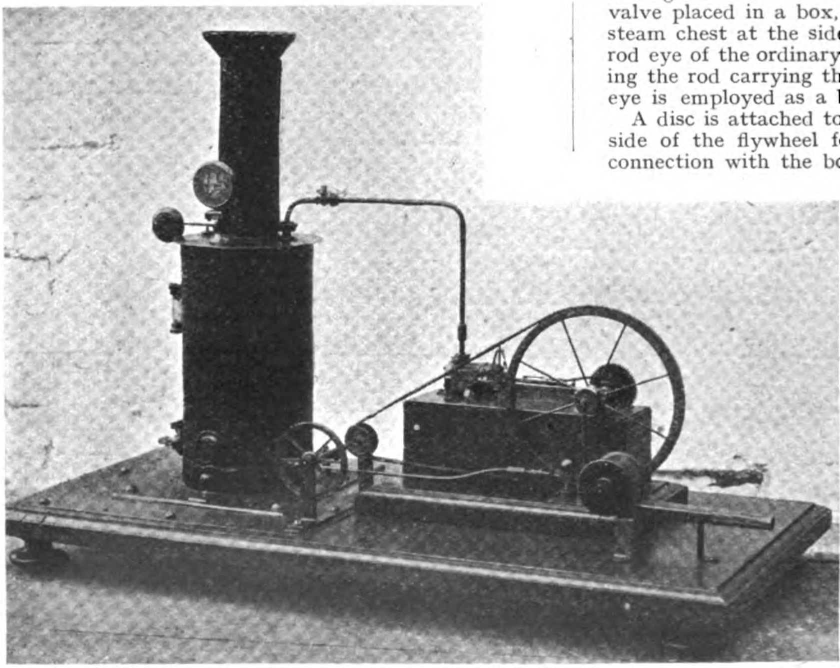


FIG. 2.—VIEW OF BOILER, ENGINE, AND BLOWER.

The air vessel used in connection with the pump originally did duty as a button on the uniform of a page boy in the service of a well-known county family, and although it is true that the piping between the pump and the boiler, and also that for the steam to the cylinder, was bought specially for the model, it remains to be said that one of the unions was formed out of part of a discarded telescope of cheap quality.

The boiler, which is, as will be seen, of the vertical type, is made of sheet copper riveted together. It stands 8¾ ins. high, and has a diameter of 4½ ins. There is a central flue measuring 2 ins.

in diameter, and at a point near the base a cross water tube is provided, having an outside cap, which may be removed for examining the tube. The cap was made from a brass name-plate taken from an old hand-saw. The safety valve has a weighted lever, and the weight used was originally the pendulum of a French clock of great antiquity; whilst the pressure gauge, which is mounted upon the top of the boiler, had seen many years' service as a Geneva watch before being put to its present use. When adapting this for the purpose, the escapement was entirely removed, but the centre wheel pinion was retained and now carries the pointer. A series of small springs and levers, ingeniously arranged, controls the movements of the pointer. The gauge is mounted on a pedestal formed from the shank of an old-fashioned door handle. The water gauge is formed from a piece of glass tubing from a barometer supported by two brackets from an old brass candlestick.

A blower is provided alongside the flywheel, and this is driven from a transmission shaft near the boiler. The blower contains a small fan with four blades, and the ends of the drum are comprised of portions of an old Dutch clock, the trunk being made of zinc and the complete device mounted upon brackets fashioned out of pieces of thin sheet iron. The engine and boiler are mounted upon a large mahogany bedplate, on the underside of which are four wooden door handles, one at each corner. The bore of the cylinder is ¾ in., and the piston stroke 1¼ ins. The flywheel is 6 ins. in diameter.

Quite recently Mr. Goodman has converted an old-fashioned sewing machine of the pattern largely used some twenty-five years ago, and known as the "Little Wanzer" machine, into a radial drilling machine for use in connection with his calling of a watch and clock maker and repairer.

The shaft and pinion originally employed for giving the necessary vertical movement to the needle have been removed, and by attaching a pulley to the shuttle shaft and driving off this by means of a piece of leather lace over two pulleys above and from there to a horizontal pulley on the vertical needle bar, radial motion is obtained in place of the original vertical movement used for the needle. The pulley on the shuttle shaft is made of wood; those above are of brass, having been part of a grandfather's clock over 100 years old; whilst the horizontal pulley on the needle bar was for some long time used for its legitimate purpose, viz., as a pulley on a blind roller. A lever for regulating the pressure on the drill has been formed out of an old electro-plated toast rack, and the machine will drill holes up to ¼ in. with ease in brass.

It should be added that Mr. Goodman never had any mechanical training whatever; also that his only opportunity for acquiring a knowledge of the principles of steam engine construction were restricted to a casual observation of the working of agricultural engines, and that except for the occasional use of a small lathe, all he had to depend upon in his model making were the tools used in connection with his trade.

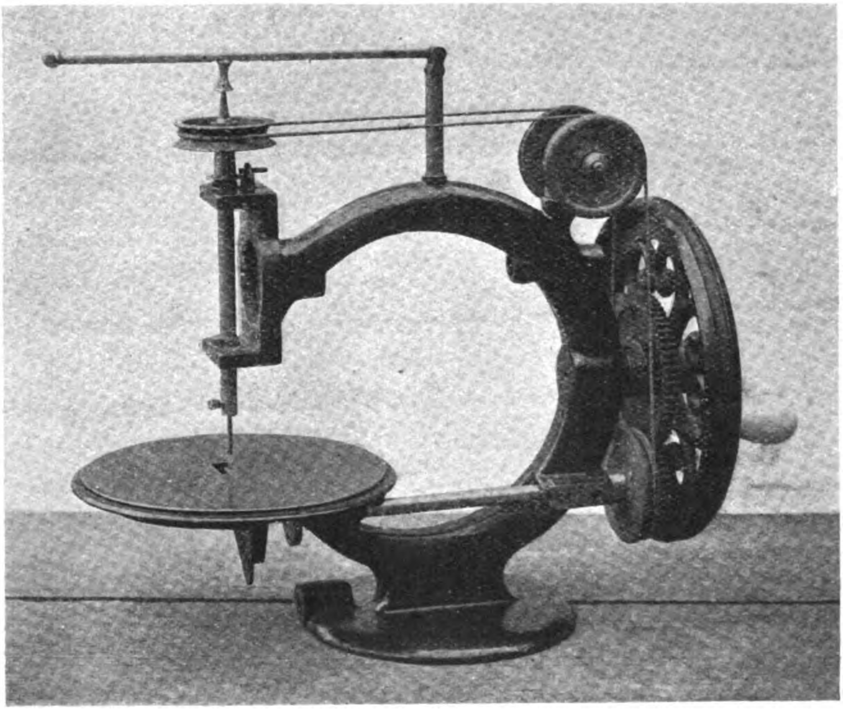


Fig. 3.—Mr. Charles C. Goodman's Novel Radial Drilling Machine.

Workshop Notes and Notions.

[*Readers are invited to contribute short practical items for this column, based on their own workshop experience. Accepted contributions will be paid for on publication, if desired, according to merit. All matter intended for this column should be marked* "WORKSHOP" *on the envelope.*]

Electro-Plating for Amateurs.

By G. Van Dyke.

As there have been many queries in The Model Engineer on the subject of electro-plating, the following notes may prove useful to readers:—

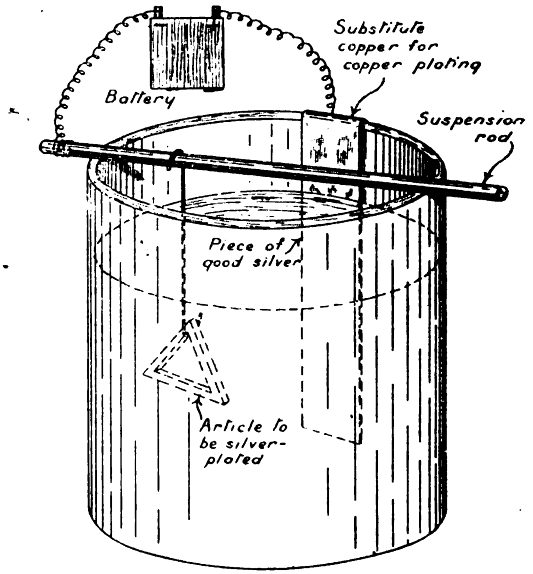
Beginners will do well to carefully read the following general remarks before attempting any work, as they are essentials to any success. Firstly, all things to be plated, either with copper, silver, or, in fact, any metal, must be *absolutely clean*—this is the *sine qua non* of electro-plating. The least bit of grease or dirt will prevent the deposit attaching itself, and it will brush off in the polishing. Before starting to plate, the articles must be made quite clean, and then polished, after which they are rubbed over with a cloth and some very fine pumice powder; this just roughens the surface enough to give the deposit a good hold. The articles are now dipped in a boiling potash solution (4 ozs. of American ash dissolved in 1½ pints of water), to remove all traces of grease. After this final cleaning, the work should not be touched with the hands. Articles, before being placed in the hot potash solution, should be hung on the wires on which they are to be suspended in the plating bath, as all handling after the potash cleaning is thus avoided; they should then be held (by the wires) under running water for ten minutes to remove all traces of potash. Try some experiments with pieces of scrap metal before undertaking any important work, as you will thus save yourself some trouble. Do not be in a hurry to take the articles out of the plating bath, twenty minutes to half-an-hour being required for a good deposit; this depends somewhat upon the size of the article. During the depositing it is well to turn the article around several times, so as to present the different sides to the silver anode.

Copper being the easiest process, I therefore take it first. For depositing copper on most metals, the well-known copper sulphate solution will not do, as it yields on simple immersion a loose coat of copper, due to local electro-chemical action, and thus renders further deposits liable to peel off.

The solution which will give the best general results is made as follows:—Dissolve 4 ozs of copper sulphate in 12 ozs. of water, and add strong ammonia solution until no more green crystals are precipitated. Now add more ammonia, and keep on stirring until the green crystals are re-dissolved, giving an intense blue solution; then slowly add a strong solution of potassium cyanide until all the blue colour disappears, leaving a clean solution. To this is added a further quantity of potassium cyanide, in bulk about one-quarter of that used in decolourising. The solution is now made up to 2 quarts with water, and will be found to give a nice, even deposit of copper, with an electric pressure of 3·5 to 4 volts.

Silver-plating.—Iron, lead, pewter, zinc, and such metals must be coated with copper before silver can be deposited on them; this is done in the alkaline copper bath already described, and they are then treated as copper. Silver can be plated directly on brass, copper, German silver, nickel, and such metals. The solution used for silver-plating is made as follows:—Dissolve ¾ oz. of commercial silver nitrate in 8 ozs. of water, and slowly add a strong solution of potassium cyanide solution until no more white precipitate is thrown down. The liquid is now poured off, and the precipitate carefully washed. (This is best done by filling the bottle with water, shaking, allowing precipitate to settle, and then pouring off the water. Repeat six times.)

Having finished washing the precipitate, slowly add to it a solution of potassium cyanide until all the precipitate is dissolved. An excess of potassium cyanide is now added—about as much as was used in dissolving the precipitate—and the solution made up to one quart with water.



Electro-Plating Apparatus.

This solution, with an electric pressure of 2 to 4 volts, will give a good white coat of silver in twenty minutes to half-an-hour: use 2 volts for large articles, and 4 volts for very small ones. If more solution is required, it is only necessary to double *all* given quantities.

The silver thus deposited is dull, and must be polished. On flat surfaces this can be done by burnishing with an agate burnisher; but although giving a good and lasting surface, it is a tedious process. By far the best way is to use a revolving scratch brush; but for those who do not possess a buffing machine, a hand scratch brush is very good. The finer the wires the better, and quick, light strokes should be taken. After scratch brushing or burnishing the articles are polished with ordinary plate powder. I give a sketch showing how the articles may be suspended in the plating bath (either copper or silver).

If accumulators be used, which I strongly advise, it is important that the positive (or red) terminal be connected to the piece of silver hanging in the bath, and that the negative (or black) terminal is connected to the article to be plated. If Bunsen cells are used, the carbon terminal takes the place of the positive terminal of the accumulator.

The above solutions are not text-book formulæ, but are the result of actual experiments, and have given good results under my own manipulating.

Method of Making Small Brass Washers.

By Frank Lodge.

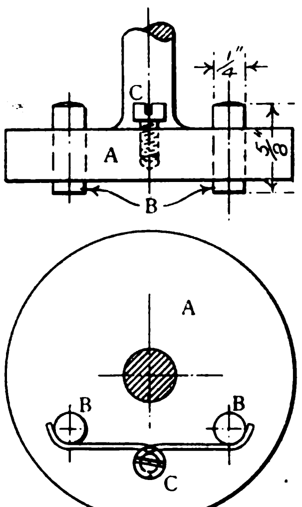
To make small brass washers, set dividers 1-16th in. over size of finished washers, and mark out on sheet brass, of the required thickness, as many squares as washers are wanted. Centre them and drill holes. Then with hacksaw cut down the lines. Place as many as convenient on a mandrel the size of hole, so as to hold them in line. Grip them in vice and file off the corners. Place them in pairs on a tap (say the hole is 3-16ths in., then the tap must be 3-16ths in.), and clamp with hexagon nut on each side; then turn them up between centres, using tap wrench as carrier. In this way both turning and chamfering can be done at one operation. If it be desired, two pairs or more may be put on at once and smaller washers placed between the pairs, so as to allow each pair to be chamfered.

I might say that a friend of mine adopted the above method recently, and turned out sixty washers in one evening's spare time.

A Method of Fixing Pegs to Scribing Block.

By "Scribo."

A very useful attachment is shown in the accompanying sketch for distance gauging and various other uses. A represents the block or base of an



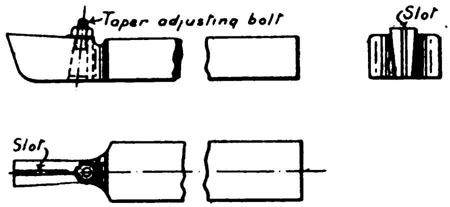
Fixing Pegs to Scribing Block.

existing scribing block at the edge, and at a suitable distance apart are drilled two holes, ¼ in. diameter. Into these holes are fitted two pegs shown at B B. The length should be about 1¾ times the thickness of the base. C is an ⅛-in. screw with a rather large head, around which, in the manner shown, is a piece of spring steel wire which is carried part of the way around the pegs B, against which it should press fairly tight, so as to hold the pegs when raised up.

Adjustable Grooving Tool.

By "Sregor."

The accompanying sketches illustrate a design for a special adjustable tool for forming grooves. The



An Adjustable Grooving Tool.

disadvantage of a solid tool which is required to cut a groove a given width is that, after being used a short time, the cutting edges get worn down, and the tool fails to cut the required width. The adjustable tool here described can be kept up to size by screwing up the taper bolt as shown in side view of the tool. This tool is only necessary, of course, in some special cases, when it is inconvenient to move the tool bodily sideways, and should only be used as a finishing tool to just skim up grooves to correct width; but the idea embodied in it can easily be extended to other tools of different design. The slot as shown in the views allows the side of tool to open out when the taper bolt is screwed up by the nut. The slot can be readily formed with an ordinary hacksaw, as it is not strictly necessary to be exactly central; but it must be cut long enough to ensure sufficient spring on the sides when the bolt is screwed up.

A Hint on Core-making.

By A. E. Markwick.

Readers of The Model Engineer who find difficulty in making cores suitable to ensure solid gunmetal or brass castings of the cored class, should try cores of dry bath brick. This material can be obtained cheaply enough from any oilman's stores, and is easily sawn or filed to the shape required. It is suitable for cores the size of the brick or anything under.

In his recent Cantor Lectures on Pens, before the Society of Arts, Mr. J. P. Maginnis stated that at the works of Messrs. De la Rue the workmen employed in making the gold pens are required to wash their hands and faces before leaving the premises, with the result that something like £150 to £200 worth of gold is recovered per annum. He also stated that in the works of the Waterman Pen Company in the United States a similar rule is enforced, producing about 90 dols. worth of gold each month. The clothing worn by the operators is the property of their employers, who burn the garments to ashes for the sake of the gold-dust they carry.

The Cyclopædia of Applied Electricity.

THIS important and extremely comprehensive guide to applied electricity has recently been published by the American School of Correspondence, at the Armour Institute of Technology, Chicago, U.S.A. In all there are five volumes, containing a total of about 2,500 pages and over 3,000 illustrations, and handsomely bound in red leather and cloth, with gilt lettering. The ground covered is generally as follows:—Part I: Elements of electricity, measurement, electric wiring and installation of machinery, telegraphy. Part II: Dynamo electric machinery and storage batteries, electric motors for machine driving. Part III: Electric lighting, electric railways, general principles of power station design, and management of dynamo electric machinery. Part IV: Alternating current machinery and power distribution. Part V: Telephony. It will be seen from this brief synopsis that practically the whole field of electrical practice is covered, and in a work of this magnitude it has been possible to give a full and adequate treatment of each branch.

The work is not addressed to the technically educated specialist, and for this reason all of the descriptions and explanations which it contains have been simplified to the utmost possible degree consistent with a thorough presentation of the subjects treated. Higher mathematics have been entirely omitted, and the subject matter of the work is explained in simple language in connection with a large number of diagrams prepared especially for the text. The half-tone engravings are of much interest, as they illustrate all of the electrical machines and apparatus made by the prominent electrical companies in the United States, and therefore acquaint the reader with the types of apparatus used in current American engineering practice.

The assistance of many eminent specialists has been obtained in the preparation of these volumes, among whom may be mentioned Prof. F. B. Crocker, of Columbia University, Prof. William Esty, of Lehigh University, Prof. D. C. Jackson, and Prof. Geo. C. Shaad, of the University of Wisconsin, Prof. Louis Derr, of the Massachusetts Institute of Technology, and many others—all of whom have prepared special articles and aided in the collaboration of this work. All of the standard works of technical literature have also been freely drawn upon in the preparation of these volumes.

As these books have been designed for text-books a great deal of attention has been given to practical examples, and each volume is supplemented with a list of review questions by means of which the reader can test for himself the knowledge which he has acquired of the subjects treated.

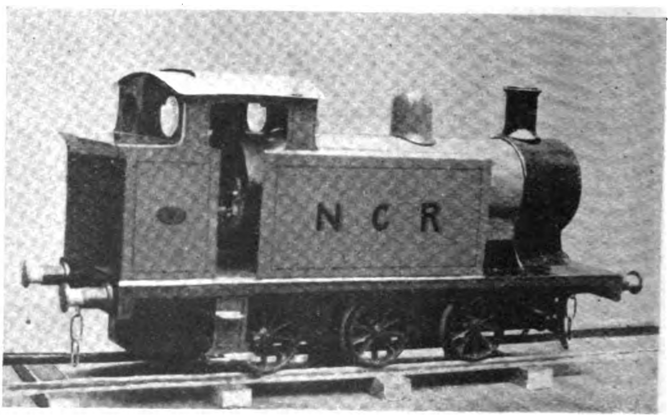
The usefulness of the Cyclopædia as a reference book is augmented by the addition of a subject index contained in the fifth volume. The practical value of the work as a whole is great, as the Cyclopædia embodies the various electrical courses which have been successfully used by the American School of Correspondence in teaching thousands of electricians. The work is, in fact, the outcome of a most successful method for the education of the busy man. It will be found of much value to designers, constructors, and operators of electrical machinery, and as it covers every department of electricity thoroughly, its use will save frequent search among scattered text-books on electricity.

To those of our readers who desire to have such a reference book (or who wish to make a serious study of modern American electrical practice), we can cordially commend these carefully prepared and explicitly written volumes. Their preparation must have entailed a considerable amount of labour and thought, but we have no doubt that they will be appreciated by many, apart from the regular students of the particular school from which they emanate. They are being offered at a special introductory price of $18 the set, payable in instalments. Full particulars and prospectus may be obtained on application to the College, at the above address.

A Simple Model Locomotive.

By E. F. Olliffe.

HEREWITH is shown a photograph of a model locomotive I built during the winter evenings of last year. It is very similar to the "Simple Model Locomotive" described in these pages some time ago. It differs by having six wheels, closed cab, and coal bunker. The length over all is 16¼ ins., breadth over footplate 4¼ ins., gauge 2½ ins. The boiler has a working pressure of 35 lbs. per sq. in., and is made of solid drawn copper tube 1-16th in.



Mr. E. F. Olliffe's Model Locomotive.

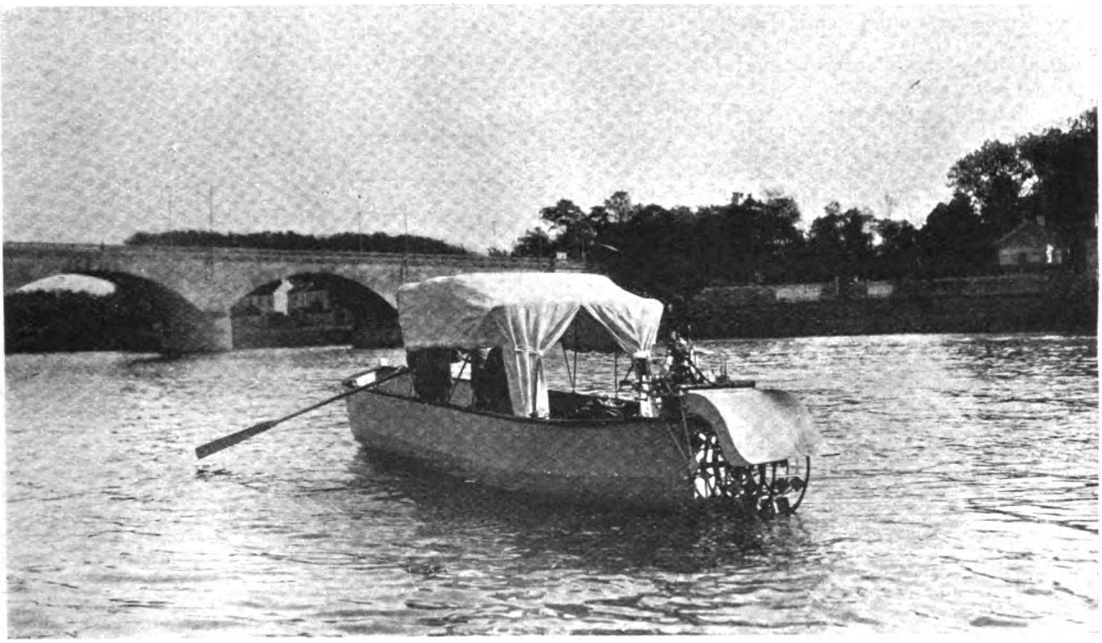
thick, and measures 9¾ ins. long by 2½ ins. diameter and has cast gun-metal ends screwed in with 16 3-32 ds in. screws (eight each end), and has two longitudinal stays 5-32nds in. diameter. There are four water tubes 3-16ths in. outside diameter. The downcomer was worked up from a casting, and is screwed and nutted on the inside of the boiler; the whole being sweated with soft solder. The fittings include safety valve (which is on the lever principle, with the weight in the cab), bib cocks and steam tap, which acts as regulator. The dome is a dummy, turned out of wood. The funnel is built up from brass tubing, having a band of brass soldered round each end, and after being turned and painted you could hardly tell the difference from a worked-up casting. The cylinder is a double-action oscillating, ½ in. bore by 1 in. stroke, working on a balanced crank, and driving 1¾ in. diameter wheels. The steam block is screwed on to the right-hand frame, which brings the spring to the outside, and thus allows of easy adjustment. The buffers are turned out of hard wood, but have a brass face, and rods passing through the centre of each screw them to the buffer boards. The roof of the cab is made to lift off, thus giving free access to the regulator, etc. It was my intention to couple the wheels, but the restriction as to turning, and the extra friction involved, led me to abandon the idea.

The steam is superheated by the steam pipe passing through the fire-box. The engine is enamelled green, with chocolate frames, being picked out with a thin black line. It works very satisfactorily, and well repays for the time and trouble spent on it.

Gas Production.—In New Zealand, gasworks producing 2,000,000 to 3,000,000 cubic ft. annually, average 10,500 cubic ft. per ton of coal carbonised, without an exhauster. The excellent bituminous coal, for which the country is famed, contributes largely to good all-round working results, and nothing below 12,000 cubic ft. per ton is considered a satisfactory yield in any well-equipped works.

The Latest in Engineering.

A Chaland-Buchet Motor Boat.—The boat, which we illustrate below, is specially constructed for Colonial rivers, and is propelled by a paddle-wheel driven by a Buchet motor. The paddle-wheel is so arranged that when the boat enters into shallow water, the boat can be placed to any angle by means of the mechanism that adjusts the position of the paddle-wheel, which can be raised or lowered according to the depth of the water.



A Chaland-Buchet Motor Boat.

Hospital Cars.—The Prussian Railroads have ordered eight hospital cars, as we may call them, to be stationed at different places in the country for the transportation of people too ill to sit up, and requiring the attendance of doctors and nurses. Each car has a sick room with bed for the patient and reclining chairs for attendants, opening into another compartment also provided with a bed, and a servant's compartment. All the appliances likely to be needed in a sick room are provided and conveniently at hand. One of these cars can be ordered at any station, on the purchase of twelve first-class tickets for the route over which it is to go. The first of the eight has recently arrived at Charlottenburg, a suburb of Berlin, where it will be stationed.

New Electric Gantry at Durban.—A noteworthy addition to the harbour equipment was officially inaugurated a few weeks ago in the shape of a large gantry and traveller for the purpose of carrying and stacking concrete blocks. Hitherto a goliath was used, but this required the labour of fifteen men, and took nine hours to convey its burden 1,000 ft. The new mechanism lifts a 20-ton block, carrying it 1,475 ft. in three minutes and forty seconds. It has been constructed locally by the Victoria Engineering Works, at a cost of £13,000, and has proved highly satisfactory. It is driven by electricity at a cost of a halfpenny a ton of concrete carried.

Locomotive Watering Arrangements.—As is well known, a phase of locomotive working which universally presents more or less serious difficulty is that of water supply for locomotives, and in this connection it is safe to state that the varying degrees of hardness of the water at the numerous watering depots constitute a *bete noire*. For the benefit of those readers who are not acquainted with the nature of the difficulty brought about by the extended use of hard water we would remark that if (as is unfortunately generally the case) the water contain more than 8 or 10 grains per gallon of chalky matter, the boiler tubes and firebox plates become furred so rapidly, and to such an extent as to reduce their conductivity on the water side. The result is overheating of the plates on the furnace side, seriously affecting durability and the cost of repairs, besides somewhat reducing the steaming power of the boiler.

This inconvenience is appreciably diminished by the use of artificially softened water. The process adopted, as many know, is to provide water-softening plants at the sites of water troughs, etc. There are several softeners now on the market, but the general idea is to add to the water precipitants of a softening nature, such as lime and caustic soda, removing the sediment by settling and filtration, and then conduct the softened water as required to the troughs, or water cranes, as the case may be.

The Great Western Railway, acting on the advice of the locomotive superintendent, have recently authorised several installations. Three are already in operation in connection with water troughs—

	Capacity (Galls. per hr.).
Aldermaston (Berks & Hants Line) ...	10,000
Fox's Wood (Nr. Bristol)	20,000
Goring (between Reading and Didcot)	20,000

The results so far have been gratifying, the hardness being reduced on an average about 10 degs. Plants are also being installed at—

	Capacity (Galls. per hr.).
Severn Tunnel Junction	30,000
Reading	15,000
Southall	10,000

—*G.W.Ry. Mag.*

Wireless Telegraphy.—The Marconi Wireless Telegraph Company has decided to erect a large station on the west coast of Ireland. It is hoped, by constructing a new station covering a larger area and of greater altitude, to obtain more satisfactory results.

How It Works.

I.—The Electric Arc Lamp.

By A. W. M.

THE term arc is used by electricians to mean an electric spark produced between two (or more) conductors carrying a current, particularly when such a spark continues for an appreciable time before becoming extinguished. The spark which takes place between the points of an induction coil discharger, however, is not usually called an arc, because it consists of a series of intermittent sparks, each lasting for only an exceedingly small amount of time, though the spark effect produced when a Wehnelt break is used is so voluminous that it might almost be called an arc.

The term arc originates from the shape which the spark assumes, particularly when the direction is horizontal; for instance, a long, steady discharge between a pair of points would not proceed in a straight line from one to the other, but would assume a curve bending upwards, something of the shape indicated by Fig. 1, approximating to an arch or arc of a circle; the greater the distance between the points the more curved will be the discharge.

Fig. 1.

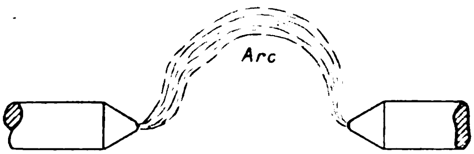


Fig. 2.

A very long high-tension arc would take a form something like that shown in Fig. 2, accompanied by some flame. The electric arc was first shown in 1801 by Davy, who used charcoal points; though carbon points are always used in modern arc lamps, an electric arc can be produced between metal points, the arc taking different colours and characteristics, according to the substance used; both continuous and alternating current can be employed. The temperature of the arc is very high, being approximately 2,500 degs. Centigrade.

The electric arc lamp is a device for holding a pair of carbon rods in such a way that their points are kept a certain distance apart, or within the smallest possible variation whilst the arc is burning. The conditions are complicated by the fact that whilst a short arc can be kept going by a comparatively low voltage, it requires a very high voltage to start the arc across even a very small gap between the points: it would be necessary to have a pressure of, say, 2,000 volts to make an arc jump across a distance of about 1-10th in.; also as the carbons are gradually consumed it is necessary that they should be moved towards each other at the same rate as they are burned away, or else the arc would lengthen and finally go out when the distance became too great for the voltage employed. The longer the arc the higher will be the voltage required to keep it going. The difficulty of starting can be entirely removed by bringing the carbon points into contact first and then separating them as soon as the current flows. This is called striking the arc, which is drawn out between the points as they are separated, and once started will continue under proper conditions of working. All arc lamps must perform the following operations :—First, the carbon points are made to touch as A, Fig. 3 ;

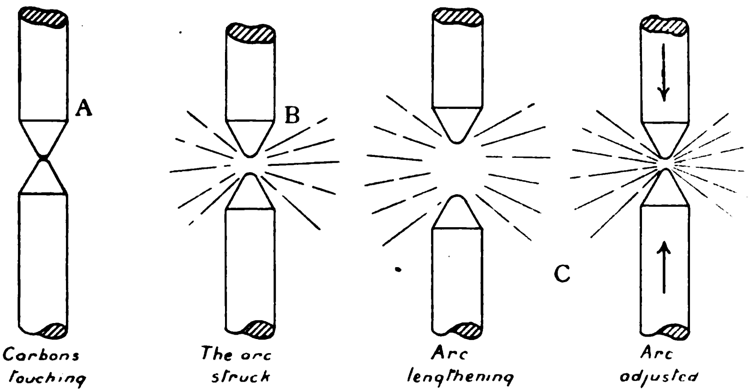


Fig. 3.

secondly, they are then separated as B ; thirdly, they are made to approach as the points are consumed, as shown exaggerated at C.

There are many arrangements of mechanism used in the various makes of arc lamps, but all of them perform the same operations. Almost any lamp can be easily understood by reasoning its action according to this explanation. It must be clearly kept in mind that the carbon points are not touching whilst the lamp is burning. It is quite possible to produce a light which resembles the arc light by keeping the carbon points in contact whilst current is passing ; the tips become incandescent and brilliant light is produced ; but this is not an arc light, and no lamp is used under these conditions. The movement of the carbons is effected in nearly all automatic lamps by the action of electro-magnets or solenoids, which may pull clutches through which the carbon slide, or release clock mechanism or brake-wheels. An examination of any lamp will reveal its action. The carbons usually slide together by force of gravity, and either rest in contact when the lamp is out of use or come into contact as soon as current is switched on, according to the particular mechanism employed. When current is switched on the carbons are immediately separated, if already in contact ; if not in contact the mechanism permits the points to come together and immediately separates them, the distance being as a rule 1-8th in. for lamps in which the arc is exposed to the air—open arc, as it is called, whether surrounded by a globe or not ; when not surrounded by a globe it is called a naked arc. As the arc continues to burn the carbon points are slowly consumed, the distance between them thus increasing. This lengthening of the arc causes the adjustment or feed mechanism to come into operation, and the carbons are made to approach, the movement ceasing as soon as the arc is shortened to the original length. The lamp is provided, as a rule, with a tension spring or other device by which the feeding of the carbons can be regulated, so that the mechanism will automatically readjust the length of the arc at the right moment. The length of the arc which gives best results has been determined by experience, and if the lamp is in order it will strike an arc of correct length to start with ; if the mechanism is out of order the carbons may not be sufficiently separated, and the arc will make a hissing noise, or they may be parted by too great a distance, in which case the arc will go out. The controlling coils, whether acting as electro-magnets or solenoids, usually work as one of three systems. First, the coil may be a simple series coil in circuit with the carbons and carrying the whole current which passes through the lamp ; such a coil would pull the carbons apart at the moment of switching on and strike the arc. As soon as the arc had increased to a certain length its resistance would cause the current to slightly diminish, the coils would lose power and allow the carbons to approach, the current would immediately rise, and restore matters to the adjustment obtaining when the arc was first started. A second type would have a coil in series with the carbons as before, but its function would only be to pull the carbons apart and strike the arc, the

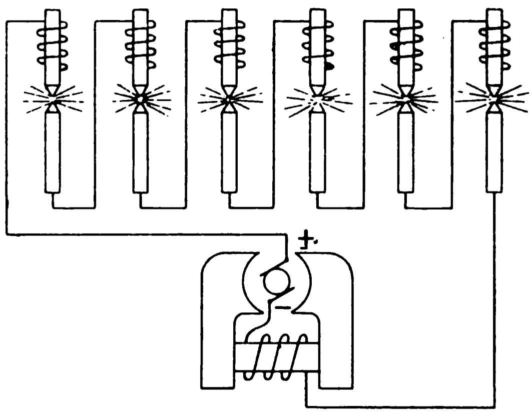


Fig. 4.

feeding together of the carbons would be controlled by a second coil wound with a very fine wire, and connected in shunt to the arc. Under normal circumstances this coil would not receive sufficient current to cause it to be effective, but as the arc increased in length owing to the burning away of the carbons more current would flow around these coils, and finally at the right moment they would become effective and bring the feed mechanism into operation. In some lamps the action of the fine wire coils is quite independent of the series coils ; in other lamps they act to magnetically oppose and weaken the series coils, in which case they would be called differential lamps. The third type of lamp has no series coil, but only a fine wire coil connected in shunt to the arc, and used for both striking the arc and regulating the feed.

A type of lamp which is now largely used is called the enclosed pattern; the idea being that if the arc was burning in a vacuum there would be no consumption of the carbons, and consequently no adjustment or trimming required. This method is

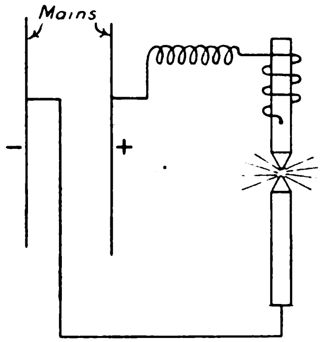


FIG. 5.

not new, as Davy carried it into effect in 1801, but it is impracticable for commercial purposes, so a compromise has been effected by enclosing the carbons in a small globe, which, when the arc is started, becomes filled with gases from the burning carbons, with the result that they do not burn away so rapidly as when the air has free access to the arc; the life of a pair of carbons being about twelve times greater with equal watts expanded in either lamp. Provision is made so that the gases can escape if the pressure becomes too great. The length of arc in these enclosed type lamps is greater than that used in the open type, being about ½ in.

There are two methods in use for working arc lamps—namely, the constant current and the constant voltage systems. In the constant-current system the circuit is only used to supply current to a given number of arc lamps; a special dynamo is used, and the lamps are all connected in series with each other, the same current passing through each lamp (see diagram, Fig. 4). The dynamo only gives a certain amount of current, and by means of a regulator keeps it at constant value, but it varies its voltage according to the number of lamps burning. Lamps of the two-coil regulating type must be used; a lamp having a single coil, whether shunt or series, would not be suitable. The object of the constant-current system is that the current being only equal in amount to that required for one lamp, small cables can be used, as they need to be only large enough to carry the current for one lamp, but the voltage must be equal to the voltage required for one lamp multiplied by the number of lamps. Each lamp is provided with an automatic cut-out, so that if any one fails to act it is cut out, and the circuit restored through a large by-pass wire. The constant-current system is nearly always used as a special circuit for arc lighting, and nothing else, such as a series of lamps in a street or large building. Owing to the high voltage employed (sometimes as much as 3,000 volts), there is danger in handling such a circuit. The lamps or any other part should not be touched without taking due precaution to avoid shock.

The other method of working arc lamps—namely, the constant-voltage system—is that in use for ordinary incandescent lighting; all arc lamps used on ordinary house supply are worked on this system. The volts are kept at constant value, but each lamp used singly takes its own amount of current, which may vary to some extent and be of different value, according to the size and make of lamp. Where the voltage is higher than that required for a single lamp it is a common practice to run two or more lamps in series, according to the voltage available and number of lamps required; but the voltage is still kept constant and the current may vary, though for each set of lamps in series its value is only that required for one lamp, as the current passes through each lamp. Fig. 5 shows a single arc lamp burning off ordinary supply mains, and Fig. 6 shows two sets of 4 arc lamps in series burning off ordinary supply mains. Lamps having a single regulating coil, whether shunt or series, or having both shunt and series coils, are suitable for use on constant voltage circuits. There remains one other method of working an arc lamp, and that is by using a single lamp with a single dynamo, which should be either series or compound wound. This method is in use and convenient for certain purposes, such as projectors for military and marine use, lighthouse lamps, spectacular and photo-

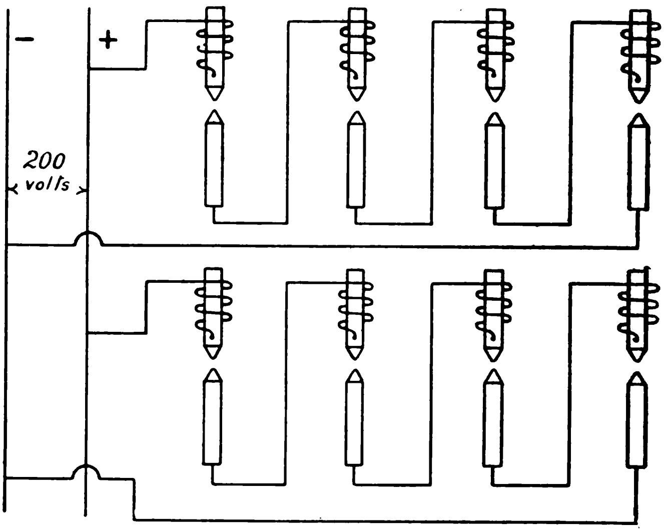


FIG. 6.

graphic lamps, etc. A battery could, of course, be used instead of the dynamo.

Arc lamps can be worked with either continuous or alternating current, but the lamp must be designed for the kind of current with which it is to be used. A peculiarity of the arc is that when continuous current is used the carbon which is connected to the positive pole of the source of current, and called the positive carbon, will burn away at twice the rate of the carbon which is connected to the negative pole; if alternating current is used, the carbons both burn away at an equal rate. When it is necessary that the arc should remain at a fixed position, such as in lamps used for optical purposes, it is necessary to feed the carbons towards one another, so that the positive carbon moves at twice the rate of the negative carbon if continuous current is used, or else to use a positive carbon which has twice the sectional area of the negative carbon.

(To be continued.)

Notes on Locomotive Practice.

By Chas. S. Lake.

New Midland Express Locomotives.

Reference has already been made in these notes to the new series of express passenger locomotives recently built at the Midland Railway Company's Works at Derby, from the designs of Mr. R. M. Deeley, M.Inst.C.E., locomotive engineer, for working fast passenger traffic on the main line. Engine No. 863, one of the new series, is, by Mr. Deeley's courtesy, illustrated herewith, and, as will be seen, the 4—4—0 wheel arrangement is employed in conjunction with inside cylinders and a Belpaire boiler. These new locomotives resemble very closely those put to work in 1903 by Mr. S. W. Johnson, to which the title "Belpaire bogies" was, quite unofficially, of course, applied, on account of their being the first engines to have that type of boiler on the Midland Railway. Mr. Deeley has, however, introduced one or two improvements over the original design. He has provided a much more comfortable cab, with the roof extending back over the front part of the tender. The smokebox door is held secure by means of six "dogs" instead of by a central fastening as usual, and the plan is said to very effectually prevent drawing of air into the smokebox. The drumhead type of front tube-plate, which was fitted to the previous engines of this type, has been replaced in the new series with one of ordinary type. The appearance of the engine in its entirety is somewhat detracted from by the huge figures representing its number, which are set forth on the sides of the tender. The numbering of locomotives is, surely, only a means of identification, and has no interest to the travelling public. One would have thought that quite small figures in the usual position on the cab sides would have sufficed for the practical purposes of the railway company's locomotive department.

The leading dimensions are as follow:—

Cylinders, 19½ ins. diameter by 26-in. stroke.
Coupled wheels, 6 ft. 9½ ins. diameter.
Bogie wheels, 3 ft. 3½ ins. diameter.
Rigid wheelbase, 9 ft. 6 ins.
Total wheelbase of engine, 23 ft. 5½ ins.
Boiler—height of centre from rails, 8 ft. 3 ins,
diameter of barrel, 4 ft. 8 ins.
length of barrel, 11 ft.
Heating surface—total, 1,455·5 sq. ft.
Grate area, 25 sq. ft.
Working pressure, 200 lbs. per sq. in.

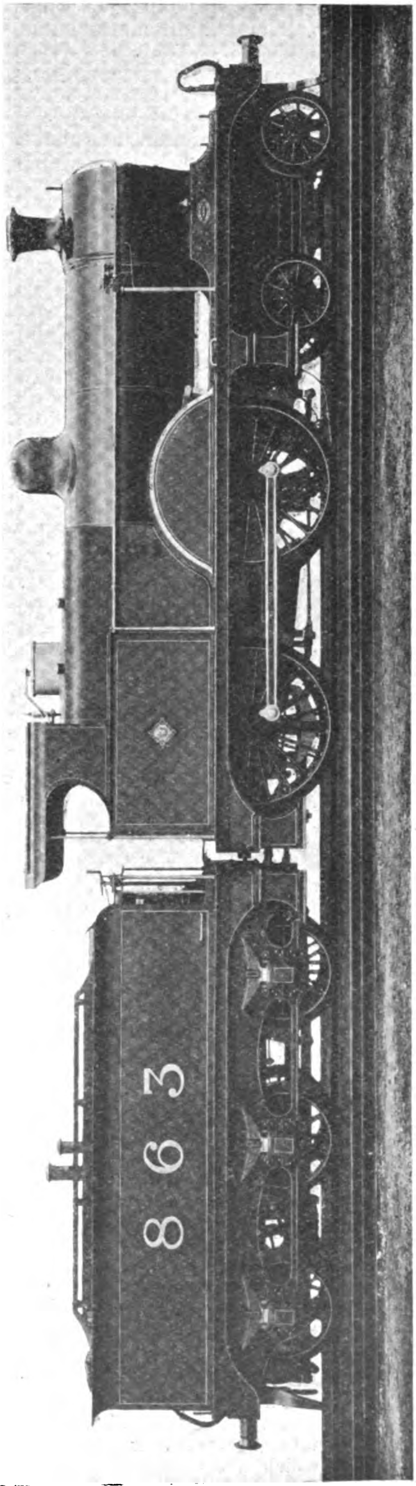


Fig. 1.—New 4—4—0 Type Express Locomotive: Midland Railway.

The engine, without tender, weighs in working order 53 tons 10 cwts. 2 qrs., of which 18 tons 9 cwts. 3 qrs. is on the driving axle and 17 tons on the trailing axle. The tender weighs 41 tons 8 cwts. 3 qrs. loaded, and carries 3,500 gallons of water.

"NEWS" FROM AMERICA.

That usually accurate and really valuable journal, *Railway and Locomotive Engineering*, of New York, makes, in its issue for October, what can only be characterised as a most remarkable assertion. In the course of an article describing the Vulcan-built Great Northern compound locomotive, No. 1,300, it is stated that the designs of this engine "were worked out by Mr. Bodmer, of THE MODEL ENGINEER, since deceased, from specifications provided by Mr. Ivatt." It is not said which it is that has "since deceased"—Mr. Bodmer or THE MODEL ENGINEER, but we on this side know that it is certainly not the latter, for the journal was never in a more flourishing condition than at present. The writer is in a position to state, on no less an authority than that of the Editor himself, that the Mr. Bodmer referred to has never had any connection with THE MODEL ENGINEER, neither has anyone bearing that name ever been associated with the journal.

RECENT BELGIAN LOCOMOTIVES.

The writer has been favoured by Messrs. the Société Anonyme John Cockerill of Seraing, Belgium, with photographs and particulars of two passenger locomotives recently built by them for the Belgian State Railways Administration, and exhibited at the Liége Exhibition. Both are four-cylinder compounds, but one is of the Atlantic type, with separated cylinders, whilst the other has the 4—6—0 wheel arrangement, with the four cylinders in line at the bogie centre, the high-pressure pair being inside and the low-pressure outside the frames.

The Atlantic type locomotive, Fig. 2, is a fine-looking engine, with a large Belpaire boiler, and is, generally, of neat and symmetrical appearance.

The inside cylinders drive the crank-axle of the leading pair of coupled wheels, whilst those outside —the H.-P.—drive the second pair. The valve motion is Walschaerts' throughout, with piston valves, and the engine is equipped with Westinghouse brake appliances and steam sanding gear. The high-pressure cylinders have a diameter of 14·17 ins., and the low-pressure 24·4 ins., with a common stroke of 25·2 ins. The coupled wheels are 6 ft. 5½ ins. diameter, and the boiler which has an internal diameter of 4 ft. 10⅝ ins., contains 139 2·76 diameter Serve tubes, 14 ft. 5 ins. long. The total heating surface is 2,577 sq. ft.; grate area 33¼ sq. ft.; and the working pressure 213 lbs. per sq. in. The engine can be worked simple when desired for obtaining exceptional power at starting and on severe grades.

The 4—6—0 type locomotive, Fig. 3, has, as before said, all its cylinders placed in transverse alignment below the smokebox. They, however, drive separate axles, those inside operating the cranks on the foremost coupled axle and those outside the middle pair of wheels. In this engine only two sets of valve gear (Walschaerts') are employed for actuating the four piston valves, the spindles of which are coupled together on each side of the engine, similarly to the practice adopted by Mr. F. W. Webb in his four-cylinder compounds on the L. & N.W.R. The boiler is fitted with a Cockerill superheater, which accounts for the somewhat curious appearance of the smokebox. By means of this superheater the steam is twice reheated before passing to the cylinders. It enters at the smokebox end and travels through a series of pipes to a combustion chamber at the front of the firebox tube-plate, then crosses to the outer side of the boiler and through a second collecting chamber and series of pipes to the smokebox end, and thence to the cylinders. This locomotive has particulars as follows:—Cylinders: H.-P., 14·17 ins. diameter; L.P., 24·41 ins. diameter; piston stroke, 26·77 ins.; coupled wheels, 5 ft. 10½ ins.; boiler: heating surface, 1894·1 sq. ft.; superheater surface, 446·7 sq. ft.; grate area, 32·4 sq. ft.; working pressure, 213 lbs. per sq. in. This engine can also be worked either simple or compound.

A VERY SIGNIFICANT ADVERTISEMENT.

The following announcement is at present appearing in the advertisement columns of the *Engineer* and some other leading technical journals:—

"METROPOLITAN RAILWAY COMPANY, LONDON.

"For Sale, Railway Rolling Stock, comprising 41 condensing side-tank locomotives and 317 passenger coaches of first, second, third and compo classes, being the whole of the remaining Metropolitan Railway Company's steam-driven rolling stock, which is being replaced by electric traction; all in first-class working condition. For particulars, apply, etc." And so the old order passes, making way for the new. It would be difficult to point to a more telling "sign of the times" than the above.

The "Fortis" Vice Prize Competition.

THE "Fortis" Electrical and Engineering Company, of Coventry, have kindly placed at our disposal three of their vices, value 18s. 6d. 10s., and 5s. 6d., respectively, to be awarded as prizes in a competition. We accordingly have pleasure in offering these useful prizes for the best three articles sent on "An Amateur's Vice Bench." What is required is a working drawing of a bench suitable for amateur use, with a short accompanying article describing its costruction and fittings (tools not included). The prizes will be awarded to the designs which in the opinion of the Editor of THE MODEL ENGINEER are best suited to the requirements of the average reader of this journal. All entries should be sent to the Editor of the *M.E.*, and should be marked "Fortis Vice Competition." The latest date for sending in will be Dec. 1st, 1905.

NOVEL USE OF MODEL YACHTS.—Model yachts were employed to establish communication between the shore and the steam trawler *City of Lincoln*, which was wrecked in Newbigging Bay recently. The wind was off shore, and after many attempts a light line was conveyed to the wreck by means of a model boat. Communications having thus been established, a stout warp was successfully hauled on board the wrecked trawler, and six of the crew were brought ashore.

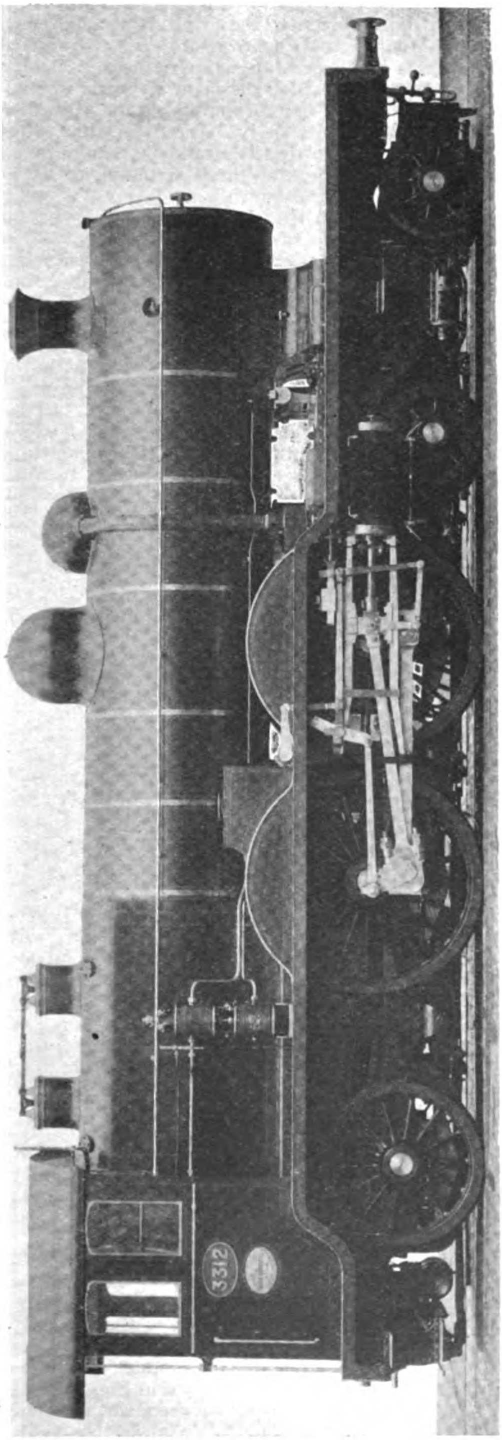


Fig. 2.—"Atlantic" Type Compound Locomotive: Belgian State Railway.

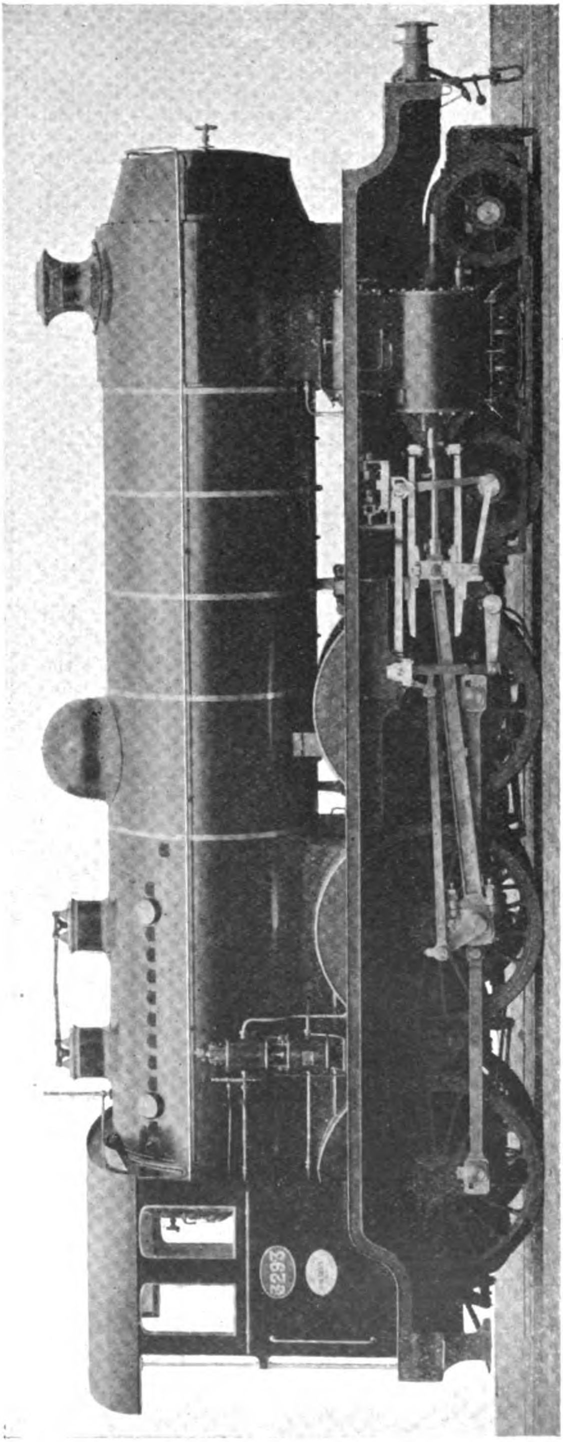


Fig. 3.—4—6—0 Type 4-cylinder Compound Locomotive: Belgian State Railway.

High-Speed Engines.

By H. Muncaster.

(*Continued from page* 376.)

An excellent form of governor is shown in Figs. 31 and 32; this is known as the "flywheel governor," not that it is essentially a part of the flywheel, but that it is generally attached to

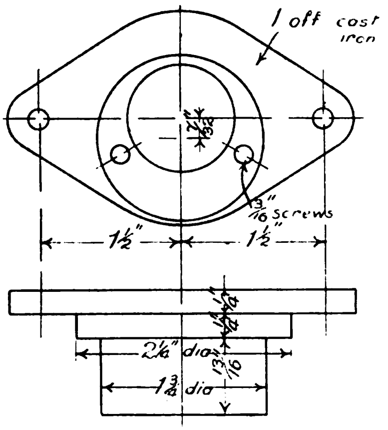


Fig. 33.

the flywheel as a suitable means to an end. To the arms of the wheel are pivoted levers that fly outwards when the engine attains a given speed, determined by the strength of the springs, which are adjusted to the required tension to balance the centrifugal force. The levers are connected by means of links to a compound eccentric, which is

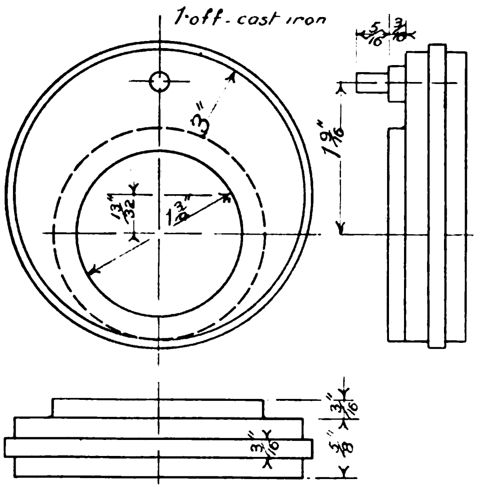


Fig. 34.

so arranged that the travel of the slide-valve is altered without altering the lead of the valve, but altering the "cut-off," and also the amount of compression in the cylinder.

The action of the gear may be understood by referring to Fig. 31. The flywheel is assumed to be keyed to the shaft so as to bring the gear into the proper position relative to the crank. Running freely on the shaft is a sleeve (shown in detail, Fig. 33); this sleeve is made with an eccentric boss, cast on, forming the seat on which the main eccentric works. The eccentricity of the former is 7-32nds, of the latter 13-32nds. We may therefore alter the travel of the valve so that it may be as a minimum equal to the difference of these amounts, or as a maximum equal to this sum; *i.e.*,

The minimum travel $= \frac{13}{32} - \frac{7}{32} = \frac{3}{16}$

The maximum travel $= \frac{13}{32} + \frac{7}{32} = \frac{5}{8}$

It is, however, necessary that the eccentrics be so proportionate that when the gear is operated the centre of the main eccentric moves along a line at right angles to the centre line of the valve rod (not the eccentric rod) when the crank is on the dead centre; to this end one of the eccentrics is made to revolve with the crank, and the other in the contrary direction.

It will be noticed that both of the levers are connected to the sleeve: this is to ensure their operating together. The main eccentric is connected to one

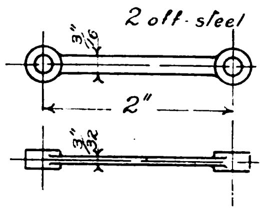


Fig. 35.

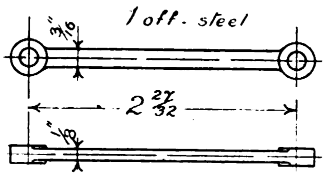


Fig. 36.

of the levers; the relative position of the eccentrics is therefore fixed in regard to the "spread" of the levers.

The exact amount of the centrifugal force is rather difficult to calculate, and some experimenting may be necessary to arrive at a correct estimate of the strength of spring most suitable. The size given will be found approximately correct.

The various pins connecting the gear to the flywheel are shown to be fixed in bosses cast to the arms of the wheel. If, however, the arms are fairly substantial, these may be omitted, so as not to demand a special casting, and the pin simply fixed into the arms of the wheel.

The details of the gear are so clearly shown in Figs. 33 to 39 that no further description will be necessary. It is very desirable to balance the various parts as nearly as possible, as there is only one lever connecting to the eccentric; the opposite lever is weighted to make up for the lack of balance by filling in to the dotted line shown in Fig. 37.

The eccentrics are placed between the flywheel and the main bearing, and no collar on the shaft will be necessary, as the eccentrics may be held between the brass of the bearing and the boss of

FIG. 31.

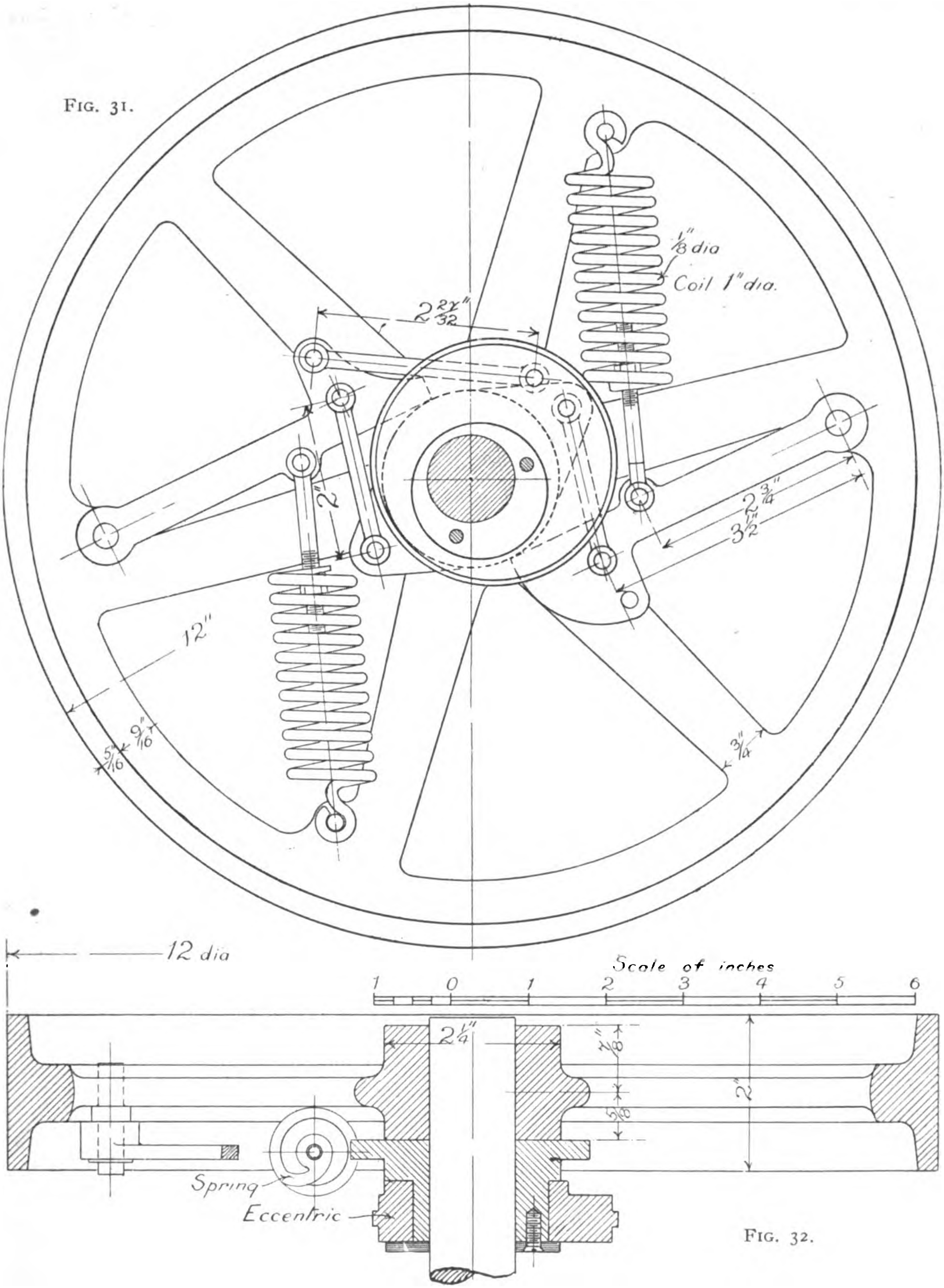


FIG. 32.

A DESIGN OF FLY-WHEEL GOVERNOR FOR HIGH-SPEED ENGINES.

the flywheel, which is keyed to the shaft; the eccentric will not require any other fastening.

The demand for some form of automatic cut-off gear on high-speed engines has practically ceased, owing to the better understanding of the theory of steam expansion. Some time ago almost every type of engine on the market was considered incomplete without automatic gear. The importance of such gears was greatly exaggerated, consequently an idea prevailed as to the value of the automatic gears as a means to the economical working of the engine out of all proportion to the actual worth of these contrivances.

To an engine running long periods without stopping it is desirable to simplify all working parts as much as possible, and all complication in gears is to be avoided, no form of trip gear should be tolerated, and if a cut-off is permitted it must be of a positive nature.

The introduction of Corliss and other gears into service for engines employed for the direct driving of dynamos is not desirable.

The effect of the wire-drawing of the steam through a throttle valve is often misrepresented, Some time ago one of the engineering journals gave an elaborate series of diagrams illustrating the superiority of the cut-off over the wire-drawing that takes place where the governor partially closes the throttle valve. Many very important points were overlooked, so that the conclusions were quite inaccurate. "A little knowledge is a dangerous thing."

Where the steam chest is of comparatively small dimensions the wire drawing is not so wasteful as we are sometimes apt to think. If we consider the case of a slide valve cutting off at about $\frac{3}{4}$ stroke, we shall find that the crank will make about one-fourth of a revolution before there will be any demand for steam, and consequent withdrawal from the chest. During this period the leakage past the throttle valves must have increased the pressure in the steam chest considerably above the average. Then there is the

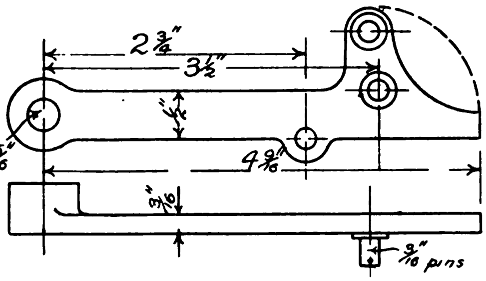


FIG. 37.

"cushion" or steam compressed from the previous stroke due to the early closing of the exhaust. This should amount to as much as will fill the port and clearance places up to the initial working pressure. It will be seen, therefore, that there is a considerable amount of expansion, and although we may not obtain a theoretically perfect diagram, we certainly get quite a different one to that frequently used to illustrate this matter.

Those of us who have experience in locomotive drawing will know the advantage of "linking up" as a method of saving steam during a run where the engine is well up to its work, say, on a falling gradient, or on the level with a good start.

To the uninitiated we may explain that linking up means that the reversing lever is put a notch or more nearer the centre of the quadrant, the result being that the travel of the valve is shortened, and although the lead of the valve is practically the same, the steam is admitted to the cylinder during a correspondingly shorter period; also the exhaust is closed sooner, giving more compression in the cylinder.

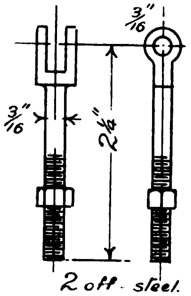


FIG. 38.

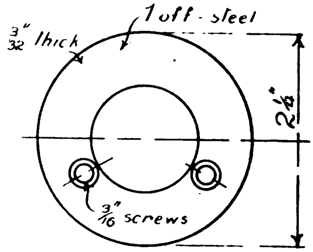


FIG. 39.

In the gear illustrated the effect is identical with notching up, the eccentric being so arranged as to give practically the same adjustment of the valve travel, only that the work is done automatically by the governor.

As regards complications, there is not much difference between this governor and the ordinary governor in the amount of mechanism employed, or in the cost of making.

(*To be continued.*)

A Pedal Boat.

By Eric Liddell.

THIS boat is, I think, something of a novelty; it was constructed by my two brothers and myself, although the idea really originated with Mr. Pitman (of Pelton-wheel fame).

It consists essentially of a pair of cycle cranks and pedals, keyed upon a short shaft 180 degs. apart, which also carries one of the two bevel wheels, a two-to-one bevel-gear transmitting the motion to the propeller shaft, which is a straight rod of wrought iron, $\frac{1}{2}$ in. in diameter, and simply filed up at the two bearings—*i.e.*, at stuffing box and at bevel-gear end.

The thrust of shaft is taken up by a piece of angle-iron (see sketch). Toe-clips are an absolute necessity, and using these, the "intrepid mariner" can drive the boat at a good speed, the while sitting comfortably in the back seat, and having the rudder lines over his shoulders. It will be seen that as the driver sits facing the direction in which the boat moves, he is quite competent to manage the boat by himself, if need be. The screw-propeller is made in (as far as I know) an unusual manner, which, however, has its advantages. A large hexagon nut was specially cast (solid) and then drilled, and tapped to screw on end of shaft, this forming the boss of propeller. The blades are affixed to this by short pieces of iron-rod, screwed at one end and hammered flat, and drilled with two holes at the other, the flat end being riveted on to blades and the other end screwed into boss, first, however, putting a lock nut on. A blade is screwed into every alternate face of nut, and locked in proper position. This arrangement allows the blades to be set to any desired angle, the *approximate* angle in our case being 35 degs., and diameter of screw equals $8\frac{3}{4}$ ins. The propeller is now bodily screwed upon end of shaft, and fixed in position by a lock-nut. The stuffing box is packed with hemp, is of the usual construction, and has never given any trouble

The photograph shows the boat, with my youngest brother in her. To persons contemplating a similar craft I should advocate the use of a higher ratio of gearing—say 4 to 1, and a smaller propeller. A launch-pattern flywheel would also, I should think, give a more uniform motion, although not essential. All parts are well painted to prevent rust. The boat will carry three persons as maximum load.

Fig. 1.—Mr. Eric Liddell's Pedal Boat.

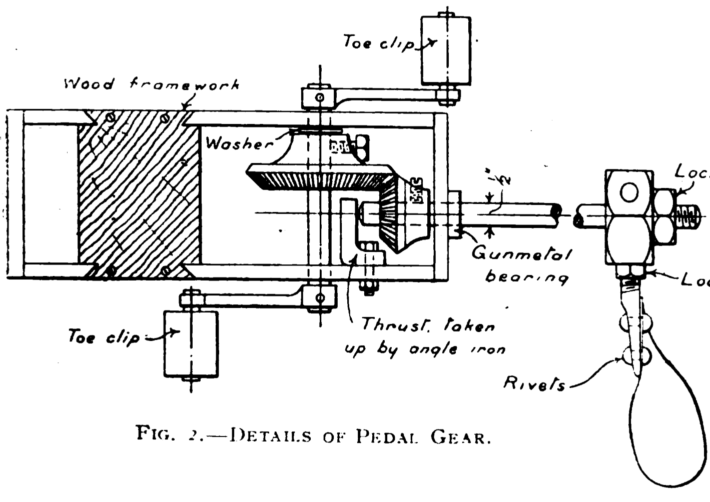
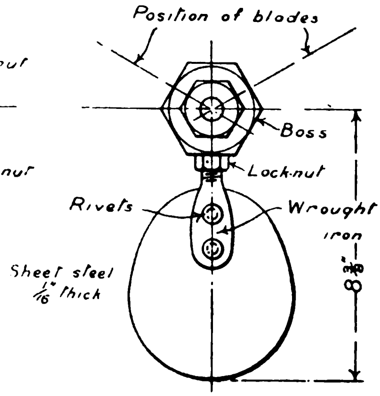


Fig. 2.—Details of Pedal Gear.

Fig. 3.—Propeller.



Length of boat (formerly an outrigger) equals 17 ft. 9 ins., beam (amidships) equals 3 ft. $1\frac{1}{4}$ ins.

Depth of boat amidships equals 1 ft. $2\frac{1}{2}$ ins. By way of improvement I have thought of having a metal plate at stern covering screw, and so helping to keep same in "solid" water, and also to prevent splashing. I recently towed a larger boat containing four people, with two friends and myself in the pedal boat, a distance of over two miles quite easily.

To conclude, the boat is a complete success, and any further particulars will be given that are required.

A Model of the Lifeboat "Uraed."

A MODEL of the small boat in which four men crossed the Atlantic last autumn was recently shown in the City by Mr. O. Brude, her designer, and captain during the voyage. The boat is built of $\frac{1}{4}$-in. steel plates, and is entirely covered in. She is perfectly elliptical in plan and side elevation, and circular in cross-section, her length being 18 ft., and diameter 8 ft. The general appearance is similar to the conventional idea of a submarine, except that a mast and sail are fitted forward. The boat can be entirely controlled from the interior, a conning-tower being fitted for look-out purposes. There is no fixed keel, but a deep centre-board, like that of a yacht, can be let down when the boat is in deep water and withdrawn into the hull when it is desired to land. To further prevent rolling and to strengthen the shell a broad wooden fender runs round just above water-level. The boat has a double bottom, the lowest part of which contains fixed ballast, and provisions and water are stored in compartments in the double bottom and under the benches around the interior. Forty persons can be accommodated in the interior. The *Uraed* was launched from the Aalesund Mechanical Works, Norway, and started on her voyage on August 7th, 1904. She remained a week at Shetland, and after a further voyage of eighty-seven days, during which very heavy weather was encountered, the crew landed at St. John's, Newfoundland, subsequently working the boat round to Boston. According to *Engineering*, in view of her seaworthy qualities, the inventor has come to this country with the intention of having boats of the type manufactured for ships' lifeboats.

The Society of Model Engineers.

[*Reports of meetings should be sent to the offices of* THE MODEL ENGINEER *without delay, and will be inserted in any particular issue if received a clear nine days before its usual date of publication.*]

London.

FUTURE MEETINGS.—It is particularly requested, in view of the special business to be transacted, that all members who are within reasonable distance of London will make a point of being present at the Annual General Meeting, to be held on Thursday, November 16th, at the Holborn Town Hall. It is also requested that members will exhibit specimens of their work freely on that occasion.—HERBERT G. RIDDLE, Hon. Sec., 37, Minard Road, Hither Green, S.E.

Provincial Societies.

Leeds.—On Tuesday, October 24th, this Society held its fifth annual general meeting, there being a good attendance. The balance-sheet was read by the treasurer, showing a balance of £1 12s. 6d., which was considered very satisfactory, after the expenses incurred during the last season of fitting the workshop to run by power, and the best thanks of the members present were given to Mr. Woodhead, who has contributed handsomely in this matter. Members can now make use of the workshop every night in the week. After the annual report was read by the secretary, the rules were read over, but no revision was considered necessary. It was proposed to get up a syllabus, if possible, of subjects to be brought up or papers read at each meeting during the ensuing season. Several members promised papers on various subjects. The meetings are to be continued fortnightly as usual, the dates to the end of the year being November 7th and 21st, December 5th and 19th. The committee appointed were Messrs. Woodhead, Stocks, Speke, Dobson, Liddle, and Prince; treasurer, Dr. Wear. —W. H. BROUGHTON, Hon. Sec., 262, Carlton Terrace, York Road, Leeds.

Tyneside.—The members of this Society extend to all model enthusiasts in the district a hearty invitation to their meeting on Saturday next, 18th inst., at the Rutherford College, Bath Lane, at 7 p.m. An interesting show of engines, dynamos and water-motors is being arranged, and Mr. H. Osborn, of Cross Street and Westgate Road, has promised to send a collection of castings, fittings, and small tools, which may be inspected, and, if desired, purchased. There must be many in the district who, by joining the Society, could help others, or have their difficulties discussed, and gain valuable help for themselves; and as this meeting practically begins a new year, the opportunity to do so is very favourable. Any prospective member can have full information at the meeting, or from the Hon. Secretary, THOS. BOYD, 128, Dilston Road, Newcastle.

Practical Letters from our Readers.

[*The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a* nom-de-plume *if desired, but the full name and address of the sender* MUST *invariably be attached, though not necessarily intended for publication.*]

The Power of Model Electrical Locomotives

TO THE EDITOR OF *The Model Engineer*.

DEAR SIR,—I send herewith an interesting photograph given me by Colonel Harvey, who thought it might prove acceptable to the readers of THE MODEL ENGINEER. It represents the little electric car described in THE MODEL ENGINEER for May 11th last. It was taken whilst hauling Master Robert Harvey, who is nine years old, and weighs six stone. The car will take him up the gradients 1 in 70 and on the level start the load quite easily.—Yours truly,

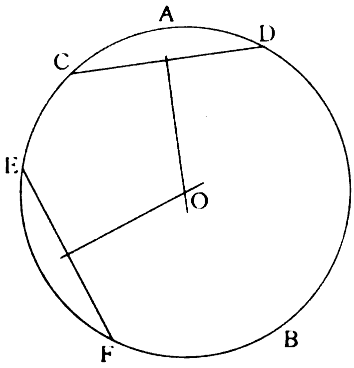
R. W. WRIGHT.

A PHOTOGRAPH SHOWING THE POWER OF COL. HARVEY'S MODEL ELECTRIC LOCOMOTIVE.

Finding Centre of Circular Work.

TO THE EDITOR OF *The Model Engineer*.

DEAR SIR,—I do not know whether the following method of finding the centre of a circular piece of work is known to many of your readers. Suppose you have a circular piece of metal A B; draw across it two straight lines of any length (as long as they are less than a diameter) C D, E F, bisect them; and at the point of bisection draw two other straight lines at right angles to C D and E F. The point where the two lines cut will be the centre. C D



Finding Centre of Circular Work.

and E F are both chords of a circle, and the rule is: The straight line which bisects the chord of a circle at right angles must pass through the centre; therefore it is obvious that if you bisect two chords at right angles the point of intersection must be the centre.—Yours truly, Archimedes.

[A source of error would be occasioned when finding the centre of, say, a circular disc, by reason of the impossibility of placing the point of the dividers exactly on the points C D, E and F. To provide a support for the dividers they would have to be set in so much, and this amount would become indefinite in practice. We would, therefore, always prefer to make and use a centreing square or callipers, such as we have illustrated in our issues of March 31st and April 28th, 1904.—Ed. *M.E. & E.*]

A Model Steamboat.

To the Editor of *The Model Engineer*.

Dear Sir,—Having a desire to build a boat, I decided to attempt one of the same pattern as the *Mogutia*, which was described in an issue of The Model Engineer. I first made some drawings to scale, then, after making paper patterns, marked

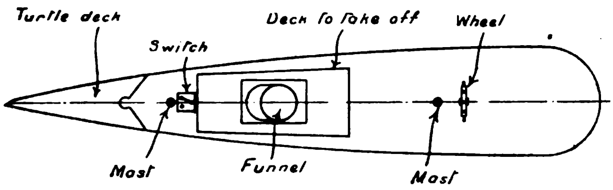


Fig. 1.—Deck Plan of Model Steamboat.

the required shapes on to No. 11 B.W.G. zinc, cut them out, bent and fixed them to a piece of ½-in. zinc tubing, which runs the whole length of boat. The plates were soldered together, allowing for a ¼-in. lap, and the joints were afterwards scraped clean, and a very smooth job was made. A piece of brass tube carries the propeller shaft, having a packing gland, which is the brass end from a cycle pump with a hole bored in it the size of shaft, and a brass collar made to fit over the tube. The propeller, which is a casting, is 3 ins. diameter, and has three blades, and is polished bright.

The dimensions of boat are as follow:—Length, 42 ins.; extreme breadth, 6 ins.; depth, 8 ins. and 3 ins. The masts are wood, and painted white, the rudder, like the prototype, is dark green; the hull is enamelled light blue, whilst the deck and funnel are white, the latter has a red band, and a

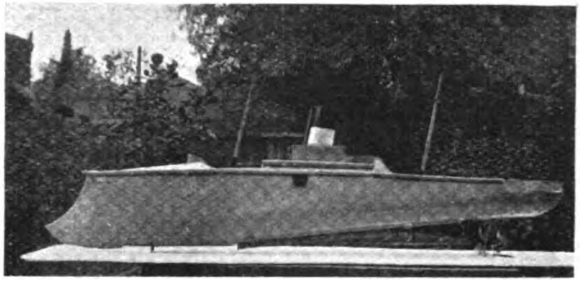


Fig. 2.—Mr. W. A. Croft's Model Steamboat.

bright brass tube in front to represent a steam whistle. I have not yet decided upon the motive power for this boat; my aim has been so far in getting her external appearance as near the prototype as possible.—Yours truly, W. A. Croft.

Islington, N.

For the Bookshelf.

[*Any book reviewed under this heading may be obtained from* The Model Engineer *Book Department, 26–29, Poppin's Court, Fleet Street, London, E.C., by remitting the published price and the cost of postage.*]

Practical Trigonometry. By Henry Adams. London: Whittaker & Co. Price 2s. 6d.; postage 2d. extra.

This is the second edition of Professor Adams' useful little work. It has been written for the use of engineers, architects, and surveyors rather than as a purely mathematical treatise, and it deals with the uses of trigonometry from the point of view of the professional man. We know of no one better fitted than the author to write such a book, and the fact of a new edition being called for proves that it has been duly appreciated by his public.

Work (Half-yearly Volume), February to July, 1905. Vol. XXIX. London: Cassell & Co., Ltd. 4s. 6d.; postage 5d.

This volume contains special articles on "How to Test Electro-plating Solutions"; "Building and Fitting up an Engineer's Workshop"; "Sailing Boats and Their Management"; "A Cosy Corner Settee"; "Pipe Threads and Pipe Failures"; "Adjusting Tailors' Sewing Machines"; "Chemistry in Relation to Photography"; "Construction of Motor-car Radiators"; "Cutting Clock Wheels"; "Building the Frame of a Motor Cycle"; "How to Use a Printing Outfit"; "Re-painting Road Vehicles." It also includes six coloured plates, and a host of short practical articles on subjects of everyday interest to handicraftsmen. It fully maintains the standard of previous volumes.

Queries and Replies.

[Attention is especially directed to the first condition given below and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-hand corner of the envelope "Query Department." No other matters but those relating to the Queries should be enclosed in the same envelope.

Queries on subjects within the scope of this journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied, wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed. (4) Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of Replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor,* THE MODEL ENGINEER, *26—29, Poppin's Court, Fleet Street, London, E.C.]*

The following are selected from the Queries which have been replied to recently:—

[14,915] **Overloading Dynamo.** J. K. (Pateley Bridge) writes: I am obliged by your Reply 14,866. One field seems all right so far as the hand test goes, but the other is not so comfortable. This particular field was found to have a broken wire when first put in. The man in charge unwound, repaired, and rewound; but did the last so badly, a quantity of wire was left out. (1) Is this the cause of extra heat? Would you advise re-winding of this field? The dynamo has been running over a week, each night 5 to 11, only four lights used. (2) How might the machine be overloaded? (3) The enclosed wire is taken from the resistance coils of voltmeter (0·30—140 volts). A quantity of whitewash lime was found amongst these coils, which appear a mass of broken ends—a hopeless case for repairs. The wire is arranged round studs criss-cross fashion. There are 86 turns round the top pair, 5¼ ins. apart; second pair, 80 turns, 5¼ ins. apart: third pair, 80 turns, 4¾ ins. apart. About 72 yds. Will this be about right resistance?

(1) Yes. Possibly fields are getting too heavy a current. (2) By putting more lamps in circuit than she can supply current for under normal conditions. (3) Yes. If the instrument worked with them once, it will again. It is probably a German silver or other high resistance wire of about No. 38 S.W.G., and may have 11 ohms per yard resistance.

[14,916] **Bichromate Cells.** C. H. (Sydenham, S.E.) writes: I am using three double fluid bichromate cells, to charge a 12 amp.-hour 4-volt accumulator, which they have done very well three times: the bichromate solution being stored in a stoppered bottle when not in use, and the cells dismantled. On taking down the cells after the third time of charging, I found a deposit of dark red-coloured crystals covering the carbons and also collected in the bottoms of the jars; these crystals were much darker in colour than potassium bichromate, and had to be scraped from the carbons with a knife. I may mention that I collected some of the substance, and placed it on a piece of sheet copper with the intention of drying it. On applying the heat of a Bunsen burner, it decomposed and turned to a grass green colour. (1) What is this substance? (2) Is it an indication that the solution is practically exhausted? (3) If not, how can I tell when the solution is nearly exhausted, as I put the accumulator on over-night, and I do not want the cells to fail soon after putting on? The charging current is about ½ amp.

(1) Probably chrome alum crystals which sometimes form when bichromate of potash is used. If you use chromic acid instead of bichromate of potash, you will avoid this trouble. (2) Your electrolyte will turn a blue colour when exhausted. (3) It is often the acid (sulphuric) which becomes exhausted first, however, and if more is added the cell will probably resume work for some considerable time.

[14,920] **Depolarisers for Bichromate Cells.** T. H. M. (London) writes: Once more may I ask your aid to the following. Having six ordinary bichromate batteries in use nearly every day, I have been reading up back numbers, etc., to see what is the best solution to use, from the experience of some of your correspondents. I noticed in your issue of September 24th, 1903, a Practical Letter on this subject, but the information given seems to me rather vague. It reads:—"If we *add* a little *nitrate of potash* to *the ordinary solution*," etc., etc. And then goes on:—"The following solution will give three hours' steady work, without polarisation. Dissolve 4½ ozs. *nitrate of potash* in 2 pints water, and add 6 ozs. H_2SO_4." What about the *bichromate of potash*? Also I am advised to use *bichromate of soda*. What is your opinion? Is this better than the ordinary bichromate of potash? Will you also give the chemical changes in the three solutions?

We think you will find that if chromic acid is used instead of bichromate of potash, you will get good results. The former is, on the whole, as good a depolariser as sodium bichromate, and, moreover, is easier to handle. It dissolves directly, and does not crystallise on evaporation. A good electrolyte is made up of 12 ozs. chromic acid, 11 pints water, 1 pint concentrated sulphuric acid. The action of all these salts you mention is to combine with the hydrogen, forming in the case of chromic acid (CrO_2) a lower oxide (Cr_2O_3). The latter is again converted by excess of sulphuric acid into the sulphate.

[14,853] **Model Railway Plans.** F. S. (Leeds) writes: Will you kindly give me a sketch of a model railway (2-in. gauge) to go round a room 10 ft. square—a double track, if possible, one that would be interesting; and, if possible, the number of rails, etc. I should require?

We append herewith a sketch plan, more or less to scale, of a railway suitable for a room. With one terminus it is very difficult to arrange a line which shall allow of the train starting from the terminus, and after traversing a continuous track for a considerable time, returning to the terminus to be marshalled and despatched again, unless the station portion is placed near the centre of the room, as shown. In this plan it is possible for the train to go either to the right or the left after leaving the terminus, and in either case may be run back into the latter without difficulty. If the station portion is made removable, then the room may be put to other (workshop) uses when the railway is not wanted to be worked.

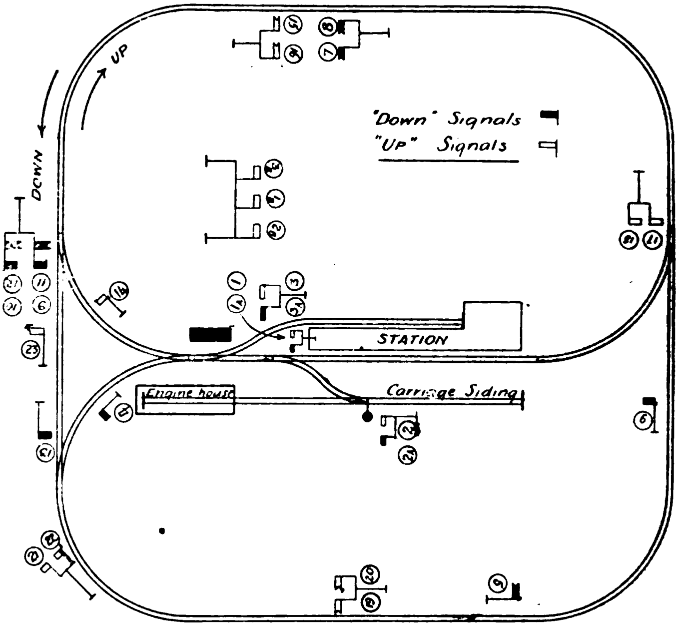


FIG. 1.—PLAN OF AN INDOOR MODEL RAILWAY.

A double main line would offer few advantages with this plan, as unless "flying junctions" and a facing cross-over from the down to the up lines were used; the signalling would become very complicated. In the plan (No. 1) the signals are arranged in such a manner that the main (continuous) line can be used either as a "down" or an "up" line. If it is desired to have quite simple, but at the same time good, signalling apparatus, then we should advise that the trains be run in one direction only. Signal Nos. 1*a*, 2*a*, and 3*a* would then only be shunting signals. Sidings to suit conditions of space could also be arranged at convenient positions on the main (continuous) line. For a double line railway, we suggest another plan. This would need two termini—one within the continuous line as shown, and the other—if the room is a small one—at the end of the line leading out of the room, as indicated. Trains could run from one terminus to the other on up and down lines, and could be made to run races without fear of collision, one train leaving one station, the second train the other, each making so many convolutions of the main line before proceeding to their respective termini. The signalling, excepting that for the straight branch terminus, which may be practically the same as for the station

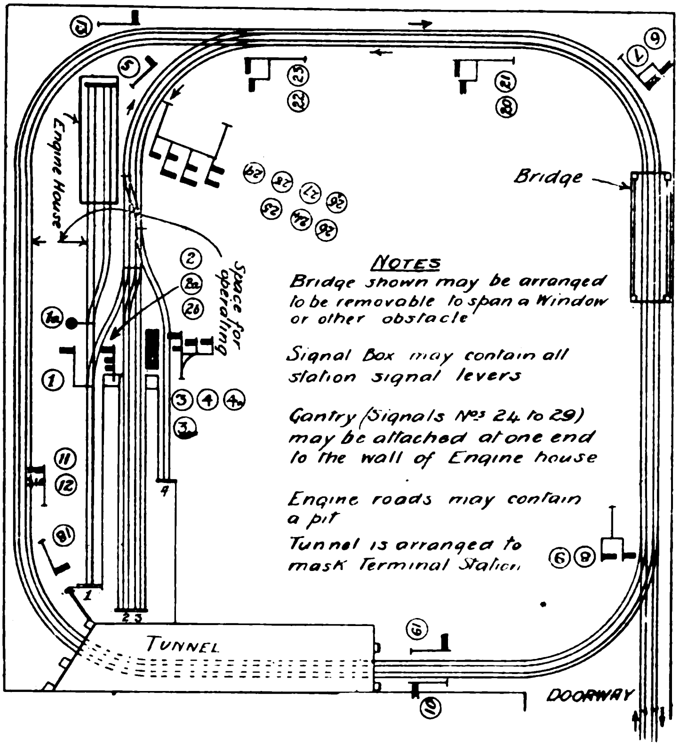


FIG. 2.—ALTERNATIVE ARRANGEMENT OF MODEL RAILWAY TRACK.

shown, is indicated on the plan. The following are a few notes on the signal of the first plan. Nos. 1, *1a*, *2a*, 2, 3, *3a* are starting signals for "down" and "up" roads respectively, *1b*, *2b*, and *3b* being the incoming signals for trains from either up or down directions. The other signals around the continuous track are simply ordinary junction signals and their distants, No. 18, of course, acting as a station home signal, and Nos. 11 and 12 to show whether any of the gantry signals are off, or whether No. 13 is showing line clear. The ground signal of the engine shed road could, of course, be substituted by a semaphore on the bracket signal Nos. *2a* and 2. In plan No. 2 we find that an extra shunting arm for station road No. 3 (numbered *3b*) is required.

[14,886] **Electric Light from Primary Cells.** J. L. (Reading) writes: I am thinking of making an eight-cell bichromate battery, as described in your book "Electric Batteries" and I should like to know (1) How many 8-volt H.E. loop lamps this will light? (2) How many hours every night? The lamps will only be a short distance away. (3) What gauge wire? (4) Must I have all the lamps on at once? (5) How many 5-volt lamps connected by about 4 yds. of wire in all? (6) How long will they burn with one charging of cells? (7) How often shall I have to charge the battery (*a*) while using 8-volt, (*b*) while using 4 or 5-volt lamps?

(1) Depends upon their candle-power. If small 1 or 2 c.-p. lamps, about two or three could be run in parallel. (2) About 12 to 15 amp.-hours. (3) Any convenient size, say, 20 S.W.G. (4) Not necessarily, unless they are *intended* to be run in series. (5) Not suitable voltage to run from 8-volt supply. (6) Depends upon unknown factors. (7) See above; and do a little experimenting.

[14,890] **Coil Winding.** A. S. (Stamford) writes: Please excuse me bothering again. I have purchased parts of a 1-in. spark coil. Have completed the four bobbins for the wire to be wound on; also have got 1¼ lbs. of No. 36 cotton-covered wire, but I am unable to wind it yet. As soon as I get half way through a layer the first part of the beginning of the layer begins to slip, and then some of the turns *cross*. I have spent three weeks over it now—been at it three hours every evening. I have not a lathe, only ordinary winder. Would it be better if I ran the wire through wax, as I am winding, please? Would that make it stick together more? Can you give me any instructions on winding? I should be most obliged, as my friends tell me that it is impossible for it to be wound without a proper winding machine.

Yes. This would make matters much simpler. Do not try to pull too tight, however. Have you read our Handbook on the subject?

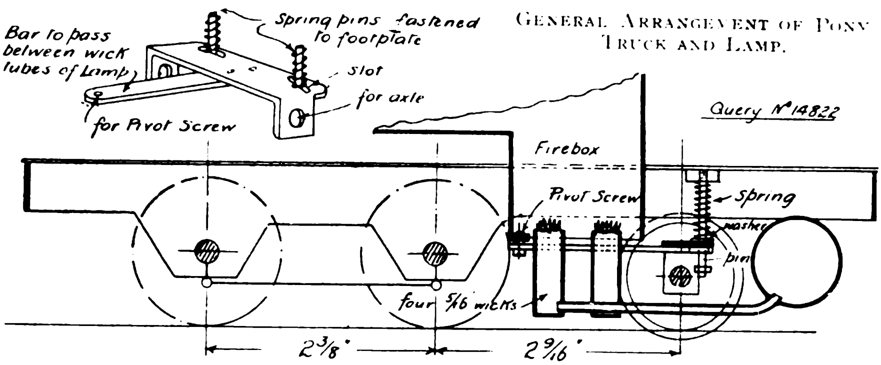
[14,897] **Hot-air Engine; Transforming.** A. H. S. (Norbiton) writes: Would a motor drive a dynamo and give more current than it takes to drive the whole concern, with good machines? Would a hot-air engine motor like Mr. Land's drive a stern wheel Mississippi steamer, 3 ft. long or under? If not, how strong engine and long boat, as I intend to try to make one?

(1) Yes, but the watts generated would be considerably less. That is, the total watts output of dynamo would be less by the losses due to conversion. (2) We should not advise a hot-air engine, as their weight in proportion to their power is extremely great.

[14,822] **Radial Truck for Small Model Locomotive. "Loco"** (Edgware) writes: I have a 6-wheeled coupled G.W.R. type saddle tank, 2-in. gauge, which I find will not go round the curves of my railway. I am desirous of fitting a pony truck at the trailing end, and have removed the coupled wheels at this end. Kindly give me a sketch of a suitable radial axle-box.

We append a sketch of a suitable arrangement of rear pony truck. You will have to cut away the main frame and horn which carried the original trailing coupled wheel to the line indicated. The slots in the top of the radial truck should be sufficiently long to allow of the maximum movement required. The spring pins should be tapped into a block soldered or otherwise affixed to the footplating, and between the top of the truck frame and the spiral bearing spring, a washer should be placed so that the spring shall not catch in the slot. The truck wheels may be as large as 1¼ ins. diameter. The lamp is shown in the sketch.

GENERAL ARRANGEMENT OF PONY TRUCK AND LAMP.



[14,957] **Pasting Accumulator Plates.** H. M. (Inverurie) writes: Would you kindly answer the following questions? I am repairing an old accumulator, and have your handbook on "Small Accumulators," but I intend pasting with litharge instead of precipitated lead; but the plates when pasted are cream-coloured instead of grey. Is the solution of chloride of lime the same as what is used in bleach works? Are the negative plates placed in chloride of lime? When I paste the negative plates the paste swells up. Is there anything to stop this? Is it advisable to clean old grids and refill, or make new ones? What length of No. 26 S.W.G. copper wire will pass ¼ amp.; to test how many amperes the cell,

will discharge, or could you give me a better plan, as I have no ampere-meter?

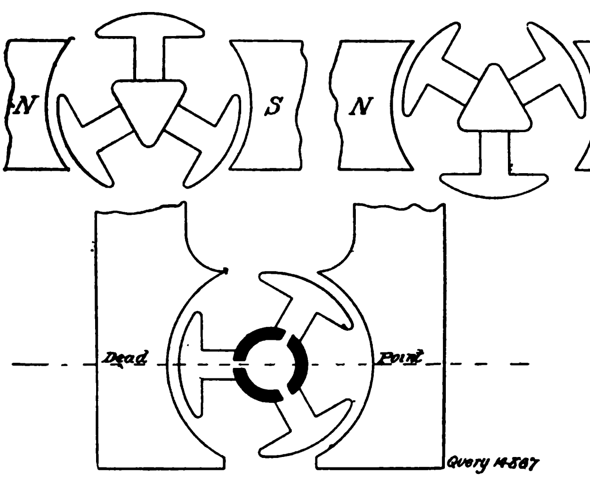
When the negative plates are quite dry, after having been pasted, they are always a pale yellow colour. They only change to a slate colour when they are formed. The forming is done by repeated charging and discharging—preferably at a slow rate. Yes, you can use old grids, if in fairly good condition, over again. You can scarcely determine what current is flowing by inserting a resistance, unless you can tell to a nicety its resistance and the voltage of supply, etc. We advise you to make or buy a small voltmeter and ammeter. Only the positives are formed by dipping in chloride of lime. It is the same as is used for bleaching.

[14,899] **Thermopiles.** H. A. B. (Stockton) writes: I should be glad if you would answer the following questions. (1) Which is the best simple form of thermopile suitable for charging accumulators not worked by gas? (2) What are its elements composed of? (3) How many couples will it require per volt? (4) About what dimensions will they have to be per ampere, or, say, 4 amperes? (5) Where can I obtain full particulars for constructing same? (6) What are the practical limits as to size and output?

(1 and 2) Various couples are used—antimony and bismuth, for instance. Gulcher's thermopile was a recognised make, but we do not know that it is still obtainable. They are seldom used for practical work nowadays, the price being somewhat high—£14 for one giving 4 volts and 3 amps. (3) 100 bismuth-antimony couples at 100° C. difference of temperature would only give 1·17 volts. (4 and 5) The thermopile is dealt with in "Primary Batteries," by Cooper. (6) They are not usually made to give more than 2 or 3 volts pressure.

[14,867] **Tripolar Motor Failure.** W. W. (Ilford) writes: I have a small electric motor ("Simplex") which I cannot get to run. It was intended to run with three quart-size bichromate cells. The field coil is wound with about 30 yds. of wire. The armature is tripolar, each limb being wound with 5 yds. of wire. Armature is wound correct, according to handbook, "Small Electric Motors." Both field coil and armature coils are wound with same gauge of wire, sample of which is enclosed. All connections are good, and there is no leakage to the carcase of machine. Field coil and armature are in series. Have tried field coil in shunt without success. Brushes and commutator are in correct positions (have tried all). When current is supplied to motor, armature stops dead in one or the other positions given in sketch. Would winding armature with a smaller gauge of wire improve matters? I should feel obliged if you could suggest cause of trouble and remedy.

Most probably you are not cutting out the armature coils at the right moment. Each coil must be cut out of circuit just as it reaches the dead point; this means that the commutator divisions must be in line with the armature poles, as in sketch reproduced above. If you adjust your brushes so that this action takes place, or adjust the position of commutator relatively to obtain the same result if brushes are fixed, you will probably find the motor will run satisfactorily.



SHOWING DEAD POINT OF TRIPOLAR ARMATURE.

[14,876] **Electric Bells for Fire Alarm.** W. H. (West Malvern) writes: I am in an awful fix about fixing an electric fire alarm. I have to fix up five bells, with a push underneath each one; either push must ring the whole lot of bells. I was going to fix the bells in series, and the pushes in parallel. Would this be correct?

You must connect the bells in parallel, and the pushes also.

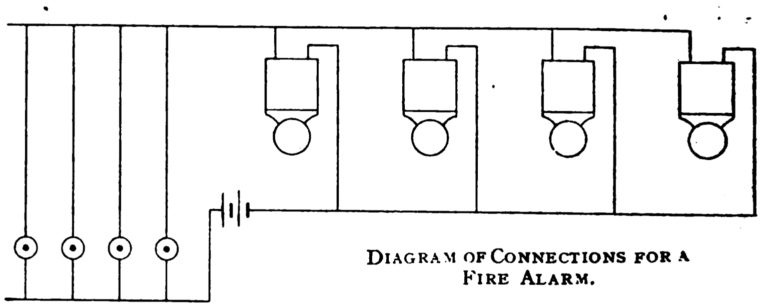


DIAGRAM OF CONNECTIONS FOR A FIRE ALARM.

[14,887] **Electric Light for Dark-room.** G. H. G. V. (Tonbridge) writes: I am thinking of making an electric light arrangement for my dark-room. I think of using a 4-volt lamp taking ½ amp., and not using a ruby lamp, but putting it in an ordinary candle ruby lamp. I should be very pleased if you would answer the following questions:—(1) Would this lamp be strong enough, as I should not want a very strong light? (2) What kind of cells, and how many would it be best to use? I do not want to have bichromates because of the bother of having to lift out the zincs from the acid. I also have no way of charging accumulators. I should want the lamp to burn for about 20 to 30 minutes at a time. We have four Leclanché cells quite close to the dark-room, but they would polarise too quickly, I am afraid. (3) I propose making a resistance as in the enclosed sketch (not reproduced). The German silver wire has a resistance of ·84 ohms per yard. How much ought I to use? I should also use a switch to switch on 1, 2, 3, etc., cells, so I should only want a resistance to make the lamp burn with a very small light with one cell on. I shall have to use asbestos insulation—I suppose between the iron pipe ring and the wire—as a certain amount of heat would be generated? Where can I get asbestos? I have tried at several shops, and I can't get it. I enclose a rough sketch (not reproduced) of the connections that I think would do.

(1) We doubt if this lamp would give you enough light; it would be better to use a lamp taking, say, ¾ amp., at least. However, you can easily substitute different lamps until you get suitable results. (2) Leclanché cells will be useless. Why not try the battery described in THE MODEL ENGINEER of April 9th and 16th, 1903, pages 344, etc.? The only other kind we can suggest would be the constant bichromate pattern, as Chapter IV of our Handbook No. 5. It is not absolutely necessary to withdraw the zincs from the solution in this type of cell, though better practice to do so. (3) As the resistance is adjustable, it does not matter how much wire you use; put on as much as convenient; about a dozen yards should be sufficient. You must certainly use insulation between the iron pipe ring and the wire; asbestos would do. It can be obtained from the Cape Asbestos Co., Ltd., 8, Minories, London, E.C.

[14,802] **Running Small Dynamo.** T. H. H. (Tiphook, Assam) writes: I have purchased a small dynamo for charging accumulators (10 volts 4 amps.). It lights up a 10-volt lamp all right, but I am at a loss to raise the amperage, or, rather, how to get it, as when switched on to an accumulator, with or without a resistance, the ammeter does not move. I want 1 to 1½ amps.—the ½ amp. it passes is too slow. The armature is 5 ins. long by 1¾ ins. diameter drum, shunt-wound, eight-slot, and apparently 22 gauge s.c. wire. I take it there is nothing wrong with the dynamo, as it excites at once with a lamp on circuit.

You do not say what voltage your accumulator is. Perhaps its E.M.F. is too high to allow much current to pass; or possibly when you put a load on to dynamo the belt starts slipping, and speed drops. You can only experiment carefully, and watch closely for anything which seems wrong.

[14,684] **Books on Electrical Engineering.** F. C. (Alfreton) writes: Will you kindly show me how to calculate for the true resistance of the installation by the output of the dynamo, generating current for the same mains? How is it that a series-wound dynamo does not refuse to build up (same as a shunt-wound

machine) with a short-circuited armature? Will two 250-volt 16 c.-p. lamps run in series with two 100-volt 16 c.-p. lamps on a 700-volt circuit, and, if not, please explain why? How do you obtain the carrying capacity (in amps.) of a switch?

Study some text-books on the subject. We cannot teach electrical engineering in a query reply. The testing of electric installation work is explained in our handbook on "Private House Lighting," price 1s. 3d. post free. Lamps to run in series must take the same current in amps. (those you mention would not run in series, as they do not take the same amount of current). Switches are designed on lines dictated by the practical experience of the designer. Your motor calculations are correct. Some articles are now appearing in THE MODEL ENGINEER under "Lessons in Workshop Practice," which will explain the action of a series wound dynamo. See issue for August 17th, and following numbers. "Electric Lighting and Power Distribution," by Perren Maycock, is a good text-book; Vol. I, price 6s.; Vol. II, price 7s. 6d.; postage of either, 4d.

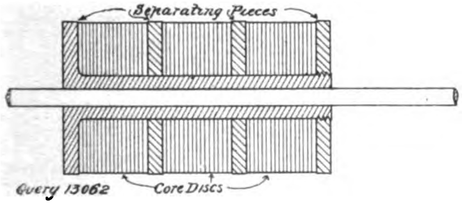
[14,963] **Building Small Dynamo.** A. E. B. (King's Cross, W.C.) writes: Will you give me a little advice on a small dynamo that I am building? I have sent a rough sketch of dynamo in letter; also I have enclosed samples of wires that I have by me. Please let me know if either of these will do for field-magnet and armature; how much to wind on armature; how to wind for six-part commutator; what speed to run at; how much wire to wind on each limb of F.M.? Also, what can I expect to get out of machine in volts and amps? I might add that field-magnets are already magnetised. Both field-magnets and armature are cast iron, machined as shown in drawing. I have kept air-gap down to 1-32nd.

Wind armature with No. 26, and F.M. with about 1 lb. No. 25. Armature will take about 3 ozs. The thicker of the samples you enclose will do for field windings—it is a full 25 S.W.G. The other is No. 27. This winding will give you about 15 to 20 volts. If you used 22 S.W.G. on armature, and 22 on F.M., you would get about 10 volts and 2 amps. We regret reply to this query has been delayed. It originated in the fact of Query Coupon having been omitted. For methods of winding, see handbook "Small Dynamos and Motors."

[14,901] **150-watt four-pole Dynamo.** A. C. T. (Withington) writes: I should be very pleased if you would answer the following queries as soon as possible. I wish to make a four-pole dynamo of 150 watts output (30 volts 5 amps.). (1) Would you give me the chief dimensions of the field-magnet, with outline sketch, if possible?

Re four-pole machine, see reply No. 7,234 in April 23rd, 1903, issue.

[13,062] **Overtype Dynamo Windings.** T. L. (Holywell) N.W.) writes: We have a dynamo which was built by Dyson Walton, of Hebden Bridge. Gramme ring armature, wound in 90-segment sections, with a 90-segment commutator. Commutator is 5½ ins. diameter by 2½ ins. wide. We propose stripping gramme ring off shaft, and converting same into a drum armature, and want to construct a machine to give an output of 25 amps. 110 volts (compound wound), using present shaft and commutator, which is a very good one, and well constructed. It will be necessary to have new castings for fields. The gramme ring was wound with 400 yds. of No. 14 B.W.G. s.c.c., and in running we found that the largest output we could get was 10 amps. at 55 volts, and speed 2,500. Would you be kind enough to give us instructions and length of drum, with amount and gauge of wire to wind armature; and whether it would be possible to use the No. 14 B.W.G. we have taken off again? Also dimensions of field-magnets, with amount



SECTION THROUGH ARMATURE.

and gauge of wire. We would prefer building one of the two-pole pattern, as made by Royce, Ltd., Manchester; speed about 1,200. We can allow 12 ins. for length of drum, with 1 in. at each end for lapping. And could you give us the address of a good firm to make castings?

We give you a sketch and particulars of dynamo required. Owing to the very large number of segments in the commutator, the armature must be of large diameter, and even then must be double wound, with one set of coils on the top of the others; and, further, this involves the use of a smooth core, as, if a slotted core was employed, it would be necessary to have very deep slots, with several sets of coils one on top of the other, making a complicated winding; or else you could not get space for the teeth without an excessively large diameter. The smooth core, however, should prove quite satisfactory. One inch is not enough to allow at each end for the overlapping wires, so we have adopted a core length of 8 ins., which will give a better allowance of room. You will find methods of constructing and mounting drum armatures illustrated in back numbers of THE MODEL ENGINEER, under the heading of "Lessons in Workshop Practice." Separating pieces for keeping the coils in place are necessary, and the coils must be very firmly bound down on to the core. Commutator, 90 sections; armature, smooth core, fitted with hard vulcanised fibre pieces between the coils to keep them in place; divided into ninety divisions wound with No. 14 gauge D.C.C. copper wire, two coils in each division—one on the top of the other—each coil consisting of two turns of wire; weight of wire required, about 10 lbs. Field-magnet winding, shunt coils, about 15 lbs. of No. 20 gauge s.c.c. copper wire on each bobbin, the two coils being joined in series with each other; series winding to be wound on top of the shunt coils, and to consist of one layer on each bobbin of 7/14 electric stranded wire cable, all joined in series, or any stranded copper cable having a sectional area of ·035 sq. in. (approximate). It will be necessary to adjust the compound series coils by trial at the particular speed at which the machine is run; that is, you will most likely find the coils in excess, and can take off a few turns until you get the regulation just right. Castings and materials can be procured from advertisers in THE MODEL ENGINEER. We advise you to finish winding armature, and then bore out the poles to suit. Cast-iron base should have a cross-sectional area of at least 48 sq. ins.; but in estimating this the whole of the base can be reckoned in. The armature should have four rows of fibre separating pieces, each 1-10th in. thick. Core discs mounted on a brass sleeve, with flange at one end and clamping nut at other end; sleeve keyed or pinned to shaft; separating pieces let into slots in brass discs, as shown in THE MODEL ENGINEER of May 26th, 1904, page 489; or any more convenient construction.

New Catalogues and Lists.

Clyde Model Dockyard and Engine Depot, Argyll Arcade, Glasgow.—We have received from this firm a new abridged list of their specialities. This includes model steam, clockwork, and hot-air engines; a varied assortment of model locos, including a new Caledonian Express and several models of other lines, model rolling stock, signals, permanent way and accessories, model yachts and steamers, and several scientific novelties. The list, which is fully illustrated, covers 34 pages, and will be sent post free for 2d. It contains at the end a preliminary announcement of two new working model locos—one a Glasgow and South-Western 6-coupled express, and the other the "Grampian Express" 6-coupled loco of the Caledonian Railway. We hope to illustrate this latter model in an early issue when we notice the firm's new complete list which is just being issued.

W. J. Bassett-Lowke & Co., Northampton.—The second section of this firm's new list (section B) has just reached us. This is devoted to what may be termed model stationary engineering, and deals with vertical and horizontal engines, boilers, fittings, sheet-metal, rod and tubing, dynamos and motors and tools. The pages devoted to boilers are worthy of special note, as is also the table showing the sizes of boilers required to drive certain sizes of engines. Several new lines are listed among the fittings, and we note also some new patterns of gunmetal feed-pumps. A table is also introduced giving particulars of the diameters and pitches of all threads used on their best quality fittings. The tools and other sundries listed have all been well selected, and the catalogue is one which should be very useful to the model steam engineer. It covers 132 pages, is profusely illustrated, and will be sent post free for 4d.

The Model Manufacturing Co., 53, Addison Road North, Notting Hill, London, W.—The new tool list, issued by this firm, will be found useful to those requiring cutting and milling tools, arbors and reamers. The list, which is well illustrated, gives prices of various size tools, and will be sent to readers upon receipt of stamp to cover postage.

T. W. Thompson & Co., 28, Deptford Bridge, Greenwich, S.E., have sent us their list of Improved "Greenwich" Dynamos, specially built for continuous running, charging accumulators, or lighting and plating. Prices of suitable lubricators for these dynamos are also included in this list.

A. P. Lundberg, 477-487, Liverpool Road, London, N.—We have received a list illustrating the "intermediate pivot," "tumbler," "three-way," and other switches, manufactured by this firm. A number of diagrams of connections are given, and some adaptations of the combined tumbler switch and wall connection are illustrated.

The Editor's Page.

SEVERAL readers have written for some further information on the subject of the "Fortis" Vice Competition, the chief difficulty being in regard to the nature of the drawings required. We may state, for the benefit of all concerned, that the first consideration in awarding the prizes will be the suitability and convenience of the bench as designed by the competitor, irrespective of the quality or character of the actual drawing. At the same time, the neatness and clearness of the drawing will count in the competitor's favour where other points are equal. Drawings should preferably be made to scale, and should be in good black ink on white cardboard or good white paper. No coloured lines or washes should be used. The size of the drawings does not matter much, provided they are large enough to show all details quite clearly. By the term "vice-bench" we do not mean a bench designed merely to accommodate a vice, but an amateur's work-bench suitable for the usual operations connected with fitting and light erecting, in the equipment of which a vice forms an essential feature. We hope this explanation will remove any uncertainty in the minds of intending competitors.

* * *

The following letter appeared in a recent issue of the *Daily Mail*, under the heading of "An Embryo Stephenson":—"Sir,—I have heard for some time past of the mechanical talent of a young cowman in my parish. One afternoon I paid him a visit, and after some difficulty induced him to show me his workshop, which he had built for himself. I found it contained a rude lathe, a furnace for melting brass, and various tools, all made by himself. There were copies of THE MODEL ENGINEER lying about, and there can be no doubt that if he got a chance he would do well as an engineer. Now, this poor lad, who is eighteen years old, steady and reliable in character, and of good physique, must remain for ever a cowman unless he gets a helping hand, and I am writing in the hope my letter may meet the eye of someone who could get him employment in any capacity in engineering works where he would have a chance to attend technical classes in the evening. He tells me he has answered advertisements, but he has no chance applying from a remote country village in Sussex, as a premium is out of the question.—COUNTRY VICAR." This letter is of considerable interest to us, showing, as it does, the influence our Journal has in encouraging latent mechanical talent. We give it further publicity in this column in the hope that possibly someone amongst our numerous readers may be in a position to hold out the required helping hand to the young man to whom it refers, and so give him an opportunity of showing what he can do. It is highly probable that, as a reader of the *M.E.*, he will see these lines; and we trust that he and others similarly placed will take heart from the fact that many engineers have risen to the top of the tree from a position and surroundings of equal difficulty.

Answers to Correspondents.

S. D. K. (Peel).—The reversing gear is probably an adaptation of the wedge motion, several modifications of which we have recently described in these pages.

H. v. S. V. (Bad Ems).—We thank you for the photographs and description of your models, but as we have, from time to time, illustrated several models of a similar character, we hardly think the contribution of sufficient general interest to publish.

A. WELFORD (Brondesbury, N.W.).—Will you please send us your full address?

Notices.

The Editor invites correspondence and original contributions on all amateur mechanical and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected or not, and all MSS. should be accompanied by a stamped addressed envelope for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

This journal will be sent post free to any address for 13s. per annum, payable in advance. Remittances should be made by Postal Order.

Advertisement rates may be had on application to the Advertisement Manager.

HOW TO ADDRESS LETTERS.

All correspondence relating to the literary portion of the paper, and all new apparatus and price lists, &c., for review, to be addressed to THE EDITOR, "The Model Engineer," 26—29, Poppin's Court, Fleet Street, London, E.C.

All correspondence relating to advertisements and deposits to be addressed to THE ADVERTISEMENT MANAGER, "The Model Engineer, 26—29, Poppin's Court, Fleet Street, London, E.C.

All subscriptions and correspondence relating to sales of the paper and books to be addressed to Percival Marshall & Co., 26—29, Poppin's Court, Fleet Street, London, E.C.

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Contents

[*The asterisk* (*) *denotes that the subject is illustrated.*]

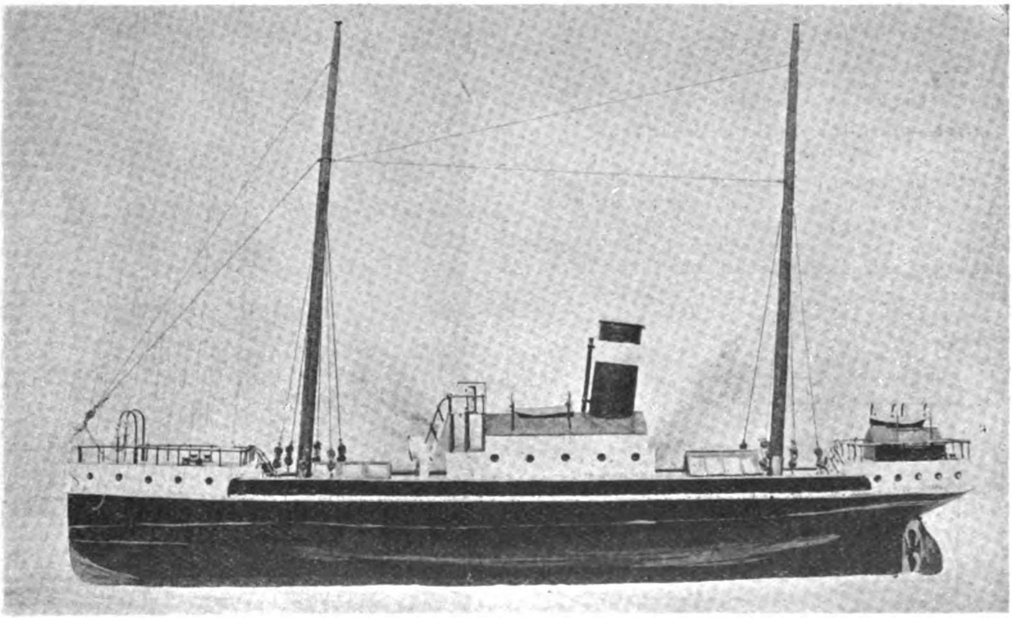
THE
Model Engineer
And Electrician.
A JOURNAL OF PRACTICAL MECHANICS AND ELECTRICITY.

EDITED BY PERCIVAL MARSHALL, A.I.MECH.E.

VOL. XIII. No. 239. NOVEMBER 23, 1905. PUBLISHED WEEKLY.

A Model Steamer.

By E. HATFIELD.



MR. E. HATFIELD'S MODEL STEAMER.

THE accompanying photograph is of my model steamer *Amy*. Her dimensions are as follows :

Length, 4 ft. 4½ ins. ; beam, 9½ ins. ; and depth, 4½ ins. The hull is constructed of layers of sheet zinc. This was the most difficult to make; I first cut sections out of wood, and then tacked the zinc strips on to them, finishing it by sweating them together with solder. The main deck is of wood, ruled to imitate boards, and is fitted so that it can be lifted out, if needed.

The forecastle is 1⅝ ins. above the main deck, the poop 1⅝ ins., and the bridge 4½ ins. These are all made out of zinc, also lined out to represent planks. The forecastle and poop are soldered on to the hull, and the bridge is made so that it can be lifted off to allow of access to boiler. The deck-house is of zinc with six windows, for which mica is used, and has two doors. The funnel is of zinc, and wired on the top. There are three skylights ; these are of zinc with windows of glass. The ventilators are made out of eight small pieces of zinc, blocked up to shape and soldered together. They have a brass ring soldered on to the mouth. There are four boats in davits which I bought. The steps are of zinc, with brass stanchions and rails up each side, also round forecastle, poop, and deck-house. The port holes are circular pieces of zinc with a hole in the centre and soldered to the sides of the hull. The masts are 2 ft. 2½ ins. high from deck, and the stays are fitted with dead-eyes, and the fore stay has a pair of brass blocks.

The engine I built up from castings which I purchased, and is a direct-acting slide-valve, ⅜-in. bore with 1½-in. stroke; it drives a 3-in. built-up propeller.

The boiler is of 1-16th-in. copper, 9¾ ins. long and 3⅞ ins. diameter, and has a riveted and soldered joint and eight ½-in. tubes placed diagonally across it; the ends are welted on to the shell. It is fitted with safety valve, steam tap, filler, and two water taps.

The heating lamp is an oblong box filled with cotton and a piece of copper gauze on top. It is fed from a tank placed forward, the fuel being methylated spirit. With the exception of anchors, the entire model is my own construction, the work taking me nearly two years of my spare time.

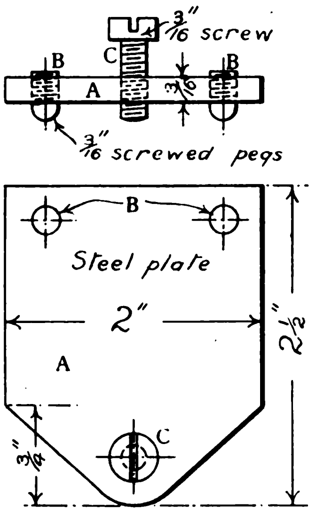
Workshop Notes and Notions.

[Readers are invited to contribute short practical items for this column, based on their own workshop experience. Accepted contributions will be paid for on publication, if desired, according to merit. All matter intended for this column should be marked "WORKSHOP" *on the envelope.]*

Angle-plate for Drilling Machine.

By "Scribo."

It is often desirable in certain jobs to drill a hole slightly angular, and instead of packing up with bits of wood or metal nearest to hand, which oftentimes slip, this plate will be found to overcome that difficulty, and is very useful for other things.



Angle-plate for Drilling Machine.

To make, procure a piece of good straight steel plate A, and file to dimensions shown; drill and tap two 3-16ths-in. holes and fit two pegs (B B) made from screws, with the ends rounded as shown. Drill and tap at the other end a 3-16ths-in. hole, and fit a screw (C) either an ordinary cheese-head screw or a knurled head screw. To use, move screw C up or down, according to angle wanted.

Machine for Screwing Cycle Spokes.

By Alexander P. Laing.

The accompanying photographs are of a machine for screwing cycle spokes, which was invented and patented by Mr. Hugh Robertson, Cycle Agent, North Station Road, Dunfermline. To this gentleman I am indebted for permission, not only to

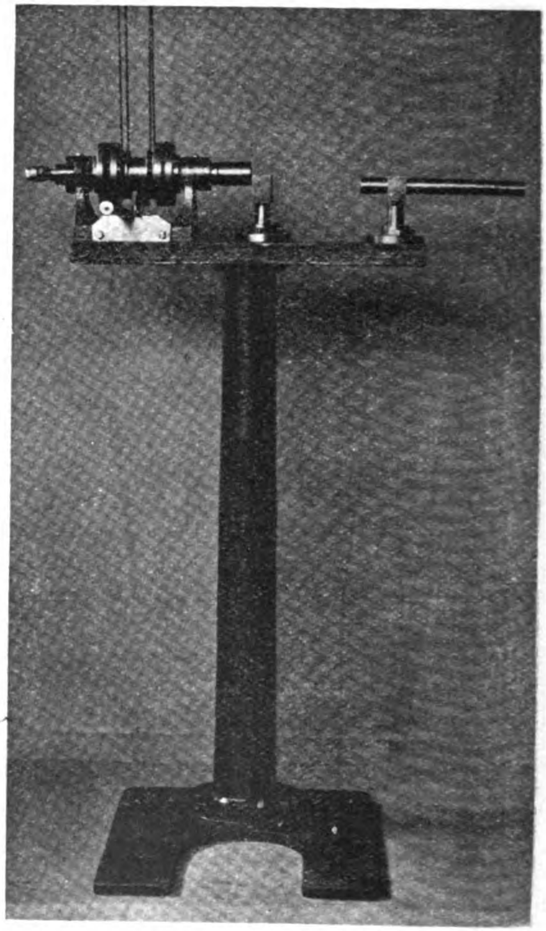


Fig. 1.—Machine for Screwing Cycle Spokes.

photograph but to witness his machine in working order. This machine supplanted in Mr. Robertson's well-equipped workshop a small machine which was operated by hand, and made the work of screwing spokes long and laborious.

The head of this machine is similar in design to the head of an ordinary lathe, with a spindle running in conical gun-metal bearings. On the spindle are mounted four discs—two loose and two fixed. The loose discs or pulleys have V-grooves to take a cord or gut band for driving same, and are faced with leather to form a friction-clutch. It will be noticed on the photographs that one of the bands is open while the other is crossed, causing one of the loose pulleys to run in the same direction as the driving shaft and the other in the opposite direction. It will be seen that the two loose pulleys run clear between the two fixed pulleys, which are placed one at each end of the spindle. The two loose discs are mounted on a slide, which can be slid backwards and forwards between the two fixed pulleys, by pushing the lever (which can be seen in the photographs) either to the right or the left. By this means the spindle is made to revolve, and can be reversed at any time. On the end of the spindle a die chuck is screwed. Just in front of this there is a rest for leaning the spoke on while entering it into the die. At the other end of the machine there is a rather ingenious arrangement for holding the spoke while it is being screwed. The head of the spoke is put into a slot, which prevents it from turning. The point is laid on the rest and entered into the die. After the spoke is screwed to the required distance the lever is pushed to the opposite side, thus reversing the motion, which screws the spoke out of the die. Immediately the end of the spoke is clear of the die an internal spring throws it clear of the machine, leaving the machine ready to take the next spoke. Eight spokes were screwed in one minute by this machine.

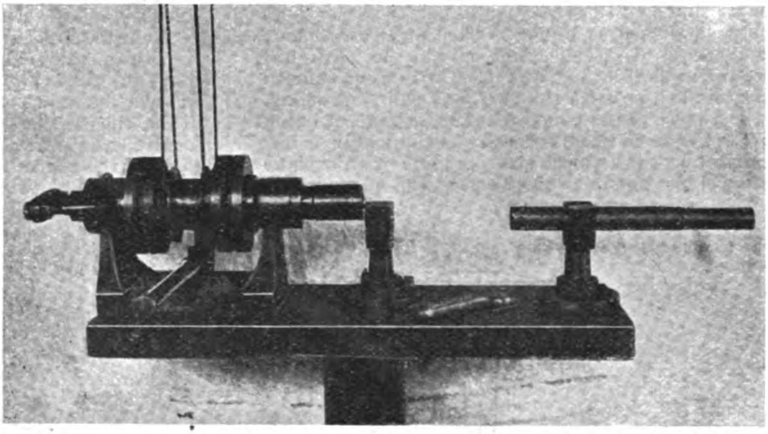
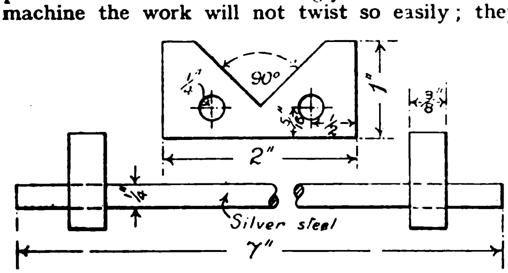


Fig. 2.—Larger View of Screwing Machine.

Parallel V-Blocks.

By "Scribo."

These will be found very useful on the driller and the marking-off plate. For holding work on the latter they will be more rigid and keep their position better than if used singly. On the drilling machine the work will not twist so easily; they



Parallel V-Blocks.

can be made from existing V-blocks by drilling the holes and fitting the steel and can be used singly when required by simply sliding off. The size here given will be very convenient.

Planing and Surfacing in the Lathe.

By H. R. Beckett.

To those who, like myself, are not possessed of any planing attachment for the lathe, the following idea may be of service. The particular awkward job was to surface up the bottoms of two C.I. field-magnets having a length of 8¼ ins., of the undertype form, and being fitted and bolted together by their flanges, the area of surface in this case to be operated upon being 7 ins. by 2¼ ins. The clamp of the tool-holder on the slide-rest being removed, the F.M. carcase is placed in a fairly accurate position, and firmly fixed by the bolt and nut of tool-holder, etc.

A steel cutter is then fixed by wedges in one of the outermost holes in the faceplate, as near the circumference as possible—in my case the faceplate is 11½ ins. in diameter. The work can now be brought up to the cutter and fed by means of the screw on the slide-rest, a good and true surface being soon obtained, the whole job taking but a short time. For the steel cutter one of the ordinary cutters used in the tool-holder is taken. The bearing portion of the gunmetal bedplate being also planed up, a solid and true seating is obtained for the field-magnets. In planing the bedplate it was bolted on the faceplate and operated on in the usual way. In the above operations it is necessary to see that the mandrel of the headstock is fairly tight and free from end-shake; also all other parts of lathe used should be as rigid as possible, all shake and backlash being removed by using the setscrews where it can be done, for, as is well known, much depends on these points—the quality of the work turned out, and in undertaking any job, more especially unusual ones, it well pays to consider how the strains upon the lathe will come, and how they are to be dealt with.

The Junior Institution of Engineers.—As the annual dinner of the Institution of Electrical Engineers has been fixed for Friday, Dec. 8th, it has been decided to postpone the reading of the paper on "Electric Mains for Power Transmission Work," by Prof. John T. Morris, M.I.E.E. (member), to the following Friday, Dec. 15th. In connection with the paper, a visit has been arranged to Messrs. Johnson & Phillips' works at Charlton on Saturday morning, Dec. 16th.

A Chuck for Ornamental Work in the Lathe.

By Thos. W. Plant.

A DESCRIPTION of my chuck for ornamental work in the lathe may be of interest to some of the readers of The Model Engineer, as it may be used on any ordinary lathe, and can be made by an amateur at a trifling cost. The accompanying illustrations are for application to a 6-in. centre lathe, fitted to an ordinary 5-in. by $\frac{3}{8}$-in. cast-iron slotted face-plate, fitted and turned true on mandrel of lathe. After turning up, clean out two of the slots A and B (Fig. 1) with a file smooth and parallel, so that the two pins will slide along. Take a piece of hardwood (hard mahogany or beech preferred, as it does not warp so quickly), 6 ins. square by $1\frac{1}{8}$ ins. thick, face one side with a plane as level as possible, then screw the planed side face-plate by means of the two screw pins put through slots A and B (Fig. 1), sliding it along till central; put on washers and nuts and screw up. The edge may be turned to 5 ins. diameter; face up front, and with a gouge turn a recess, $\frac{3}{8}$ in. wide, $\frac{1}{4}$ in deep, $\frac{3}{4}$ in. from the centre *e* (Fig. 4). Leave $\frac{1}{2}$ in. raised, and turn outer edge down $\frac{1}{4}$ in.; with the 5-16ths bit bore the hole in centre. The brass plate (Fig. 5) may now be fitted, having 5-16ths hole, and slotted to take cotter on central pin fastened in with two wood screws; take off face-plate, saw off piece H, bore a $\frac{3}{4}$ in. hole *a* (Fig. 4), and the block is ready for spring (Fig. 7).

Next required is a piece of brass $6\frac{1}{4}$ ins. square by 1-16th in. thick, and a piece of iron $4\frac{1}{4}$ ins. square by $\frac{1}{8}$ in. thick. If brass is used for both pieces, it will be much easier for an amateur to work. Take the smaller piece of brass or iron, find the centre, and draw a circle $2\frac{1}{8}$-ins. radius; drill a hole in the centre with 5-16ths in. drill. Now turn or cut off edge to $4\frac{1}{4}$-ins. diameter. Take the larger

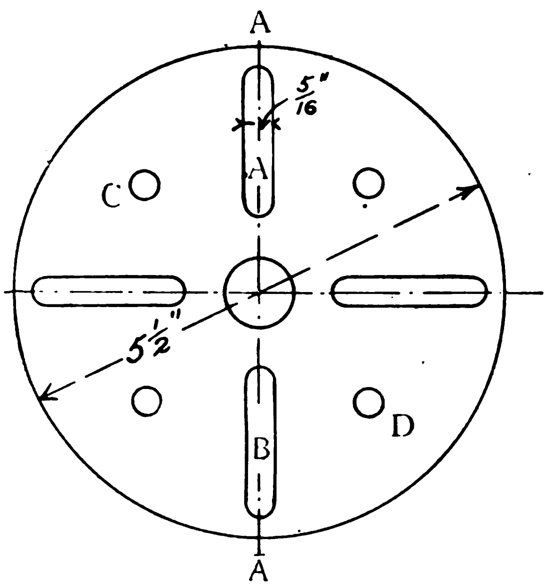


Fig. 1.—Iron Face-plate.

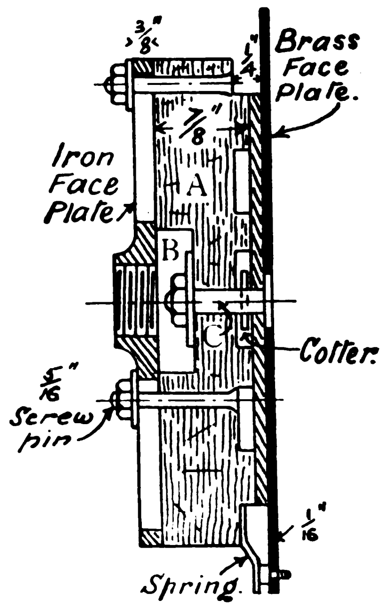


Fig. 2.—Section A, A.

Mr. Thos. W. Plant's Chuck for Ornamental Work in the Lathe.

from the back of face-plate to the latter through holes C and D (Fig. 1), with two ordinary $\frac{3}{4}$-in. wood screws; turn up the face as flat as possible, using a straight edge to see if flat. Turn the recess B (Fig. 2) in the centre $1\frac{1}{4}$ ins. by $\frac{3}{8}$ in. deep. (This faced side will be the back of finished chuck.) Now turn the edge down to $5\frac{1}{2}$ ins. diameter; take off face-plate, and with a pencil draw a line across the face, through the centre, the same way as the grain; with your compasses set off the holes *b* and *c* (Fig. 4), and bore with a 5-16ths in. bit, taking care to keep bit upright. Next get two $1\frac{1}{4}$-in. by 5-16ths-in. screw pins, either countersunk or square heads; fit them into holes in the block, countersink the holes so that the heads are a $\frac{1}{4}$ in. below the surface (from the side of the block that was screwed to face-plate). Now fix the block again on piece of brass; having found the centre, mark a circle 3 ins. radius, close compasses and mark another $2\frac{3}{4}$-ins. radius. This circle is divided into 96 parts; each division is drilled with a 1-16th in. drill. Make a circle 5-16ths in. radius, and cut out, leaving a $\frac{3}{8}$-in. hole in centre, cut off outer circle, taking care not to bend plate; put pin (Fig 6) into hole in small plate up to head; take large plate and fit hole over head of pin; drill holes *a*, *a*, *a* through both plates; countersink and rivet together; clean off rivets flush with plate; drill the nine holes (Fig. 3), and countersink from back; these holes are for attaching work to chuck, screwed through *a* in wood block The spring is made of a piece of thin steel, shaped as Fig. 7. Rivet a stud in one end, shouldered to fit holes in dividing plate, and a hole is drilled at other end for attaching to wood block. Screw spring on wood block with the stud pressing towards dividing plate; put cotter in central pin, and fit into slot in brass plate on wood block, and fasten with nut and washer at back, so that the dividing plate may revolve round on wood block as required. Now screw the chuck on to face-plate (Fig. 1), with the two screw-pins, through slots A and B (Fig. 1), and tighten up; put the stud on spring into hole *a*, and the chuck is ready for use.

The following are a few instructions on using the chuck just described. Having first

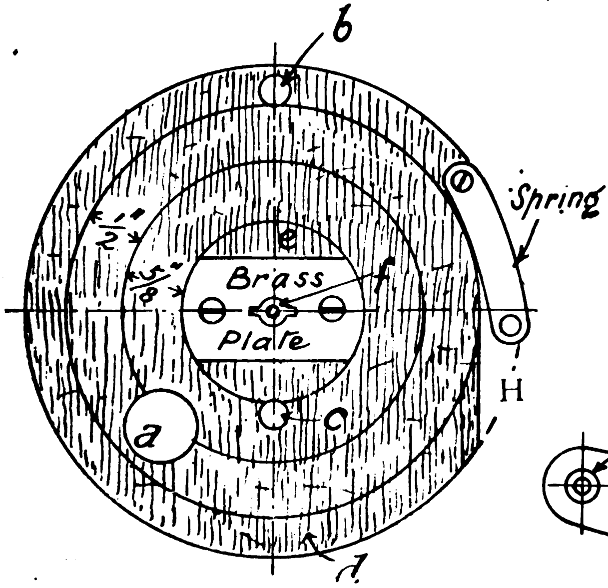


Fig. 4.—Plan of Wood Block A.

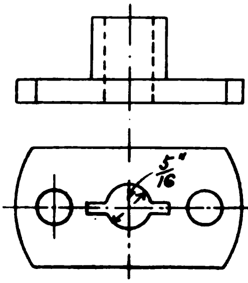


Fig. 5.
Brass Plate.

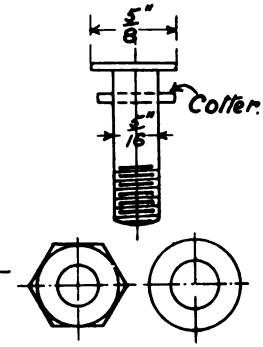


Fig. 6.
Pin, Nut and Washer.

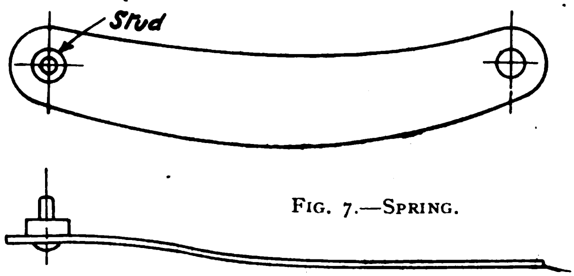


Fig. 7.—Spring.

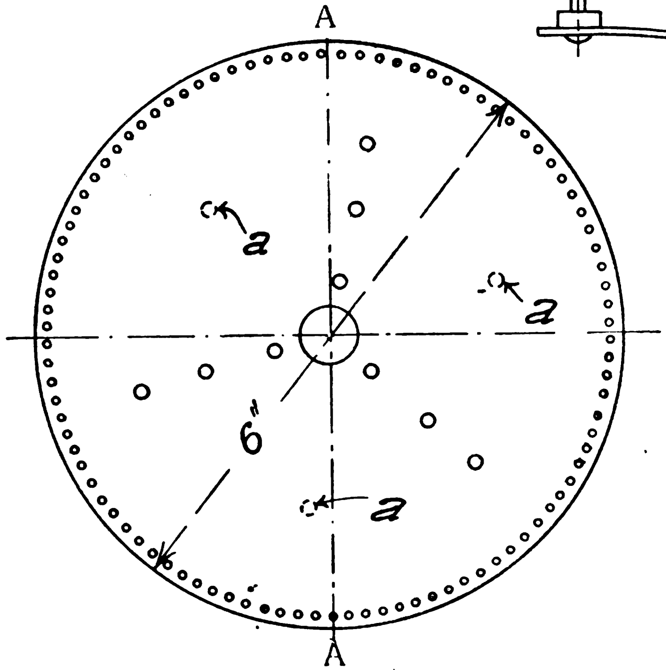


Fig. 3.—Brass Face-plate.

tried it on lathe mandrel to make sure it runs true, take chuck off face-plate by unscrewing nuts at the back of face-plate. Now take a slice of boxwood about 2¼ ins. by ⅜ in. thick, cut so that it presents the end of the grain on the flat sides; this will work best for a beginner. Vulcanite, ivory, celluloid, brass, or any hard, close-grained wood may be used equally well. Having made the wood flat on one side, proceed to fasten on the dividing plate by means of three short wood screws through the hole in wood part of chuck, turning dividing plate round to each hole in succession. Now attach to face-plate again, so that it runs true, and tighten nuts at back. See that the stud on spring is fitted in hole number one of dividing plate. Start lathe and turn up rough side of piece of box flat and true to straight edge; bring T-rest round, and turn edge of boxwood to 2 ins. diameter; one or two small beads about 1-16th in. each may be turned on outer edge of face of the wood.

Readers not having a slide-rest attached to their lathes may make a good substitute for it by first drilling a hole in each end of their T-rest, and screwing a piece of hardwood about 1 in. deep by ¾ in. thick along the inner face of rest, by two screws through the two holes drilled, letting the wood stand a little above the edge of rest. The piece of wood must be as long as the rest, and with a twist-drill or other boring bit carefully bore a hole about $\frac{1}{4}$ in. diameter lengthways through the wood about a $\frac{1}{4}$ in. from top of wood and parallel to top and edge of rest.

A tool to use with this rest may be made of a piece of round steel fitting hole in the wood part of rest, so that you can just push it in or draw it out without any looseness.

This tool must be either bent at one end in form of an L, or be fitted with a handle; the other end must be sharpened something like a lead pencil to a smooth but not too sharp point; it must be a little longer than the wood rest. Place it in the rest and adjust the point to centre of the piece of boxwood on chuck. Anyone having a slide-rest may use an ordinary tool, ground to a smooth point, fastened on tool holder. While the tool is pointed to centre of work, slacken nuts at back of face-plate, and draw chuck along slots about $\frac{3}{4}$ in. and screw up nuts again. On rotating lathe the wood will turn eccentric to face-plate, then draw back T rest without lowering, until point of tool nearly touches the edge of inner bead when the chuck rotates. Press up tool with right hand against work, and rotate lathe with either left hand or foot; the tool will cut a ring in wood eccentric to the circular beads. Draw stud on spring out of hole I, and turn dividing-plate two holes towards operator, and replace stud; press up tool and turn as before; repeat this operation until you arrive at hole I. You will have a series of circles overlapping each other all round the inside of beads, somewhat resembling engine-turning, with a blank space in the middle. By varying the number of holes advanced each time, and by altering position of chuck in slots, you can get a large number of beautiful and complicated designs, suitable for box-lids, ornaments for cabinet work, etc., as per example. Advance three holes in succession, and then missing three; but the number of holes advanced each time must be dividers of 96 without remainder, as 1, 2, 3, 4, 6, 12, 16, 24, etc. Slacken nuts and push chuck central, fix and finish centre with circular beads.

The writer will be pleased to assist anyone who may find any difficulty in following this description.

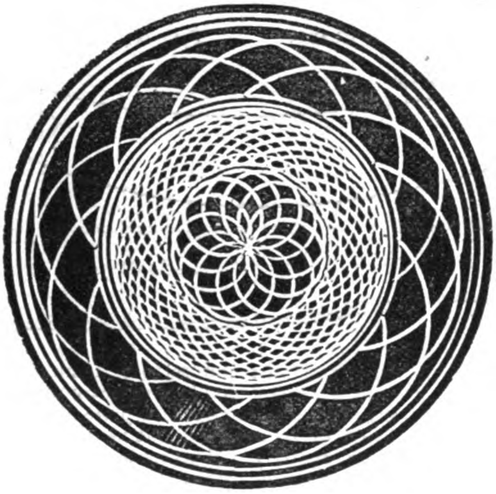


FIG. 8.

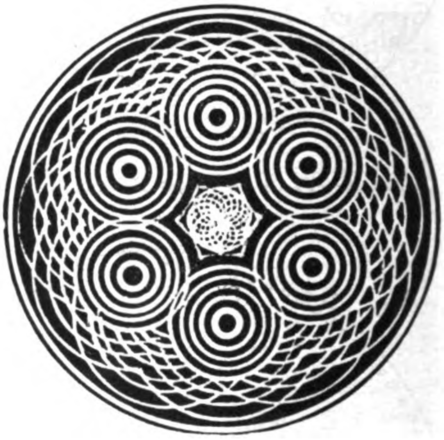


FIG. 9.

SPECIMENS OF MR. THOS. W. PLANT'S ORNAMENTAL TURNING.

Traction Notes on Road and Rail.

By CHAS. S. LAKE.

A ROYAL COMMISSION ON MOTOR OMNIBUSES.

The recently issued report of the Royal Commission on London Traffic revealed the fact that during "crush" hours motor omnibuses maintain an average speed of from six and a half to eight and a quarter miles per hour, as compared with five and a half to seven of electric tramways, and two to five miles per hour by horse-drawn trams. During slack hours the speed of the motor omnibuses and that of the electric trams average about the same, but the advantage will always lie with the 'buses because of their individual freedom. A breakdown on one does not interfere with the working of several others, as is the case with the electrically operated trams; moreover, the 'buses are free to steer a devious course through the traffic, instead of being tied to one part of the road, which often means a loss of several minutes during the course of the run. It is for the municipal authorities who are contemplating the introduction of an electric tramway service to consider whether they will not better serve the public interest by adopting motor omnibuses instead.

MORE STEAM RAIL MOTOR-CARS.

British railway companies are still following one another in rapid succession in adopting rail motor-cars for branch line and local passenger traffic in country districts. Among the most recent additions to the already formidable list of rail-car users are the Midland Company, who have just completed at Derby works two steam motor coaches for service on the Belfast and Northern Counties section of the line, which is now controlled by a body known as the "Northern Counties Committee."

One of the new cars is, by courtesy of Mr. R. M. Deeley, the Midland Company's locomotive superintendent, illustrated herewith, and it will be seen that the engine takes the form of a small outside cylinder locomotive with uncoupled wheels. The presence of the steam pipe outside the boiler, coupled with the employment of the Walschaerts type of valve gear, gives the engine quite a "Continental" appearance, but it looks a very workmanlike machine, and the *tout ensemble* is undoubtedly a pleasing one. The carriage portion comprises three passenger compartments—viz., one smoking and one non-smoking for third-class passengers, and a first-class saloon. There is also a luggage room and a driver's compartment at the rear end, used when the car is running with the engine at the rear. Several new "haltes" have been erected on the Greenisland and Antrim section of the line, for working over which the cars have been built.

The following are the leading particulars :—

Cylinders—

9 ins. diameter by 15 ins. stroke.

Boiler—

Mean diameter of barrel inside, 3 ft. 7½ ins.
Thickness of plates, ½ in.
Length of barrel between tube plates, 4 ft.
139 brass tubes, 1¾ ins. outside diameter.
Length of firebox shell, 3 ft. 1 in.

Heating Surface—

Firebox	51 sq. ft.
Tubes	262 ,,
Total	313 ,,

Grate area, 7·6 sq. ft.

Wheel Base—

Engine bogie, 10 ft.
Carriage bogie, 8 ft.
Centres of bogies, 30 ft. 7½ ins.
Length over buffers, 60 ft. 5¼ ins.

Diameter of Wheels—

Engine driving, 3 ft. 7½ ins.
Engine trailing, 3 ft. 3 ins.
Carriage, 3 ft. 6 ins.
Water capacity of tank, 500 gals.
Coal capacity, 11½ cwts.
Number of passengers (1st class), 6.
Number of passengers (3rd class), 40.

The weights as determined at Belfast are as follows :—

	t.	c.	q.
Driving	14	16	0
Trailing	8	4	0
Carriage bogie	12	10	2
Total	35	10	2
Working Order—			
Driving	16	2	0
Trailing	9	8	2
Carriage bogie	13	12	2
Total	39	3	0

The Wolseley Motor Fire Engine.

The Corporation of Leicester have recently added to their Fire Brigade equipment a Wolseley Chemical Motor Fire Engine, specially designed for travelling with rapidity to the scene of an outbreak, and when there keeping the fire in check before the slower, although more powerful, pump appears on the scene.

The Wolseley chemical fire engines are equipped with first-aid appliances, and are fitted with a 50-gallon or 60-gallon chemical cylinder ; also two "extincteurs," two 9-ft. ladders, and a hose-reel with 160 ft. of hose. The speed of which the engine

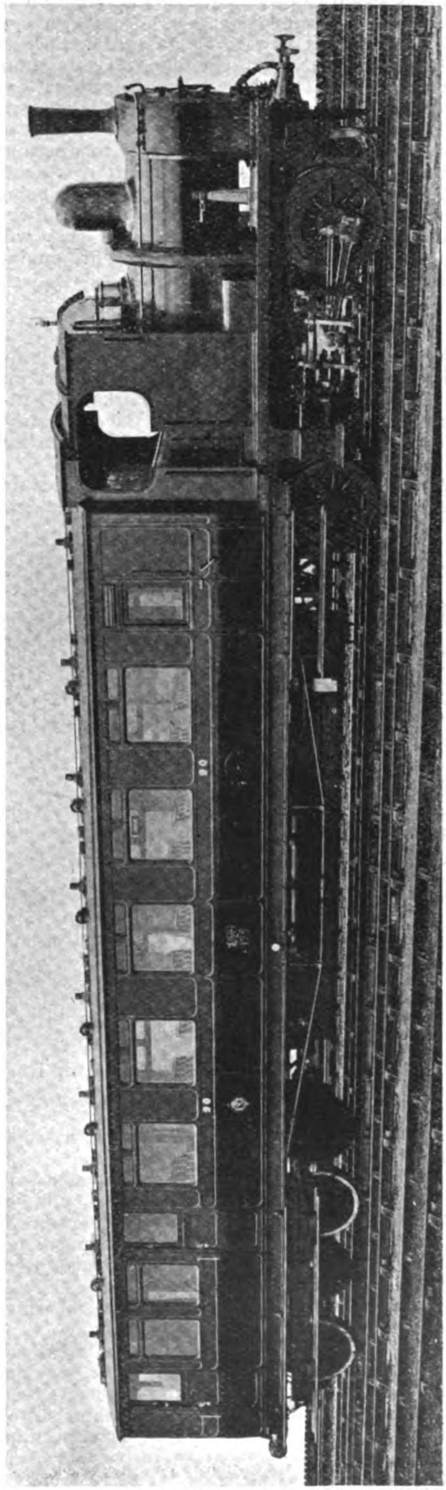


Fig. 1.—Steam Rail Motor-car : Midland Company.

is capable is twenty miles, which is of course far in advance of that attained by the horse-drawn machines. The *chassis* carries a horizontal 24-h.-p. four-cylinder motor, with cylinders 4½-in. bore by 5-in. stroke. The cranks and pistons are balanced, and the engine and valve gear is encased in an aluminium sheathing. The carburettor is of the float-feed spray type, having one jet for the four cylinders, and electric high tension ignition is used, accumulators and induction coils with tremblers being employed. Other particulars will be given in the next issue of these Notes, and it is hoped they will be accompanied by a photograph of the fire engine referred to.

The Clarkson Motor Omnibus.

While speaking on the subject of motor omnibuses, it may be well to call attention to the striking looking vehicle built by Messrs. Clarkson, Ltd., of Chelmsford, for the London Road Car Company. Two views of the *chassis* without the body portion are illustrated herewith.

The 'bus, which is propelled by steam power, commenced service in London on September 4th, and has not missed a single day's run. It has now covered considerably more than 5,000 miles.

The seating capacity is for 34 passengers—16 inside and 18 out. The engine is two-cylinder, double-acting, 4 ins. by 4 ins. The generator is of the automatic water-tube type, the firing being governed by the temperature of the steam generated, and the water-feed controlled by pressure.

The lubrication of both cylinders and all bearings of the engine and mechanism is automatic.

Paraffin is the fuel used, which has the great advantage of reduced fire risk, seeing that it does not give off inflammable vapour at the ordinary temperature, and can therefore be handled and stored without any of the troublesome restrictions pertaining to petrol. Also the combustion of paraffin being very complete, there is no trail of offensive odour left behind. This quality, combined with smoothness of running and quick acceleration without jerk (owing to the absence of change-speed gears), has made the car extremely popular with the public.

Messrs. Clarkson, Ltd., have orders for nine more double-deck cars for service in London, consequent upon the successful running of the one now in service with the London Road Car Company.

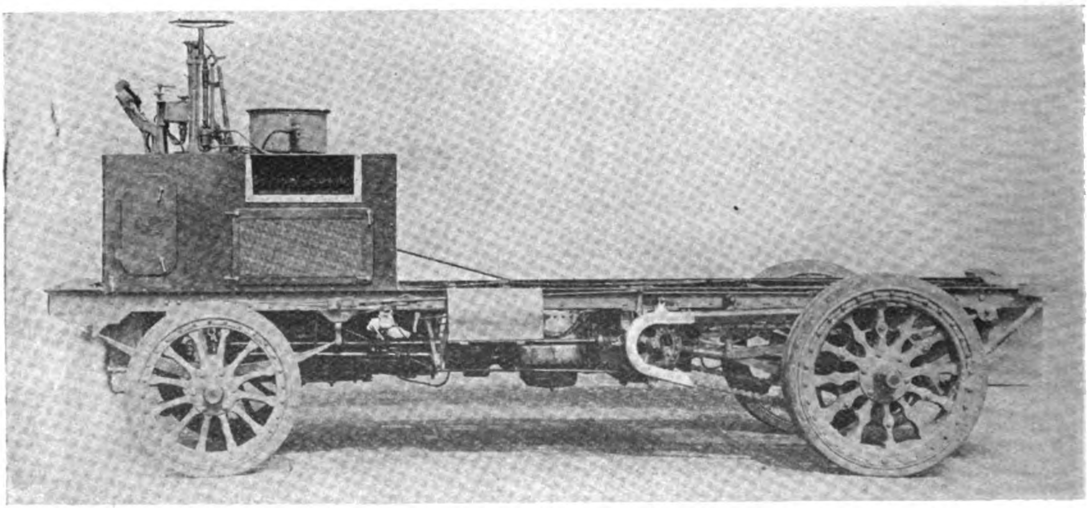


Fig. 2.—Chassis of the London Road Car Company's Omnibus.

(*Built by Messrs. Clarkson, Ltd., Chelmsford.*)

The Problem of the Gas Turbine.*

By Dugald Clerk, M.Inst.C.E.

The wonderful success obtained by your distinguished past-president, the Hon. C. A. Parsons, and his many able followers, with the steam turbine in its various forms, has naturally attracted the attention of engineers to the apparently analogous problem of the internal combustion turbine. Accordingly, much mathematical and engineering ability has been recently devoted to the subject—so far, I am sorry to say, without concrete result. In this subject, as yet, the dreams of the theorist obstinately decline to realise themselves in tangible iron and steel.

I have not been able to find any gas turbine in a state of effective rotation doing useful work, although I have noted many statements in the press to the effect that some wonderful German, French, or Italian gas turbine had worked, or was about to work, in such manner as to relegate the ordinary cylinder and piston gas engine to the museum, with which many engineers used to threaten the steam engine.

One gas turbine only has really rotated within my own direct knowledge. It was designed by Mr. F. W. Lanchester, of Birmingham, to operate with the exhaust gases from one of the petrol

* Presidential Address recently delivered to the Junior Institution of Engineers (Incorporated).

engines used in his well-known motor cars. He assured me a few days ago that it really rotated at a high speed, and made a loud shrieking noise, but only gave, he said, a total brake horse-power equal to that capable of being evolved by two blue-bottle flies. This power he did not consider to be satisfactory.

Speaking seriously, it does seem remarkable that so much interest should be taken by so many able men without any sort of result in practice.

Why is this? I propose to-night to answer the question in so far as I can. It appears to me that most of those who have written on gas turbines, and have even designed and patented them, have given too little weight to certain differences-between the steam and internal combustion engine problems. Many, indeed, have assumed that the solution of the gas turbine problem is the easier of the two, and that few difficulties exist which have not already been met and conquered by Mr. Parsons in the steam turbine.

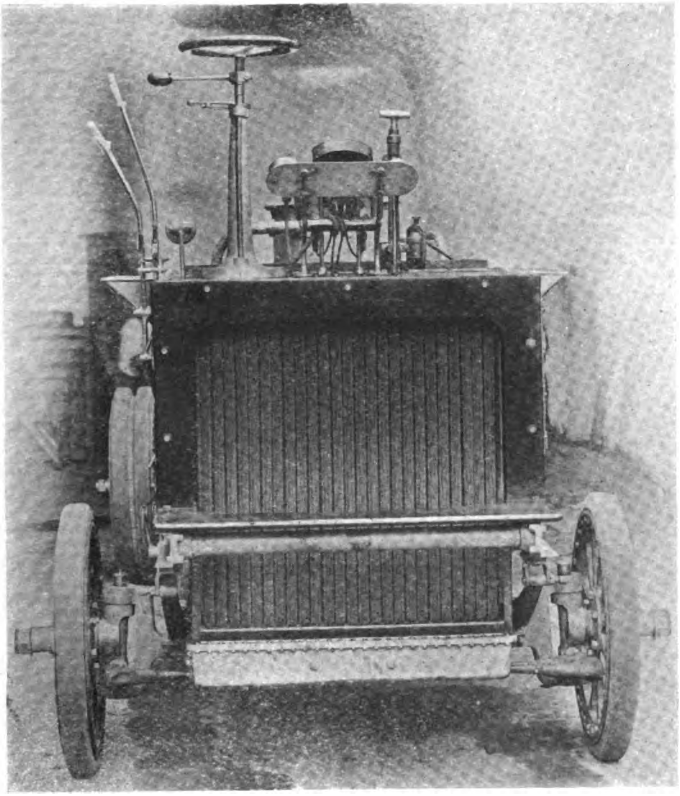


Fig. 3.—Front View of Chassis.

Many distinguished men have been of this opinion, and even Mr. Parsons himself, so early as his first turbine patent (No. 6,735 of 1884), appears to have been of opinion that the hot gas or internal combustion turbine presented practically the same problem as the steam turbine. In that specification he makes the following statement :—

" Motors according to my invention are applicable to a variety of purposes, and if such an apparatus be driven it becomes a pump, and can be used for actuating a fluid column, or producing pressure in a fluid. Such a fluid pressure producer can be combined with a multiple motor according to my invention, so that the necessary motive power to drive the motor for any required purpose may be obtained from fuel or combustible gases of any kind. For this purpose I employ the pressure producer to force air or combustible gases into a close furnace of any suitable kind, such as used for caloric engines, into which furnace there may or may not be introduced other fuel (liquid or solid). From the furnace the products of combustion can be led, in a heated state, to the multiple motor, which they will actuate. Conveniently the pressure producer and multiple motor can be mounted on the same shaft, the former to be driven by the latter; but I do not confine myself to this arrangement of parts."

Clearly here Mr. Parsons intended to apply his invention to the gas turbine, as well as to the steam turbine, and in this paragraph he outlined the fundamental idea of nearly all subsequent proposals of gas turbines. Many other inventors have followed him, but I may only mention two well-known names—those of Ferranti and Stodola. Both have proposed turbines similar to this, with more or less elaboration, as well as other modifications intended to overcome certain difficulties.

In a very able paper read before the Institution of Mechanical Engineers last year, Mr. R. M. Neilson discusses various cycles of operation which can conceivably be applied to gas turbines, and he calculates the efficiencies of these cycles in various combinations. More recently, too, the subject has excited great interest in America, and very interesting articles are to be found in the *Engineering Magazine* by Dr. Charles E. Lucke and Prof. Sidney A. Reeve. These gentlemen take somewhat opposing views of the position of the problem.

In most of the recent discussions upon gas turbine problems it has been recognised that the temperatures possible in the cylinder gas engine are impossible for the gas turbine It has been fully proved by many investigators, including myself, that the temperatures quite common in ordinary gas engine practice range as high as 2,000° C., although in the best practice, for most economical results, 1,500° C. or 1,600° C. appears to be an upper limit. With the temperatures of 1,500° C. or 1,600° C., a first-class modern gas engine of about 50 h.-p. will give an indicated efficiency of 35 per cent. At the same time, the negative work of the cycle is so low that the mechanical efficiency of the engine may be as high as 86 per cent., or even over. If one realises what the temperature 2,000° C. means, it becomes very evident that no turbine constructed either on the lines of Parsons or Laval could possibly be made to work with continuous supply of such gases; 2,000° C. is considerably over the melting-point of platinum. It is much higher than the temperature at which cast-iron flows from the crucible, or, indeed, the temperature of the interior of the blast furnace itself. Any blades of iron, steel, or, in fact, of any other material—even brick-fire itself—becomes fluid or semi-fluid at this temperature. It is so obviously hopeless, therefore, to attempt, in the gas turbine, temperatures which are quite feasible in the cylinder engine. This fact, as I have said, is generally recognised. It is accordingly said, by those who take a favourable view of the gas turbine, that it is necessary to supply the turbine with gases at a much lower temperature. Mr. Neilson fixes the temperature of 700° C. as one which steel turbine blades would probably stand, without too rapid deterioration. I fear that on this point I must differ from him, because, in my experience, oxidation of steel, and even iron, is a fairly rapid process at this temperature. Nothing new has been proposed as to the thermodynamic cycle of the gas turbine, so that all reasoning upon efficiencies depends upon the deductions already made from internal combustion engine practice.

Seeing the impossibility of constructing a turbine with materials to stand a high temperature, many have proposed to convert high temperature into kinetic energy, so that instead of having work stored up in the gas in the form of heat, the heat shall disappear, and the energy of the heat be transformed into motion of the gaseous particles at a high velocity. Such proposals, then, include the compressing of a gaseous mixture to, say, 50 lbs. or 60 lbs. above atmosphere, the igniting of that mixture within a combustion chamber at constant pressure, and the expansion of the mixture through an expanding jet of the Laval type, so as to drop the temperature and obtain its equivalent in kinetic energy or velocity of the gaseous particles. The rapidly moving particles at the relatively low pressure and temperature are then allowed to impinge upon rapidly rotating blades of sickle configuration, and they are supposed to give up their energy of motion to those blades, and so expend work upon the turbine. This appears to be the most feasible of all the gas turbine proposals, so I will proceed to examine it a little more minutely.

Success by this cycle of operations requires—

(1) A rotary or turbine compressor of high relative efficiency.

(2) An expanding nozzle which shall ensure that free expansion is quantitatively equivalent to adiabatic expansion behind a piston.

(3) A rotating turbine of such construction as to secure very high efficiency of transformation of kinetic energy of the moving gas into effective work available at the turbine shaft.

Assuming air to the working fluid, and specific heat to be constant through the temperature range, it is easy to calculate the efficiency of the Joule or Brayton cycle, which these operations in effect represent. It would be useless to attempt to work a turbine at a pressure so low as to be relatively inefficient compared with the gas engine, so I have chosen a Joule cycle of, say, 48 per cent. ideal efficiency, which in a cylinder gas engine would probably give, in practice, about 30 per cent. indicated efficiency. For this ideal efficiency the pressure of compression would require to be 141 lbs. per square inch absolute. To give power with a reasonably small pump, I shall assume a maximum temperature of 1,700° C. That is, assuming a perfect compressor and a perfect nozzle expander, the temperature would only fall from 1,700° C. to 750° C. Plainly, this temperature would be too high for a Laval disc with blades. In order to get a reasonable temperature on expansion, it would be necessary to assume a maximum temperature in the combustion chamber no higher than 1,000°, and this would bring down the temperature, after complete expansion, to about 500°, which, no doubt, steel turbine blades can be expected to stand for some considerable time.

With these assumptions, however, the gas turbine would not be very economical, as compared with cylinder engines, even assuming all difficulties overcome. The theoretical and practical difficulties, however, are very serious indeed.

To begin with the question of an efficient air compressor. I am not aware of any turbine compressor capable of compressing up to 140 lbs. absolute from atmosphere with anything like 60 per cent. efficiency. Before success could be attained, this efficiency of compression, so far as diagram is concerned, should be at least 90 per cent., in order to allow for unavoidable mechanical and other losses in the subsequent processes. It has, it is true, been proposed to substitute cylinder compressors operated from the turbine, instead of turbine compressors; but this, it appears to me, would be equivalent to abandoning at once all the advantages of the turbine principle. If reciprocating cylinders are to be used for compression there is no objection to using them also for expanding. No gas turbine with cylinder compressors could, in my view, succeed.

Assuming, however, even 90 per cent. efficiency from a turbine compressor, and assuming that we have a compressed gaseous mixture burning freely in the combustion chamber at the desired pressure and temperature, we have yet to face the problem of the expanding nozzle. It is always assumed that with the use of an expanding nozzle temperature drop can be as certainly attained as with an expanding piston in a cylinder. This, it seems to me, has been by no means proved.

(To be continued.)

The "Fortis" Vice Prize Competition.

THE "Fortis" Electrical and Engineering Company, of Coventry, have kindly placed at our disposal three of their vices, value 18s. 6d., 10s., and 5s. 6d. respectively, to be awarded as prizes in a competition. We accordingly have pleasure in offering these useful prizes for the best three articles sent on "An Amateur's Vice Bench." What is required is a working drawing of a bench suitable for amateur use, with a short accompanying article describing its construction and fittings (tools not included). The prizes will be awarded to the designs which in the opinion of the Editor of THE MODEL ENGINEER are best suited to the requirements of the average reader of this journal. All entries should be sent to the Editor of the *M.E.*, and should be marked "Fortis Vice Competition." The latest date for sending in will be Dec. 1st, 1905.

A Model Steam Fire Engine.

By H. Stevens.

HEREWITH is illustrated, and briefly described, a rather unusual form of model steam fire-engine, the length over-all of which is 16 ins., and height 13 ins. The main body is constructed of oak, stayed and screwed together where necessary, and left in its natural colour and varnished. The wheels are of iron; this was particularly necessary in the case of the rear ones, on account of the heat from the boiler. They are mounted on steel axles, and brakes are made to apply. The front wheels are attached to an under-carriage, or turntable, which is made to take the shaft for the horses as in the real engines; the body also opens for the insertion of the hose, etc.

The boiler is of 1-16th-in. copper, and 6 ins. high by 4 ins. in diameter. Two ends were flanged and riveted in, the lower one being fixed about 3 ins. up from the bottom; eight $\frac{3}{8}$-in. tubes were then fitted, expanded each end, and sweated round. The fittings include pressure gauge, water gauge, whistle, safety-valve, and blow-off cock. Steam is raised by a spirit fire, which is fed by a pipe leading from a vertical brass tank situated on the right-hand side of boiler.

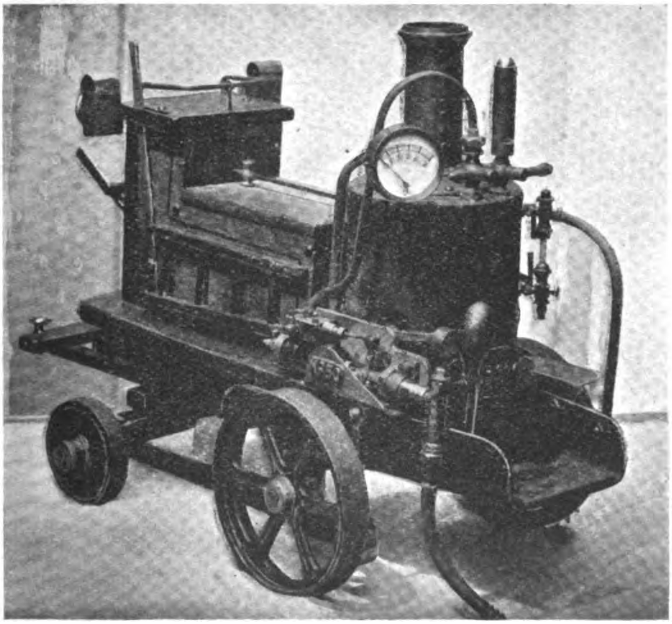


Fig. 1.—Mr. H. Stevens' Model Fire Engine.

There are no means at present of filling boiler while working, but it holds plenty of water for a "turn-out." The engine is bolted on to the side of boiler, and the cylinder is $\frac{1}{2}$-in. bore by 1-in. stroke. The pump is single action, $\frac{1}{4}$-in. ram, 1-in. stroke, and fitted with an air vessel and necessary unions for the connection of suction and delivery hose. The valve gear is operated by a fork, the ends of which are hit and thrown forward by a projecting pin on the coupling of the piston and pump rods. This pin is really the coupling pin, which goes right through into a slot in bedplate, and acts as a guide. On trying the engine under steam, I found that the speed was too great, so I fixed a long lever, with a weight on the end, in order to balance it. This lever swings like the pendulum of a clock (the arrangement is shown

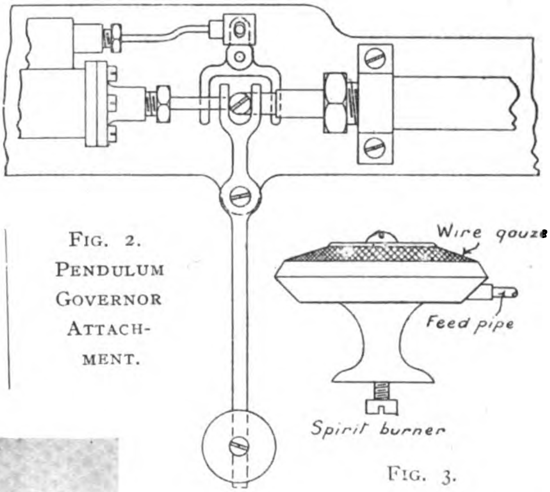


Fig. 2. Pendulum Governor Attachment.

Fig. 3.

in Fig. 2), and "steadies" the pump to a nicety. The en ine will work at 10 lbs. pressure, but the safety valve is screwed down to 40 lbs. per sq. in. With the lamp, ladder, and other accessories in their places, the engine looks very realistic.

A Cause of Brittle Steel.—In experiments during the last five years, Dr. Hjalmar Braune has proven that the brittleness met with in steel is often due to the presence of nitrogen, which forms a nitride of iron, dissolving the remainder of the metal, and altering the appearance of sections under the microscope and the properties. In a steel containing 0·060 per cent. of carbon, as little as 0·07 to 0·08 per cent. of nitrogen caused a marked change. The nitrogen was added by fusing the steel in an atmosphere of ammonia, and the metal was then annealed. Under the microscope the cells usually seen on an etched surface are greatly reduced in size, disappearing entirely with 0·200 per cent. of nitrogen. With hard steels even less nitrogen has decided effect, and a steel containing 1·15 per cent. of carbon was maoe quite brittle by 0·03 to 0·04 per cent. of nitrogen, the elongation on fracture being reduced to a tenth of the original.

How It Works.

I.—The Electric Arc Lamp.

(*Continued from page* 467.)

By A. W. M.

A LAMP in which the arc maintains a fixed position is called a focussing lamp. It is important with a continuous current lamp to connect the positive pole of the supply to the carbon intended to be positive,

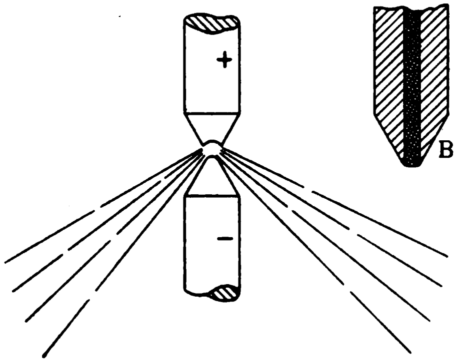


FIG. 7.

because the principal source of light is not the arc, but a small cup-shaped depression which forms at the point of the carbon which has been connected to the positive pole, and which is called the crater; except in the case of an illuminated ceiling the top carbon is always made positive, so that the light is largely directed downwards (see Fig. 7). To assist the formation of this crater in the centre the positive carbon is usually made with a soft core (see B, Fig. 7). The negative carbon

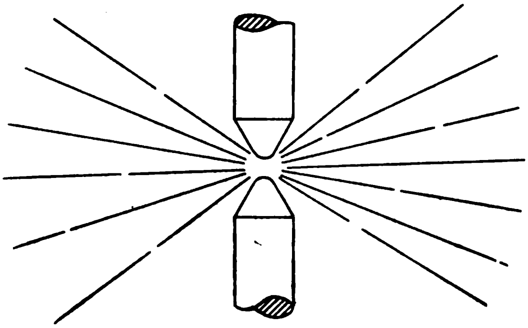


FIG. 8.

is solid and has no core. When alternating current is used the carbons burn away at equal rates, as each carbon becomes alternately positive and negative, no crater is formed, the light being diffused equally upwards and downwards (see Fig. 8).

When the arc is enclosed in an air-tight globe, as previously explained, the carbon ends take a somewhat different shape to that which they assume when burning in air; they assume a less pointed form.

Arc lamps require a certain approximate voltage, according to the kind and amount of current used and the length of the arc; they cannot in practice be made to burn on a great variety of voltages like incandescent lamps. With continuous currents and carbons burning in air it is necessary to have about 43 volts at the arc for a medium current of about 8 amperes. If the arc is an enclosed one, the voltage can be raised to about 75 or 80 volts. In each case, however, it is necessary to use a small wire resistance in series with the lamp to prevent the arc burning in an unsteady manner. This resistance would be arranged to absorb about 7 volts, so that a total voltage of about 50 volts is required for a single open-type and about 87 volts for an enclosed arc lamp.

When alternating current is used the arc requires about 33 volts when burning in air and about 65 volts when enclosed; steadying resistances are also required.

These figures should not be considered as exact; they will alter to some extent according to the make of lamp and other circumstances, but are sufficiently exact to be used as a guide to the voltage required in ordinary lighting practice. Where the voltage available is very much less—say 20 volts, or even 30 volts—the arc would not burn; when the voltage is higher—say 200 volts—it would be

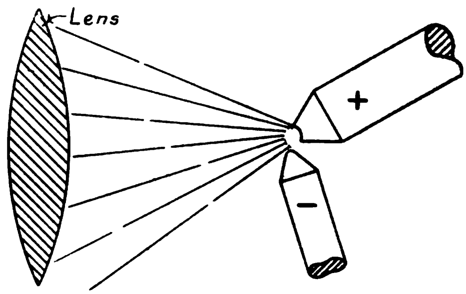


FIG. 9.

necessary to reduce it to that required by the lamp, you could not adjust or construct the lamp to require 200 volts. In ordinary continuous-current domestic lighting practic: it is usual, as far as possible, to put several lamps or arcs in series (see Fig. 6) with perhaps some resistance as well, so as to make up a total voltage required as near as practicable to the supply voltage for motives of economy. Special series arc-lighting systems used for arc lighting alone are self-contained, and these considerations do not apply. In such systems the generator is arranged to produce a voltage approximately equal to that required by one lamp multiplied by the number of lamps.

With alternating current domestic supply matters are more conveniently adjusted, as the supply of voltage is readily reduced or adjusted to that required for the lamp by means of a small transformer or choking coil, though the latter is not economical unless made in a certain form.

The reason why it is not praticable to make arc lamps to work on any voltage is that the arc itself gives a certain back electro-motive force, approximately 39 volts for an open-type continuous and 33 volts for an open type alternating current arc, which must be equalled before the current can flow through the lamp, and a few more volts added to overcome the resistance of the carbons and coils. As a matter of fact, some very small arc lamps, taking only about two amperes, will work with a voltage as low as 35 volts continuous current, but would do better with a little higher pressure.

Lamps in ordinary use take from 5 to 20 amperes, depending upon the size. The candle-power is a somewhat indefinite quantity, and not easy to measure.

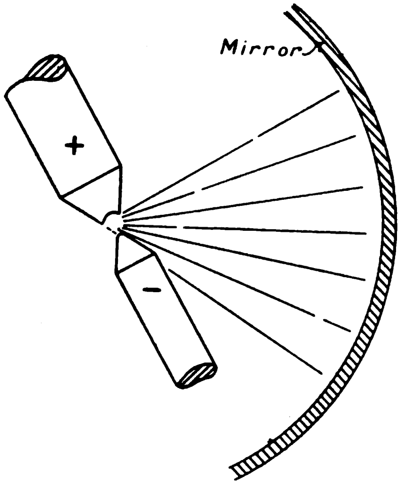


FIG. 10.

A mean is taken, and may be roughly considered as about 800 c.-p. for a continuous current lamp taking 500 watts. Arc lamps for use in optical lanterns and projectors should be supplied with continuous current, if this kind can be obtained, because it is then possible to use the crater previously mentioned in the positive carbon as the

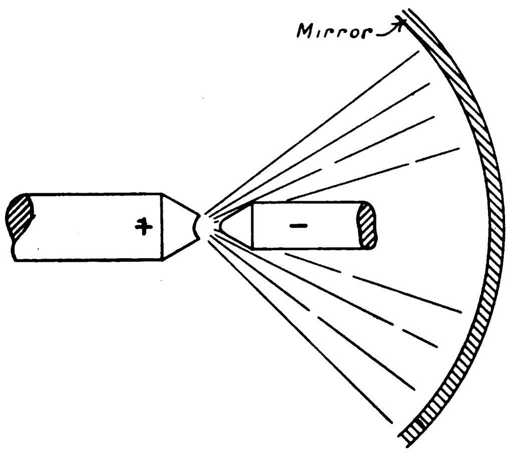


FIG. 11.

point from which the light proceeds, and to focus this point in the lens or mirror, the crater being exposed by inclining the carbons, see Fig. 9, which shows the rays of light falling upon a lens, or Figs. 10 and 11, which show two methods of directing the light upon the mirror of a searchlight projector.

Such arc lamps must be of the focussing type, and are frequently operated by hand-driven mechanism, being then termed hand-feed arc lamps. The same operations must be performed as with an automatic lamp—namely, the carbon points are first brought into contact with each other for a moment to permit the current to flow, and they are then separated to strike the arc, at intervals discovered by the experience of the operator the carbons are fed towards one another as the points burn away. Such lamps require a heavy current, from 30 to 80 amperes or more, and from 60 to 80 volts or so, according to circumstances. For lighthouse work, where the optical considerations are different, alternating current is used.

There is a new class of arc lamp now in use, sometimes called flame lamps, which use a comparatively long arc, and carbons having a special

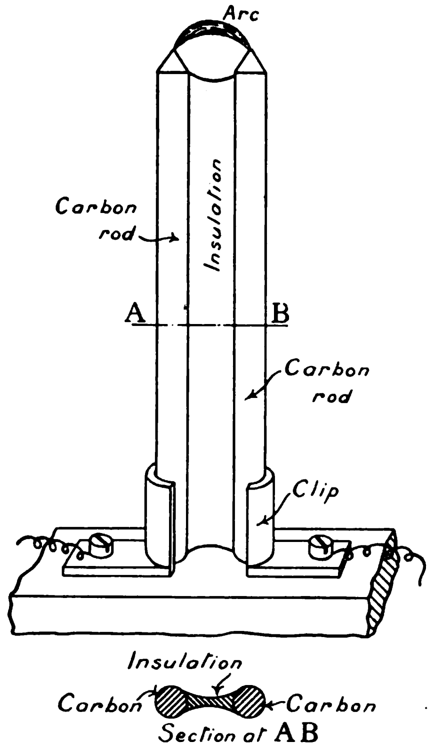


FIG. 12.

composition in order to impart a yellow colour to the light; the general principles of striking the arc and feeding apply to these also.

An ordinary single open arc lamp with carbons burning in air will burn for about 15 hours before the carbons require renewing; if the arc is enclosed in an air-tight globe the carbons last for about 150 hours; these are only approximate figures; they will vary with different makes of lamp. Sometimes two pairs of carbons are fitted, the second pair to automatically come into use when the first pair is consumed. It is generally considered that continuous current is preferable for arc lamps used for ordinary lighting purposes, as, if the upper carbon is made positive the greater part of the light is directed downwards. To secure this advantage where alternating current systems are in operation, motor-driven rectifying machines have been installed, which change the alternating current into a current which, though pulsating, is always flowing in one direction. With such a current one carbon can be kept positive and the advantages of continuous current practically secured.

Though not very much used now, it is interesting to notice the very simple arc lamp known after its inventor as the Jablochkoff candle. This consists of two similar carbon rods (see Fig. 12) placed side by side and separated by a thickness of some fusible insulating clay to which the carbons adhere, so that the whole forms a kind of flat candle, which is placed in a holder consisting of a pair of insulated clips, to which the wires carrying the current are attached. The current flows up one carbon and down the other, the arc forming at the ends, as indicated in the diagram. As the carbons are consumed the insulating material crumbles away, and the whole candle burns away like an ordinary wax candle. The arc is started by means of a carbon fuse bridge, which connects the ends of the carbons; when current is switched on this fuse melts and the arc is started. If through any cause the arc goes out it will not start again without external help. This is one of the drawbacks of the system. Alternating current is used to ensure the carbons burning away at the same rate.

The action of striking and feeding can be examined by observing the arc through a piece of red or blue coloured glass. This is an interesting study, and will show the formation of the crater in the positive carbon when continuous current is used, as well as the movements of the arc which continually shifts its position. On no account should the arc be examined for any length of time by the naked eye.

(To be continued.)

The Race for the Branger Cup.

It will be remembered by many of our readers that in our issue of June 22nd last we published an illustrated article on the first race for the cup for model motor boats presented by M. Branger, of Paris. A second competition for this trophy was held a few days ago, and we are now enabled to give some photographs of the event. It will be noticed that a much larger number of competitors participated on the present occasion, showing an evidently increased interest in this sport on the part of our French neighbours.

FIG. 3.—THE START FOR THE BRANGER CUP RACE.

The race this time was held on the Grand Lac of the Bois de Boulogne, and was divided into three heats and a final. A weak point in most of the boats was shown in the steering gear, for, of the eleven competing craft in the first heat only two succeeded in reaching the winning post, the others getting off the course and running ashore at various places. A similar fault was shown by several of the boats in the other heats, some of them merely describing large circles on the lake until their steam or current supply became exhausted. In the final heat the winner proved to be the *Quinquina* of M. Gérard—a boat which was illustrated in these pages last June. This, it will be remembered, is a steamer with a twin cylinder vertical engine. One

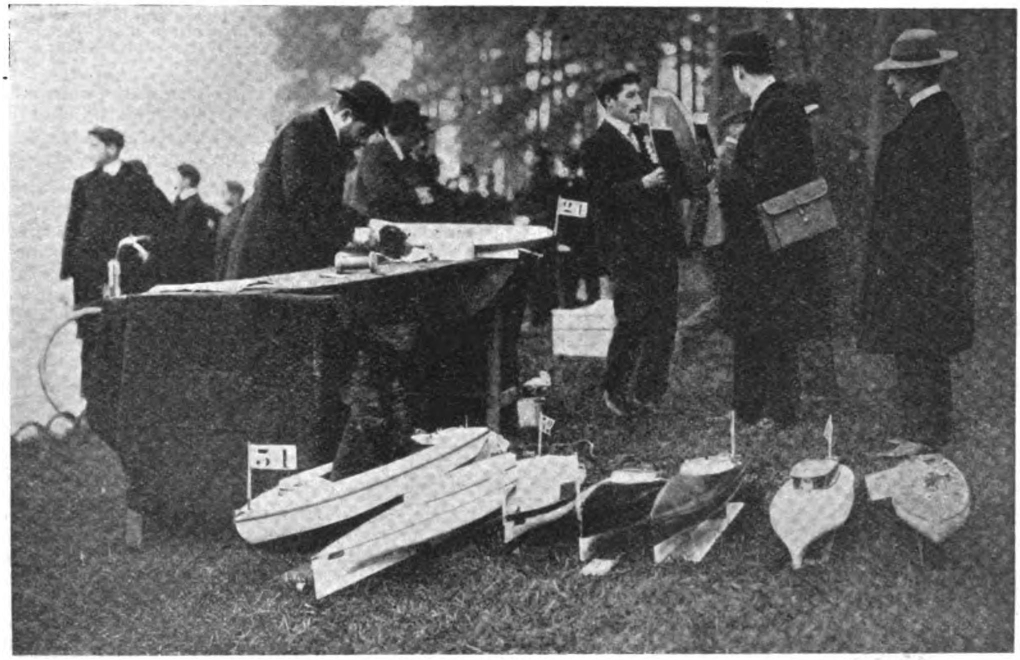


FIG. 1.—PREPARING THE MODELS FOR THE RACE.

FIG. 2.—READY FOR THE START.

of the competing boats was driven by a small petrol motor, while a number were electrically driven by motors and accumulators.

The first prize was the Branger Cup, which is a very handsome and appropriate trophy, as will be seen by the accompanying photograph; but

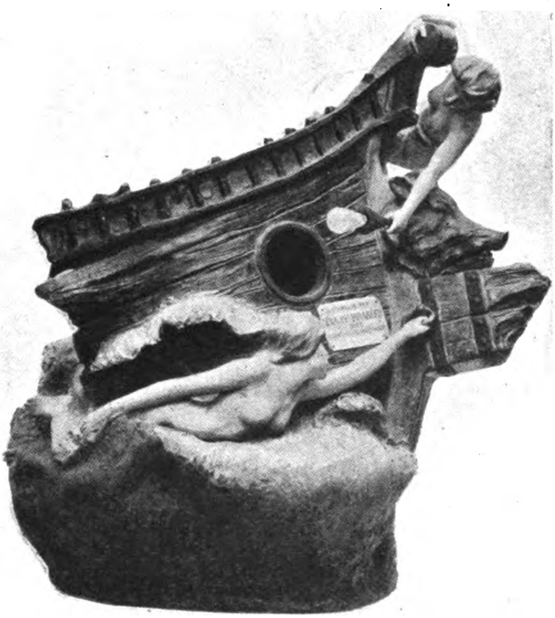


FIG. 4.—THE BRANGER CUP.

in addition to this a number of extra prizes were given to other competitors whose boats did good performances. We regret that we have not sufficient information to enable us to compare the speed of the *Quinquina* or the other boats with the best models on this side of the Channel, but we are inclined to the opinion that the "Old Country" still retains the lead on this point. In June last the *Quinquina* accomplished a speed of nearly five miles per hour, which is excellent for her length—38¾ ins. She has since been partly decked over, and possibly some further improvements introduced. The other photographs we give will show that the affair has aroused a considerable local interest, and we shall look forward to some further races under the same enterprising auspices.

THE syllabus of the Association of Engineers-in-Charge announces for Dec. 13th a paper on "High-Pressure Gas Illumination," by J. W. Blakey, Esq., at the St. Bride Institute, E.C.

For the Bookshelf.

[*Any book reviewed under this heading may be obtained from* THE MODEL ENGINEER *Book Department, 26-29, Poppin's Court, Fleet Street, London, E.C., by remitting the published price and the cost of postage.*]

FOWLER'S MECHANICAL ENGINEERS' POCKET BOOK, 1906. Manchester: The Scientific Publishing Co: Price: Leatherette, 1s. 6d. net; leather, and gilt edges, 2s. 6d. net; postage 3d. extra.

The 1906 edition of this work is, like its predecessors, excellent value. Its utility is increased by the various revisions which have been made to bring it up to date; a useful addition being a section on proportions of machine tool parts, such as lock-nuts and washers, handles, knobs, cone bearings, T-slots, knuckle-joints, V-strips, etc. Containing, as it does, over 500 pages of useful mechanical information in a condensed and easily get-at-able form, it may well be regarded as a good investment for every engineer.

ELEMENTARY ELECTRICAL ENGINEERING. By P. T. White. Wigan: Strowger & Son. Price 4s. 6d.; postage 4d. extra.

This is a book intended for the practical man, who wishes to gain an intelligent grasp of the principles and functions of electrical apparatus and machinery without undue indulgence in mathematics. The ground covered is as follows:—Introduction; electric batteries, bells, and telephones; the dynamo, motors, and their applications; accumulators, arc lamps; the physical theory of dynamo-electric machinery; electrical instruments, apparatus and testing; the three-wire system. Some useful notes on the care and management of dynamos and motors are incorporated in the chapters dealing with these machines, and throughout the practical side of things is kept well to the front. The illustrations in many instances are capable of improvement, but, apart from this defect, the book is one which will be found very instructive by the class for whom it has been written.

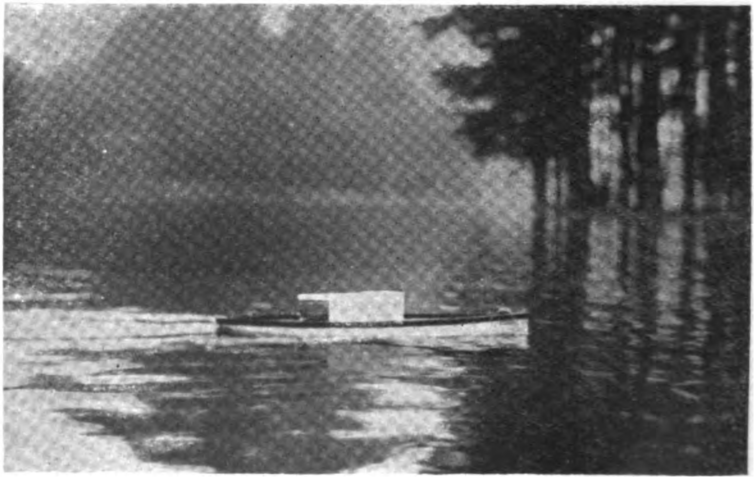


FIG. 5.—ONE OF THE COMPETITORS.

Practical Letters from our Readers.

[*The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a* nom-de-plume, *if desired, but the full name and address of the sender* MUST *invariably be attached, though not necessarily intended for publication.*]

A Novel Electrical Musical Instrument.

TO THE EDITOR OF *The Model Engineer*.

DEAR SIR,—I am sending you a drawing of a novel musical instrument which I have had working for the past six months. As you will notice, the machine is electrically operated, and any number of tunes may be played upon it. The following is a brief description :—A drum is operated by a motor, and on the drum is a paper chart with slots cut in it. As the drum revolves, springs make contact just as the slots are brought to their position, thus ringing a bell of a certain note. There are ten bells, and they are tuned respectively to A, B, C, D, E, F, G, A, B, C, and as the slots come into line, a tune is played.

With the bells hung up in the hall, and an ordinary clock with contacts fixed on it, a very fine result follows.—Yours truly,

Gloucester. J. G. THAIN.

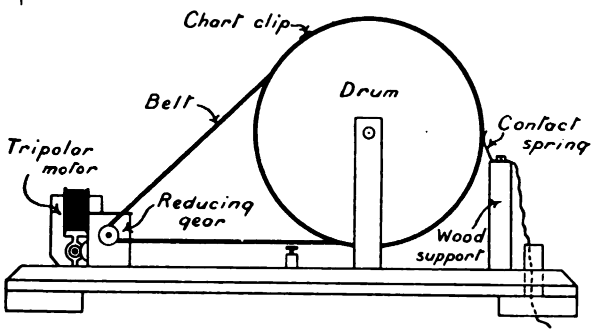


FIG. 2.—DRIVING MECHANISM.

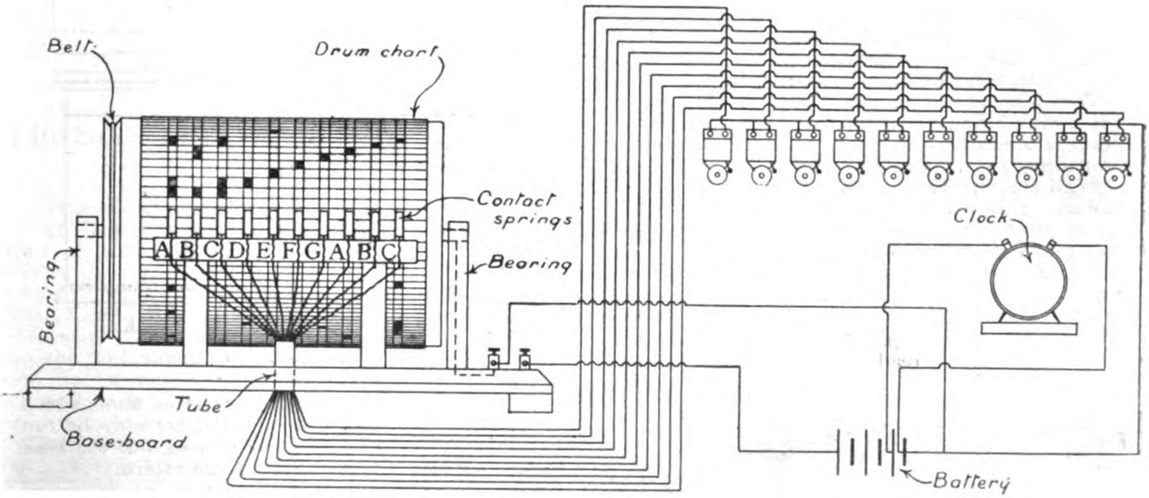


FIG. 1.—DIAGRAM OF CONNECTIONS FOR NOVEL MUSICAL INSTRUMENT.

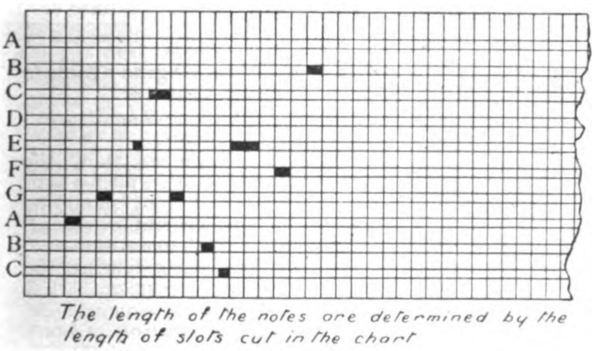


FIG. 3.—PAPER CHART.

Armature Reaction and Distortion of Field.

TO THE EDITOR OF *The Model Engineer*.

DEAR SIR,—As requested by Mr. Warren, I have examined this question again, but I am still of opinion that he is in error. It must be remembered that it takes *two* magnetic fields to make *one* mechanical force ; and so one magnetic field cannot possibly tend to pull a cylinder of iron asunder.

Again, if there be two magnetic fields superimposed upon each other, and the direction of one is parallel to the direction of the other, then there is no torque produced ; but if one field is directed at *right angles* to the other, there *will* be a torque acting which will tend to twist one or other of the fields round until their directions are parallel. I am already well acquainted with the fact that if I want to reverse a motor I must reverse the direction of the current, through either the fields or the armature, but not through both ; but this does not affect the question, so far as I can see.

With regard to my question, "Where do you think the torque is to come from ?" there can be no torque available for doing external work when the fields are unexcited (without overloading the armature). The torque depends upon the strength of the main field (due to the field-magnets) and the armature current; so if we want a large torque, we must have well excited fields and large armature current.—Yours truly,

Forest Gate. F. J. KEAN.

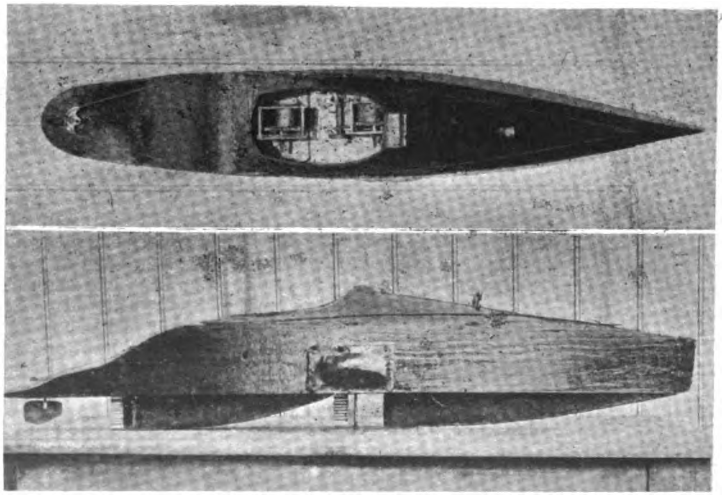
A New Propeller.

TO THE EDITOR OF *The Model Engineer*.

DEAR SIR,—I have pleasure in enclosing two photos of a model motor tug-boat, designed by me, and driven by a new form of corrugated fishtail propeller invented by me; the hull is specially designed to skim on the surface of the water, instead of cleaving through the water; the wetted surface is not in the line of resistance. To keep the boat in its course in a rough sea, it is fitted with vertical knife-edged keels, which also protect the propellers from being damaged. You will notice in the photo that the propellers are keyed on vertical shafts, which impart a direct horizontal thrust to the hull. No thrust blocks are necessary, as the thrust is taken on the bearings of the shaft. The boat is also water-tight, without any stuffing-boxes.

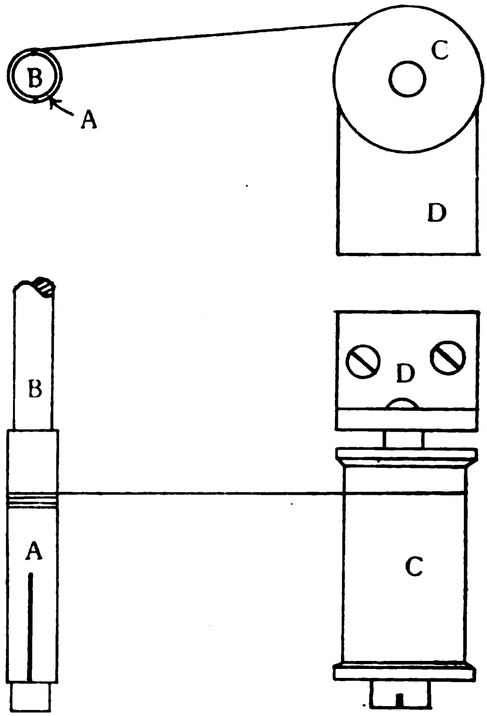
The dimensions of the boat are:—Length, 3 ft. 4 ins.; beam, 7 ins.; displacement, 8 lbs. 6 ozs.; draught forward, ¾ in.; aft, 1¼ ins.; diameter of propellers, 2 ins. You will notice in the plan view a small steering-wheel between the two clockwork motors; this wheel controls the forward motor, which is mounted on a turntable, and coupled direct to forward propeller, which has a universal radius of action; so that, without stopping or reversing the motor, the boat can be propelled ahead, astern, broadside, to port or starboard, or at any desired angle by simply turning the steering wheel.

If any of your readers have a speedy steam or other form of boat, I would like to meet them,



DECK AND SIDE VIEWS OF MODEL MOTOR TUG-BOAT FITTED WITH A NEW CORRUGATED FISH-TAIL PROPELLER.

either for speed or in a tug-of-war. From results I have obtained with this model, and from experiments I have made with different forms of screw-propelled boats, I would not mind running my boat against a larger sized model. The propellers may be of any pitch or any surface, but the diameter to



A SIMPLE SPEED COUNTER.

be about the same as mine, which is 2 ins. The engine may be run at any speed desired, but the boat must be able to go astern.

I have designed a continuous impulse petrol motor to drive my propeller. It will be on show at Olympia next month.—Yours faithfully,

W. COCHRANE.

London, W.

Power of Model Engine; Simple Speed Counter.

TO THE EDITOR OF *The Model Engineer*.

DEAR SIR,—I do not think the last paragraph of Mr. Pullen's article (November 2nd, 1905) should be allowed to pass without comment, as it might mislead some novice.

According to his statement, the engine was receiving steam with a pressure of 60 lbs. per square inch. Allowing for the loss of pressure due to friction in the probably inadequate ports, etc., the mean pressure on the piston should have been at least 30 lbs. per square inch, or a total of 44 lbs. on the piston (area of piston 1·48 sq. ins.).

Taking the revolutions at 1,000, this gives a piston speed of 250 ft. per minute, which, multiplied by 44 lbs., gives 11,000 ft. lbs. per minute = ⅓ h.-p., against ¼th as stated.

Mr. Pullen does not mention how this power was absorbed; surely the friction of the engine was not sufficient?

I send you a sketch of a simple means of counting revolutions which I have never seen described before, and it may be as useful to your readers as it has proved to me.

A is a sleeve turned an easy fit to spindle B, and split as shown, and slightly pressed together to take a light grip on B; B is the spindle, the speed of which is required to be measured; C a common reel of cotton; D a bracket carrying a spindle, on which C can revolve easily.

To measure the revolutions of B, the cotton is tied to A and placed in position shown. C is held by the hand till the time comes to measure the revolutions. On releasing C, A will revolve, winding the cotton. On the lapse of a certain number of seconds or minutes, C is again held, and the number of revolutions can be counted as A is unwound.—Yours truly,

V. W. DELVES BROUGHTON,
Upper Norwood, S.E. Assoc. M.Inst.C.E.

The Society of Model Engineers.

London.

FUTURE MEETINGS.—The next Ordinary Meeting of the Society will be held at the Holborn Town Hall on Thursday, December 7th, when Mr. J. Glover will read a paper on "Motor Cars, Past and Present," to be followed by an informal discussion. A good show of members' work is requested.

Readers of this Journal who are thinking of joining the Society are requested to apply to the Secretary for a ticket of admission to this meeting, when they will be given full information as to conditions of membership, etc.

The Seventh Annual Conversazione will be held on Friday, January 12th, 1906.—HERBERT G. RIDDLE, Hon. Secretary, 37, Minard Road, Hither Green, S.E.

Queries and Replies.

[Queries on subjects within the scope of this journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied, wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed, and also a "Queries and Replies Coupon" cut out from the advertisement pages of the current issue. (4) Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor,* THE MODEL ENGINEER, 26-29, *Poppin's Court, Fleet Street, London, E.C.]*

The following are selected from the Queries which have been replied to recently:—

[14,566] **½-in. Sparking Coil.** A. S. (Stamford) writes: A week ago I purchased a shocking coil from a second-hand dealer; I paid 2s. 6d. for this. I have no use for a shocking coil, and would like to unwind and convert it into a sparking coil. I enclose two pieces of the wire for your inspection. The thin wire is on the outside, the thick over the core. The dimensions of coil are (the coil by itself, not including the baseboard): Length, 4½ ins. (a trifle over); diameter of bobbin ends, 3 ins.; core, over 6 ins. long (a piece enclosed for your inspection). Can I convert this into a ½-in. sparking coil, please? Must I unwind all the wire, or not? It is hardly insulated at all, but for some pieces of paper between the two windings. The weight of coil is quite 3 lbs.—perhaps more. The terminals are very large—bell kind—but there is no contact-breaker on it. I don't know how to make dischargers or join up the wires to terminals. Wires are not joined up in any way, but there is no break in wires, for I have tested them. There is a regulator to 100. I am sorry for troubling you, but have read of your readers making the sparking coil, and should very much like to make one also. The whole of the wire is wound on one length. Do you advise winding two or four bobbins? Wire is all cotton-covered.

You will find complete instructions for making a ½-in. spark coil in our Handbook No. 11, and can see by reading this book if any of your coil parts can be used. The primary and secondary wire as per samples enclosed would be of no use; they are both of too thick a gauge. The iron wire might be used for the core, if well annealed; that is, it should be made dull red-hot and allowed to cool very slowly by covering it with lime or fine ashes. The copper wires which you send are No. 15 gauge (the larger), and No. 26 gauge (the smaller). For a spark coil of any kind, No. 36 gauge is the largest which may be used. You will find full information in our handbook.

[14,465] **Failure of Small Electric-Car Motors.** E. S. M. (Preston) writes: Will you please answer me the following? I am making a tramcar, like the one described by Mr. Simpson (see *M.E.*, April 30th, 1903), but am fitting two motors, working on the series-parallel system. I have made these motors, but cannot get them to work. They are a copy of Fig. 1 (*M.E.* Handbook No. 14). The armatures are 1¼ by 1¼, drum type, having eight slots ¼ in. by ¼ in. Field-magnets are wrought iron. Windings: Armature, 1½ ozs. 24 S.W.G.; field-magnets, 3 ozs. 24 S.W.G., in series, with eight coils on armature. They run freely in bearings, and connections to commutators, etc., are all correct; yet, with shifting the brushes right round, I cannot get them to move, or show any tendency to. The pressure is 12 volts; current, 7 amps., can be taken from dynamo terminals. What ratio of gearing ought to be used between motors and wheels to get the best speed out of this car, wheels being 2¼ ins. diameter? Please state where mistake in motor lies, and what ratio of gearing ought to be put in to give best results.

Re motors. Are you sure that your dynamo is working well? It rather seems as if the fault was there. Try putting the field coils of each motor in parallel. Perhaps you have wound the field coils so as to produce two N. or two S. poles, instead of N.

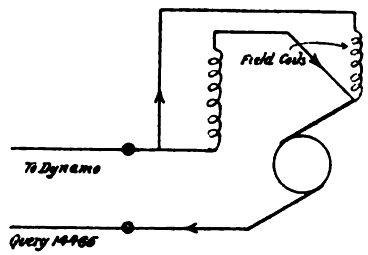


DIAGRAM OF CONNECTIONS TO DYNAMO.

and S. poles. Read Chapters I and VIII of our Handbook No. 10. *Re* gearing, this is a matter for trial. As a general rule, it is advisable to let the motors run at as high a speed as practicable; so you will not be far wrong if you make the gear ratio as large as convenient—three or four revolutions of the motor spindle to one revolution of the wheel axle would be a good ratio. If you do not get sufficiently good results, try re-winding the field-magnets of motors with No. 22 gauge s.c.c. copper wire, and armatures with No. 26 gauge s.s.c. copper wire. Get on as much wire as you conveniently can.

[14,547] **300-watt Kapp Dynamo Failure.** H. A. W. (Kenley) writes: I would crave your assistance with my new dynamo, which refuses to excite properly. The following are its details:—Output, 50 volts 6 amps.; armature, 3 ins. diameter, 4½ ins. long, 16 slots, wound with 8 coils, 32 conductors in each coil, exactly equivalent to 3 ozs. of wire per coil, as sample. Stampings insulated with thin paper and shellac; total length of stampings under pressure and without paper, 3½ ins. Field-magnets: Resistance about 20 ohms (see thinner sample of wire). Insulation: Vulcanised fibre throughout; 1-64th in. thick on the armature slots, and 1-32nd in. in the commutator and field-magnet coils. Coils were basted with shellac in alcohol in front of a gas fire, and left all day to dry. The metal got as hot as the hand could bear, but no hotter; the coils are now a deep brown colour. Commutator bars are separated by mica, and insulated from the rings with fibre, and also from the shaft. On running the machine at about 3,500 r.p.m., (1) hardly any power seems to be absorbed; (2) slight sparking takes place at the commutator; (3) on grasping

the brushes, shocks are felt; (4) on breaking F.M. circuit, a spark occurs; (5) altering the connections of the brushes to F.M. coils has no effect; (6) altering the brush lead through an arc of 45° has no effect; (7) connecting F.M. coils in parallel does not better matters, slight sparking at the brushes and shocks occurring just the same; (8) when driven in the opposite direction, nothing at all occurs. The machine runs well as a motor on 8 volts from four 20 amp.-hour accumulators, though it sparks somewhat at the commutator. A detector galvanometer and 3·5 volts shows no deflection when connected to the windings and the metal of the machine. The commutator has been disconnected, and all the coils tested for insulation from each other and the core, and for conductivity. Each coil is joined up beginning to end with the next but one, as in *M.E.* handbook. The fields are strongly magnetised. The air-gap is extremely small—a good deal less than in my 30-watt Avery dynamo. The parts and wire were supplied by Messrs. Macmillan. I shall be much obliged for any hints.

The dynamo seems to be in order, and should work. We are inclined to think that the brushes do not make good contact with the commutator: this would cause sparking, and prevent the machine from exciting. Are the brushes copper or carbon? If the latter, try a pair of copper gauge brushes. Perhaps your method of testing is at fault; you will find some information in our "Lessons in Workshop Practice," which appeared in THE MODEL ENGINEER recently.

[14,461] **Power of Hydraulic Engine.** H. S. (Bloomington, Indiana) writes: Will you kindly give me some information on the following points? Regarding the oscillating hydraulic engine described in a recent number, about what is its speed and power at water pressure of 50 lbs. per sq. in.?

The area of the ram (1 7-16ths ins. diameter) is 1·623 sq. ins., but only half of this is effective during each stroke. Therefore at 120 r.p.m., and a pressure of water of 50 lbs. per sq. in., the 1 h.-p. will be:—

$$\frac{\text{Pressure} \times \text{length of stroke} \times \text{effective area of ram} \times \text{number of strokes}}{33{,}000}$$

$$= \frac{50 \times \frac{2}{12} \times \frac{1 \cdot 623}{2} \times 120 \times 4}{33{,}000}$$

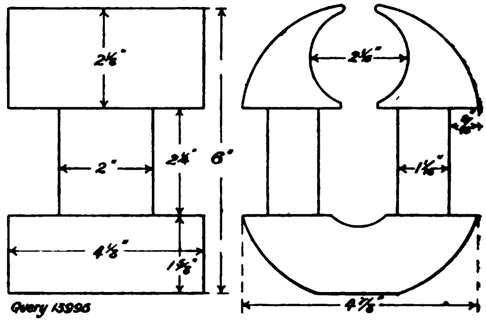
$$= \frac{50 \times 2}{12} \times \frac{1 \cdot 623 \times 480}{2 \times 33{,}000}$$

$$= \frac{1 \cdot 623 \times 2}{33} = \frac{1}{10} \text{ h.-p.}$$

[14,744] **Starting Switch for Motor Charging Accumulators.** H. B. (Birmingham) writes: I propose running a 20-watt dynamo (10 volts 2 amps.) as a motor from three 4-volt 20-amp.-hour accumulators. Could I make a small resistance board, as per sketch (Fig. 1), so that I could run the motor at different speeds? If so, what gauge German silver wire should I use, and what length? By turning switch to E, I presume I should start on lowest speed, if I connected A to G, B to H, and so on. Could I charge the accumulators from this dynamo (which is suitable for charging) in the following way:—Put two of them in series and charge for five hours; then take one away, and put in the other, and charge for five hours again; then take away the one which has been charged for 10 hours, and put in the one which has only had five hours' charging, and then charge for another five hours?

charge the accumulators would be to charge the three in series, and obtain the volts required by running the dynamo at a higher speed. We do not expect you will have any difficulty in getting the 15 volts required. You must watch the field coils, however, to see that they do not get too hot. As long as you can keep your hand on them they are not too hot. You would probably have to raise the speed about 20 per cent.; it depends upon the design of the machine.

[13,995] **120-watt Dynamo.** G. R. (Gloucester) writes: (1) Would you please let me know what is the output of dynamo of which I have given sketch; also what speed to be driven at? (2) Would a ¼ b.h.-p. do? (3) Could I get enough light from it to light a small shop about 9 ft. high, 16 ft. long, 15 ft. broad (it is a bootmaker's shop)? (4) Could I use a tripolar armature, as I have never made one before? I have got your handbook on Dynamos and Motors. (5) What amount of wire for each pole of magnet



DYNAMO FIELD-MAGNETS.

and gauge? Also amount for armature and gauge? (6) What volts and amps. to light an 8 c.-p. lamp? Also, how many 8 c.-p. lamps will dynamo light?

(1) About 120 watts at 3,000 r.p.m. (2) A ¼ b.h.-p. engine is not powerful enough to drive this machine at full load; you would require about ¼ b.h.-p., or rather more; but you could drive it at less than full output with ¼ b.h.-p. (3) At full output you should be able to light four 8 c.-p. lamps. (4) We advise you to use a simple laminated shuttle armature, as you only require to light lamps, and this is your first attempt. This type of armature also gives maximum output, and serves very well for lighting. It is most easy of all to wind. (5) Assuming you will use a shuttle armature, wind it with No. 20 gauge D.C.C. copper wire, getting on as much as you can—about ¾ lb. will be required. Wind field-magnet with 1½ lbs. (or more, if you can get it on) No. 23 gauge S.C.C. copper wire on each magnet pole, both coils to be joined in series with each other, and in shunt to the brushes. (6) Output about 25 volts and 4 amps. A 25-volt 8 c.-p. lamp would take rather more than 1 amp. You can vary the volts within limits by running at higher or lower speed. As your magnet is deficient in mass of iron, you may not get 120 watts' output, if it is not of very good

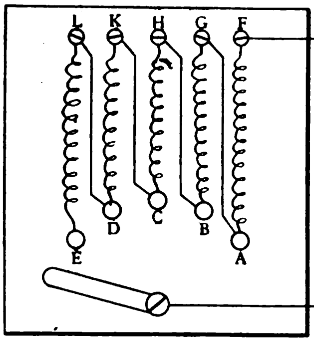


FIG. 1.

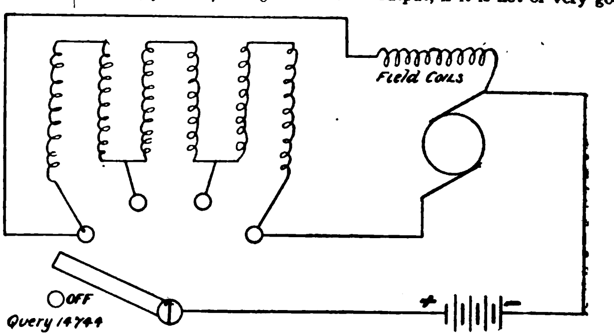
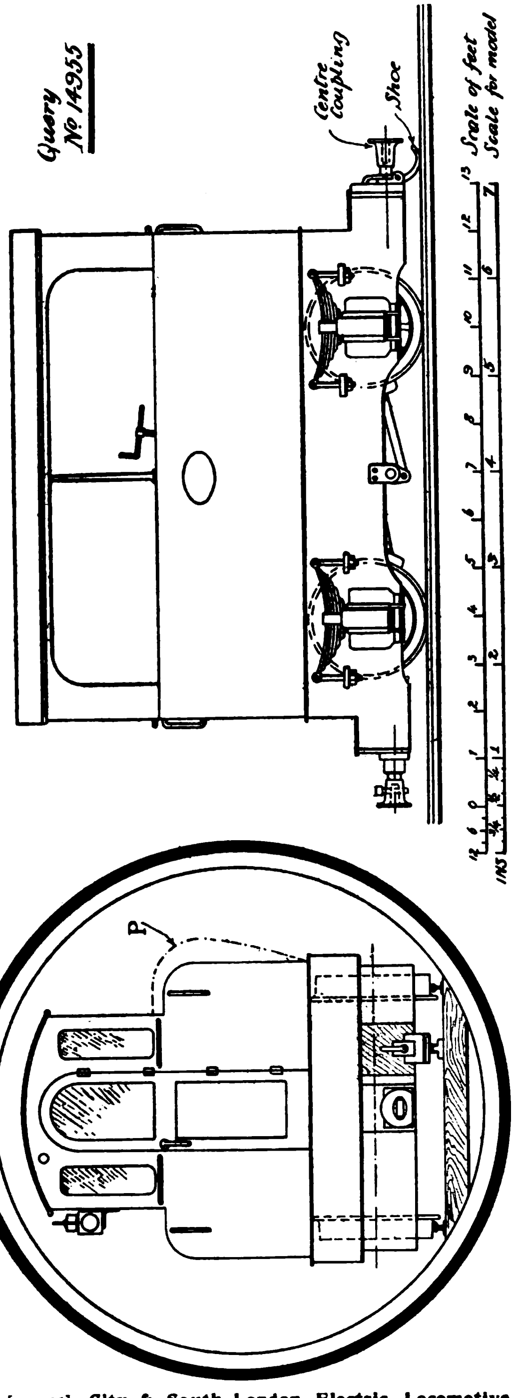


FIG. 2.

STARTING SWITCH FOR MOTOR CHARGING ACCUMULATOR.

Yes, you can control the speed of your motor precisely in the way you suggest; but as your machine is shunt-wound, it would be better to connect your resistance as sketch (Fig. 2), as the machine will start with more freedom. The resistance can be divided into as many stops as you prefer. Use about 2 ozs. of No. 22 gauge bare German silver wire. You can easily adjust the coils by taking out some of the wire if resistance is too much. The best way to

quality. The diameter of armature should be 2 ins. If the pole-pieces do not approach very closely to the armature all round, your output will suffer accordingly; there should, however, be no doubt as to the machine giving at least two 16 c.-p. lamps' output. If you have no means of trying the voltage which the dynamo is giving before buying your lamps, it would, perhaps, be on the safe side to get 20-volt lamps. Remember, when testing the machine, that the volts will fall considerably as you increase the load. There will very likely be a difference of 10 volts between light load and full load, so you should really put on at least three lamps or four lamps when making a trial.



City and South London Railway Electric Locomotive.

[14,955] **City & South London Electric Locomotive.** F. H. R. (South Woodford) writes: I should feel greatly obliged if you could give me the following particulars. A dimensioned side and end elevation of the usual type of electric locomotive used on the City & South London Tube Railway; also whether you think a model, say, of ½-in. to 9-16ths-in. scale—I cannot go in for a larger one, as I have not the room to run it—could be made successfully?

We append herewith a drawing of the earlier type of locomotive on the City & South London Railway. The scale gives dimensions for the actual locomotive and for a ½-in. scale model. As the actual locomotives are small (compare with a drawing of a steam loco) we think that your choice, under the circumstances, is a wise one. A very powerful locomotive may be obtained without any difficulties arising with regard to the curves of the railway. You will find that even a ½-in. scale locomotive running on a gauge of 3½ ins. would not make a very cumbersome engine. The wheelbase would only be about 3 13-16ths ins., and the loco would pass round a 5-ft. or 6-ft. radius with the greatest ease. The chain-dotted line (P) on one side of the end-view represents, approximately, the profile of the sides of the newer engines on the C.S.L.R. Whatever gauge and scale you adopt, you will be limited to "tube" type of locomotives and rolling-stock, owing to the buffer height, etc., peculiar to these vehicles. However, the excess of width for length, height, and size generally obtained will make a good deal of difference for the better.

[14,964] **Model Steamer.** F. R. (Dungannon) writes: I am fitting a steamer with a boiler 3¼ ins. diameter with a furnace tube 1¼ ins. diameter, with cross tubes. I have only 3 ins. between face of boiler and face of spirit tank. Would it be possible to make a blowlamp after the style as described in "Machinery for Model Steamers"? Could you also give me the name and dates of any engineering paper that would have given the measurements or drawings of the Midland Railway steamer *Londonderry*?

Yes, it will be quite possible to arrange a spirit vaporising blowlamp within this space. We cannot very well give exact dimensions from the particulars you send. We cannot call to mind any drawings of the Midland Railway steamer *Londonderry* having been published. Perhaps one of our readers could oblige?

[15,021] **H.E. Lamps.** R. H. P. (Norwich) writes: Will you kindly reply to the following? (1) I have a 4-volt H.E. lamp which, when connected to a 4-volt accumulator, does not give anything like the same amount of light as a 4-volt lamp from a flashlight connected to the same accumulator—why is this? (2) What is the difference between an ordinary lamp and a H.E. lamp, and why does the latter consume less current? (3) What is the longest difference for which two bell telephone receivers, with compound bar magnets, could be used when connected together without bells or microphones?

(1) Possibly their candle-power is different, and one takes more current than the other. (2) H.E. lamps give maximum c.-p. for current used. (3) Impossible to say—depends on many minor details, conditions, and adjustments, etc. See handbook "Telephones and Microphones," 7d. post free.

[14,877] **Running Dynamo from Small Gas Engine.** S. C. (Bolton) writes: I have a gas engine (Madison), 2 ins. by 3 ins., which I intend to drive a dynamo with for lighting purposes. I have enclosed sketch of dynamo I propose to make, particulars of which I have got from the *M.E.* handbook. (1) The dimensions are for a dynamo of 100 watts. Do you think the above engine would be powerful enough to work this size? If not, what size would it work? (2) Are the dimensions of dynamo wrong for a machine of this size? If not, please correct same. (3) I propose having a drum armature of eight slots, 2½ ins. by 2½ ins. Is this correct? (4) I wish to wind the F.-M. with 22 D.C.C. wire, as I have about 2½ lbs. of this wire. How much of this wire will it need altogether on the F.M.'s, and what gauge and quantity of wire shall I need for armature, as I want voltage to be from 20 to 30? (5) What will be the correct voltage when wound with the wire you state?

(1) We doubt if you will be able to obtain the full 100 watts output; it is a matter for trial; with everything in best condition you may obtain something near it. We presume you understand that a dynamo takes power according to the output demanded of it, so that if unable to obtain 100 watts, you could obtain something less according to the power available; you could get full volts, but perhaps less current. (2) Your dimensions are slightly small, but would do. Deficiency in size means slightly higher speed in running; refer again to the scale on page 23 of our handbook. (3) Drum armature with eight slots will do. Wind it with eight coils, two in each slot, and connect to an eight-section commutator. (4) No. 22 gauge wire will do for the field-magnet; 1½ lbs. will be wanted for each core. Armature will require about 14 ozs. wire; use No. 20 gauge D.C.C. wire. (5) Voltage 20 to 25 volts; it can be adjusted by running dynamo at higher or lower speed.

[14,891] **Charging Accumulators from Primary Cells.** B. P. (Walmer) writes: I have recently completed a dynamo which I made from castings supplied from a firm who advertise in your Journal, and would esteem it a favour if you will kindly answer the following questions, viz.:—(1) If I wanted to charge a 4-volt 8-amp. accumulator from dynamo, which is 25 volts 4 amps., would a 25-volt 1-amp. lamp pass the right amount of current for charging same? (2) If I wanted to charge four 4-volt accumulators, of which the charging rate is 1 amp. per hour, could I couple the four in series or parallel with four 1 amp. lamps? (3) What

amperes would a 25-volt 8 c.-p. lamp pass? (4) How many 4-volt accumulators could I charge up at once in series? I have six 4-volt accumulators, four of them 8 amp.-hours and two 10 amp.-hours. Could I charge this lot up in series? (5) Could I get any lamps which would only pass ½ amp.? If so, what candle-power would each give?

(1) Yes, if 1 amp. is the proper charging rate of current; about 1 to 1½ amps. would be a common rate for a cell of this size. (2) The accumulators should be charged in series with each other; they would require full 5 volts per accumulator, so that the four in series would take quite 20 volts. Some resistance wire in series with them, or an alteration in the dynamo speed would adjust the voltage, so that the right current passes. Try about 5 yds. No. 24 gauge German silver wire as the resistance. (3) Depends upon the efficiency; about 1 amp. with a lamp of average efficiency, to 1½ amps. as a maximum. (4) Yes, by running the dynamo at a slightly higher speed, so as to obtain 30 volts; the charging rate would be about the same for all. (5) Try the Universal Electric Supply Co., 60, Brook Street, C.-on.-M., Manchester. If you only intend to use it as a resistance, you should be able to obtain such a lamp. A 35-volt 5 c.-p. lamp would pass about ½ amp. at 25 volts if it had an efficiency of about 3½ watts per candle-power.

[14,725] **Small Gas Engine.** A. N. (Bury) writes: I have made a small gas engine (2½ ins. bore, 3½ ins. stroke), and had no trouble in getting it to work; in fact, it ran well, and pleased me exceedingly; but the second day I tried it it did not go so well, and went worse as days went on, till at last it refused to explode. I found, on examination, that both valves were not working—the exhaust, when pushed in, would sometimes stay in, and the gas and air-valve (combined and worked by suction) stuck fast to the valve seat. On taking valves out, I found nothing to cause them to

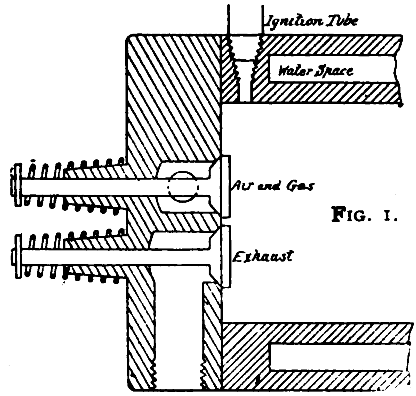


FIG. 1.

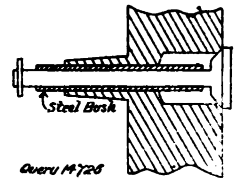


FIG. 2.

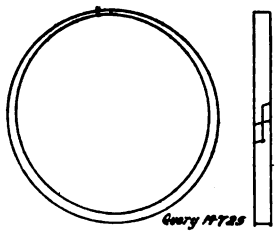


FIG. 3.

GAS ENGINE DETAILS.

stick; but the spindles were rust-coloured at the part where they touch nothing. Can you tell me (1) If the valve spindles should fit well, or rather slack, in the holes in cylinder? (2) Should the valve spindles be oiled, and, if so, with what kind of oil? (3) Is the bearing surface in cylinder back enough; if not, would a steel or gunmetal tube act all right secured in valve spindle hole, and the valve faces re-ground, as shown in Fig. 2? After cleaning valve faces, spindles, etc., the engine ran all right again. I have your book on Gas Engines, and all the volumes of the *M.E.*, but cannot find anything about valves sticking. (4) Is there any particular method of springing cast-iron piston rings on without breaking them? The piston is 2½ ins. diameter, and the rings are exactly the size of drawing. (5) Are they about right proportion for springing? They are home-made ones, and I can alter them if too thick at the back end. The engine, when running, seemed to go at about 500 r.p.m., and this was not its fastest speed. I was afraid to "let her go," as I was doubtful whether the flywheels could stand the strain. I send drawing of full-sized section of flywheel. (6) What would the bursting strain of a wheel like this be? (7) What is a safe limit of speed to run engine at? There are two flywheels, both same size, with a crank between them.

(1) When engine is cold, the valve spindles should be quite an easy fit in their bushes—especially the air, as it is only opened by suction. (2) Yes, a little oil is a good thing. It must be good oil, however, or valve will soon stick up. Price's is to be recommended. It is 2s. 9d. per gallon, taken at one-gallon lots. (3) Yes, a bush of gunmetal is desirable. This can be renewed at intervals when badly

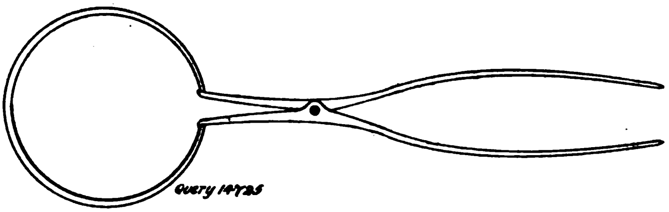


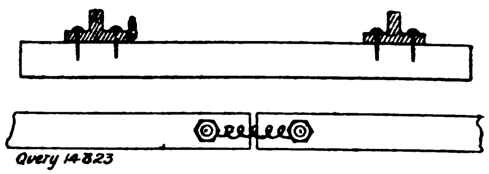
FIG. 4.—PISTON RING PLIERS.

worn. (4) A pair of ring pliers are usually employed, as shown in sketch above; but great care is needed to manipulate them, to avoid breaking the ring. (5) They seem about correct proportions. If they break, try one a shade thinner. You could also make them wider with advantage—say, ¼ in. wide. (6) This wheel will stand the speed easily, if sound. (7) Should be able to run at 550 revolutions, but much depends on the build of engine; 600 would not be too high, if well balanced.

[14,722] **Electro-Magnets.** E. D. W. (Aberdare) writes: I have a magnet wound to the following dimensions for use with a 110-volt circuit, and I wish to get the same pull with 220-volt circuit. Could you kindly give me the particulars for same, viz., whether iron core would have to be longer, and how many extra turns of wire would be required? Iron core is 12 ins. long, 1 in. diameter; 36 coils (or layers) No. 22 wire, cotton-covered; weight of wire, 16½ lbs. Magnet used for lifting weights; volts, 110. Does not heat after two hours' use.

Re-wind the magnet with about the same weight of No. 25 gauge s.c.c copper wire; or use the present winding, but place in series with it a resistance having a value of about 90 ohms—say, 1½ lbs. of No. 22 gauge bare German silver wire, made up into coils and stretched across insulators. Wire for magnet would cost about 30s.; bare German silver wire, about 3s. 6d. If you re-wind the magnet, you will save half the cost for current, as the amperes will be only half the value used with the present winding.

[14,823] **Small Electric-Car Motor.** F. W. (Peckham) writes: I thank you very much for your answer to a query of mine a month ago. I am happy to say my knowledge of practical electricity has advanced very much in that short time, with the help of your little sixpenny handbooks 5, 8, 14, 22, and 24. The motor I asked you about runs splendidly, and I can understand all the working parts. I am now writing to ask you about the little electric-car motor described on page 52 of the *M.E.* Handbook No. 8. I have made it to the figures given there, and I want you



RAILS AND SLEEPERS FOR SMALL ELECTRIC CAR.

to be kind enough to furnish me with particulars of the rails on which it is to run. I should like to know (1) the best and cheapest material to make them of; (2) a few details of construction—how the sleepers are to be joined, and of what material? (3) How I am to pass the current through the rails to the car? You will find these details are lacking in the book referred to. I shall take my current from a six-cell pint-size bichromate battery. The jars are 1 pt. square shape (pickle ones), and the carbon and zinc details are the "Excelsior" battery (purchased from the Universal Electric Co., 60, Brook Street, Manchester).

(1) Strip brass, copper, or iron—preferably the first; L or T section. (2) Wood; and fix with small tacks, as shown. (3) Join up with flexible wire, as above; either soldered on, or held by small bolt and nut.

[14,944] **Gas Battery; Mercury Pump.** F. D. (Paddington) writes: I wish to make a gas battery, as described in THE MODEL ENGINEER for November 15th, 1902, and as I have a dozen porous pots on hand, I wish to use them. They are 5½ ins. high and 2½ ins. diameter. (1) How many porous pots should I need to obtain a current of 12 volts 4 amps. to work a 2-in. sparking coil, and how connected? I wish to use cast zincs, ½ in. diameter, inside the porous pots. (2) What is the smallest amount of mercury it is possible to use in a mercury pump for exhausting small vacuum tubes, etc., as I wish to make a small mercury pump?

Each cell gives about 1·5 volts. (1) You would need eight cells to get the voltage required; connect in series. (2) For a small mercury pump you could make this with a few pounds of mercury, say 4 lbs. It would depend upon the volume of the pipes and containers of the particular apparatus in question. Such pumps are illustrated and described in many text-books on physics, to which you should refer.

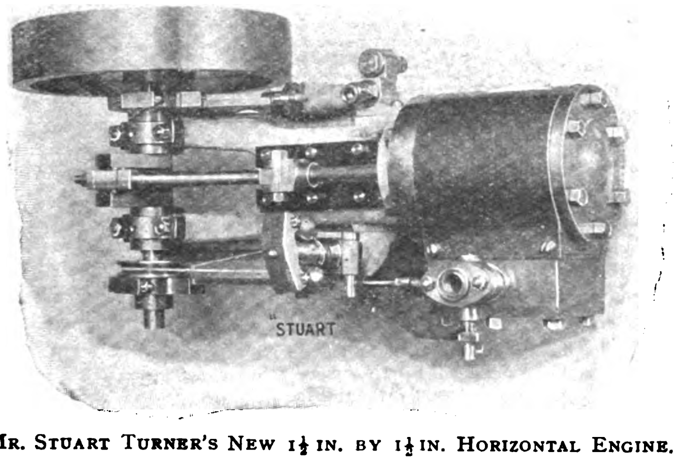
The News of the Trade.

[*The Editor will be pleased to receive for review under this heading samples and particulars of new tools, apparatus and materials for amateur use. It must be understood that these reviews are free expressions of Editorial opinion, no payment of any kind being required or accepted. The Editor reserves the right to criticise or commend according to the merits of the goods submitted, or to abstain from inserting a review in any case where the goods are not of sufficient interest to his readers.*]

* *Reviews distinguished by the asterisk have been based on actual Editorial inspection of the goods noticed.*

*The "Stuart" 1½ by 1½ Horizontal Engine.

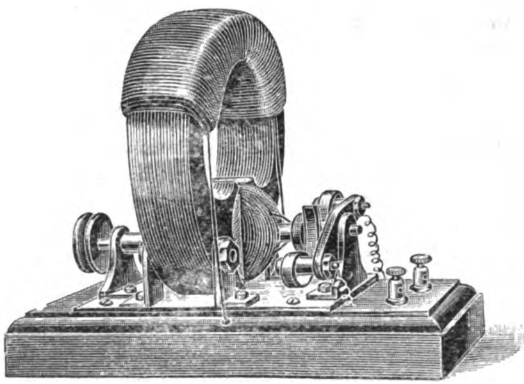
Some few weeks ago we reviewed in these columns Mr. Stuart Turner's new design of 1 in. by 1 in. model horizontal engine. This excellent model having been received most enthusiastically by readers of THE MODEL ENGINEER, Mr. Stuart Turner has just produced a larger size with cylinder 1½ ins. bore by 1½ ins. stroke, fitted with high-speed governors of modern design, and a balanced throttle valve. We have seen a finished model—a photograph of which, reproduced herewith, speaks for itself—and also the sets of castings and drawings supplied for making the model, which can be heartily recommended to readers who are desirous of building an up-to-date model. Further particulars and prices may be obtained from Mr. Stuart Turner, Shiplake, Henley-on-Thames.



MR. STUART TURNER'S NEW 1½ IN. BY 1½ IN. HORIZONTAL ENGINE.

The "Islington" Dynamo.

A newly-designed small dynamo, known as the "Islington," and patented and introduced by Messrs. Archibald J. Wright, Ltd., Leyton Green Road, London, N.E., possesses several features which will appeal to our electrical readers. This machine, which is shown in the accompanying illustration, has been designed largely with the idea of supplying parts to amateurs who have not the requisite tools or mechanical ability to fit up a machine from castings of the usual kind. No further turning, drilling, or screwing is required to be done to the parts as supplied, and the machine can be completed in a perfectly satisfactory way with the aid of a few simple tools. This is made still more easy by an excellent eight-page illustrated instruction book, which is supplied with the parts. It will be noted from the illustration we give that the field-magnets are built up from stampings, these being of soft wrought-iron, and of such a shape as to provide ample room for the winding. The makers claim that this and certain other points in the design of the machine make it most efficient in its working, and they state that the output is about double the output of any other machine of similar weight and size; whilst the power required to obtain this output is half that required by other such machines. We have not had an opportunity of testing one of these machines, and so are not in a position to endorse these claims but at the same



MESSRS. ARCHIBALD J. WRIGHT'S "ISLINGTON" DYNAMO.

time, we think the "Islington" dynamo is one which a good many amateur electricians will take a fancy to, on account of the ease with which it can be fitted up. It may be had either as a finished machine, or, as already stated, in sets of parts, and in either case an H-armature or a tri-polar armature may be fitted. In the former case the output is 15 volts 2 amperes, and in the latter case 10 volts 3 amperes. Full particulars as to prices, etc., may be had on application to Messrs. Archibald J. Wright, Ltd., at the address given above.

New Catalogues and Lists.

Northern Modelling Co., 189, Abbey Road, Barrow-in-Furness.—The list issued by this firm includes prices and particulars of horizontal engines and launch engines (both finished and in castings), and also stationary and locomotive engine parts, such as cylinders, wheels, funnels, regulators, etc. (both rough and finished). Some neat blue-prints of working drawings which we have seen show these models to be of good design, and well worth the attention of our readers. Some reductions in prices have recently been made, and the list will be forwarded on receipt of 1d. stamp.

Harry I. Johnson, 12, Trinity Street Boar Lane, Leeds.—We have to hand the price list of name-plates, stencils, steel letter, figure, and name punches, moulder's letters, rubber stamps, and small home printing outfits. List will be sent to all readers upon receipt of stamp to cover postage.

W. Hutton, 13, Regent Street, Ipswich.—We have received a useful 32-page list from Mr. Hutton, dealing with electrical goods and novelties. The items given include accumulators and parts, electric jewellery, lamps and lamp stands, coils, batteries, terminals, small motors and dynamos, castings, bells, telephones, model steam engines, fittings, and a number of sundries. The list, which is fully illustrated, will be sent post free to any reader on application.

The Editor's Page.

WE have received several letters on the subject of the exhibition treatment of models, but space this week only permits us to quote the following passages from a very interesting and spirited communication from a reader in Scotland. He writes :—" My experience on the subject under discussion only extends back to 1904, when I exhibited an 80-watt undertype dynamo, for which I was awarded a first prize, and this year, when I took a second prize for a switchboard on which were mounted volt and ampere meters and two switches. The dynamo came back rolling about the packing-case, minus an oil-cup, lid, and, as your correspondent says, 'smothered in dust.' This year's experience was even worse. Foreseeing the rough usage the exhibit would be subjected to, I took the precaution to clamp down the handle of each switch with 3-16ths-in. copper bands, the ends of which were tucked tightly beneath their respective ebonite switch-blocks; but notwithstanding this, some vandal had literally pulled one of the switches up by the roots (just to see if it really worked, I expect), and when it came back to me the hinge-block was almost wrenched off the base, and the copper-knife part of the switch entirely missing. To add insult to injury, the receiving manager sent back the exhibit in an old soap-box belonging to some Co-operative Society, four times deeper than required, the extra space being filled up with old calendars, papers, and other packing-room rubbish, instead of in the dust-proof case I made for it. When remonstrated with, the secretary (poor man!) only said there were worse things than soap-boxes! I expect he was thinking of herring-boxes. But that by the way. After mature deliberation, I venture to think the amelioration of the condition of models previous to, at, and after an exhibition lies, to a great extent, with the exhibitors themselves; and I would suggest that, in all cases where the object is not too large, the exhibit should be enclosed in a glass case (this does away with the 'halo of dust' given gratis, but, to a certain extent, precludes the successful exhibiting of a working model). Small parts, accessories, and detached portions of exhibits should be securely jointed or connected to the main part by the least visible method possible, and packing-cases just large enough to hold the exhibit, and no more, should be employed in transit. Heavy machines should be secured to the bottom of the case by screws through holes in the baseboard or clamps over the bedplate, etc., and, to secure their return, cases should be marked indelibly on every side, inside and out, with owner's name and address, as well as exhibition private number. On the other hand, promoters of an exhibition could surely see to the complete covering up with large sheets models which are likely to suffer in appearance from the effects of dust (and what model is not ?) previous to the daily sweeping of floors, as that is the time when most of the dust is stirred up and deposited elsewhere. They should also see to the better guarding against mischievous and ignorant persons tampering with and defacing exhibits, by placing responsible individuals or more policemen than there are usually, on duty (of course, if glass cases were adopted, this watching could almost be dispensed with). And, lastly, managers could surely inaugurate a system of storing packing-cases whereby each exhibitor would receive back his model in the proper case."

Answers to Correspondents.

J. H. H. (Leeds).—We should advise copper conductors, as being cheaper and more convenient to use.

Notices.

The Editor invites correspondence and original contributions on all amateur mechanical and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected or not, and all MSS. should be accompanied by a stamped addressed envelope for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

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Contents.

[*The asterisk (*) denotes that the subject is illustrated.*]

THE

Model Engineer

And Electrician.

A JOURNAL OF PRACTICAL MECHANICS AND ELECTRICITY.

EDITED BY PERCIVAL MARSHALL, A.I.MECH.E.

VOL. XIII. No. 240. NOVEMBER 30, 1905. PUBLISHED WEEKLY.

A Model Steam Tug.

By C. BLAZDELL.

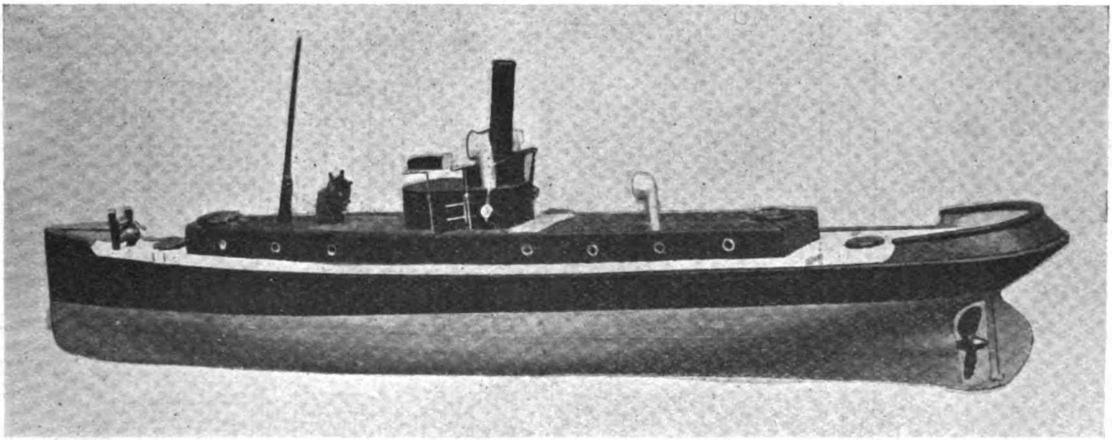


FIG. 1.—MR. C. BLAZDELL'S MODEL STEAM TUG.

THE following description of a small model steam vessel may be of use to amateurs interested in such work, and who do not possess an elaborate stock of tools and appliances.

The boat above water-line was intended to represent as far as possible a fast tug and despatch-boat built for the London Fire Brigade, particulars being taken from a model of this vessel at South Kensington. The hull measures 3 ft. over all, 6 ins. beam, with a depth amidships of $3\frac{1}{2}$ ins. It is built of wood in two layers, as indicated in the section (Fig. 2), and being a first attempt is not particularly beautiful. The only point in the hull and deck fittings needing description is the method of making the ventilating cowls, which I will endeavour to give later.

The propelling machinery consists of a simple water-tube boiler supplying steam to a double-acting slide valve engine $\frac{3}{8}$-in. bore by $\frac{1}{2}$-in. stroke, the boiler being very successful as a rapid steam generator. The drawings will make its construction clear. It has a heating surface of about 60 sq. ins., weighs complete with water $2\frac{1}{2}$ lbs., and evaporates about 44 cubic ins. of water per hour from and at 30 lbs. per sq. in., with induced draught. This is equal to about $1\frac{1}{4}$ cubic ins. per minute per 100 sq. ins. of heating surface, which, I believe, is good for such a small boiler. The consumption of methylated spirit in the lamp is equal to about 23 cubic ins. per hour. The ratio of water evaporated to fuel consumed is thus approximately as 2 is to 1, a somewhat startling fuel consumption compared with the performance of real water tube boilers; but no doubt low efficiencies are usual in these little boilers, and economy of fuel is certainly second to rapid steaming.

Referring to the drawings (Fig. 2), the drum consists of a piece of solid-drawn brass tube $1\frac{3}{4}$ ins.

diameter by 6½ ins. long, having cast brass ends turned a good fit on the tube and secured by a central stay 3-16ths in. diameter. They can thus be readily removed at any time by taking off a nut, a thin brown-paper washer smeared with white lead and oil making a tight joint against the working pressure of 30 lbs. Fourteen ½-in. outside diameter "field" tubes are soldered (in this case) into the drum, but brazing would be far better. The circulating baffle shown at the top of the inner tubes in the drawing was not fitted, as it was not thought to be necessary, but its presence is theoretically essential to separate the ascending and descending currents of water, although the boiler, as made, works very well without it.

Steam is taken by a perforated pipe—to which is attached an anti-priming plate—from the top of the drum and led through the combustion spaces, as shown, being thus superheated on its way to the engine. The exhaust from the latter discharges up the funnel, a good draught being essential to the success of the boiler. Flame baffles are fitted as shown in the section through the boiler (Fig. 2), to ensure that the heat plays upon the whole length of tube instead of making direct for the uptake. The limits of water-level allow of a

The central air passage between the trays is necessary to success, a lamp made without it being a failure.

The engine has a cylinder ⅜-in. bore by ½-in. stroke, the only points worthy of notice being the extra large stuffing-boxes to the piston and slide rods, packed with a mixture of blacklead and as-

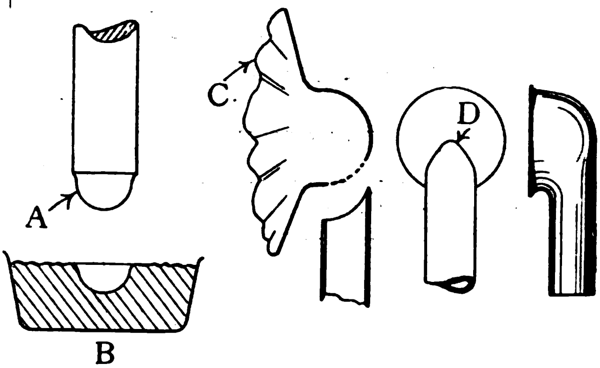


FIG. 5.—CONSTRUCTION OF VENTILATORS.

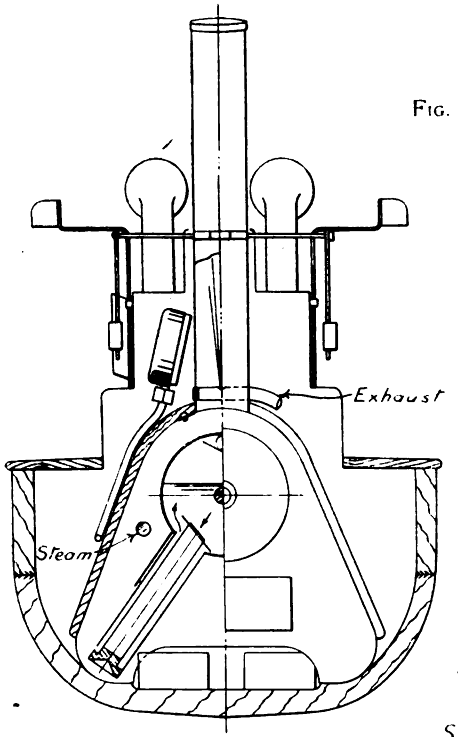


FIG 2

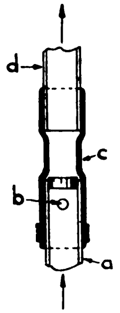


FIG. 4

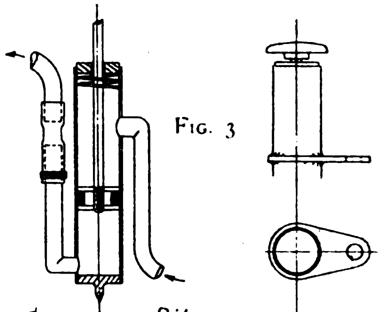
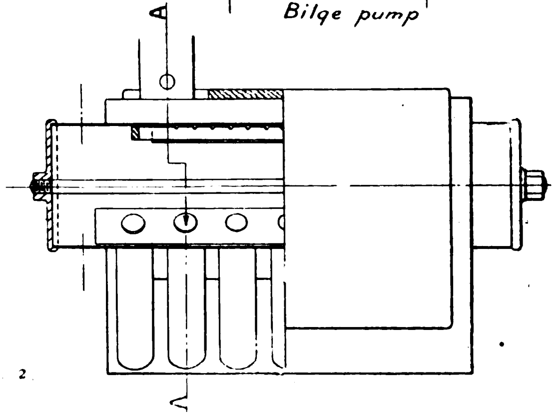
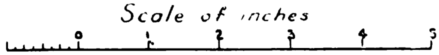


FIG. 3

Bilge pump





MIDSHIP SECTION AT A A.

PART LONGITUDINAL SECTION OF BOILER.

run of about 20 minutes, but a continuous feeding device would be a great improvement.

The lamp consists of two tin trays, ½-in. deep by 1 in. by 4 ins., with asbestos wicks, burning methylated spirit fed from a tank at the stern.

bestos fibre, and the provision of fairly large bearing surfaces, both of which appear to be necessary if the engine is to run for any length of time without giving trouble.

A bilge-pump is fitted to get rid of the water, etc., which drains to the bottom of the boat. It is very simple in construction, and has no troublesome valves, so the following description of it may be of interest:—A piece of brass tube 7-16ths in. bore by about 2¼ ins. long has a plug soldered into the bottom. An ordinary cotton-packed piston is fitted with a brass piston rod and thumb-button. (a steel rod quickly rusts.) The top cover through which the piston-rod works is just a driving fit into top of barrel, and drilled a very loose fit for the piston-rod, to allow of ready escape of air, a couple of coils of brass spring being placed between this cover and the piston to cushion the latter at the top of its stroke. In place of the usual suction-valve the suction-pipe is brought up and soldered into a hole drilled near the top of the barrel in such a position as to be fully uncovered by the piston a little before the latter reaches the top of its stroke. Working under its ordinary conditions of about 2-in. lift and 3-in. head, this little pump gave an efficiency of about 85 per cent.

As no special tools were available for the cowl ventilators, they were made in the following manner: A piece of brass rod, A (Fig. 5) was turned at the end of the shape of the hood, and immersed in a small vessel of molten lead, B, and held there until the metal had solidified, thus leaving an impression of the shaped end of the rod in the lead. A disc of thin sheet copper considerably larger than the finished cowl was then laid on the mould and worked down into it with the brass rod and a hammer. This sounds easier than it really is, for the copper crinkles up and has a tendency to crack. The creases were carefully knocked out with a hammer, and the metal annealed a dozen times or more during the operation. The cowl at this stage has a

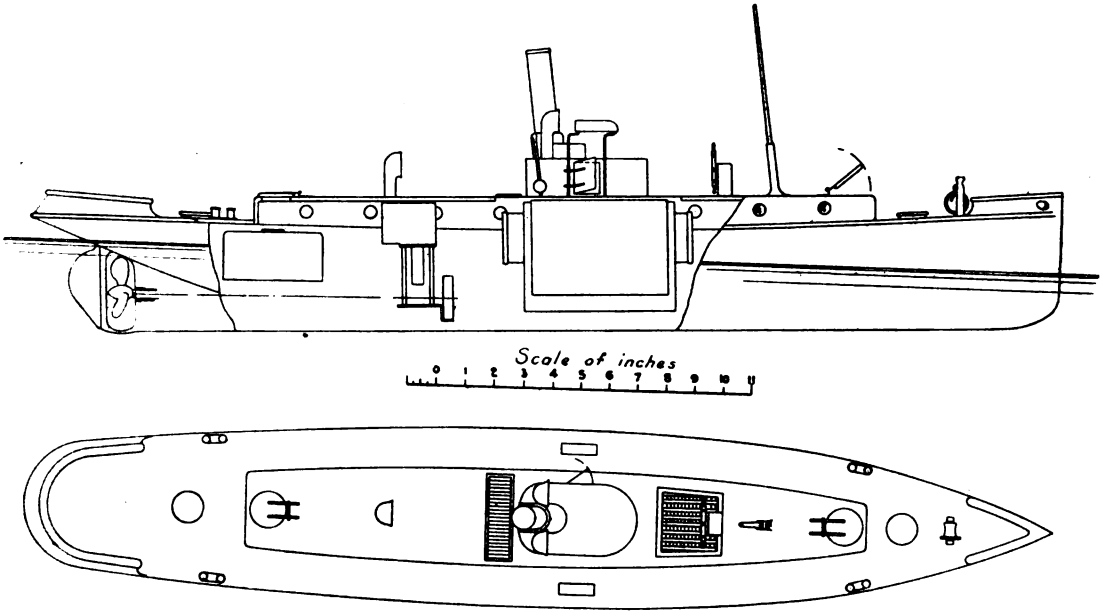


Fig. 6.—General Arrangement of Model Steam Tug.

The discharge valve is a modification of a cycle tyre valve, and is shown enlarged in Fig. 4. The discharge pipe *a*, soon after leaving the barrel, has its end plugged as shown. Two small holes are drilled diametrically opposite at *b*, and a tightly-fitting piece of rubber tubing *c* slipped over and secured by a few turns of wire at the bottom. Another pipe *d* in the top of the rubber tube carries the discharge overboard. Supposing the piston at the bottom of its travel, a partial vacuum is created in the barrel by drawing the piston up, to satisfy which water rushes up the suction-pipe as soon as its end is uncovered by the piston. On the downward stroke, the suction port being again covered, the water in the barrel is forced into the discharge pipe through the small holes, expanding the rubber tube into the pipe *d*, and so overboard, the rubber closing round the holes *b* immediately after the passage of the water, thus forming the valve.

crinkled edging like that shown at C in the sketch. This is cut off with a sharp pair of scissors or snips, and trimmed up with a file, a narrow edge being turned up all round the mouth with a pair of pliers. In place of the edging a half-round beading of wire might be soldered round the mouth by way of a finish. The trunk of the ventilator consists of a piece of brass tube shaped at the top to take the hood, a hole for the throat being cut in the latter where it joins the trunk, the two being then soldered together. The realistic appearance of the ventilator depends on the way this is done, the idea being to conceal the joint shown at D in the figure, by means of a plentiful application of solder worked round with the soldering iron, and afterwards cleaned up with emery cloth so as to give a nice graceful curve between the tube and the hood. Aluminium paint looks well on the outside of the ventilator, and effectually hides all solder, while vermilion is the usual colour for the mouth.

As I had no means of turning up the spokes of the steering wheel, they were made from short pieces of wire held vertically over a spirit flame, with a drop of solder hanging from the end. When this solidifies it makes a fair imitation of a handle.

I do not think there is much else in the boat needing description, except that all the space forward of the boiler is packed with cork, making her unsinkable, and also that the pressure gauge is viewed by opening a small door in the boiler-casing on deck, shown in the drawings; a better arrangement than allowing the gauge to stick out through a hole in the deck. The boat is fitted with gratings, hatches, winch, sidelight screens, etc., as shown in Fig. 6, the funnel being arranged to lower with counter-balance weights. This was a necessary arrangement in the original to allow the vessel to pass under the bridges on the Thames at all states of the tide, but this scarcely applies to the model. Probably the provision of rather more freeboard would have been an improvement in this model, unless the deck is made water-tight; and I should advise an amateur making a similar boiler to braze and not solder the tubes.

In conclusion, I must say that I have gained much information from the pages of this journal and its handbooks, without which I should have found the construction of this little craft impossible.

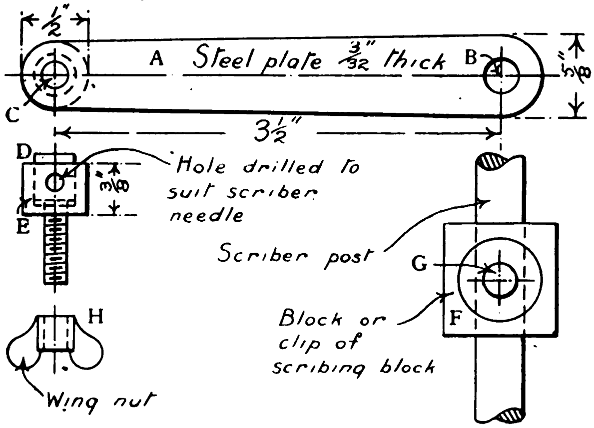
Workshop Notes and Notions.

[*Readers are invited to contribute short practical items for this column, based on their own workshop experience. Accepted contributions will be paid for on publication, if desired, according to merit. All matter intended for this column should be marked* "WORKSHOP" *on the envelope.*]

An Extension Bar for Scribing.

By "SCRIBO."

A is a piece of steel plate 3-32nds-in. or 1/8-in. thick, about 3½ ins. from centre to centre of holes C and B. B is a hole drilled the same size as



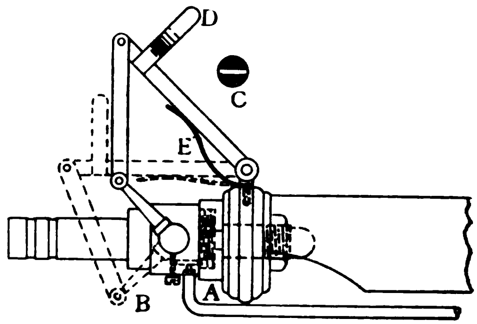
DETAILS OF EXTENSION BAR FOR SCRIBING.

diameter of the pin that tightens up clip of block shown at F. C is a 3-16ths-in. hole drilled to take a simple clip D with a bush E. The hole in the clip should be drilled same size as scriber needle, and the thumb-screw G is for tightening the whole up. The pin G of the scribing block goes through the hole B, and the thumb-screw or nut H tightened up, when it will hold the bar A firm. The size here given is suitable for a scribing block with an 8-in. post. It is very handy for marking off over projections in holes, and a good many other uses.

A By-Pass Bunsen.

By W. P.

Having a large amount of soldering to do lately, and heating the iron on a Bunsen, it occurred to me that a by-pass would economise the gas, and also save much time in re-lighting; so I proceeded to "rig up" one as shown in sketch. The by-pass works automatically by the weight of the iron. I



A BY-PASS BUNSEN.

first removed the original gas inlet, and made one similar, but with a flange. This flange I screwed out to take a by-pass of an old incandescent burner which I had by me. I then screwed a piece of tube to fit the other end of by-pass to take the india rubber tube. A hole is drilled at A, and tapped to take a piece of 1/8-in. brass tube, which is led a little above surface of Bunsen burner. The screw B regulates the size of flame of the by-pass. C is a section of the cock showing groove which supplies gas to the by-pass. As will be seen, when the iron is laid on the Bunsen, the handles resting on the crutch D, the weight brings the lever down to the position shown by the dotted lines, which lights the Bunsen, and on lifting the iron off, the Bunsen is shut off, and the by-pass lit. The cock must not be too tight; a little tallow will make it work easy. The spring E (which is a piece of clock spring) should be strong enough to lift the cock, but has to be overcome by the weight of the soldering iron.

Effective, Simple and Cheap Trammels.

By "CANTAB."

The accompanying sketches show a very rigid set of trammels, which can be easily made in a short time, and at comparatively small cost. Most trammels require castings, a lot of machining and fitting, and often then the pointers are fixtures, and not serviceable for circles in different planes. In this design the pointers are adjustable, and no castings are required, very little fitting, and all the machining can be done on any drilling machine; they can also be used to caliper lengths, etc.

The sketches are reproduced half full size, and little need be said of the construction of the trammels. It may be mentioned that the blocks (Fig. 3) look well in steel or bronze, and the holes should be plugged while drilling the holes at right angles. The rod is of cold rolled steel, and in filing on flat, commence by filing flat about 1-16th in. deep on the screw, as shown in Fig. 2, then filing extreme end of rod to fit, after which place rod in vee-blocks, and with the scribing-block run two lines along the entire length of rod ; then file flat to the lines. These flats will keep blocks quite true with one another. Bend pointers, as shown, for the purpose of calipers ; also grind them as indicated ; then, by slightly twisting them, a fine adjustment is easily obtained.

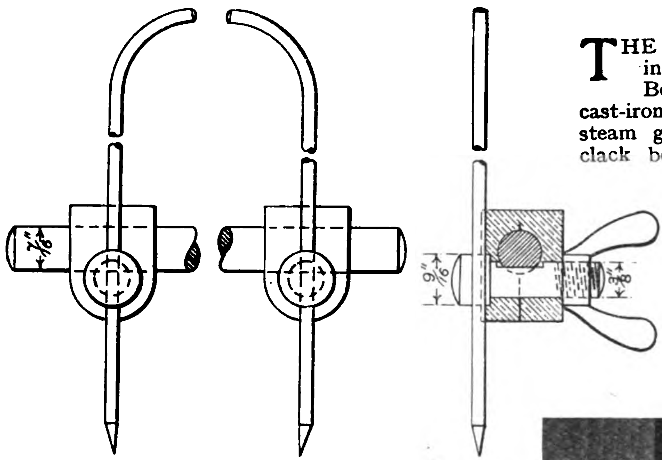


FIG. 1. FIG. 2.

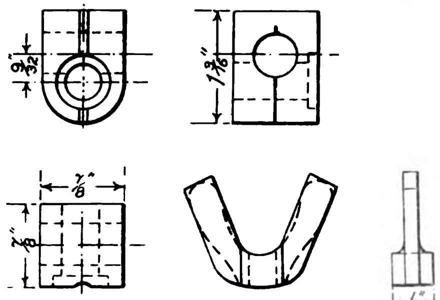


FIG 3. FIG. 4.

DETAILS FOR CONSTRUCTION OF TRAMMELS.

A good way of making a wing-nut without a forging is to procure a piece of mild steel, ½ in. by ⅜ in., about 3 ins. long ; bend it vee-shape, as Fig. 4, then saw it down as shown, leaving the piece at the angle to form the boss of nut for drilling and tapping. Allow 1 in. longer on rod than the radius of circle likely to be required—say, 2 ft. 1 in. The pointer may be 6 ins. or 8 ins. long and 3-16ths in. diameter. The sizes given make a firm job, although they may be modified to suit one's fancy. A ⅜-in. tommy screw, with two holes plugged up, make good screws, although screws especially made are better.

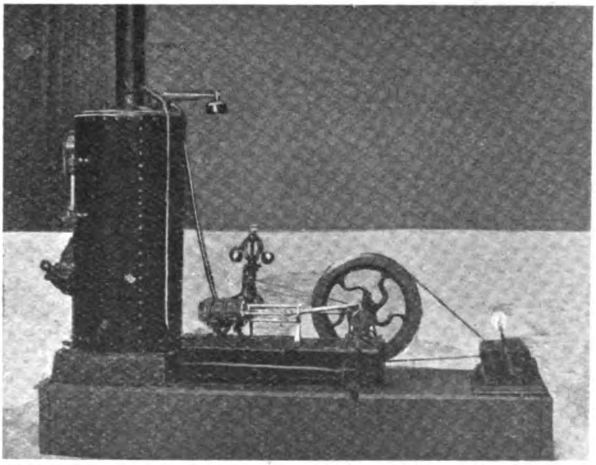
Heat-Resisting Cements.

The following formulæ for cements capable of resisting heat may prove useful to our readers :—(1) For cementing joints : Make into a thick paste, asbestos powder and liquid silicate of soda. This cement will withstand a very high temperature. (2) For stoves and ranges : Use fireclay and a solution of silicate of soda. (3) The following cement will resist white heat : Pulverised clay, 4 parts ; plumbago, 2 parts ; iron filings, free from oxide, 2 parts ; peroxide of manganese, 1 part ; borax, ½ part ; sea-salt, ½ part ; mix with water to a thick paste, and use immediately. Heat gradually till it comes nearly to a white heat.

A Small-Power Lighting Set.

By Geo. Guttridge.

THE enclosed photograph represents my lighting set, which consists of the following :—Boiler of steel, 12 ins by 24 ins., fitted on cast-iron stand, fitted with water gauge ; 3-in. steam gauge, blow-off cock, wheel valve, pump clack box, with tap to shut off feed-water ; lever safety valve. The pressure usually worked at is 50 lbs. The engine is 1¼-in. bore, by 2½-in. stroke ; flywheel, 11¼ ins. diameter, 1¾ ins. on rim. It is fitted with a governor on the throttle (as shown in photograph), which works admirably. The pump supplies more water than is needed, and is fitted with a by-pass ; size of the plunger, ½ in.; stroke of same, 1-in.



MR. GEO. GUTTRIDGE'S SMALL-POWER LIGHTING SET.

The dynamo is 10 volts 3 amps., which the engine drives very easily. The whole is mounted on a very heavy wooden base, making a very compact outfit, and, at the same time, very portable, as it is very easily moved about with handles on the ends of the base. The fuel used is small coal and coke.

At the test I made at your suggestion, I find that the consumption of water and fuel for one hour is 1½ gallons of water and 7 lbs. of coke. I tested the engine over a period of three hours, and found that the rate of consumption was the same, the average steam pressure being 50 lbs., the water being kept constant by means of the by-pass on the pump. The speed throughout the test was 280 revolutions per minute, as set by the governor.

The Latest in Engineering.

An Electric Clock.—An electrically-driven 4-ft. dial turret clock, erected by the Standard Time Company, is constructed upon a modification of Hipp's principle, and its performance, so far, leaves nothing to be desired. The entire movement is contained in a box 24 ins. by 14 ins. by 9 ins. Energy is obtained from the electric light main, with an alternative source provided by a few small dry cells, which come automatically into operation if the other fails. The pendulum weighs 20 lbs., and beats 80 to the minute. A pawl connected to the rod hooks the escape-wheel tooth by tooth at each alternative swing. The train consists of a worm and wheel, and the ordinary motion work. Under normal conditions the pendulum takes current every 100 swings. There are two sets of contacts operated simultaneously—one connected with the lighting main, the other with the battery; so long as there is current on the lighting main the closing of the first contact breaks the battery circuit, but should this current fail, the battery circuit is closed, and excites the magnet, which pulls the armature attached to the pendulum bob. The movement is quite noiseless, and has sufficient energy at the point of the minute hand to lift a 5-lb. weight. There would appear to be no limitation to the power to which the time-measuring motors on this principle might be constructed, or to the size of the clock to which they might be applied. The dual contact system has been made the subject of an application for a patent.

A New Drill Chuck.—Whilst at Messrs. C. W. Burton Griffiths' extensive warehouse the other day, we were shown a new drill chuck embodying quite a new principle of construction. As our readers well know, the defect of the average small drill chuck is that it allows the drill to slip unless the screws are strained almost to their breaking point. In the "Gronkvist" chuck the gripping is done automatically, and the more the drill is forced the greater is its holding power. The action is shown in the accompanying sectional diagram, Fig. 1. The main parts of the chuck are—(1) the chuck

FIG. 1.—SECTIONAL VIEW OF CHUCK.

body (A); (2) the cylinder (B); supported by the body, and fitted inside with three cam-shaped curves, all curving towards a common centre; (3) three rolls (C) to work in the grooves in the body, with distance pieces (D), and which serve as the jaws to grip the drill shank (E). The body has a taper hole for arbor to fit drilling machine spindle, and a spring encircles the body inside the shell one end being fastened to the body and the other to the shell. This spring tends to turn the shell so that the rolls are brought together by the internal cams, and in this way the drill shank is automatically gripped and centred. As the drilling machine spindle rotates in the same direction as the tension of the spring (see arrow in section, Fig. 1), and as the action of drilling tends to force the drill in the opposite direction, the rolls are conducted towards each other, gripping the drill shank tighter as the resistance increases. In other words, you can break the drill by forcing it through your work too fast, but it will never slip. To change the drill without stopping the machine, it is only necessary to grip the body lightly and the rolls are

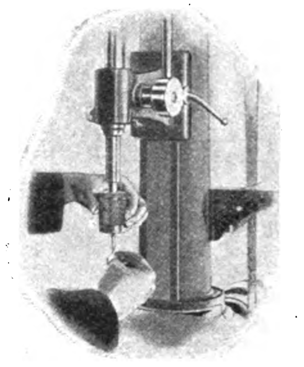


FIG. 2.—DRILL BEING INSERTED IN THE CHUCK.

opened, allowing the drill to drop out, and another one can then be inserted. The chuck body is then released, and the new drill is gripped in the chuck ready for work. Gripping the body of the chuck frees the drill immediately; and this should prove a useful feature in drilling light and delicate work. The only drawback to the invention is that the range of each chuck is limited. Three chucks are necessary to take drills from 1-32nd in. to ¼ in. However, its many advantages should make it an invaluable chuck for model and experimental engineering work.

A Motor-Driven Centrifugal Pump.—An interesting, though small, installation in which direct current transmission is employed for actuating a vertical motor driving a pump has been erected at the Alexandra Docks, Newport, Mon. The motor is of the Westinghouse direct-current multipolar type, is supplied with current at 500 volts, and develops 320 h.-p. It drives a centrifugal pump at 300 revolutions per minute, the pump raising a million gallons of water per hour against a head of 25 ft. The water is pumped from the river into an adjacent dock for the purpose of keeping up the level of the water in the latter. The Westinghouse generator which supplies the necessary current is of 300 kw. capacity, and is rope-driven at 325 revolutions per minute, it being of sufficient capacity to work other motors. Bare copper conductors of about 0·5 sq. in. sectional area constitute the overhead transmission line, and are suspended on special hook insulators supported on steel lattice poles. The work was carried out by the British Westinghouse Electric and Manufacturing Company.

Marine Engineering and Shipbuilding Notes.

By Chas. S. Lake.

Deterioration of Steam Turbine Blades.

Discussing the subject of the wear on the blades of steam turbines, the *Steamship* refers to the experiments which have been made to ascertain the cause of the trouble experienced with the blades, and from these it appears that with superheated steam the effects of wear are very sensibly reduced. The firm of Sulzer Bros. have lately been investigating the matter, and their experiments show that the wear is due to the particles of water in the steam, and that if water is present in steam that flows at extremely high velocities, as is the case in single stage turbines, the cutting is apt to be rapid. With superheated steam, or with saturated steam in multi-stage turbines, the cutting is not a serious matter. It is undoubtedly a fact that the continued success of the turbine largely depends upon this one point of blade wear, for if the blades of a particular turbine should have to be renewed constantly because of deterioration, and consequent loss of economy in the use of steam, that turbine would not make a commercial success.

Smart Feat by a Ship's Engineers.

The African liner, *Nigeria*, was recently navigated home from the West Coast of Africa by jury rudder, having lost her proper rudder and post whilst on a voyage from Liverpool to Forcados. She struck the bar at the entrance to the Forcados river, and there remained fast. All efforts to get her off proved futile at first, but after some 400 tons of the cargo had been jettisoned, she was successfully towed off—minus her rudder and its post. Mr. Alexander Craigie, the chief engineer of the vessel, after consultation with the commander and members of his own staff, determined to make an attempt at rigging up a jury rudder and rudder-post strong enough to take the ship home under her own steam. The fact that strong trade winds would have to be encountered on the voyage did not interfere with this decision, and an examination of the damaged portions was commenced forthwith.

It was discovered that the rudder had been broken off at the coupling, part of which latter was also broken; the rudder stock was also found to be badly bent and twisted. A visit was paid to the Niger Company's works on the West Coast of Africa, and sufficient channel and scrap iron was procured to render unnecessary any cutting up of any part of the ship itself for material. The cargo having been discharged, the fore-hold was filled with water, this putting the ship down by the head and throwing her after end up. A wooden rudder, comprised of 4½-in. pitch pine planks, bolted together with 1-in. diameter bolts, and sheathed with ¼-in. plate, was constructed, the measurements being 15 ft. long by 4 ft. 6 ins. wide. The broken flange of the rudder stock was cut away, and the sides levelled off; then templates were made, and two check-plates were formed by riveting two ½-in. steel plates together and bending them into shape. Eleven 1⅛-in. bolts were used to fasten the check-plates to the rudder stock.

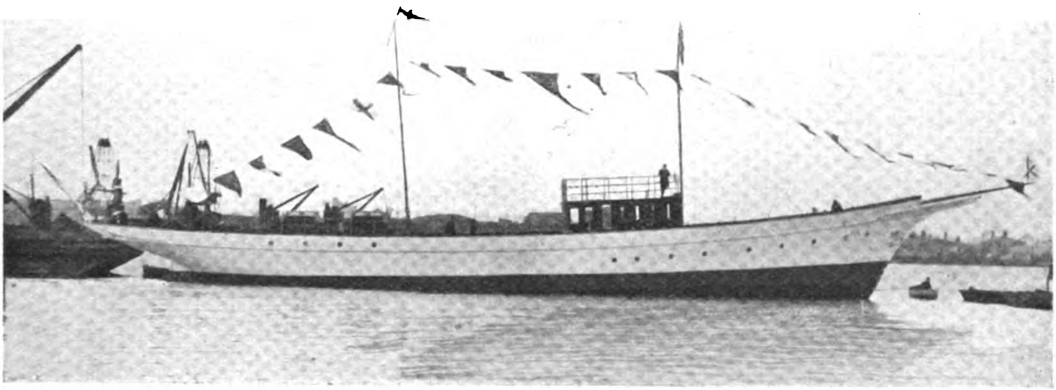


Fig. 1.—The Steam Yacht "Branwen."
(*Built by Messrs. J. I. Thornycroft & Co., Ltd.*)

The rudder-post was formed of two channel bars, 9 ins. by 4 ins., one on each side of the stern frame, to which they were bolted. A system of stays was introduced for stiffening the construction, taking up the after drag of the rudder and post, and assisting to take up any forward strain due to the ship going astern or a following sea striking the rudder.

Sixteen days were occupied in the work of constructing and fitting the jury rudder and post, and then a trial trip was run in the Forcados river, with such successful results, that Lloyd's agents on the Coast unhesitatingly gave a certificate clearing the ship as seaworthy.

The voyage home was then commenced, and was brought to a safe conclusion. In spite of the fact that a full gale raged for three days while the vessel was off the Portuguese coast, the improvised rudder gave no trouble whatever, thus testifying to the admirable manner in which it had been constructed.

Shortly after arrival in the Mersey, the *Nigeria* was placed in dry-dock, where the jury rudder was inspected by a number of well-known engineers, also by Sir Alfred L. Jones, K.C.M.G., principal of the firm of Elder Dempster & Co., owners of the ship. All pronounced the achievement of the ship's engineers a particularly smart and ingenious piece of work.

Some excellent photographic reproductions of the rudder appear in the November issue of the *Marine Engineer*, to the editor of which the writer is indebted for the foregoing particulars.

The Steam Yacht "Branwen."

There was recently launched from the Woolston yard of Messrs. J. I. Thornycroft & Co., Ltd., at Southampton, a steam yacht constructed by the firm to Lloyd's highest class, and under special survey for Lord Howard de Walden. The new vessel is, by the courtesy of the builders, illustrated herewith, together with her boiler and propelling machinery. The latter are situated amidships, and consist of a triple expansion condensing engine, having cylinders 9 ins., 15 ins., and 25 ins. diameter, with a stroke of 18 ins., and a cylindrical multitubular return tube boiler, 9 ft. 7 ins. inside diameter by 8 ft. 9 ins. long, constructed for a working pressure of 180 lbs. per square inch, to Lloyd's requirements.

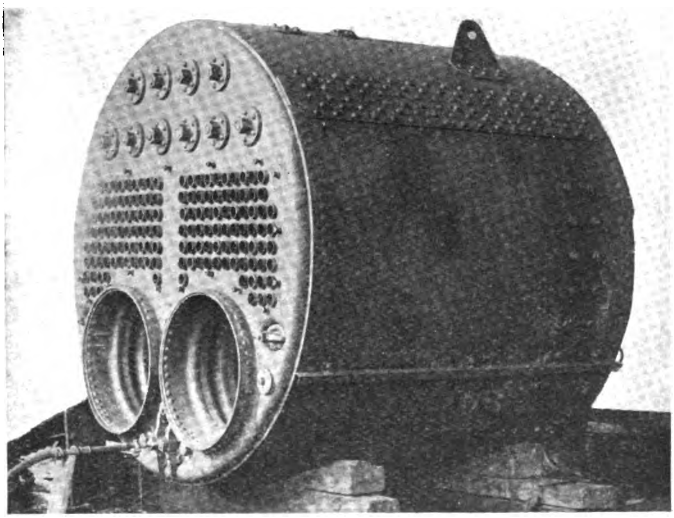


Fig. 2.—Multitubular Return Tube Boiler of the Steam Yacht "Branwen."

The decks and all skylights and fittings are of teak; a teak deck-house is situated at the fore end of the machinery space, and is arranged as a smoking-room, a companion stair communicating with the accommodation below. The after end of the deck-house forms a bridge deck, from which the vessel will be steered by means of steam steering gear; an awning is arranged to be fitted over the raised deck.

The accommodation aft is entered by a sliding companion and ladder-way down to a roomy vestibule, with seats fitted up on either side, and with a door leading to the main saloon, which extends across the vessel. On the fore side of the saloon, and entered from same, is a lobby, with lavatory and bath-room accommodation, and forward of this are two staterooms.

The forward accommodation consists of the deck saloon before-mentioned, the stairway in same entering direct the dining saloon below, which extends across the vessel. Abaft the saloon is the pantry on port side, and a bath-room on starboard side. On the fore side of the dining saloon are two staterooms, which comprise the owner's accommodation.

The after vestibule will be panelled in teak, the after lobby panelled in light oak, and the remainder of the owner's accommodation enamelled in white.

The main and dining saloons, with all bulkheads, side panelling, furniture, upholstery, decorations, etc., are to be supplied by Messrs. Waring, of London.

The crew are berthed forward in the forecastle, with captain's and engineer's cabin abaft same. Fresh-water tanks to hold 500 gallons of water are arranged forward and aft, with connections to pantry and galley.

A hot-water tank is fitted inside boiler casing to supply baths and lavatories, and a drain tank is fitted aft to take the waste water from pantry, baths, and lavatories.

The yacht will be heated throughout by steam, with radiators in the principal cabins. Two boats are to be carried in davits—a 20-ft. gig, and a 16-ft. cutter. Occasionally a 14-ft. motor launch will be carried in place of the cutter. A steam capstan for working the cables and warping the yacht is fitted forward.

The principal dimensions of the yacht are as follows:—

	ft.	ins.
Length over-all	135	0
,, between perpendiculars	111	6
,, on load water-line	108	0
Breadth moulded........	16	6
Depth..................	11	3

The yacht is of steel, with handsome scroll; figure-head and trail board, quarter badges, etc., the design being oak leaves and acorns in relief, and embodying the owner's armorial bearings.

She is rigged as a fore and aft schooner, with two pole masts.

More Turbine Steamers for the Allan Line.

The Allan Line Company having met with such marked success with their two monster turbine steamers, *Victorian* and *Virginian*, are now arranging for the construction of two very large vessels of the same kind. They will be 600 ft. long by 67 ft. by 46 ft., and have a speed of 20 knots.

California leads the world in long distance, high tension, transmission of electric power. A number of its pole lines are longer than anywhere else in the world, one being 212 miles in length.

A Design for a Model Automatic Cut-off Steam Engine.

By P. D. Johnston (U.S.A.).

THE engine shown in the general arrangement drawings is of a type much used in the United States, and while its construction calls for some ability on the part of the builder, it is not really a difficult one to build.

In designing, I have followed, as nearly as possible, the proportions that are generally employed in good practice in this country, but in some points it has been necessary to depart from this practice, notably in sizes of flanges; also in the proportions of some of the parts. It was considered advisable to adopt a size for the cylinder that would make an engine capable of doing some useful work; therefore 2 ins. diameter, with a stroke of 3 ins., was decided upon, and a speed of from 800 to 1,000 revolutions per minute. With an initial pressure of 60 lbs. in the cylinder, and cut-off at ¼ stroke at 800 r.p.m., the indicated horse-power should be practically 1·13 h.-p., and, deducting 10 per cent. for friction, the brake or net horse-power would be 1·00 h.-p. when running non-condensing. With condenser attached, the brake horse-power would be about 1·2.

The valve gear is designed for varying cut-off, from zero (0) to ¾ stroke, the cut-off being automatically determined by the governor or regulator, according to load and steam pressure. The governor is of a design used by the writer with most satisfactory results on a number of engines, varying in size from 75 h.-p. to 800 h.-p. On these engines it has proved its ability to control the speed to within 1¼ per cent. under extreme variations of load and steam pressure. Of course, such duty as this could not be expected in such a small piece of

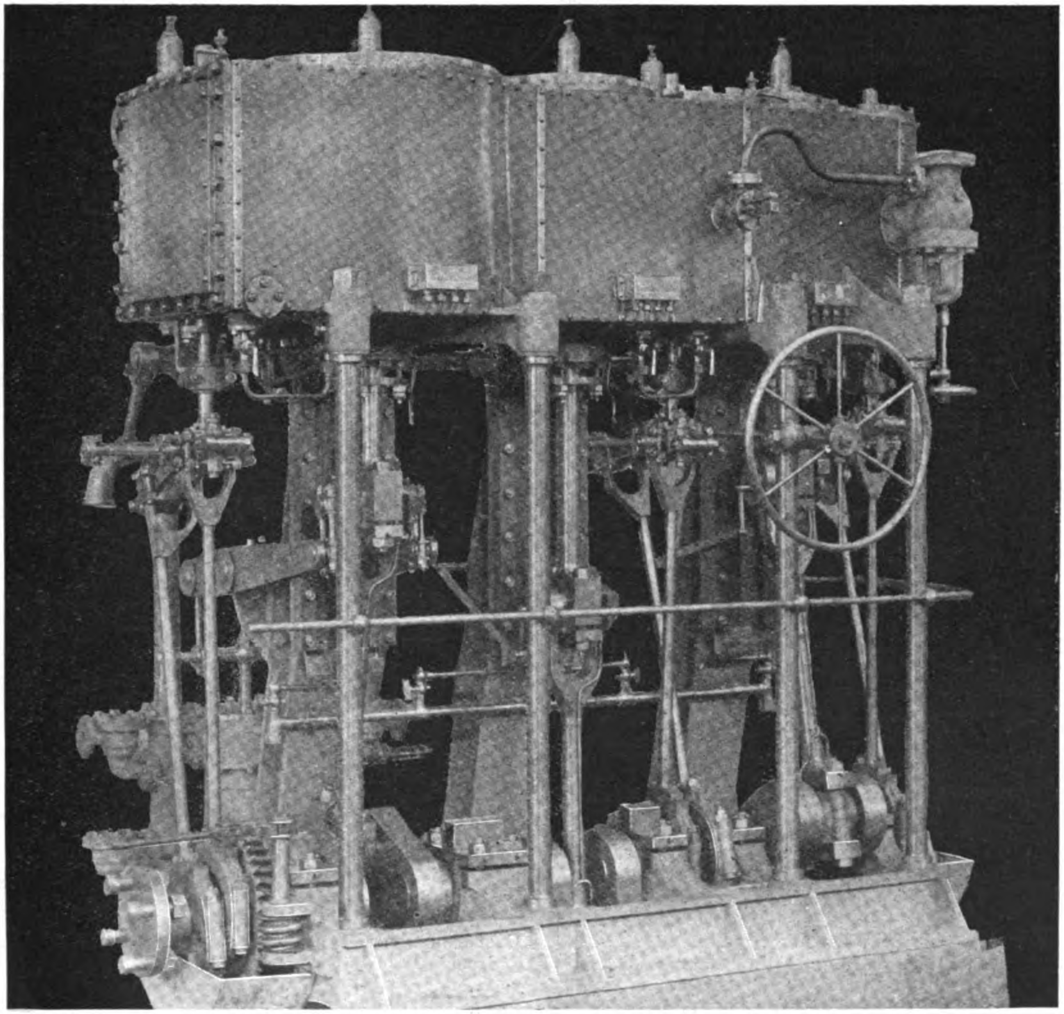


FIG. 3.—THE ENGINES OF THE STEAM YACHT "BRANWEN."

DESIGN FOR MODEL AUTOMATIC CUT-OFF STEAM ENGINE.

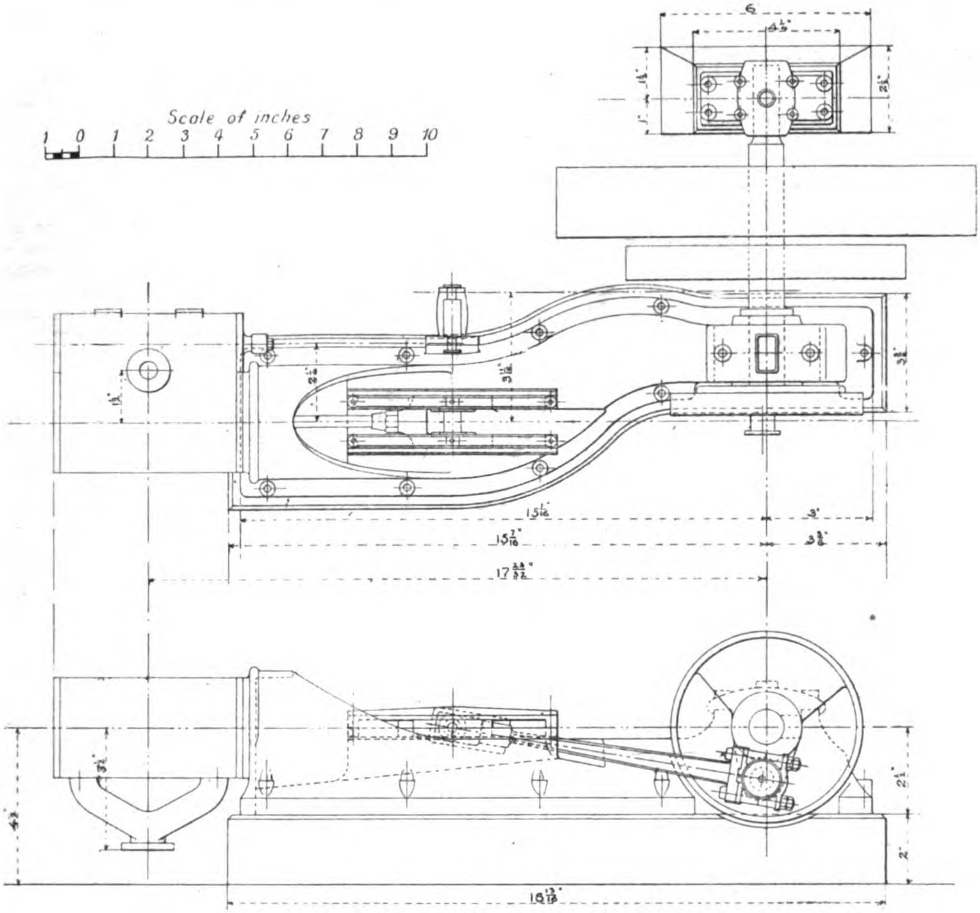
Specification of Parts: First Half.

Piece Number.	Number of Pieces Required.	Name of Piece.	Material.	Pattern Number.	Remarks.
1	1	Cylinder	Bronze	1	Finish where marked *f*.
2	2	Valve bushing	,,	—	,, all over.
3	2	Peep-hole cover	,,	2	,, where marked.
4	1	Front cylinder head	,,	3	,, ,, ,,
5	1	Gland	,,	—	,, all over.
6	1	Floating bushing	,,	—	,, ,,
7	1	Back cylinder head	,,	3 altered.	,, where marked.
8	1	Cylinder head cover	,,	—	,, all over, turn from bar.
8½	1	1-16 × ¼ screw	Steel	—	To hold No. 8 in place (not shown)
9	1	Steam chest cover	Bronze	—	Finish all over, turn from bar.
10	1	Stuffing-box nut	,,	—	,, ,, ,, ,,
11	1	,, gland	,,	—	,, ,, ,, ,,
12	1	Steam chest cover	,,	—	,, ,, ,, ,,
13	1	Piston valve	,,	—	,, ,, ,, ,,
14	1	Exhaust Y	Cast iron	4	,, where marked.
15	1	Piston	Bronze	5	,, all over.
16	1	Bedplate	Cast iron	6	,, where marked.
17	1	Quarter box	,,	—	,, all over, make from scrap.
18	2	,, ,, bolt	Steel	—	,, all over.
19	1	Main bearing cap	Cast iron	7	,, where marked.
20	2	,, ,, bolt	Steel	—	,, all over.
21	1	Oil cup cover	Cast iron	—	No finish, make from scrap.
22	2	Guide bar	,,	8	Finish where marked.
23	4	,, ,, bolt	Steel	—	,, all over.
24	1	Outboard bearing	Cast iron	9	,, where marked.
25	1	,, ,, cap	,,	10	,, ,, ,,
26	4	,, ,, bolt	Steel	—	,, all over.
27	1	Oil cup cover	Cast iron	—	Turn from scrap
28	1	Bottom liner	Babbitt	11	Finish all over
29	2	Top liner	,,	12	,, ,,
30	1	Oil ring	Brass	—	,, ,, from bar.
31	1	Connecting-rod	Steel	—	,, ,, from forging.
32	1	,, ,, strap	,,	—	,, ,, ,, ,,
33	1	½ wrist-pin box	Bronze	13	,, ,,
34	1	,, ,, ,,	,,	13	,, ,,
35	1	Wedge block	Steel	—	,, ,,
36	2	,, ,, bolt	,,	—	,, ,,
37	2	Strop bolt	,,	—	,, ,,
38	1	½ crank-pin box	Bronze	14	,, where marked.
39	1	½ ,, ,,	,,	14	,, ,, ,,
40	2	Crank-end bolts	Steel	—	,, all over.
41	1	Piston-rod	Tobin bronze	—	,, ,,
42	1	,, nut	Steel	—	,, ,,
43	1	Crosshead	Cast iron	15	,, ,,
44	1	Wrist-pin	Steel	—	,, ,,
45	1	,, ,, bolt	,,	—	,, ,,
46	1	Rocker	Cast iron	16	,, where marked.
47	1	,, pin	Steel	—	,, all over.
48	2	,, ,, cap	,,	—	,, ,,
49	2	Screw for 48	,,	—	,, ,,
50	1	Taper pin for 47	,,	—	,, ,,
51	1	Rocker stud	,,	—	,, ,,
52	1	,, ,, plate	,,	—	,, where marked.
53	1	,, ,, cap	,,	—	,, all over.
54	1	Screw for 53	,,	—	,, ,,
55	2	Bolts for 52	,,	—	,, ,,
56	1	Valve stem	Tobin bronze	—	,, ,,
57	1	Valve lock nut	Bronze	—	,, ,,
58	1	Lock nut for 56	Steel	—	,, ,,
59	1	Eccentric rod	,,	—	,, ,, from forging.

apparatus as this model, but if it is carefully built and fitted, it will certainly regulate well within 5 per cent.

In the detail drawings to be published in future issues, the parts will all be numbered, and herewith is given the first half of a list of parts correspondingly numbered, giving the names of parts, as well as materials from which they are to be made, together with general directions as to finish. In the following description the parts will be referred to by the proper numbers.

(*To be continued.*)



DESIGN FOR AN AUTOMATIC CUT-OFF HORIZONTAL STEAM ENGINE.

THE DIESEL OIL ENGINE.—The 500 brake-horse-power Diesel engine built by Messrs. Carels Frères, of Ghent, exhibited at the Liége Exhibition, has been awarded the Grand Prix. At a recent test carried out by the purchasers of this engine the extremely low figure of 0·38 lb. per brake-horse-power-hour was obtained for fuel consumption at full load. This, with oil at 42s. per ton, represents a cost of 0·086d. per brake-horse-power-hour, or about 11½ brake-horse-power-hours for one penny.

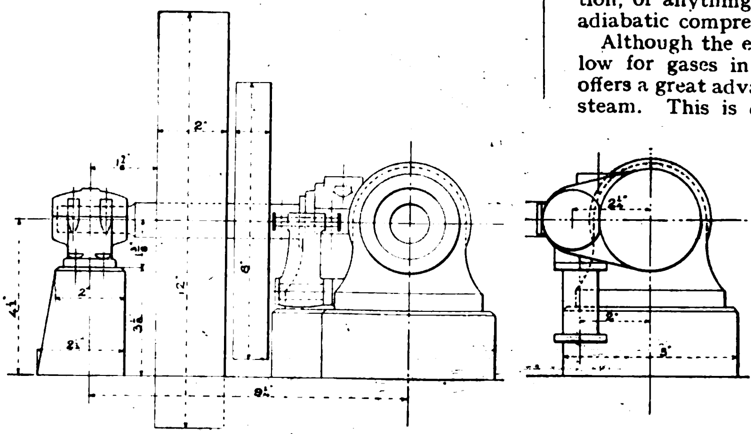
The Problem of the Gas Turbine.

By DUGALD CLERK, M.Inst.C.E.

(*Continued from page* 490.)

YOU will all recollect Dr. Joule's famous experiment with two vessels immersed in water and connected together by a pipe having a stop-cock upon it. Air was compressed into one of those vessels, the water round the vessels stirred, and equilibrium obtained, while the other vessel was rendered as vacuous as possible. The stop-cock between the two vessels was opened, and it was then found that when the water was stirred again, no disturbance of the equilibrium ensued. This, of course, meant that although heat was lost in the one vessel, giving velocity to the gases, it was gained in the other vessel by the impact of the gases against the walls. Joule modified this experiment by placing the two air vessels in separate water-containers. He then found that the temperature of the one vessel dropped, due to expansion, but the temperature of the other vessel rose as much as the first dropped. Now apply this experiment to reasoning on the behaviour of the flame in an expanding nozzle. Assume the two vessels to be connected together by a Laval nozzle, and assume that while in the nozzle the gases experienced the full temperature fall due to adiabatic expansion. Immediately, however, on contact with the walls of the second vessel the velocity of the particles would be stopped, and the temperature would be restored to a point somewhat above the original temperature; that is, the mass of expanding flame in the pressure vessel would gain heat by the amount the first vessel lost. That is the result of the final process. It will be easily recognised that to obtain a sufficient temperature drop in an expanding nozzle necessitates the practical absence of turbulent motion of every kind; that is, to expand adiabatically the jet must be so constructed that there is an absolutely smooth flow from high pressure to low, and no impact or loss of velocity from any cause whatever. So far as I understand expanding jets, no adiabatic expansion so perfect as this has ever been obtained.

Assume, however, that the efficiency of expansion in such a jet is, say, 90 per cent. We now come to the question of the efficiency of conversion



End Elevation, Cylinders Removed. — Elevation of Cylinder End.

Design for Automatic Cut-off Steam Engine. (*See page* 515.)

by the turbine blades. In many calculations from diagrams, it is assumed that the efficiency of conversion of motion into work is practically perfect. This, however, is by no means the case in present turbines. Even the steam turbine, high as its efficiency is, compared with the reciprocating engine, has no very high efficiency of conversion in any of the forms of turbine at present on the market. That is, if we assume a mass of gas to exist in a compressed state in a reservoir, and we choose to expand this mass of gas in two ways, for the sake of comparison—(1) behind a piston; and (2) by means of a Laval jet and turbine, we shall find that the efficiency of conversion of the turbine, once high velocity is attained, does not exceed 80 per cent. In this respect the efficiency of conversion of rotating turbine blades is inferior to that of a moving piston in a cylinder. The reason of this is obvious. It is impossible to so arrange the impact of a rapidly moving gas with a turbine blade or blades in such manner as to entirely avoid turbulent motion. The impact, for example, of swiftly moving gases on a fixed surface results ultimately entirely in turbulent motion, which restores to the gas or to the blade struck all the heat which has disappeared in temperature fall due to adiabatic expansion. What is true of a fixed blade is, to some extent, also true of the moving turbine blades. A certain proportion of the energy existing in the gas in the form of motion is inevitably lost whenever this gas comes into contact with any solid surfaces. So much is this the fact that in designing steam turbine blades for any type of turbine, the shape of the blades, the shape of the space between the blades, both moving and fixed blades, or fixed jet and moving blades, is of the first importance; and it has only been found by experiment that certain shapes of blades and passages have a much higher efficiency of conversion than other shapes. In this respect, too, the turbine principle is inferior to the cylinder and piston. In a cylinder, gases expanding behind the piston, the efficiency of expansion may be considered to be 100 per cent., and even an efficiency of compression in many gas engines is also the same order. I do not here refer, of course, to heat losses due to conduction, or anything of that kind, but to efficiency of adiabatic compression or expansion.

Although the efficiency of expansion is relatively low for gases in steam turbines, yet the turbine offers a great advantage in total work obtained from steam. This is due to the fact that the turbine avoids initial condensation; and, further, it permits of the utilisation of a very long range of expansion at the low-pressure end, which is not available in the case of steam engines. By saving, therefore, in minimising initial condensation, and in obtaining added work from pressures wasted in the ordinary steam engine, the Parsons steam turbine more than compensates for any inefficiency of expansion, as compared with the cylinder engine. It is well known, however, in turbines of practically all constructions, including Mr. Parsons', that the efficiency of the steam turbine at the high-pressure end is not so great as that at the low-pressure end. This is partly due to difficulty of adjusting the velocity of blades to suit the necessarily varying velocities at different points of the flow of the steam. This, however, is a small difficulty with the steam turbine, but it is a very great difficulty with the gas turbine. Compared with cylinder expansion, I cannot see how it is possible with present knowledge to obtain an efficiency of conversion in a gas turbine greater than 80 per cent. This, of course, is partly due to the high velocity of the issuing hot gases. To produce an efficient gas turbine, therefore, on the favourite cycle so much discussed recently, it is necessary, first, to have, as I have said, a very efficient compressor, a very efficient expanding nozzle, and a very efficient conversion when the moving gases strike the turbine blades. Using the numbers I have suggested, of 90 per cent. efficiency of compression, 90 per cent. efficiency of nozzle expansion, and 80 per cent. efficiency of conversion in turbine, we have, with a cycle having negative work equal to 0·4, the following efficiencies: To get 0·4 of work in compression, we shall require 0·445 of work put into the compression. On expanding in the nozzle, we shall obtain 0·9 only of the total energy of the flame gases in the shape of kinetic energy, and of that 0·9 we shall only get 0·8 returned in the shape of available work by the turbine part. That is, we shall get a total work from the turbine of 0·72, and deducting the negative work 0·72 - 0·445 = 0·275; that is, from a cycle which should give us 0·6 in work, we shall only get 0·275, or about 22 per cent. The practical efficiency of an engine of this kind will only be 22 per cent., even assuming the high efficiencies of compression and jet expansion which I have mentioned. In my view, no such efficiencies of compression or jet expansion are at present known, and accordingly there appears no likelihood of the production of any gas turbine which can rival the reciprocating gas engine in efficiency and in economy. To produce such a turbine requires the solution of three problems:—

(1) An efficient turbine compressor, comparable in efficiency with cylinder compression.

(2) An efficient nozzle expander with a higher efficiency than 90 per cent.

(3) An efficiency of conversion of kinetic energy of the moving gases into work delivered at the turbine spindle, of greater than 80 per cent.

Either these problems must be satisfactorily solved, or else new materials discovered which will stand temperatures which at present melt fire-brick. The outlook, I fear, is not hopeful.

This thermal efficiency of 22 per cent. assumes no losses in the combustion chamber due to heat conduction, no losses in the expanding jet due to heat conduction, and no losses in the turbine itself from the same cause. Considering the losses in gas engine cylinders of small size, it would not be too much to allow in a turbine a heat flow loss of at least 25 per cent. This, of course, reduces the efficiency from 22 per cent. to 16·5. In arriving at this figure, I have assumed that no greater loss would be incurred from heat flow in the turbine than in the cylinder engine; but even with reduced temperatures when striking the turbine, the very fact of requiring a reservoir for combustion to operate, and the forcing of the whole of the hot products through a relatively small nozzle, necessarily means greater loss than I have assumed. Assuming, however, no more loss than I have given, an engine with an efficiency of only 16 per cent. of the total heat given to it could not compete with internal combustion motors of existing construction. It may be said that the advantage of continuous-rotation is so great that even at this low efficiency the gas turbine would be successful. Personally, I doubt it very much, because the mechanical difficulties with gas turbines would be much greater than the mechanical difficulties of the steam turbine. In all steam turbines, as you, I am sure, know, it is necessary to work with relatively small clearances between the tips of the blades or shrouding and the enclosing casing. This is also true as to endwise clearance between fixed and moving blades. Comparatively small clearances are necessary for economy. The use of even temperatures so high as 400° C. or 500° C., by introducing unequal expansions, greatly increase the difficulty of obtaining economy. No doubt if a plentiful supply of relatively low temperature gases under considerable pressures could be obtained, these gases might, with advantage, be expanded in a nozzle, and used to operate a turbine. To carry this idea into effect has already been attempted, as I have said, by Mr. Lanchester, and there is some hope of operating in this way. I fear, however, that the temperature of the gases in the exhaust in the gas engine are too high, as they stand, to be so used. Gases, however, from an exhaust or air supercompression engine, such as I have lately been working with, could, no doubt, give considerable efficiencies in turbines. I do not see, however, any solution of the gas turbine problem here, because the amount of energy available for the turbine after the gases leave the gas engine is too small for consideration in connection with any really high-power machines.

Some of the difficulties I have discussed with you have been mentioned by Dr. Lucke. He adopts the view that jet expansion is not as efficient as piston expansion; and here I agree with him. No doubt the type of jet expansion has to be carefully considered, and the efficiency of a jet as a means of converting the expansion from a high-pressure to a low into kinetic energy, depends entirely upon its configuration, and the design of the proper areas and relative lengths for the nozzle. All this, however, is as yet a relatively new field, and much study will be required before any certainty can be attained in the design of expanding jets. Professor Reeves, in another able article which I have already mentioned, differs from Dr. Lucke, and considers that he has over-stated the difficulties of the expanding jet. He accordingly takes a more favourable view of the turbine problem. There is a great deal of truth, however, in what Dr. Lucke has said. Even the best expanding jets yet known appear to have a low efficiency, and nothing is known of the efficiency of expansion starting from flame temperatures. Apart from the mechanical efficiency of the expansion, as I have already pointed out, the heat loss due to conductivity will be great in such nozzles.

I quite agree with Professor Reeve, however, that the more hopeful line for the gas turbine lies in the use of steam to provide the working fluid under compression without a compressor, and in the heating of this steam when produced by a very small quantity of combustible mixture of gas and air under pressure. Such a turbine would be a compromise between what I may call the flame turbine and the steam turbine, and it presents more possibilities; but its efficiency would not be high, although, no doubt, such a machine could be got to operate mechanically with fair success.

This line of work depends upon the fact that negative work may be greatly reduced by using steam as working fluid, when steam is heated highly by internal combustion of a relatively small amount of inflammable gas and air. This proposal is more hopeful, but for success, even it requires temperatures, in my view, too great for existing turbines to stand with economy. This proposal may be considered to be analogous to that of an excessive superheat, as used in an existing steam turbine.

Many methods have been discussed which depend upon the use of regenerators. I have a great distrust of regenerators, so far as engine work is concerned. Many able men have proposed regenerative contrivances, from the time of Stirling, in 1817, down to the present day; but I am not aware of any actual working engine which has ever succeeded in practice using a regenerator.

From what I have said, you will see that my view of the future of the gas turbine is not favourable; but, notwithstanding, the subject is so fascinating that many inventors and scientific men will doubtless continue to investigate the problem, and possibly new solutions may be discovered which are not dreamt of to-day. I am the last man in the world to deprecate daring in any practical and scientific work, but I would advise the junior engineers—members of our Institution—to avoid the subject except as a scientific study. I fear there is little hope for a young man to make a position and a business success of any internal combustion turbine, so far as our present knowledge carries us.

The British Manufacturers' Exhibition in Egypt.—An exhibition of British manufactures will be held in Alexandria and Cairo between the months of November, 1906, and February, 1907; and it is proposed that the duration of the exhibition will be about one month in each city.

Northern Model Yachting Association.—This Association has just completed its most successful session since its incorporation in January, 1903. The championship again goes to the Wirral Model Yacht Club of Seacombe, Cheshire, who have held this much coveted honour ever since the formation of the Association. The result of this season's racing (by points) is as follows:—Wirral M.Y.C., 18 points; North Liverpool M.Y.C., 3 points; Derby M.Y.C., 0 points; Bootle M.Y.C., minus 22 points. A Model Engineer silver medal has been awarded to the Wirral M.Y.C., and a bronze medal to the North Liverpool M.Y.C.

Notable Models at South Kensington Museum

I.—Some Slide Valve Models.

An article in a recent issue of our well-known contemporary, *The Engineer*, revived in the writer's mind the notion of describing some of the most interesting and instructive models in the large collection now reposing in the southern galleries at South Kensington. As a first step we are reprinting this article, with additional notes and some photographs which the Board of Education authorities have kindly placed at our service. The subject of the article is the case of slide valve models lately made in the Museum workshops. These models reflect great credit upon the latter, and considerably enhance the value of the whole machinery collection. They should prove of high educational value to all those who reside in or near the Metropolis and can readily have access to them. The models are in half-section, and are all made movable by means of small handles placed on the outside of the case.

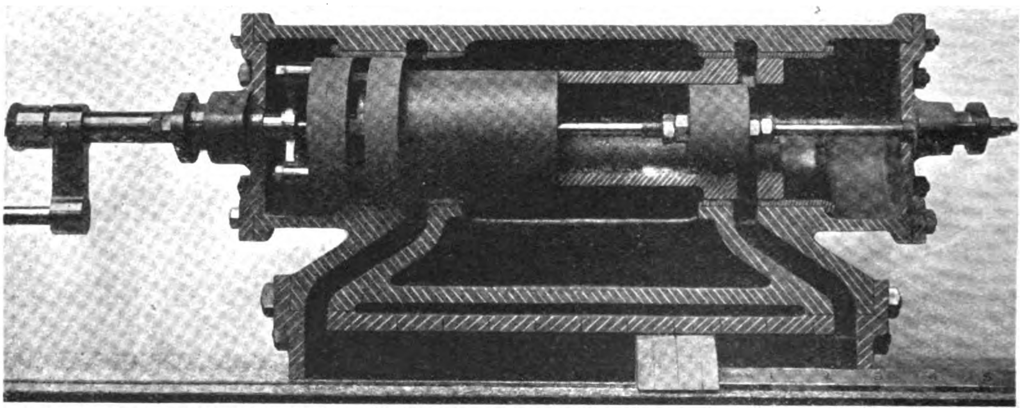


Fig. 1.—Models at South Kensington: An Expansion Piston Valve.

Taking one side of the case first, the nearest model of the upper series is an example of a piston expansion valve on a scale of one-third. In this form (see Fig. 1) both main and cut-off valves are of piston construction, the cut-off valve being situated within and concentric with the main valve. The latter is a long tube, with ports formed through it near the ends, and packed with metal rings on each side of the ports; it slides within perforated liners fixed in the valve chest, and is driven by a tubular valve-rod worked by an eccentric in the ordinary way. The cut-off or expansion valve consists of two pistons secured to a valve-rod, which is driven by a separate eccentric, a stuffing-box being provided where the internal spindle passes out through that of the main one. The cut-off is varied by altering the travel of the cut-off valve; increased travel giving a later cut-off.

The next example (see photo., Fig. 2) is a copy of the automatic expansion valve, patented in 1869 by Mr. A. K. Rider, of New York. It consists of an elongated main valve with ports through it near the ends and having in its back a cylindrical recess, in which slides a cut-off valve whose edges, when developed, form the inclined sides of a trapezium. The edges of these back ports are parallel to the edges of the cut-off valve, so that by rotating the latter the amount of its lap is altered and with it the point of cut-off. This rotation is performed by the rise and fall of the governor acting on the cut-off valve-rod through a lever and link, or by a toothed sector gearing with a rack, as shown on the model.

To Rider's invention succeeds Meyer's well-known adjustable expansion valve, which in a different manner employs the same principle of action. It was introduced in 1842 by J. J. Meyer, of Mulhausen, and is an ordinary flat slide valve somewhat lengthened, with two admission ports through it equal to those in the cylindrical face. The back of the valve is finished as a valve face, and upon it a pair of expansion plates are fitted, which can so slide as to close the through passage at either end; these passages are connected by nuts to a spindle having on its right and left-hand screw threads, and capable of being rotated by a wheel outside the steam chest. For convenience this spindle has different diameters at the threaded portions, but in each case the threads are of the same pitch. The effect of rotating the hand wheel and spindle is to alter the distance between the

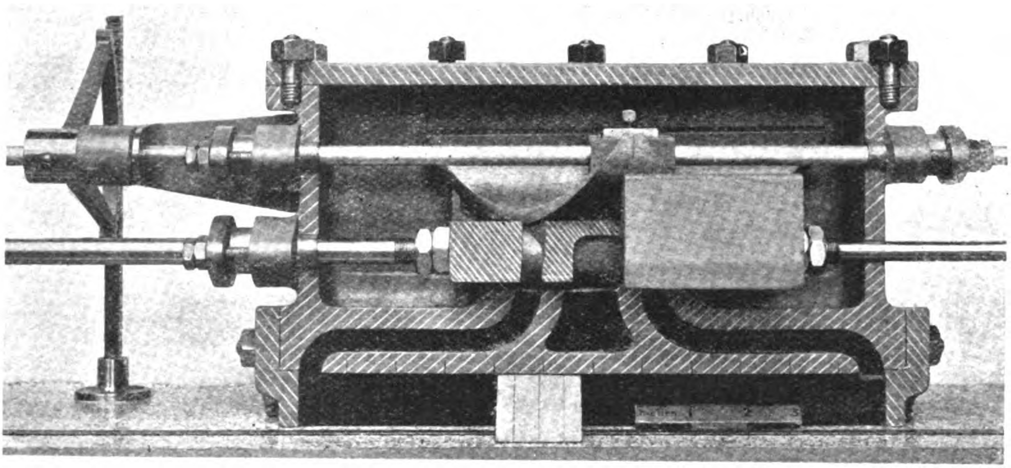


FIG. 2.—A WORKING MODEL OF RIDER'S EXPANSION VALVE.

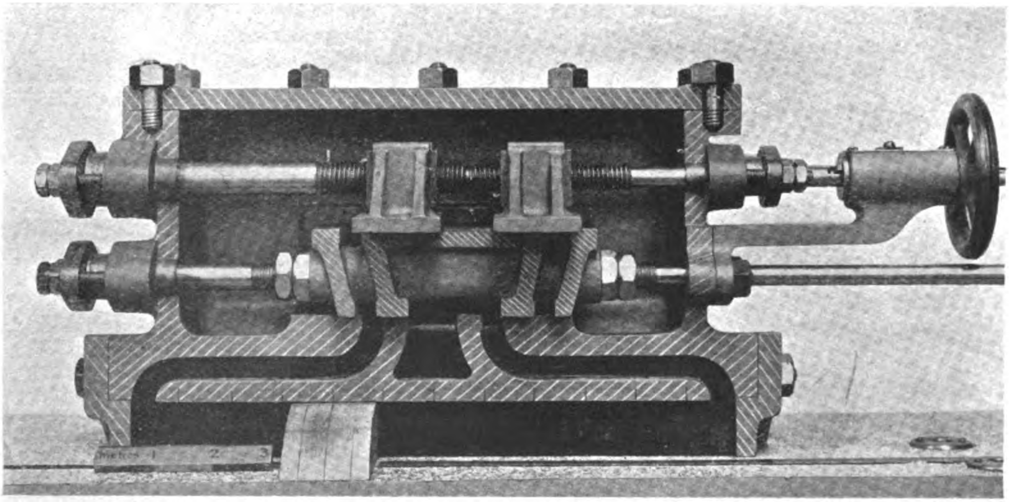


FIG. 3.—MEYER'S WELL-KNOWN HAND-OPERATED VARIABLE EXPANSION VALVE.

cutting off edges of the expansion plates, thus increasing or decreasing the lap, and giving earlier or later cut-off. The expansion valve-rod is prolonged through the end of the valve chest, and has a feather-way cut along it, so that it may be rotated by means of a fixed hand-wheel, through the elongated boss of which it slides. Cut-off for any given position of the wheel is shown on a stationary external index. This enables the engine attendant to set the valve gear to exactly the cut-off he knows is suitable for the load the engine has placed upon it.

(To be continued.)

A Model Captive Flying Machine.

By Frank Baron.

Herewith is reproduced a photograph of a model of the captive flying machine erected at Earl's Court Exhibition. The leading dimensions are as follows:—From bottom of baseboard to top of centre shaft is 2 ft. 7 ins.; length over all, 2 ft. 6 ins.; breadth over all, 2 ft. 2 ins.; breadth of platform, 2 ft.; height of platform from

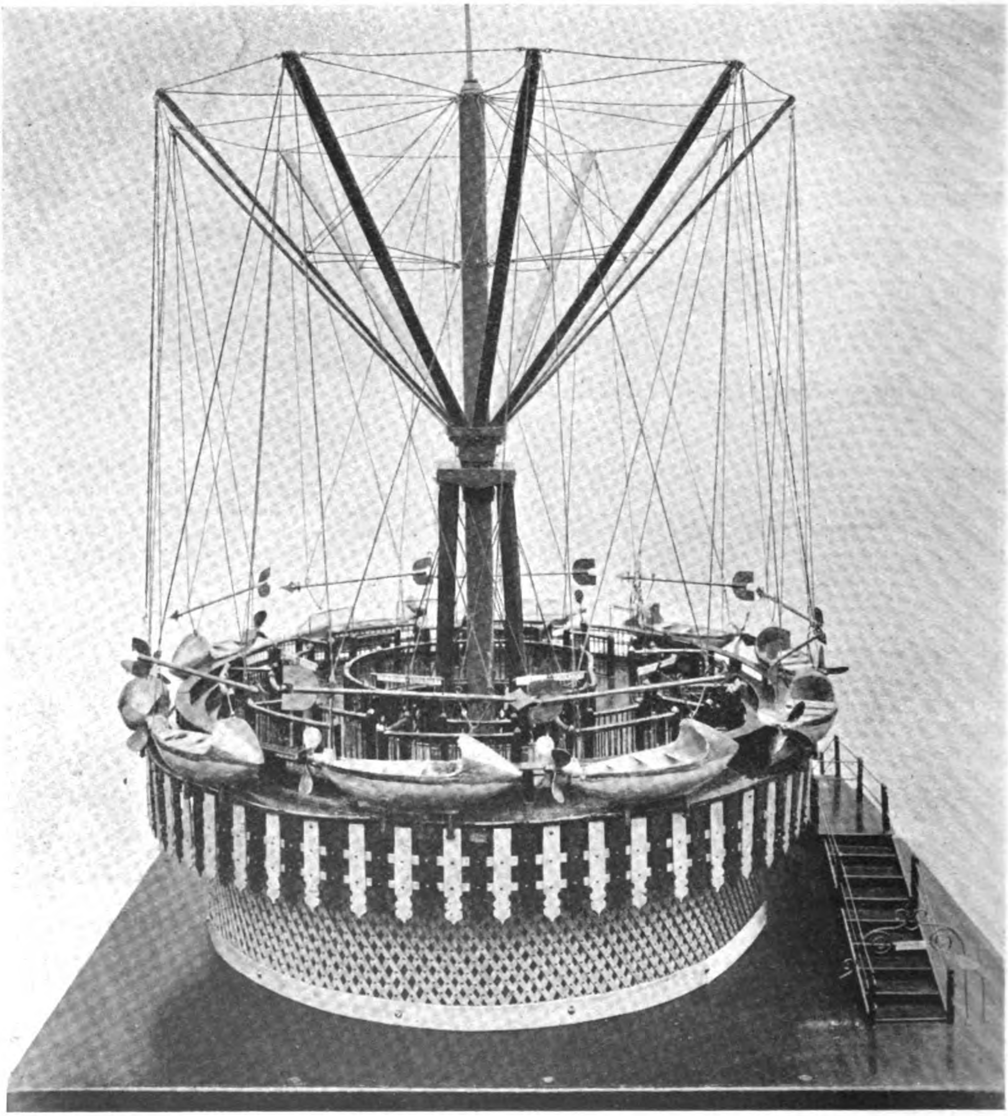


Fig. 1.—Mr. Frank Baron's Model Captive Flying Machine.

the base, 7¼ ins. The machinery, which is my own idea, is constructed of sheet brass, with a counter-balanced flywheel to ensure starting smoothly. When the machine is set in motion, the boats rise to an angle of about 45°, and when the machinery is thrown out of gear the boats are 3 mins. returning to the platform. There are ten boats, cast in lead, and weigh 1 lb. each. A brass fan is attached to the back of each boat to act as a drag when the machine is in motion. The centre shaft consists of a piece of steel tubing.

The crow's nest (which I had to get turned, as I have no lathe) is of boxwood, holding ten arms stayed up with brass wire. The trellis work around the base is constructed of 300 pieces of wood, and contains 1,900 rivets. The boats are enamelled green and gold, the woodwork being stained a dark walnut. I may say that this model has occupied my spare time for about eight months, and is my first attempt at model making.

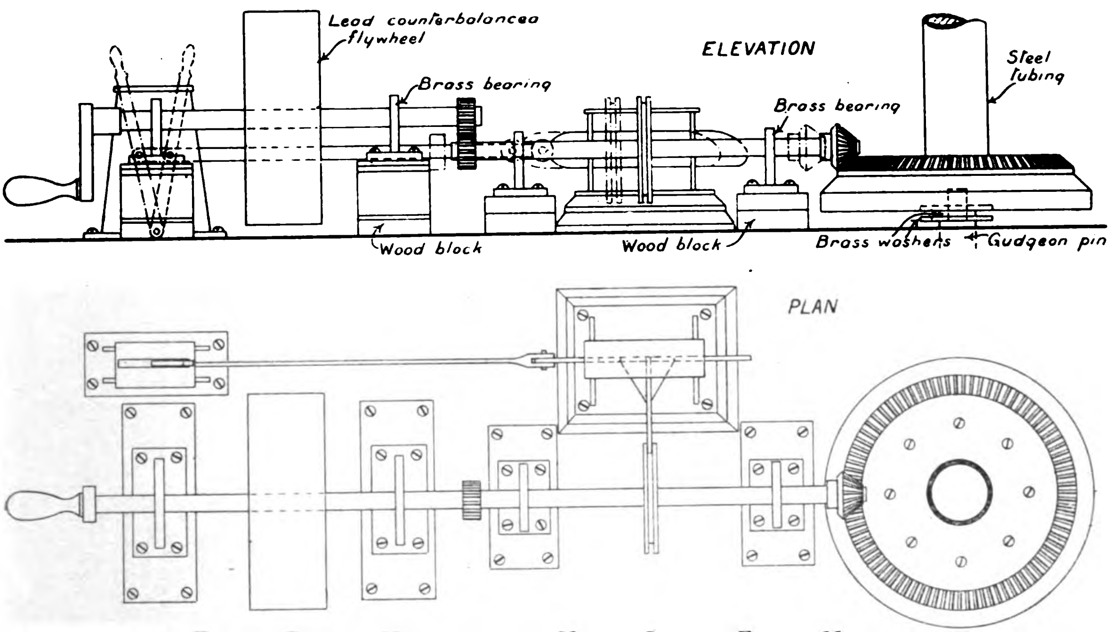


Fig. 2.—Driving Mechanism for Model Captive Flying Machine.

For the Bookshelf.

[*Any book reviewed under this heading may be obtained from* The Model Engineer *Book Department, 26–29, Poppin's Court, Fleet Street, London, E.C., by remitting the published price and the cost of postage.*]

The Practical Engineer Pocket Book for 1906. The Practical Engineer Electrical Pocket Book for 1906. Manchester: The Technical Publishing Co., Ltd. Price: Cloth, 1s.; leather, 1s. 6d. each; postage, 2½d. each.

The 1906 editions of these two pocket books are fully up to the standard of previous years. The former includes new matter on recent tests of mechanical stokers and forced draught systems; types of indicators; flow of air, gas, and steam through pipes; emery wheels; and suction gas producers; while the notes on mining engineering have undergone revision, and the patents section has been brought up-to-date. Although containing 600 pages of matter and a diary, it is not at all too bulky for the pocket. The "Electrical Pocket Book" also contains much new matter, this comprising, amongst other items, formulæ for calculating loss of energy in conductors, localising faults in mains, new testing and indicating instruments, synchronisms, rotary converters, multiphase distribution, three-wire distribution, etc., etc. As a practical pocket book for the electrical engineer it is excellent value.

Practical Electric Wiring. By C. Metcalfe. London: Harper & Bros. Price 5s. net; postage 4d.

The author gives prominence at the commencement of this book to the statement that while bad workmanship cannot be redeemed by the use of good materials, good workmanship can do much to redeem inferior material. He does not, of course, advocate the use of bad material, but he does emphasise the importance of good workmanship, and impresses the reader with the fact that upon this and upon his personal knowledge the success of any wiring scheme he undertakes must largely depend. The book is essentially practical throughout, and is very thorough in its scope. It deals with the mechanical work of fitting, tools, accessories, systems of wiring, conductors, the making and insulation of joints, and with the plans, schedules, specification, and installation of a complete private house contract. It is a book which may be cordially commended not only to students and to workmen who may have to carry out such schemes, but also to architects, engineers, and others who, while not having to do the work, may require to know how it should be done.

Practical Letters from our Readers.

[*The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a* nom-de-plume, *if desired, but the full name and address of the sender* MUST *invariably be attached, though not necessarily intended for publication.*]

Acetylene Gas Generator.

To THE EDITOR OF *The Model Engineer.*

DEAR SIR,—Permit me to point out to "Practical," who, while commenting on my experiments on acetylene generation in a letter in October 5th of the *M.E.*, refers to the generator I used as being suitable for use as a bomb—permit me, I say, to point out that the generator mentioned was not intended for continued practical use. As a matter of fact, it was laid on the shelf as soon as I had satisfied myself as to the conditions under which the so-called "dry" generation was possible.

Again, even if the nozzle should have choked, the rising pressure would either blow out the obstruction, and spend its energy gradually in escaping through its designed road; or, it would accumulate until the lid flew off. In the latter case, there would be no explosion of the gas and air mixture, unless a naked light were very near, because if the nozzle were choked, it stands to reason that the jet of flame would be extinguished.

Also, even if a naked light were near, when the lid blew off, the resulting explosion would have been very slight; for it must be borne in mind, that the generator was only 2 ins. high by 1 in. diameter.

But since the evolution of gas is very slow in this process, no chemicals could possibly be blown into the jet by a rush of gas; and even if such a thing should happen, in ninety-nine cases out of a hundred the experimenter, immediately the light went out, would haul off the lid to see, if possible, what had gone wrong.—Yours truly,

Kincardine-on-Forth. NATHAN SHARPE.

A Model Made over 50 Years Ago.

To THE EDITOR OF *The Model Engineer.*

DEAR SIR,—I enclose herewith a photograph of a model vertical steam engine made fifty-three years ago, the engine bearing a brass nameplate "King's College, 1852." The cylinder is 2½-in. bore, 3½-in. stroke, and stands about 2 ft. high. The columns are of polished steel; the base is of cast iron, the cylinder of gunmetal. The model is as good now as the day it was finished. I purchased it at a sale a little while ago.—Yours truly, EDWARD C. PRINCE.

Southampton.

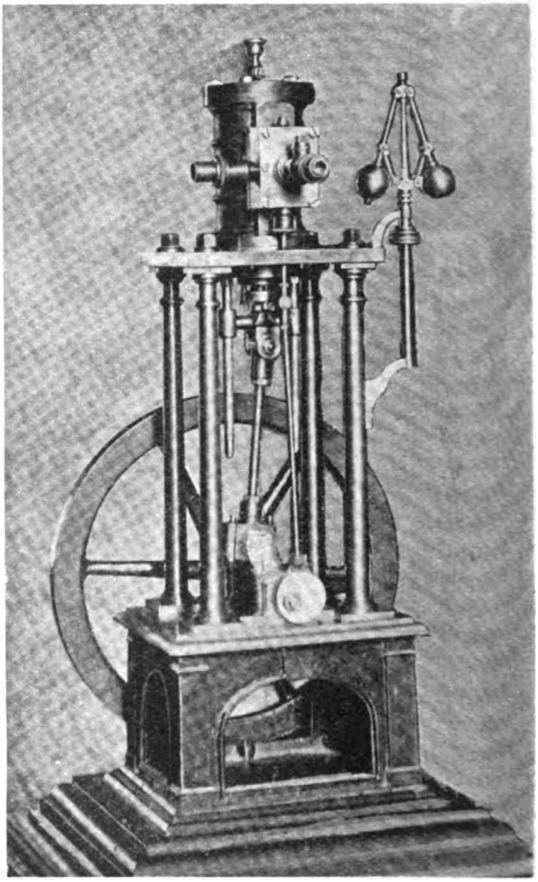
Lapping Cylinder Liners in the Lathe.

To THE EDITOR OF *The Model Engineer.*

DEAR SIR,—"J. T." and I are evidently not of the same opinion. An amateur's shop should contain, equally as well as steel rod of various sections, a supply of plaster of paris and fusible metal of various grades.

"J. T." implies that it is a constant requirement of the model engineer to lap down metal in a sort of wholesale way. In my idea, the work should be finished from the tool, and if any lapping is to be done at all, it should only be of the very slightest order, say, the last 1-2000th-in. or less. For this, some thoroughly washed rotten-stone or tripoli powder will be found ample on soft materials, such as phosphor-bronze.

In finishing hardened steel or case-hardened iron, more will be required, and quite a different system to that proposed by "J. T." If the work be first



A MODEL VERTICAL STEAM ENGINE MADE OVER 50 YEARS AGO.

bored with a properly shaped tool, to 0·01 in. of the required size, then finished with a reamer, and finally lapped with a soft lap for a few seconds, a finish as perfect as possible should be obtained, and the subsequent wear of the valve or other piece of mechanism working in the hole would be minimised, whereas in "J. T.'s" system probably some of the abrading material would remain imbedded in the cylinder, causing rapid wear.

I do not think that any true-hearted mechanic would grudge the extra time required, provided he could turn out a more perfect piece of work.

For the purpose stated in "J. T.'s" letter, I should prefer to lap the liner by hand, simply rub the cylinder up and down the lap—the cylinder and lap being revolved in different directions by the right and left hand, respectively. In all cases, it is advisable, where possible, to have the finishing cut work in the direction of motion.—Yours truly, V. W. DELVES BROUGHTON, Upper Norwood, S.E. Assoc.M.Inst.C.E.

The Society of Model Engineers.

[Reports of meetings should be sent to the offices of THE MODEL ENGINEER *without delay, and will be inserted in any particular issue if received a clear nine days before its usual date of publication.]*

London.

THE eighth Annual General Meeting was held at the Holborn Town Hall, on Thursday, November 16th, Mr. D. Corse Glen taking the chair at 8 o'clock and forty-three members being present. The minutes of the previous Annual General Meeting were read and signed, and Messrs. Francis Owen and H. C. Sprague elected members of the Society. The report and accounts for the past year were presented and shortly discussed and adopted, the very favourable financial position of the Society being commented on.

The election of officers for the coming year was then proceeded with, and on the nomination of Mr. D. Corse Glen, Mr. Herbert Sanderson and Mr. A. M. H. Solomon were unanimously elected to the positions of Chairman and Vice-Chairman, respectively. Mr. Sanderson being willing to still act as Treasurer, he was elected to the dual position. The Hon. Secretary having signified his willingness to remain in office for another year, and it being the wish of the members present he should do so, he was unanimously elected.

As the result of the ballot for members of Committee, Messrs. E. W. Payne, P. Blankenburg, F. R. Welsman, and S. L. Solomon were elected. Mr. H. Hildersley was asked to continue the office of Librarian, which he consented to do.

The new Track Committee consists of the following members: Messrs. W. B. Hart, H. Greenly, H. Clayton, H. C. Willis, J. T. Read, and John Wills, junr., with Messrs. H. W. Greenfield and H. F. Jefferson in reserve.

The usual votes of thanks were proposed and carried to the late Executive, Honorary Auditors, and Scrutineers.

A lengthy discussion arose during the evening as to the practicability of equipping a workshop with a lathe, planer, and other tools, members having access thereto once a week and the services of a paid instructor being requisitioned; the almost unanimous opinion of the members present, however, was that the scheme was on several grounds impracticable. An alternative suggestion that a portion of the large balance at the bank be employed in the purchase of a portable work bench and tools to assist the giving of practical demonstrations at the ordinary meetings, and also in the purchase of further tools and apparatus to be loaned to members, was approved.

The only exhibits were a finely finished eccentric chuck for ornamental turning, by Mr. Hildersley, and a very compact 6-volt 4-pole motor by Mr. J. W. W. Munro.

The meeting terminated at 10 p.m.

FUTURE MEETINGS.—The next ordinary meeting will be held on Thursday, December 7th, at the Holborn Town Hall. Paper by Mr. J. Glover, "Motor Cars Past and Present."

The seventh Annual Conversazione will be held on Friday, January 12th, 1906.

Readers wishing to join the Society are requested to communicate with the Secretary immediately, so that they may reap the full benefit of their subscription for the new Session just commenced.—HERBERT G. RIDDLE. Hon. Sec., 37, Minard Road, Hither Green, S.E.

Queries and Replies.

[Attention is especially directed to the first condition given below and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-hand corner of the envelope "Query Department." No other matters but those relating to the Queries should be enclosed in the same envelope.

Queries on subjects within the scope of this journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied, wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed, and also a "Queries and Replies Coupon" cut out from the advertisement pages of the current issue. (4) Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor,* THE MODEL ENGINEER, *26–29, Poppin's Court, Fleet Street, London, E.C.]*

The following are selected from the Queries which have been replied to recently:—

[14,780] **Coil Failure.** V. F. M. C. (Ascot) writes: (1) I have just made a 4½-in. spark coil by your handbook on Induction Coils, but I can only get a ½-in. spark. The dimensions are as follows—are they right? Primary: core 1 lb., No. 22 tinned soft iron wire, ⅞ in. diameter, 11 ins. long; winding, 1½ lbs. No. 14 D.C.C. copper wire in three layers, all soaked in shellac, and a layer of tape outside, also shellaced. Insulating tube: ebonite; outside diameter, 1⅝ ins.; inside, 1⅜ ins.; length, 13 ins. Secondary: 4½ lbs. No. 36 s.c.c. copper wire, wound in forty-four sections; size of each coil—inside 1 13-16ths ins., outside 3⅞ ins.; thickness, 5-32nds in. Insulated with two paraffined paper discs between each; size of discs—inside diameter 1⅞ ins., outside 4½ ins. (2) I have built up the coil, as in your book, with ebonite ends and condenser, as book. The latter I have built up three times to make sure it was all right—the last time very carefully. The primary works all right with a hammer break, but I have now made a mercury break, as in your book, with bell magnets, which works very well. Could it be the condenser is leaking at all? (3) The secondary connections are all soldered, but I still have the ends sticking out, and have not filled in the outside covering of wax and ebonite paper. Would this allow of brush discharge, and so lessen the spark as much? I tested each section before building up with small voltmeter and dry battery. (4) The current I use is taken from our private electric light supply—100 volts (continuous), which I reduced with a large resistance box I made with coils of manganese wire, so using about 12–20 volts, which I varied, making the spark a little longer or shorter, according to the current. Is this about right at about 3-4 amps.? (5) What is the best way, to get the secondary off the ebonite tube for examining? I enclose a specimen of secondary coils; one I had over, and made rather worse than the ones I used. Also two of the paraffined discs between the sections.

Make sure that none of the secondary coils are opposing one another. Most probably your condenser is at fault. Have you tried coil both with and without condenser and noted the difference? There is nothing but experimenting and testing till you hit upon what is wrong. To get the tube away from the secondary easily, it is only necessary to insert a metal tube inside the insulating tube after the primary and core have been withdrawn. Allow the metal tube to project a few inches each end, and apply heat—a Bunsen flame or spirit lamp can be used. The heat will be conducted fairly uniformly along tube, and the wax will be slightly softened, and the ebonite tube can be withdrawn by giving it a slight rotary motion quite easily. Of course, the heat must not be sufficient to *melt* the wax.

[14,530] **Wimshurst Machine Experiments.** A. H. L. B. (London, S.W.) writes: I have a "thunder house." There are two windows, each in two layers—one plain one, facing the further

side; one with a brass rod up it, facing the near side. I understand the windows should be blown out on passing a strong spark down the rods. I have tried with a Wimshurst giving 2-in. sparks but nothing occurs except sparking across the gaps. (1) Should the layers bearing the rods be turned so as to be inside? (2) Should the windows fit quite loosely, only just stiffly enough to remain in? Or have you any other explanation?

(1) There should be decided gaps in the lightning conductor, as formed by the various pieces of metal, but it is not necessary that the pieces of metal on the wooden shutters should be inside the house. (2) The shutters must not fit tightly, but just enough to keep in place. The discharge from a Wimshurst is scarcely violent enough to dislodge the shutters; a Leyden jar, of fairly large size, is usually employed to provide the discharge. The jar is first charged, then the hook at bottom of lightning conductor is connected by a wire or chain to the outer coating of the jar. The jar is then discharged by connecting the inner coating to the knob at top of lightning conductor. When doing this, you must be careful not to touch the conductor, or you will receive a shock; a discharger having a glass or ebonite handle should be used. The discharge passes violently across the gaps and expels the shutters, and avoid sending current through the lamp circuit. We trust these details will assist you. The leads from accumulators to K and N should be changed over to prevent cells opposing one another.

[14,833] **Switch for Accumulator Charging, Lighting, etc.** J. B. H. (New Hey) writes: I have twelve large Daniell cells and eight 2-volt accumulator ditto. I should be obliged if you could give me a sketch showing switchboard connections. I wish to have four cells charging at once, and, when charged, to switch on to the lighting mains, and then the other four switched in; also to be able to switch all the eight cells on to the main to drive small motor.

The diagram below shows necessary connections in circular switch, and switch-arm to obtain the action you describe. If you superimpose the three-arm switch, you will see that the required circuits will be made in turn, on moving the switch-arm from left to right. In the first position the current flows from the primary battery to contact R, through switch-arm to A, thence through accumulators, and back to S, thus completing the first circuit. In second position, the switch-arm is still on contacts R and S, but current is now sent through the other set of accumulators, *via* contacts D, C, and so back to primary cells. At the same time, the arm W is engaging the contacts E, F, G, J, thus allowing the first set of accumulators to discharge through the lamps as required. Two sets of contacts must be provided in arm W, insulated one pair from the other. The third movement allows the arm W to engage P, M, N, K, *and also* F and J. Please note that contracts E and G must be shorter than F and J, so that the accumulators may be put in parallel to drive direct on to the motor,

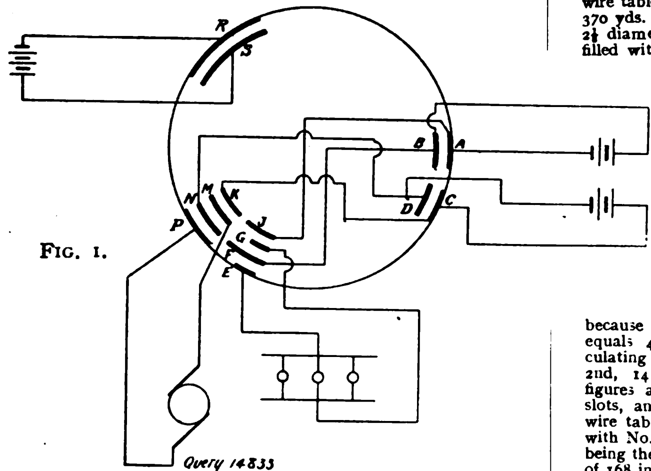
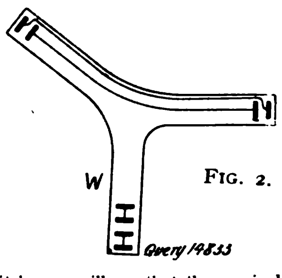


FIG. 1.



SWITCH FOR ACCUMULATOR CHARGING.

FIG. 2.

[14,979] **Small Rotary Converter.** H. G. B. (Woodhall Spa) writes: I should be very much obliged if you would kindly answer the following questions:—(1) In the issue for July 13th. 1905, there was an account of a small rotary converter by Mr. J. G. Perry. In the account he said he got his windings from your handbook on "Small Dynamos and Motors." I have the said handbook, and can find nothing about the windings of the armature, how and what wires to connect to the second commutator. (2) Can you tell me of any warehouse which sells small commutators of not more than ½ in. in diameter, and what their prices are? I have a small motor with a commutator just about ⅝ in. diameter, and it has got broken, and I wish to replace it. The armature is tripolar, 1¼ ins. diameter. Would it matter if the commutator was larger than ½ in.? In the issue for October 12th, 1905, there was an article on "Two Fast Model Steamers," by J. B. Greenwood. In the account of Fig. 2 Mr. Greenwood says the blades are let into a long torpedo-shaped boss. I should be very pleased if you could tell me where those propellers may be obtained in castings and finished state.

(1) A converter of this type is simply two armatures wound for different voltages and outputs, mounted on the same shaft, each armature being of the same over-all dimensions. (2) Any of our advertisers in electrical goods will supply you with commutator; send them a dimensioned sketch of what you require. (3) Try the Clyde Model Dockyard Co.; see advertisement in our journals.

[14,883] **Dynamo and Motor Windings.** F. L. (Ossett, Yorks) writes: I have designed a dynamo-magnet (Avery-Lahmeyer type); pole-pieces 1⅞ ins. wide, 1¼ ins. thick; winding space ⅝ in. long by 11-16ths in. deep. According to calculations based on wire table in the *M.E.* for January 1st, 1901, I shall be able to get 370 yds. of No. 24 (about 1¼ lbs.) on the two bobbins. Armature 2¼ diameter, 2 ins. long, eight slots, 7-16ths in. wide, ⅝ in. deep, filled with No. 22. By the above table I should be able to get (eight coils) twelve turns, five layers deep (about 112 yds.) on armature. (1) What output may I expect at about 2,500 r.p.m. I want from 15 to 20 volts pressure. Please suggest different winding for this if the above will not do. I am unable to follow all the formulæ in "A.B.C. of Dynamo Design," so shall be glad if you will assist me with criticism and suggestions for improvement. The magnet I have had cast in local foundry to my own pattern. In the *M.E.* for April, 1900, "A.B.C. of Dynamo Design," Mr. Avery says: "We will make our armature a cogged-drum with six teeth, the wire spaces being 7-16ths in. wide by 5-16ths in. deep. It is possible to get ten wires per layer in each slot of the armature core discs, and six layers deep will about fill the space." (2) Is there a mistake here? I ask this because on referring to wire table, I find S.S.C. wire No. 24 equals 41 per inch; D.S.C., 38; S.C.C., 35; D.C.C., 29. Calculating from this, if the first be used, 16 turns, 12 deep: 2nd, 14 by 10; 3rd, 13 by 9; 4th, 11 by 8. And these figures allow somewhere about two wires diameter at sides of slots, and one wire diameter at bottom, for insulation. If the wire table is approximately correct (and I know from experience with No. 24 S.C.C. it is not far out) and D.C.C. No. 24 be used, as being the nearest to Mr. Avery's figures, it would make a difference of 168 in the number of armature conductors—no small difference, you will admit. (3) Supposing the above number of wires increase wire put on the armature, how would it affect the output and the design generally? I have made a small motor, single coil; field-winding, 36 yds. No. 24; armature, tripolar, wound with 10 yds. No. 22. Connected as series motor, this will not run but at a crawl, even with three bichromate cells. Connected as shunt, or armature and field coil in parallel, it fairly hums, and will create a small hurricane with a 6-in. four-bladed fan on spindle. Why is this motor not a success when series wound?

(1) If the frame of your field-magnet is well proportioned, and the armature runs close to the pole faces, you may be able to obtain about 20 volts at the speed you mention and about 4 amps. The winding you have adopted is in good proportion for a shunt-wound machine. You can adjust the voltage by running at higher or lower speed. (2) *Re* number of turns in armature, Mr. Avery has probably allowed for a thicker insulation between winding and core than you have in view, or for wire having a thicker covering. There is a considerable difference in the thickness of the covering of various makes of copper wire, especially with cotton coverings. We do not think you will be able to improve upon his figures to the extent you state—it is a matter for individual experience. (3) An increase in the number of turns of wire means an increase in volts for a given speed, but the internal resistance of the armature will also be increased, so that the gain is, to some extent, neutralised. The result desirable is to get as much of the winding space as possible filled with wire—not necessarily as regards number of turns, but as regards copper. *Re* motor. The field-magnet winding is of too fine a gauge to be suitable as a series winding. When connected in series with the armature, it absorbs too many volts and does not leave sufficient pressure at the brushes to drive the armature properly. No. 18 gauge wire would be more suitable for a series winding. On the other hand, it is suitable for a shunt wind-

ing, as it is of sufficiently high a resistance not to rob the armature of too much current.

[14,875] **Model Locomotive.** H. O. (Leicester) writes: I am making a 1-in. scale model of a goods engine (with tender), four-coupled wheels, 5 ins. diameter, outside cylinders 1¾-in. stroke, gauge 4 13-16ths ins. What bore do you advise for cylinders? I should like them as large as possible, as I want the engine to draw me (11 stone 7 lbs.). I have room for a very large boiler, outside firebox could be 9 ins. or 10 ins. long. My design also allows me to make a deep firebox, so that solid fuel can be employed. What diameter ought the boiler barrel to be? I should also like that as large as possible. As requested, I am sending a rough sketch of loco. The cylinders I have by me are 1¾-in. bore, 1¾-in. stroke.

In reply to your query, we may point out that the wheel arrangement chosen for your model locomotive, whilst we do not think it one which is at all pleasing, would not provide any advantage over, say, a leading bogie four-coupled (4—4—0 type) engine, excepting perhaps that almost the whole of the weight can be placed upon the driving wheels. The outside framing to the trailing carrying wheel does not confer any advantage. You will find that a design such as we indicate in outline will look just as well, and be certainly nearer the real thing. If you wish the engine to be more like a goods engine, why not go in for a "Consolidation" 2—6—0 type, or a 6-coupled bogie type of locomotive. The boiler may be 5½ ins. diameter, and have at least fourteen tubes, ⅝ in. diameter. The bogie wheels may be 3 ins. diameter, and then they will give the engine a better appearance. You will find the firebox shown on the drawing deep enough. The cylinders may, of course, be 1¾ ins. by 1¾ ins., but 1½ ins. by 2¼ ins. or 1 5-16ths ins. by 2 ins. would be a more usual proportion.

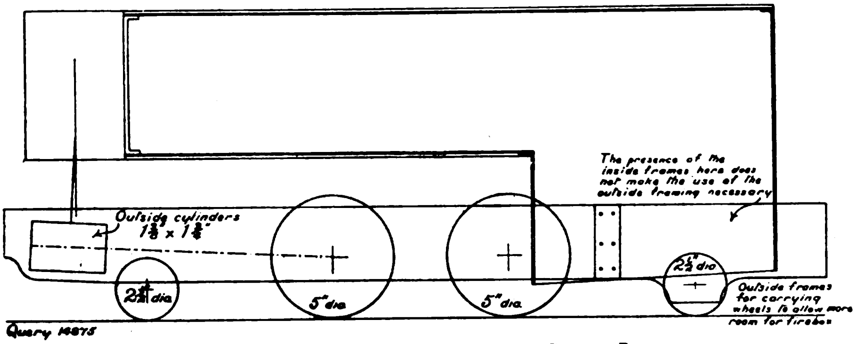


Fig. 1.—Outline Design for a Model Goods Locomotive.

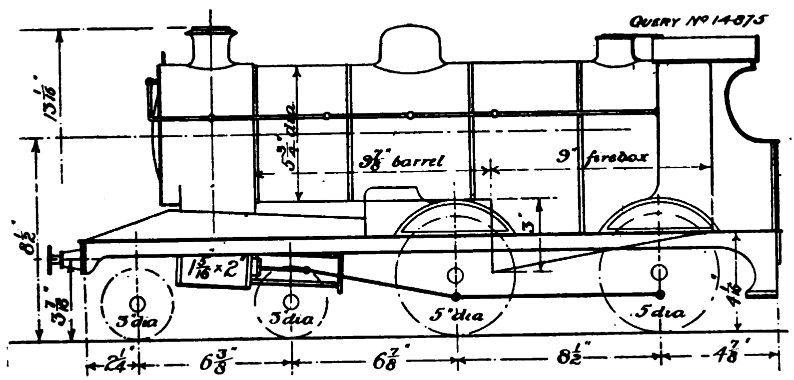


Fig. 2.—Alternative Design for Locomotive.

[14,895] **Primary and Secondary Cells.** H. R. B. (Portsmouth) writes: Will you kindly answer, at your earliest convenience the following questions? (1) I am making a battery of eight cells, gravity type, as per instructions in the *M.E.* handbook "Electric Lighting for Amateurs," to use with a night-light. The plates are of the following dimensions:—copper, 9 ins. by 3 ins.; zinc, 3 ins. by 2¼ ins. by ¼ in., rectangular. Should the zinc be amalgamated? (2) What distance should bottom of zinc slab be from top of copper plate? (3) The lamp will be about 14 ft. from battery—what voltage H.E. lamp should I use? (4) How many lamps would battery light at a time for an hour or so? (5) You say that it is advisable to always have gravity cells discharging. What length of the enclosed specimen platino silver wire should I have in circuit, so as to just allow enough current to pass to keep copper from depositing on zinc slab? (6) I am making an accumulator (4-volt), each cell containing five plates—two positive and three negative—each plate being 2¼ ins. by 1½ ins. by ¼ in. What would the capacity in ampere-hours be? (7) I have not been successful with the method of pasting negative grids with precipitated lead, so propose pasting with commercial litharge. Should the mixture be made very stiff? (8) I have already successfully made the positive plates of red lead, and have placed them in the solution of chloride of lime to form them—will they do, since I shall use litharge for negatives, or ought I to make up the positive plates again, and not place them in the chloride solution? (9) Should I be discharging accumulator at too high a rate if I lighted two high efficiency lamps at the time? (10) Would the eight gravity cells be too high a voltage to charge this accumulator with? If so, what length of No. 22 iron wire ought I to insert as resistance? (11) Should resistance be inserted between positive pole of battery and positive of accumulator?

(1) Yes, the zincs should be amalgamated. (2) There is no particular distance: it must be in the zinc sulphate solution, and not in the copper sulphate solution (see drawing in handbook). (3) An 8-volt lamp, if wires are of ample size, say not less than No. 20 gauge. (4) Depends upon the candle-power of the lamps; probably two or three 8-volt 1 c.-p. lamps. (5) Your sample of resistance wire has apparently not reached us, as we do not find it. The resistance for keeping the cells on closed circuit should be at least 80 ohms; perhaps you can calculate it. (6) About 1½ amp. hours may be expected. (7) Yes, so that it can be pasted on easily. (8) Positive plates will do as they are. (9) Depends upon the candle-power of the lamps. Such an accumulator should be discharged at ½ to ¾ amp. as a maximum. (10) Each accumulator cell requires 2½ to 2¾ volts to charge it. About 25 yds. wire would be required if 8 volts is used. (11) May be anywhere in the circuit so long as it is in series with the cells.

[14,669] **Charging Accumulators.** R. G. A. (Forest Hill) writes: Will you kindly help me with the following? I am thinking of fitting a 4-volt electric lamp to my bicycle, and propose using two 4-volt accumulators—one in use, and the other being charged. Can I charge the accumulator from, say, five Leclanché cells? Would it injure the accumulator if I left it connected up to cells after it was fully charged; and about how long would it take to charge it? Which should be connected to the positive terminal—zinc or carbon?

It is practicable to charge small accumulators from primary batteries, but before buying your cells read our handbooks Nos. 1, 5, and 22; also back numbers of the *M.E.* which give information on the subject. The charging should be distributed over a fairly long period, so as not to exhaust the primary cells. As far as possible, do not entirely discharge the accumulator before re-charging, but re-charge immediately you have finished, using the lamp so as to keep the cells in as fully charged condition as you can. It is absolutely necessary to connect the positive pole of the battery to the positive pole of the accumulator. The zinc of the battery is always negative; it would not do any harm to leave the accumulator on the battery beyond the time required for charging. If not carried to excess, an hour or two would not matter at a time. We should advise Daniell pattern cells instead of Leclanché.

[14,670] **Loss Through Resistance of Circuit.** W. R. (Croydon) writes: I have a small electric light installation to be worked off a dynamo, and on testing the wires with a small dry cell I find that at the switchboard main entry wires, with the ammeter in series, the ammeter registers 3; on testing lower down (one yard) the wires, the ammeter gives 2½; and 5 ft. off gives 2. Can you explain this? There are no faulty joins in the wire, or "shorts," and it seems that the longer the wire, the lower the ammeter registers. I was not burning any lamps off the cell, but just shorting the wires to find the internal resistance of cell.

The explanation is, as far as we can understand your letter, that by connecting the cell at a greater distance the current has to pass through a greater length of wire, and therefore through a greater resistance; as the voltage of the cell remains approximately the same, the current will be less, the greater the amount of wire in circuit. The wire you are using is probably of small gauge. Your dynamo should give a greater voltage than that required by the lamps to compensate for this loss in the wires.

[14,997] **Gas Engine for Small Workshop.** A. M. (Streatham) writes: Would you be good enough to advise me what would be the *best* power to use as regards economy and efficiency for driving a small dynamo of about 120 to 150 watts to charge accumulators, a Barnes' 4½-in. screw-cutting lathe, a light drilling machine, and an emery wheel? Please tell me what power would be required. I can get a ½ h.-p. nominal slide engine cheap. Would this be powerful enough? Are they any good? I hear the makers have given up making this type now. Can you tell me why? I could get electrical power, as the company's mains are in.

An old, out-of-date type of engine, such as you mention, we do not advise. It would cost as much, due to its high consumption, as would pay for the difference in cost of a new engine, or, at least, a modern second-hand one. We should advise a 1 b.h.-p. engine to do the work comfortably. A gas engine would be much cheaper to run than an electric motor. See our handbook on "Gas and Oil Engines," by W. C. Runciman, 7d. post free.

[15,015] **Small Oil Engines.** A. B. (Lewisham) writes: I have an oil engine (1), 2-in. cylinder and 3-in. stroke. What is about the power? (2) It runs at such a terrific speed when it is supposed to run at about 600 r.p.m. Could I run it at less speed? (3) It says in the "Oil and Gas Engine" book to keep it clear from soot and grit. What parts do you have to take apart, and how often does it want cleaning? (4) What size dynamo would the engine drive, and what lamps should I require? (5) The oil and air is drawn into the engine by suction together, and I have no governor to engine. Is it necessary to have one, and would it cost much to be done?

(1) As you give no details of engine design or construction, we can only reply to your inquiries in a general way. Power may possibly be as much as ½ or ¼ h.-p. (2) You can cut down the supply of oil when engine is running at less than full load; or you must put on such a load that speed will never increase beyond a certain limit. Of course, it is impossible to regulate the speed in a reasonable way when no governor is included in the design or build of engine. (3) Depends upon kind or type of engine. All valves, vaporiser, and passages should be cleaned whenever they appear to be getting dirty. (4) Possibly a 100-watt machine. (5) See above.

[14,729] **Cells and Bells for a Colliery Shaft.** T. R., Standley) writes: I should be pleased to know if you could tell me what strength of battery will be required to ring electric bells top and bottom of colliery shaft 600 yds. deep? Also, how to ring electric bells at each end of two line wires 1,000 yds., with battery at one end?

Impossible to say exactly without further information; it depends upon the size of wire used and amount of current the bells take—perhaps twenty Leclanché cells in series. Connect your battery circuit to points midway between the bells, or use a relay bell and local battery at the far end. We shall be pleased to advise you further through our Expert Service Department for a fee depending upon the amount of information required.

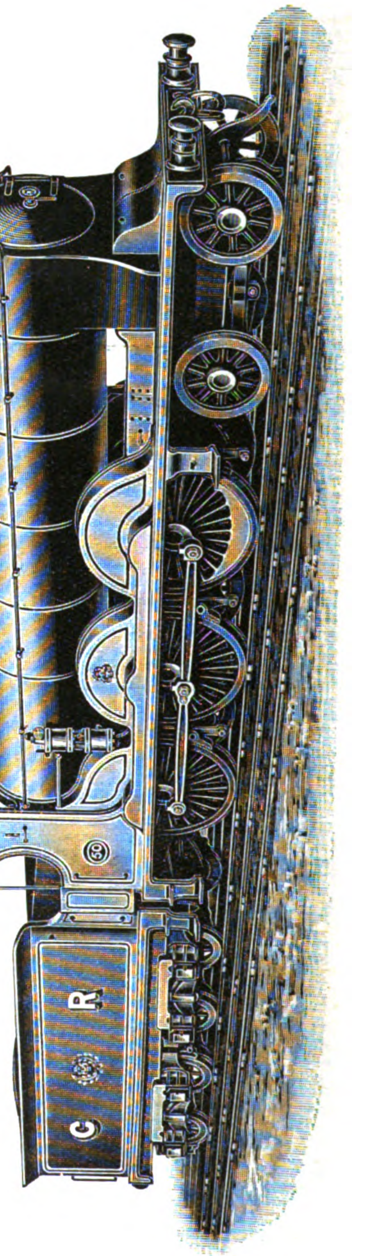
The News of the Trade.

[*The Editor will be pleased to receive for review under this heading samples and particulars of new tools, apparatus and materials for amateur use. It must be understood that these reviews are free expressions of Editorial opinion, no payment of any kind being required or accepted. The Editor reserves the right to criticise or commend according to the merits of the goods submitted, or to abstain from inserting a review in any case where the goods are not of sufficient interest to his readers.*]

* *Reviews distinguished by the asterisk have been based on actual Editorial inspection of the goods noticed.*

A New Model Locomotive.

We are now able to illustrate the attractive new model of the C.R. "Grampian Express," just being introduced by the Clyde Model Dockyard, of Argyll Arcade, Glasgow. This is built to a ½-in. scale from official drawings, and we understand that the first model built by the makers is being sent to the Caledonian Company for their inspection. The engine has two double-acting slide-valve inside cylinders, link-motion reversing gear, special pattern downcomer copper boiler, with brazed circulating water tubes and usual fittings, blast pipe and cylinder lubricators in smokebox, spirit tank in tender, with regulator for supplying spirit to lamp, screw couplings and draw-bar hooks, and imitation



THE CLYDE MODEL DOCKYARD AND ENGINE DEPOT'S NEW CALEDONIAN EXPRESS LOCOMOTIVE.

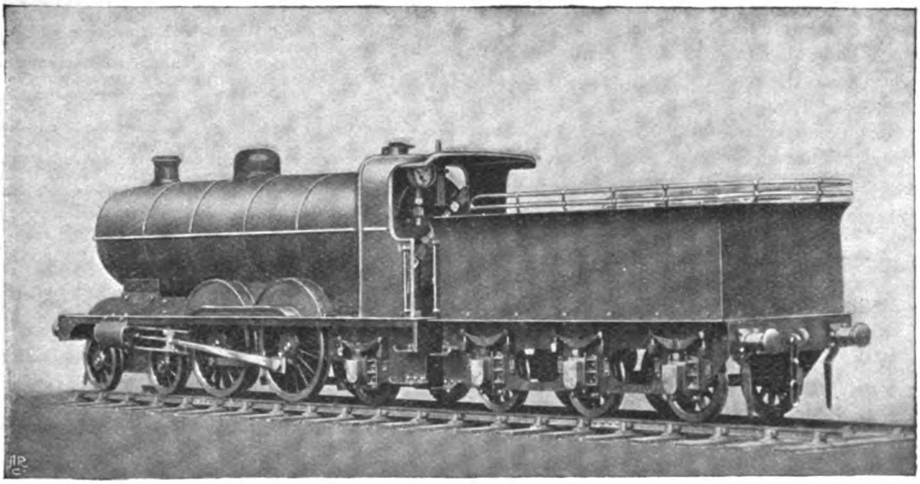
Westinghouse pump. The firebox of the boiler is 5½ ins. long by 1¾ ins. wide, and the total heating surface is 90 sq. ins. The length of the engine is 2 ft. 9 ins., and total weight 25 lbs.; the gauge is 2½ ins. Either complete models or sets of castings and parts can be supplied. Scale model rolling-stock to suit the above engine can also be supplied to order. In addition to this new speciality, the complete list of this firm, which we have just received, contains a large range of steam models of every description, including the L. & N.W. "Clyde" model loco. of which a good number have been sold, model rolling-stock and railway equipment, rails and points, etc., engine and boiler parts and fittings, model sailing yachts, steamers, model ship fittings, electrical goods, and scientific novelties. The list covers 88 pages, and will be found of much interest to model engineers. It will be sent post free for 6d.

A New Radius for Model Rails.

Those readers who are uses of model tin-plate rails will be interested to learn that curves of larger radii are now being sold by Messrs. Bassett-Lowke & Co., of Northampton. The new radius for each gauge is considerably larger than has hitherto been made, so that the sharp curves of the old standard will no longer be compulsory on model railway builders. Both the old and the new curves will be kept in stock, and a spring-catch fastener is now fitted in place of the bent-wire fastener previously employed. The connecting spikes are placed one at either end instead of both at one end.

*A New Model G.N.R. "Atlantic" Type Locomotive.

The engine shown in the accompanying illustration has lately been built to a special order by Messrs. Bassett-Lowke & Co., Northampton. It is not intended to be an exact model of the G.N.R. No. 251 Class (the footplating being carried straight along, instead of raised over the coupling-rods, and the Wootten firebox dispensed with), but was designed with a view to obtaining the best working qualities required by owners of scale model railways, viz., easy manipulation, good hauling power, and a boiler that will steam for about one hour without requiring fresh water. It is a plain, straightforward design, and free from all unnecessary detail. The scale is 11-16ths in. to one foot, the length over buffers being 39½ ins., width over footplates 5½ ins., and the gauge 3¼ ins. between rails. The boiler is made on the water-tube principle, constructed of solid-drawn copper, with gun-metal ends, and is provided with steam jet (for quickly raising steam), steam-pressure gauge, water gauge, and all the usual fittings. The working pressure is 80 lbs. per square inch. The cylinders are 1¼-in. stroke, ¾-in. bore, fitted with ordinary slide-valve and Green's (provisionally protected) reversing valve, worked from the cab by means of the usual pattern lever. The tender is the regular G.N.R. pattern, mounted on six cast-iron wheels, with steel axles and spring bearings. Two copper tanks are fitted, the back one holding water and being provided with hand feed-pump for supplying boiler. The forward tank holds the spirit, which is supplied to the lamps on the displacement principle of an entirely new design, by means of which part or whole of the fire can be alight or completely shut off. With this arrangement, the engine can be left standing with a small fire for any length of time. We understand that complete sets of castings and material, including full working drawings, are in course of preparation, and will be ready shortly.



Messrs. W. J. Bassett-Lowke's New Model G.N.R. "Atlantic" Type Locomotive.

Scale Models and Accessories.

In the latest list we have received from Messrs. Carson & Co., 51, Summer Row, Birmingham, we note some interesting particulars of some ½-in. scale model locomotives which they have recently been placing on the market. The types at present available are L. & N.W.R. "Precursor," G.W.R. "City of Bath," M.R. 2,609, and a G.C.R. "Atlantic." Two of this firm's models we show in the accompanying illustrations. These are all supplied either in sets of castings and parts, or as finished models, and we are informed that scale models of any other types will be reproduced, at short notice, to order. In addition to locomotives, Messrs. Carson & Co. have a number of specialities in rails, signals, and

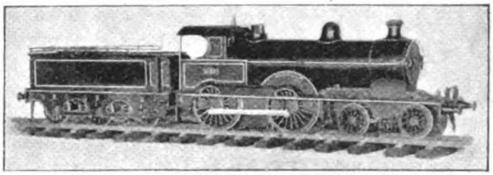


Fig. 1.—L. & N.W.R. "Precursor" Type.

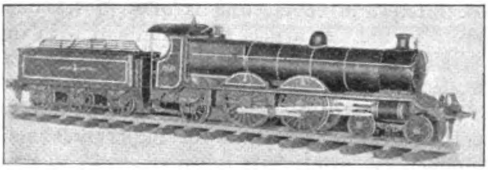


Fig. 2.—G.C.R. "Atlantic" Type.

Messrs. Carson & Co.'s ½-in. Scale Model Locomotives.

sundry track and rolling-stock fittings. We also note in their list well-designed model horizontal and vertical engines and a good assortment of model steam fittings. Model engineers should write for these lists.

New Catalogues and Lists.

T. H. Wathes & Co., Ltd., High Street, Leicester.—From this firm we have received a very useful little list of electric novelties and sundries. It covers 36 pages and includes small motors and dynamos, water motors, accumulators, charging sets, measuring instruments, electric light fittings, batteries, medical coils, and accessories, electric bells and alarms, telephones, magnets, wires, etc. It is fully illustrated and will be sent post free on application.

Shaw & Brother, Leabrooks Engineering Works, Alfreton, Derbyshire.—We have just received an illustrated list of angle-plates, machine vices, vee blocks, machine clamps, lathe face-plates, slotted tables, vertical milling attachment, independent four-jaw chucks, and other machine accessories, etc. The list also contains prices of steel shafting, and bright drawn square, hexagon and flat steel.

The Editor's Page.

We have lately commenced a new series of articles under the title "How It Works." It is our intention, under this heading, to give a series of simply written articles explaining the principles and working details of all the more important appliances of engineering, both electrical and mechanical, and we feel sure that an educational series of this kind will be as much appreciated by our amateur readers as by those whose interest in engineering is of a professional nature. In the first article we have dealt with the subject of the arc lamp, while the second will deal with electrical resistances. Some of the subjects will be treated completely in one article, whilst others of greater complexity or importance may require several instalments to satisfactorily dispose of them. In every case the matter will be of a particularly instructive character, and this series will, we feel sure, do much to increase the educational value of our Journal.

* * *

Another correspondent who writes us on the subject of exhibition models, says:—"I am glad to find that someone has called attention to the bad treatment models get when sent to industrial exhibitions. Twice this year I exhibited, and in each case damage was caused. In the first place, a pump had been used for working it: warm, moist air coming in contact with the cold metal caused condensation; and this had evidently been repeated day after day, with the result that the steam chest and cylinder were a mass of rust, the bore of the cylinder (iron) being scored and grooved, necessitating lapping. The whole of the steel parts were very rusty, and so badly packed on return, that the enamel was scratched, and the engine had to be re-enamelled before I could exhibit it again. In the second place, bad packing caused the lubricator to get smashed, and the enamel scratched. In each case I respectfully requested that, on return, the engine should be packed same way as sent, but in neither case was my request complied with. I have found the best way to pack is to remove the engine from the polished wood base, securely screw down to a strong piece of wood slightly smaller than the bottom of the case, and, in turn, screw this to the bottom o the case. If this is properly carried out, no damage will result."

* * *

If the reader of our Journal referred to on page 480 of our November 16th issue, under the title of "An Embryo Stephenson" will communicate with us, we will put him in touch with an electrical engineer who has kindly offered to see if he can assist him in his engineering progress.

Answers to Correspondents.

W. S. W. (Constantinople).—Many thanks for your two interesting post-cards from Palermo and Constantinople.

T. J. (Stockton-on-Tees).—In any case the pressure will come on the outside rail, owing to the action of the centrifugal force. The locomotive will also tend to burst the track laterally.

F. W. (Smethwick).—You do not specify your wants. The illustration was published with a scale, and you can take off any further dimensions from the drawing. For constructive details and dimensions, see "The Model Locomotive," by H. Greenly, price 6s. net, 6s. 4d. post free, from this office.

G. H. A. (Winlaton).—This matter is dealt with in our handbook—"Electric Batteries," 7d. post free, to which please refer.

A. H. (Port Glasgow).—Kindly comply with our Rules.

Notices.

The Editor invites correspondence and original contributions on all amateur mechanical and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected or not, and all MSS. should be accompanied by a stamped addressed envelope for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

This journal will be sent post free to any address for 13s. per annum, payable in advance. Remittances should be made by Postal Order.

Advertisement rates may be had on application to the Advertisement Manager.

How to Address Letters.

All correspondence relating to the literary portion of the paper, and all new apparatus and price lists, &c., for review, to be addressed to The Editor, "The Model Engineer," 26—29, Poppin's Court, Fleet Street, London, E.C.

All correspondence relating to advertisements and deposits to be addressed to The Advertisement Manager, "The Model Engineer, 26—29, Poppin's Court, Fleet Street, London, E.C.

All subscriptions and correspondence relating to sales of the paper and books to be addressed to Percival Marshall & Co., 26—29, Poppin's Court, Fleet Street, London, E.C.

Sole Agents for United States, Canada, and Mexico: Spon and Chamberlain, 123, Liberty Street, New York, U.S.A., to whom all subscriptions from these countries should be addressed.

Contents.

[The asterisk (*) denotes that the subject is illustrated.]

THE
Model Engineer
And Electrician.
A JOURNAL OF PRACTICAL MECHANICS AND ELECTRICITY.

EDITED BY PERCIVAL MARSHALL, A.I.Mech.E.

Vol. XIII. No. 241. DECEMBER 7, 1905. PUBLISHED WEEKLY.

A Small Gas Engine.

By H. M. Blenkinsop.

HEREWITH is reproduced a photograph of a small ½ h.-p. gas engine, which I made when at school. I bought the various castings and forgings, and did the machining and fitting myself. The principal dimensions are as follows:—Overall measurements: Length, 23 ins.; width, 12 ins.; height, 13½ ins.; bore, 2 ins.; stroke, 4 ins.; diameter of flywheel, 12½ ins.; crankshaft, ¾ in.; sideshaft, ⅝ in. The greatest trouble was experienced with the piston rings (three being fitted) for which a special piece of metal had been supplied with the castings; but, unfortunately, it had been mislaid, and so I had to experiment with three different kinds before I could produce a ring that would go on to the piston without breaking, and, at the same time, give the requisite amount of spring. The inlet valve was originally automatic, but I converted it to mechanical, using the same cam as for the exhaust valve, and also the same screws to hold the bracket for the lever to pivot on as were used to hold the valve itself in place, so that there was no alteration to the engine at all, except as regards the amount of power obtainable, which was considerably increased by the addition I have mentioned. From the results thus obtained I do not wish it to be thought that every engine so converted would give proportionate results, because, I think, in my case, the difference was due to bad detail work put in on the automatic valve, such as making if far too heavy and giving it too coarse a spring. I can now regulate the lift of the valve by two nuts screwed on to the end of the stem, which lock together just under the end of the lifter. Originally there was nothing to prevent the gas from escaping when turned on at the engine, with the result that, if the engine would not start at once, the gas escaped into the surrounding atmosphere. This I remedied by counter-sinking the top of the gas tap and placing an ordinary cycle ball on the top, which just counter-balanced the gas pressure, and was raised from its seating on the inlet stroke.

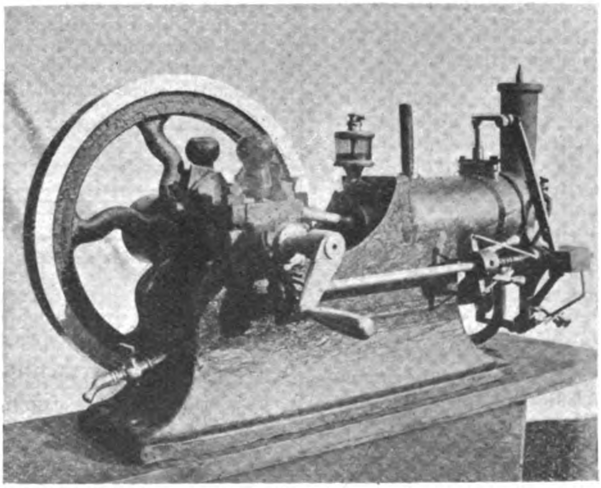


Fig. 1.—Mr. H. M. Blenkinsop's Small Gas Engine.

The governor, which is seen on the half-speed shaft, I have just lately fitted, and is really more of an experiment than a permanent piece of work, as some of the parts are made of wood. The photograph hardly gives it in detail enough to be understandable, so I will explain the principle on which it works. It is simply a modified form of centrifugal governor, the theory of which is well-known; but as I had very little space for the arms to fly out, because of the cylinder casting, it was rather a job to get anything workable, and, as it is, having learned by the experience gained in fitting up the temporary one, it could be greatly improved. The motion of the arms is transmitted by wires to a sliding collar on the shaft, which in its turn moves a wedge-shaped piece of oak backwards and forwards according to the speed of the engine. This piece of oak is held opposite to the end of the inlet valve lifter by a lever capable of lifting the exhaust valve, and is protected by a piece of file screwed on to the surface where the lifter hits it. The action is that when the sliding collar moves the wedge-shaped block forward (by reason of the engine speed increasing), the surface of the wedge comes nearer to the end of the inlet valve lifter, which hits it on the inlet stroke, and therefore, opens the exhaust valve more or less according to the position of the wedge, which is, of course, controlled by the speed. The result of this is to draw back part of the exhausted charge, and also to lessen the suction in the inlet pipe. One thing that I am not quite satisfied about is,

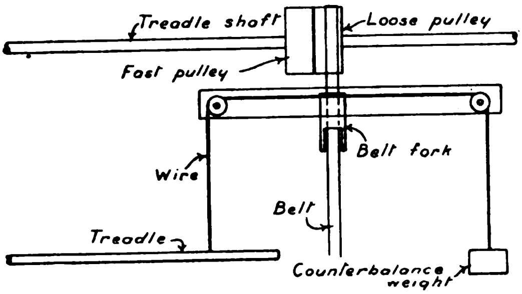


FIG. 2.—ARRANGEMENT OF STRIKING GEAR.

whether this weakens the mixture or whether the used gas and the new gas keep separate, and the effect is merely to lessen the amount of fresh mixture, and not to weaken it. I may say that it works excellently in practice, and the difference in the fluctuations in the gas-bag is most noticeable when the load is put on and then suddenly taken off, or *vice versa*. It seems to me that a governor of this kind is better than the "Hit and miss" principle, as it does not strain the engine or any of the parts with first giving a strong explosion and then none at all. When I can get a good gas supply (which is not always), and a good hot tube, the engine will run without missing at all, with the governor in action. It will be seen that the same cam works both inlet and exhaust valves, and also the governor. The exhaust gases of the engine I have conducted up the chimney through a disused kitchen range, with the result that they cannot be heard at all.

The piston is lubricated by a drip lubricator, and the two crankshaft bearings by ordinary glass lubricators. As my gas supply was insufficient for running the engine and for lighting, I fixed an extra gas-bag, besides the one in the frame, made of part of an ordinary cycle inner tube, which has greatly improved matters. I made a handle (which is clearly seen in the photograph) for starting the engine; this is far preferable to the usual method of starting by pulling the flywheel, as if the first charge of mixture is not right, the engine can be turned until the correct mixture is found. The handle is constructed in three pieces—the handle proper, the crank, and a piece of metal hollowed out to fit the end of the crankshaft. These three parts are fitted together and the extremities riveted over. On the inside end of the portion which fits the crankshaft are filed two teeth, which engage the ends of a piece of steel wire, which is made a tight fit for a hole drilled through the shaft. The action is the same as that of the usual motor-car starting handle, which allows the engine to over-run the handle at the first explosion. I have fitted a pedal for lifting the exhaust valve, so that the engine can be stopped without stooping or altering the mixture. This is also useful for starting to relieve the initial compression.

The engine drives a small home-made lathe with great ease, through a countershaft, fixed on the floor, to treadle shaft. The treadle of the lathe (for it was originally a foot lathe), I have made capable of shifting the driving belt from loose pulley to fast on depressing treadle (which is counterbalanced by weights) by means of a "Bowden" wire running over two pulleys, and a belt fork. I give a rough sketch of this, which forms a very convenient arrangement, as the foot naturally stays on the treadle when the lathe is being used, and it leaves the hands free.

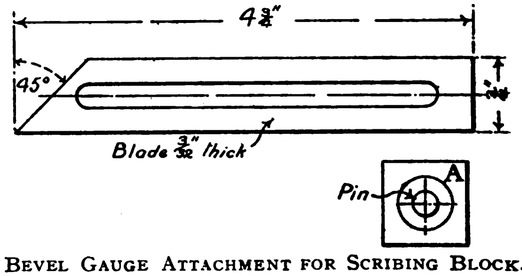
Workshop Notes and Notions.

[Readers are invited to contribute short practical items for this column, based on their own workshop experience. Accepted contributions will be paid for on publication, if desired, according to merit. All matter intended for this column should be marked "WORKSHOP" on the envelope.]

Bevel Gauge Attachment for Scribing Block.

By "SCRIBO."

This is a very useful addition to a scribing block; it can be used to advantage in certain types of jobs, such as transferring angles to similar pieces, whilst being machined on a shaper, etc. To make this, procure a piece of good cast steel, 3-32nds-in. thick,



BEVEL GAUGE ATTACHMENT FOR SCRIBING BLOCK.

true the edges up well to finish about ¾ in. wide. The slot in the blade is the same width as the diameter of pin, as shown at A; it can be used in the block type of clip or the split clip type. To use, take off the thumb-screw or nut that tightens the clip to post, then slip on the blade and put back nut, set at the angle desired and tighten up.

A Home-made Drilling Machine.

By EDGAR CROSLAND.

The following is the description of a small drilling machine, made mostly from scrap. The head A is a piece of an old fret machine (an old lathe headstock will answer equally well). This is screwed to a piece of wood about 1 in. thick, which is in turn screwed to the workshop wall (the workshop is built of wood), and a band is taken over the pulley B at the end, and over the small pulleys C, C_1, C_2, and over the flywheel D at the bottom. The small pulley C_1 is put horizontally to give the band a better grip on pulley B. The end of the spindle E is tapped to fit a drill chuck off a small level-wheel drill. The drill has a table feed which is arranged as follows :—

A piece of hardwood is obtained, to project about 3 ins. beyond the spindle E. It may be of any convenient length. In my case it was 6 ins. long. Next get three pieces of ¼-in. iron—two to form the guides F, F, and the other to form the feed-screw G. A small bracket is now screwed to the wall, midway between the end of the spindle E and the top of the flywheel. The guide-bars should have a hole drilled through one end ; the other end should be let into the bracket H, about ½ in. from the wall. They should not go quite through. Bore two holes through the table J, ½ in. from the edge, and put a brass plate each side of each hole to allow the ¼-in. guide-bars to slide through easily.

Now take the third ¼-in. iron bar and tap it, and make two nuts to fit it. Screw one nut up to within ¾ in. of the top ; square the end above this nut and drive it into the table J, so that when the table is put on to the guide-bars and they are in their places, screwed to the wall by a screw through the hole before mentioned, in one end, the feed-screw G comes exactly under the end of the spindle E. Before putting the table in its place get an egg-beater (one of the 6d. bevel wheel kind), and take off the large cog-wheel and one of the small ones. Bore a hole through the large wheel so that it will slide easily over the screw G. Now turn a wooden disc the same size as the large wheel and cut a hole in it to fit the nut on the feed-screw.

Now screw the large wheel on top of this disc (cogs upward), and put the nut into the square hole in the wooden disc, and screw a small brass plate on the opposite side of the cog-wheel to keep the nut in its place. Bore a hole in the bracket at the same distance from the wall as the hole for the feed-screw in the table J. Screw the cog-wheel and disc on to the feed-screw G, and pass the guide-bars through the hole in the table J, and pass the feed-screw through the hole in the bracket and screw the guide-bars to the workshop wall, but put a ½-in. washer on the screw between the wall and guide-bar. Now take the small cog-wheel off the egg-beater and fit it on to an axle. The best way of doing this is to get a piece of wire slightly larger than the hole in the cog-wheel. Tap this for 1 in., so that it will screw into the cog-wheel, and make two nuts the same thread. These nuts must be slightly smaller than the cog-wheel. Screw one as far as it will go.

Next screw on the cog-wheel and a nut outside that. These nuts must be screwed up fairly tight to keep the cog-wheel from revolving on the axle. Now cut off the axle about 2 ins. from the small cog-wheel, and fix a piece of brass about ¼ in. by ½ in. by 2 ins. This should be fixed as follows :—

Square the end of the axle and drill two holes in the brass plate about ¼ in. from each end. Into one of these secure a small handle ; the other end should be driven on to the square end of the axle, and a small nut screwed on outside it. Now get two small brass plates, and bend over the bottom about ½ in., L shaped, and drill two small holes through the bottom of the L to screw down to the bracket H. Drill another hole on the other side of the angle to take the axle L. These holes should be drilled so that when the brackets are screwed down the small cog-wheel meshes with the large one K. Put a small washer outside the plate between the handle and plate, and cog-wheel plate. Now screw these plates to the bracket, so that one comes up against the small cog-wheel and keeps it in place. The other one should be screwed up against the handle, so that the axle L has no end play.

If the table J will not come down of its own weight when the handle M is turned to the left, a piece of brass should be passed over the large cog-wheel K and screwed down at each end. The flywheel is off an old sewing machine. I found it was not quite heavy enough, so I put a lead weight on it. A bolt goes through the centre of the flywheel,

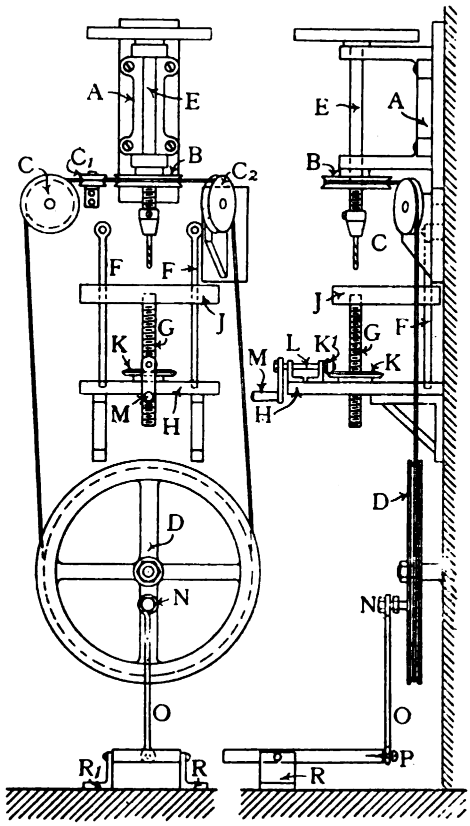


FIG. 1.—FRONT ELEVATION. FIG. 2.—SIDE ELEVATION.

MR. EDGAR CROSLAND'S HOME-MADE DRILLING MACHINE.

and has a shoulder on behind the wheel. This bolt goes through the workshop wall, and a nut was put on from the outside.

A bolt N goes into one of the spokes of the wheel, and a piece of thick iron wire is put round this and connected to the end of the treadle by a screw at P The treadle was made of wood, and is 9 ins. by 4 ins. by 1 in. The iron wire is screwed on at one end It should not be screwed on tight, but left so that it can move a little each way. This treadle is swung in the middle by two screws, which pass through small metal plates at each side, R, R^1, and is similar to the small plates mentioned.

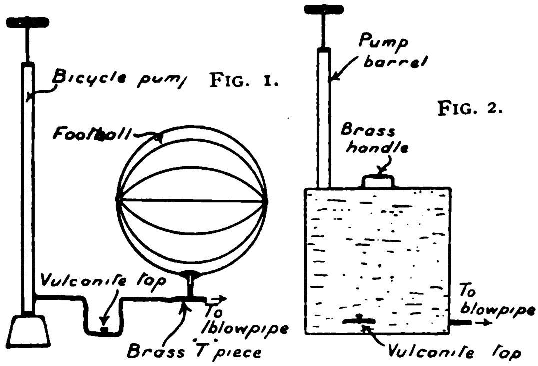
The drawings reproduced will give a good idea of the general construction and appearance of the machine. If any point is not clear, I shall be glad to explain it to anyone who would care to know.

I have not given any fixed dimensions, so that anyone who makes this drill had better fix his own, as mine might not be right for anyone else.

A Cheap Blow-pipe Bellows.

By O. Mansell-Moullin.

As I think there may be others who, like myself, use a gas blow-pipe for various purposes, a description of a cheap and effective blowing apparatus, which I made a few months ago, may be of assistance to those of them who are not willing to pay the



Blow-pipe Bellows.

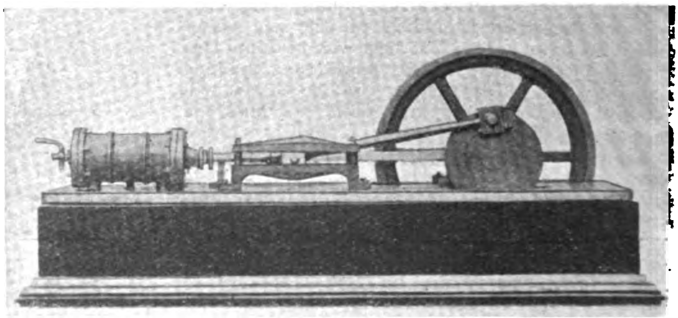
30s. necessary to buy a really good one. My blowpipe is used for several purposes—*i.e.*, for soldering and melting metals, for glass working, and for chemical experiments requiring a higher temperature than a Bunsen burner will give. The first thing tried was a pair of kitchen bellows used in combination with a football to keep up the pressure. The football answered admirably, but the strain on the bellows was too great, and they split. They were patched up, but at the first trial split again, so were abandoned in favour of an old bicycle foot-pump (Fig. 1). This gave such good results that I bought a new pump, which almost doubled the efficiency. The whole apparatus was carefully packed inside a wooden box in shape of a cube (Fig. 2), with edge 10 ins., which just held it all, and a hole was bored in the top to exactly fit the pump-barrel. The pump is wired down to the bottom of the box. The tube leading from the pump is fitted with a small vulcanite tap, which is brought outside the front of the box. This is not necessary, but is a useful fitting. When a very small pointed flame is being used, as in certain glass-working operations, a sufficient pressure can be easily stored in the football to last a considerable time without further pumping. The tap is then turned off, and none of the air can leak out through the pump (for, however good the pump may be, under the great pressure a slight quantity of air tends to work out backwards through it). The actual working of the pump is very little trouble, as it is worked quite gently with one hand. For operations in glass-blowing requiring both hands I get a friend to work it, and in this way all the attention can be concentrated on the glass. The connections will, I hope, be made clear by the diagram. With this blower remarkably steady roaring flames of great size are obtained; in fact, it is perfectly as efficient as any ordinary foot-blower. The chief points to be observed are to use good thick rubber tubing for the connections (bad rubber will soon split), and to wire these tightly. The cost of the pump was 3s. 9d., and the T-piece 1s.

A First Attempt at Model Making.

By H. Drummond.

The following is a short description of a horizontal engine I made two years ago, as a first attempt at anything of the kind. I got the design from The Model Engineer of May 15th, 1901, and, with a few alterations in the bedplate, etc., used a 1¼-in. and 2 5-16ths-in. stroke cylinder, the casting for which had been given to me. All the patterns, with the exception of the flywheel, were made by myself. The engine took about a year of my spare time to construct, as I then only had a small 3-in. centre single-geared lathe, and the turning of some of the parts was rather heavy work. The bedplate is a brass casting, 17 ins. by 4½ ins., with a 5-16ths in. edge, and 3-16ths in.; the plate, with strengthening ribs. The piston and valve rods are of steel, the former being ¼ in. and the latter ⅛ in. diameter.

The connecting-rod is also of steel, 5⅞ ins. between centres, ⅜ in. diameter in the middle, and reduced to ¼ in. at each end. The crank pin is 3-16ths in. diameter and 5-16ths in. wide between collars.



Mr. H. Drummond's Model Horizontal Steam Engine.

The crank disc is 2⅞ ins. diameter and ¼ in. thick. The eccentric is 1 in. diameter, ⅜ in. throw and fitted with straps. The crankshaft is ⅜ in. diameter at flywheel and pulley, and reduced to 9-32nds in. in the bearings. The flywheel, which is of cast iron, is 6⅝ ins. diameter, ¾ in. on face; can be taken off the shaft without removing the crank disc, the latter being made a driving fit on the shaft, and sweated with soft solder. The bearings are ⅜-in. thick with 9-32nds in. holes for shaft. The pulley, which has two speeds for flat belt, is 1¾ ins. and 1½ ins. diameter and 9-16ths in. face. The eccentric rod is of mild steel, ¼ in. by ⅛ in. with knuckle joint to valve rod and sweated into eccentric at other end. The valve-rod guide and parallel bar guides are of gun-metal, the latter being ⅜ in. thick, the steel slide blocks being ⅜ in. by ⅝ in. long, with a 7-32nds in. hole for crosshead pin, which is ¼ in. diameter in the middle for connecting-rod end. The knuckle joint was made from a piece of ½ in. square mild steel, turned down at end, drilled and slotted for piston and connecting rods, and also for crosshead pin. I have a small vertical boiler, 4 ins. by 8 ins., with internal flue and firebox, with which I have tried the engine, and it keeps it going at an average speed of 230 revolutions per minute, using a gas-ring to fire it.

The Latest in Engineering.

Turbine Planing Machine.—A turbine planing machine, recently made by Messrs. George Richards and Co., Ltd., of Broadheath, consists of two beds with sliding saddles and crosshead, the beds being supported by ten legs, and the whole mounted on a solid baseplate, 15 ins. deep and 31 ft. 6 ins. long. The machine will plane 25 ft. long, and across the top of work, 10 ft. wide, or down the sides of work 8 ft. wide, and admit work 5 ft. deep under the tools. The crosshead is driven by pulleys through bevel gears, and two 4-in. diameter steel screws, and carries two tool rams, which can be swivelled to any angle, and have an automatic down feed of 30 ins. The crosshead has three cutting strokes of 20, 27, and 35 ft. per minute, and a constant quick return of 35 ft. The reversing mechanism to the crosshead is independent of the feed arrangement, and the feed only put on when the saddles come in contact with the reversing stops, enabling the machine to be started or stopped anywhere between these points without putting on the feed. The baseplate is built up in sections, tongued and grooved, and securely fastened by bolts. The top is planed true, and the T-slots are cut out of the solid. A railed platform is fixed at the back of the crosshead, enabling the attendant to travel with the head, and conveniently operate the machine. The machine is fitted with two sets of driving pulleys, and is motor-driven by 40 h.-p. motor, the motor being connected direct to countershaft by spur gearing. The weight is 50 tons, and the machine is designed for taking heavy cuts at high speeds.

A New Method of Copper Wire Manufacture.—According to the *Electrician*, a new method of producing copper wire directly from the crude material has been devised by Mr. Sherard Cowper-Coles. The production of copper wire by electrolytic means is a more difficult problem than the production of copper tubes and sheets. Various processes have been suggested and tried from time to time, such as electro-depositing copper on a thin copper wire until it has attained a considerable thickness, and then drawing the thickened wire down again to a comparatively fine wire. Other experimenters have tried placing insulating strips on a cylindrical mandrel so as to produce long copper spirals; the spirals thus produced are uneven and unsuitable for drawing down to wire on account of the roughnesses formed on the edges. The method employed in conjunction with Mr. Cowper-Coles' centrifugal process consists in making on the mandrel a spiral scratch. The effect of this scratch, which must be angular, is to affect the molecular structure of the copper and to form a cleavage plane; if the scratch is not angular, but round at the base the copper will not divide. The line of cleavage is, no doubt, formed in the same way as in a cast metal. If the mould has rounded corners, the crystallisation would be radial, and there would be no cleavage plane. The crystalline structure of the deposited copper has a line of cleavage starting with the sharp point of the scratch on the mandrel. The copper separates more readily if unwound at an angle to the axis of the mandrel. The vat is annular in construction, the mandrel being 7 ft. in diameter, and making about fifty revolutions per minute. A great feature of such a vat is that there are no working parts in the electrolyte and no stuffing-boxes and glands. Mr. Cowper-Coles states that the capital expenditure on plant required for the centrifugal process compares very favourably with an up-to-date rolling mill and wire-drawing plant; the cost of such a plant, with buildings, engines, and the necessary plant, is about £80,000 for an output of about 100 tons per week or 5,000 tons per annum.

The New Graving Dock at Southampton.—The new graving dock of the L. & S.W. Railway, when in use, will contain 85,000 tons of water, which, by means of two 48-in. centrifugal pumps, manufactured by Messrs. Gwynne, of Hammersmith, can be emptied in two-and-a-half hours. The pumps are driven by direct-acting vertical engines, to which steam is supplied from a battery of seven boilers of the locomotive type. A 12-in. centrifugal pump is also installed to deal with any water that may perchance leak in when the dock is empty. The same boilers will also serve to drive the six sets of dynamos installed in a new electric power station, built on the westerly side of the dock, to replace a structure which is now inadequate for the general electrical requirements of the docks. A plant for condensing and utilising the exhaust steam has been laid down, and the waste gases from the boiler furnaces pass through special flues to a chimney shaft rising 100 ft. above ground level. Mr. D. Drummond, the company's chief mechanical engineer, has designed the whole of this new machinery. The dock is fitted with every modern appliance for convenient working, including an electric crane constructed by Messrs. Stothert and Pitt, of Bath, to lift no less than 50 tons at a radius of 87 ft. Weighing 300 tons, and travelling upon twenty wheels along the east wall of the dock, this crane—the largest in the world—will be especially useful for the handling of heavy material required in merchant steamers, as well as for the removal of guns in the event of the dock being used by any of his Majesty's ships.

L. & N.W.R. Signalling.—Crewe Station is being fitted with signal boxes which will contain the finest electrical equipment of any signal cabins in the world. There are to be 500 levers in one of them, controlling the signals on the Manchester, Liverpool, and Holyhead main lines, and they will be manipulated by simple finger pressure.

An Electric Motor of the Ayrton and Perry Type.

By A. W. M.

THIS form of electric motor is probably unknown to a large number of the readers of THE MODEL ENGINEER, though by no means a novel form of construction. Patented in 1882 by the distinguished scientists and engineers, Professors Ayrton and Perry, it is one of the earliest machines of the type in which the field-magnet revolves inside a stationary armature. To anyone who has a fancy for making something different to the usual accepted patterns of dynamos and motors, it should be an interesting piece of work to undertake; whilst, owing to its compactness, it may be a useful design for an electric motor to go into a confined space; it would also serve very well as an experimental alternating current motor. The machine is really of very simple construction, and the winding and connections quite straightforward. The mechanical work requires some care and skill, but the electrical part is within the capacity of a novice to undertake.

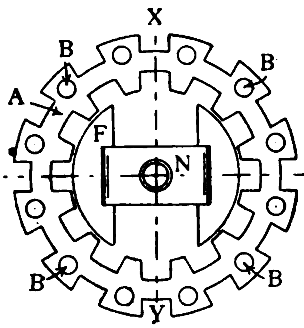
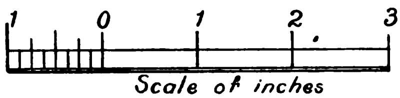


FIG. 1.—ARMATURE AND FIELD-MAGNET STAMPINGS.



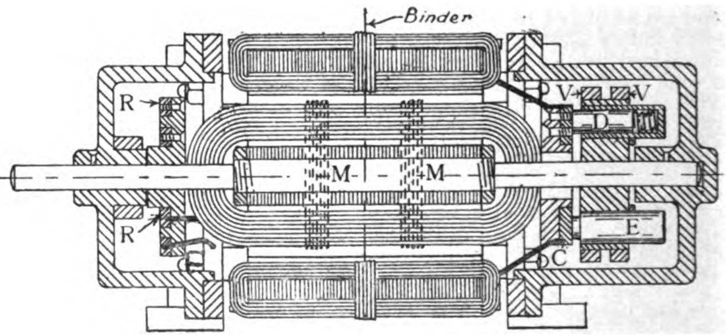


FIG 2.—SECTIONAL ELEVATION.

The armature consists of a toothed ring wound in the ordinary ring fashion, and connected to a commutator in the usual way. This commutator is fixed, and does not rotate (contrary to the general practice), but the brushes rotate instead; the effect, electrically considered, is exactly the same as if the commutator rotated and the brushes remained stationary. The field-magnet is precisely similar in shape to a Siemens shuttle armature, and is wound in the same way, the ends of the winding being connected to a pair of sliding contact rings, through which the current passes. A second pair of sliding contact rings are also necessary to convey current to the brushes if the machine is to be reversed from a separate reversing switch, and this arrangement has been adopted for the present design. The original motors were reversed by rotating the brushes through half a revolution in relation to the field-magnet, thus sending the current through the armature in a reverse direction; but on account of the mechanical difficulty of accomplishing this, the author has preferred to adopt the contact rings, which plan has also the advantage that the reversing switch can be placed away from the motor.

Referring to the drawings, Fig. 1 shows the shape of the stampings for A, the armature, and F, the field-magnet. The armature ring has twelve slots cut in both the outside and inside circumference, and is pierced with twelve holes to receive the bolts which clamp the stampings together. The field-magnet stamping is a simple H pattern, with a hole in the centre to take the spindle. The general construction of the motor is shown in Fig. 2, which is a sectional elevation on X Y, and in Fig. 6, which is a plan. Fig. 8 is an end elevation looking from the commutator end. The other drawings show various details.

Eight of the bolts which clamp the armature stampings together are used for this purpose entirely, but four marked B are used to hold the two brackets G in position. These brackets are made in the form of a flat ring (see Fig. 10), each having two feet, upon which the motor is supported. The bolts B are fitted with circular nuts H (Fig. 6), which assist in clamping the armature stampings, and act as distant-pieces to keep the brackets G at a distance to allow room for the ends of the armature windings. The bolts B pass through the brackets, and clamp them in place by means of the hexagonal nuts shown. The bearings K, which support the spindle, are each fixed by means of four screws to the brackets G, and are centred in place by the small ridges shown, which are turned concentric to the bearing centre, and fit into the interior ring surface of the brackets G, which is bored out concentric with the centre of armature tunnel.

Theoretically the bolts B ought to be insulated from the brackets G to prevent idle currents from being generated in them; but it introduces some mechanical difficulty, and the motor may be tried first without this precaution.

The field-magnet stampings are clamped together on the spindle by means of the flat nuts N (Fig. 1). Current is conveyed to the field-magnet coils through the metal rings R (Fig. 2), which are fixed upon a disc of ebonite or vulcanised fibre by means of small screws.

Fig. 4 is an end view of these rings and the disc, which should be driven tightly upon the spindle, and, if advisable, fixed by means of a small set-screw. Two spring contacts S (Fig. 6) rub one against each ring; they are fixed to an ebonite or fibre bar T (Figs. 5 and 6) by screws and nuts, as shown, the second nut on each acting as a terminal to which the battery wire is attached. The bar T is supported upon the boss of the bearing.

The brushes D (Fig. 2) are of carbon and slide in brass tubes E, which are carried in an ebonite or fibre disc P (Fig. 3), to which they are fixed by flanges and screws as shown. The disc is to be made a good fit upon the spindle, and fixed to it by means of a setscrew. The brushes are pressed against the commutator by means of coiled springs in the tubes.

Fig. 3.

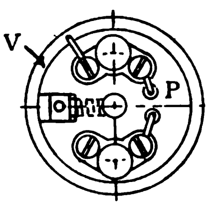
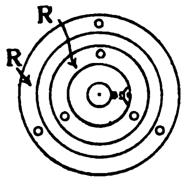


Fig. 4.



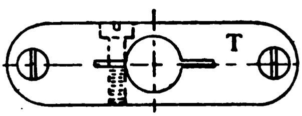


Fig. 5.

A pair of metal rings V (Figs. 2 and 3) are fixed to the circumference of the disc, each being connected to one brush tube. Contact is made to these rings by the springs W (Figs. 6 and 8), which are fixed to a fibre bar Q by screws and nuts. Current is conveyed to the armature through these springs. The second nuts act as terminals, to which the battery wires are connected.

The commutator C (Figs. 2 and 7) is of the disc pattern, and consists of twelve segments fixed to the fibre bar Q by means of small screws. The connections from the armature coils pass through the bracket G to the segments, as shown, and are either soldered to them, or small clamping screws may be fitted to the segments. The fibre bar Q is fixed to the bracket G by two screws, distance washers Z (Fig. 6) being placed behind it to determine its position. The field-magnet is to be provided with two grooves to receive the binding wires MM (Fig. 2), and the armature stampings are to be separated into two portions, being divided by an air space to allow binding cord to be wound round each of the coils to prevent them from spreading downwards into the tunnel and rubbing against the field-magnet; this air space is obtained by threading a washer L (Fig. 6), about 3-16ths in. or ⅛ in. in thickness, over each of the clamping bolts which pass through the armature core. The binding coils are clearly shown in Fig. 2.

It is important to clamp the armature stampings as tightly together as possible, or they will be liable to move and put the bearings out of line. The bearing at the commutator end is shown in the drawing as a thrust bearing, because the action of the brushes and contact springs S is to press the spindle towards this bearing, and it is advisable to prevent the fibre disc P from rubbing against the boss. To avoid disturbing the commutator, the spindle and field would be withdrawn, when necessary, at the pulley end of the machine. This can only be done by removing or slackening the disc P from the spindle; the hole into which its setscrew is recessed must, therefore, be made to open at the side away from the commutator, to permit of access to the screw-head as the contact rings V close the top of the hole. The screw-head is provided with a tommy hole, so that it can be turned to slacken and tighten it. The contact rings can be fixed by small screws tapped through them into the fibre disc—two in each ring.

The following materials are suitable:—Stampings for armature and field-magnet, soft iron; bearings and supporting brackets G, gunmetal; clamping bolts for armature, mild steel; contact rings and commutator segments, copper or gunmetal; contact springs, hard brass or copper.

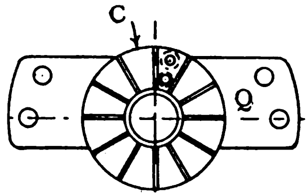
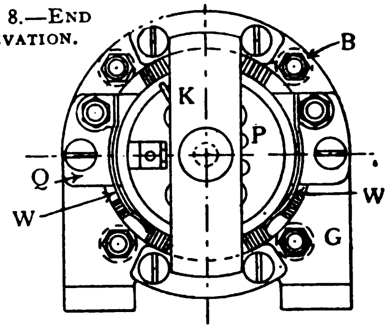


Fig. 7.

Fig. 8.—End Elevation.



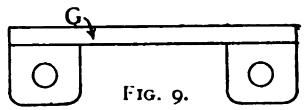


Fig. 9.

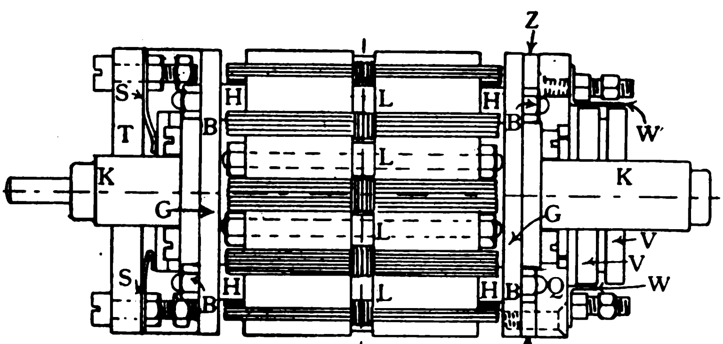


Fig. 6.—Plan.

spindle, mild steel; : nuts and screws, brass or iron.

The armature is to be wound exactly the same as an ordinary toothed ring armature, and connected to the commutator in the usual manner. The field-magnet is to be wound exactly the same as an ordinary Siemens H armature, the ends being connected one to the outer and one to the inner of the rings R. The insulation should be well carried out, to avoid taking the machine to pieces more than necessary, as its parts are not so easily accessible as those of an ordinary motor. Shunt or series winding can be adopted, the terminals being connected up in the usual manner.

The action of the machine may be considered to be this: When current is passed through the windings N. and S. poles are produced in the field-magnet and armature, those in the latter being at the points opposite to where the brushes press upon the commutator. If the brushes are set, as they should be, at a right angle to the field-magnet poles, the N. and S. poles produced in the armature core will be at a right angle to the poles of the field-magnet (see diagram, Fig. 12), which will be attracted by the armature poles, and move towards them; but in doing this the brushes rotate with the spindle, and move the armature poles continually in an onward direction. The field-magnet

FIG. 10.

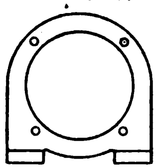
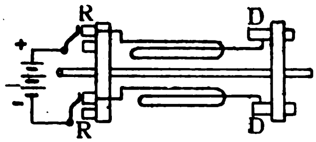
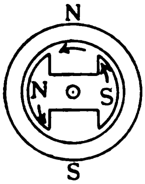


FIG. 11.





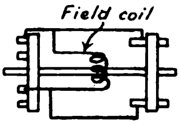


FIG. 12.

poles can thus never overtake the armature poles, and therefore the rotation continues. The experiment can be tried of running the machine, without winding, on the field-magnet, current being sent through the armature only, the brushes being given a certain amount of lead in one direction.

If not required to be used as a reversing motor, the contact rings V V and springs and terminals W at the commutator end may be dispensed with by adopting the system of connection shown in diagram (Fig. 11); the machine would then be series wound. It will be seen, by reference to the diagram, that the field coil is divided into two portions the ends which are not connected to the contact rings R (Fig. 2) are connected one to each of the brushes D; current then passes in, say, from the outer ring R through one-half of the field-magnet winding to one of the brushes D, then through the armature winding to the second brush D, back by way of the second half of the field-magnet winding to the inner ring R, and thence to the battery. The armature is thus connected in series with the field winding, the two portions of which must be so wound that they do not oppose one another, but are the equivalent of one large coil. The arrangement merely amounts to cutting one of the turns of a single large coil, and joining the ends to the brushes D.

A shunt winding would be arranged by carrying a wire from each of the brushes D along the field-magnet, and joining it to one of the rings R, the field coil then consisting of an uninterrupted winding having two ends each connected to one of the rings R, so that it is in parallel to the armature winding (see Fig. 12).

A convenient battery winding would be No. 20 gauge D.C.C. copper wire for the armature, and No. 18 gauge D.C.C copper wire for the field-magnet, the field coils being connected in series with the armature. A shunt winding for the field coil would be No. 24 gauge S.C.C. copper wire. The battery should give 8 or 10 volts, and current would be 5 or 6 amps. at full load. The motor could, however, be run with less volts and amperes, if not required to give out so much power; speed would probably be 2,000 to 2,500 r.p.m.

The following are suitable series windings for higher pressures:—

100 volts continuous current: Armature, No. 30 D.C.C.; field-magnet, No. 28 D.C.C. 200 volts continuous current: Armature, No. 34 S.S.C.; field-magnet, No. 32 S.C.C. 100 volts alternating current: Armature, No. 24 D.C.C.; field-magnet, No. 22 D.C.C. 200 volts alternating current: Armature, No. 28 D.C.C.; field magnet, No. 26 D.C.C.

The field-magnet and armature will each require about ½ lb. of wire, with continuous current; the motor may be reckoned to give about 1-25th b.h.-p. The alternating current windings are based on the assumption that the frequency of the supply is about fifty periods per second or less; with higher frequencies wire of about two gauges thicker would probably give better results.

The Junior Institution of Engineers.

THE programme of this Institution for the current Session includes the following papers and functions:—January 26th: "Some Notes on Boiler Trials," by Professor J. D. Cormack, B.Sc. (honorary member). February 2nd: "Some Recent Electrical Engineering Measuring Instruments," by Mr. Kenelm Edgcumbe, M.I.E.E. (member). February 10th: Anniversary Dinner in the Victoria Hall of the Hotel Cecil, the President in the chair. February 15th: "Architectural Design and Expression," by Mr. H. Heathcote Statham. March 2nd: "Gas Engine Indicators," by Mr. L. F. de Peyrecave, Stud.I.C.E. (member). March 10th: Conversazione; a lecturette on "The Evolution of the Man-of-War" illustrated by lantern slides kindly lent by the Navy League, will be given during the evening by Mr. C. Alfred Smith, B.Sc. (member). April 11th: Joint meeting with the Discussion Section of the Architectural Association, at 18, Tufton Street, Westminster (near the Church House and Westminster Abbey), commencing at 7.30 p.m.; paper on "Ferro Concrete," by S. N. Bylander, Mem.J.Inst.E. April 20th: "The Internal Combustion Engine as applied to Marine Purposes," by Mr. Francis J. Maddox, Stud.Inst.C.E. (member). May 11th: "The Structural Design of Factories," by Mr. Adam Hunter, Assoc.M.Inst.C.E. (chairman).

Notes on Locomotive Practice.

By CHAS. S. LAKE.

THE NEW GREAT WESTERN COMPOUNDS.

THESE locomotives have already been illustrated by diagram in these columns* and the principal dimensions given. It will not, therefore, be necessary to refer in detail to the leading characteristics of the design on this occasion, when, by the courtesy of Mr. G. J. Churchward, locomotive engineer. G.W.R., a photographic reproduction of one of the new engines appears. It will be agreed that these compounds present a very neat and well-proportioned appearance. We have become too well accustomed to the presence of outside valve gearing on our locomotives of late to suggest that No. 104 and her sister engines are in any way spoilt by a little extra complication of detailed parts, especially when it is remembered that the Walchaerts gear gives such fine results in distributing steam to the cylinders.

These new G.W.R. de Glehn locomotives have 2755·7 sq. ft. of heating surface—the highest used in Great Britain. This must, however, be attributed to the fact that the boiler is fitted with Serve pattern tubes.

HUGE BRITISH-BUILT LOCOMOTIVE FOR SOUTH AMERICA.

Messrs. Robert Stephenson & Co., Ltd., of Darlington, have just completed at their works a monster "Decapod" goods locomotive for the Argentine Great Western Railway. As they have kindly promised to supply the writer with a photograph of the engine very shortly with full particulars, detailed reference to the design will be deferred until the next issue of these notes.

In working order the engine weighs 123 tons, and is constructed for the 5 ft. 6 ins. gauge on which the Argentine G.W.R. is laid out.

Very elaborate arrangements were made for the locomotive's conveyance from Darlington to Liverpool for shipment. The transit was carried out on a Sunday, and the various parts of the locomotive were loaded upon a number of trolley wagons. As some parts, such as the engine framing and the tender, were of such proportions as to exceed the ordinary loading gauge in width, it was necessary to reserve both sets of rails so that no harm should accrue from the fact of the parts projecting beyond the normal width.

The "Decapod Special" left Darlington early on the Sunday morning, both tracks (as before said) being reserved throughout the entire distance of 150 miles. A maximum speed of 20 miles per hour was enforced.

A NEAT-LOOKING TANK LOCOMOTIVE.

Messrs. Andrew Barclay, Sons & Co., Ltd., have recently built two neat-looking side tank locomotives having the 4—6—0 wheel arrangement and generally large proportions, for the Dunderland Iron Ore Co., Ltd. The engines are for service in Norway, where the Dunderland Company's operations—or a part of them—are carried out.

* Page 159, MODEL ENGINEER, August 17th, 1904

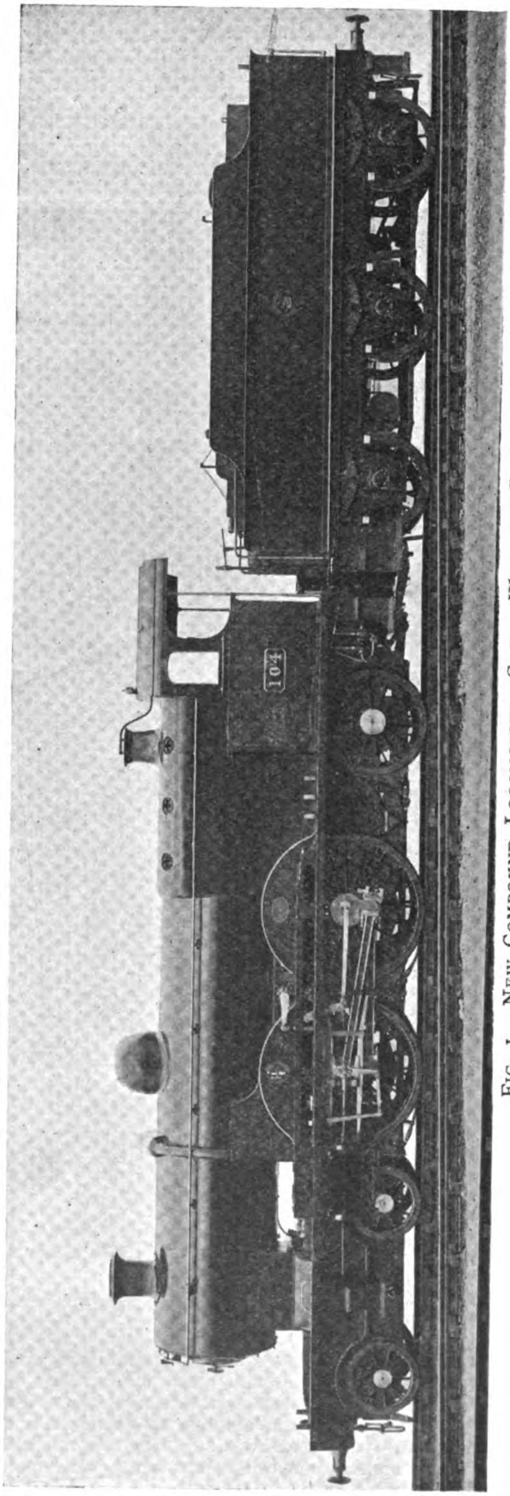


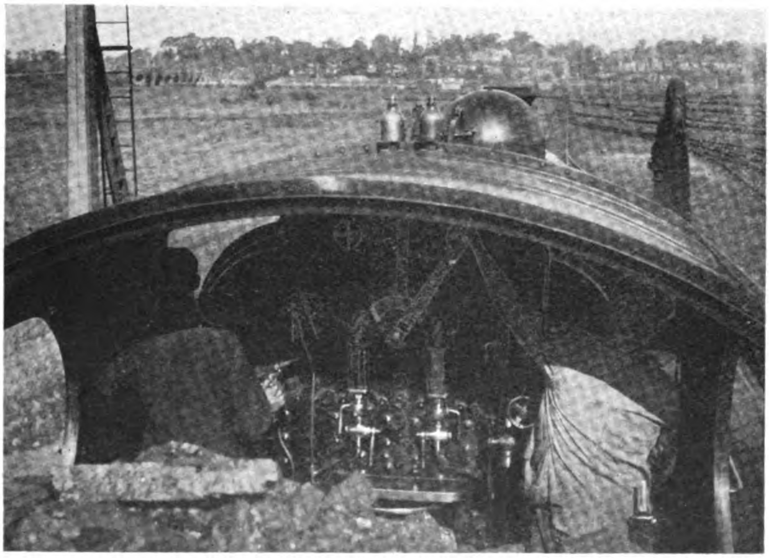
FIG. 1.—NEW COMPOUND LOCOMOTIVE, GREAT WESTERN RAILWAY.

The new locomotives possess an especially substantial appearance, whilst being, as before said, of neat outline. An illustration of the design will appear in the next issue of these notes.

Fine Work on the Great Central.

By courteous permission of Mr. J. G. Robinson, M.Inst.C.E., chief mechanical engineer of the Great Central Railway, the writer recently travelled upon the footplate of the locomotive hauling the "Sheffield Special" express, leaving Marylebone at 3.25 p.m. daily, and running through to Sheffield (Victoria) in 2 hours 55 minutes. As the distance is, roughly speaking, 165 miles, the average booked speed works out at 56·5 miles per hour. This speed is, however, considerably exceeded, as a rule, after passing Quainton Road Junction, where the Great Central trains leave the Metropolitan Company's tracks.

On the occasion referred to, the train, which consisted of six bogie coaches as far as Leicester (where two were slipped), left Marylebone terminus sharp to time, hauled by the "Atlantic" type locomotive No. 266, and driven by George Turner, of Gorton. Excellent headway was made as far as Aylesbury, which station was passed through at greatly reduced speed owing to the nasty **S** curve which has to be negotiated on the London side, but a signal check occurred near Waddesdon Manor, which resulted in the loss of very nearly a minute, all told. On clearing the Metropolitan tracks at Quainton Road Junction, the driver had 125 minutes in hand in which to cover the 120¾ miles intervening between this point and Sheffield. No difficulty was experienced in performing the work in two minutes less than this time, in spite of the slackenings at Leicester and Nottingham—the latter station being approached at a very moderate speed, there being some permanent way renewals in progress near Arkwright Street station. The total distance of 164¾ miles between London and Sheffield was covered by No. 266 in the net running time of 173 minutes, an average speed of just over 57 miles per hour. The "Atlantic" type engines designed by Mr. Robinson for the Great Central Railway have a large margin of power over that required on such runs as that referred to above, which was more a test of their speed capability. The writer has, however, had frequent opportunities of testing their hauling capabilities from the footplate, and has always found them equal to the tasks imposed upon them. The accompanying photographic reproductions, showing No. 266 at Neasden before starting, and passing that place *en route* for Sheffield at over 50 miles per hour, are from originals specially taken by Mr. A. J. Budd, of The Model Engineer staff (Drawing Office Department), by arrangement with the Editor, Mr. Robinson having kindly granted the necessary permission.



Engine No. 266 Leaving Neasden Sheds for Marylebone.

Train Robbery in America.

Railway and Locomotive Engineering, of New York, publishes in its issue for November, the following:—"The holding-up of a railway train by robbers is now getting to be a rare occurrence, but the hold-up of the Great Northern last month, near Ballard, Washington, shows that train robbery is not yet a lost art. The train was skilfully flagged, and when the engineer slowed up, two masked men presented revolvers while another deftly uncoupled the engine. The engineer was ordered to pull ahead about 200 yards. The express messenger refused to open the baggage car; a charge of dynamite was placed against it and the explosion blew the car nearly to pieces. Charles Anderson, the express messenger, was severely injured. The safe was blown up and about $50,000 fell into the hands of the robbers." This may be said to rival the most extravagant doings of the highwaymen who infested the public roads of this country in the "Good old coaching days."

For the Bookshelf.

The Bodie Book. By Walford Bodie. London: The Caxton Press, Ltd. Price 2s. 6d.; postage 3d. extra.

This is a handbook in which the author details his methods and his experiences in hypnotism, mesmerism, clairvoyance, telepathy, and kindred matters. Although written in a popular and occasionally sensational style, and savouring very much of self-advertisement, there is a good deal of matter of real interest in the book, and it is worthy of perusal by all who are attracted by the mysterious phenomena of animal magnetism.

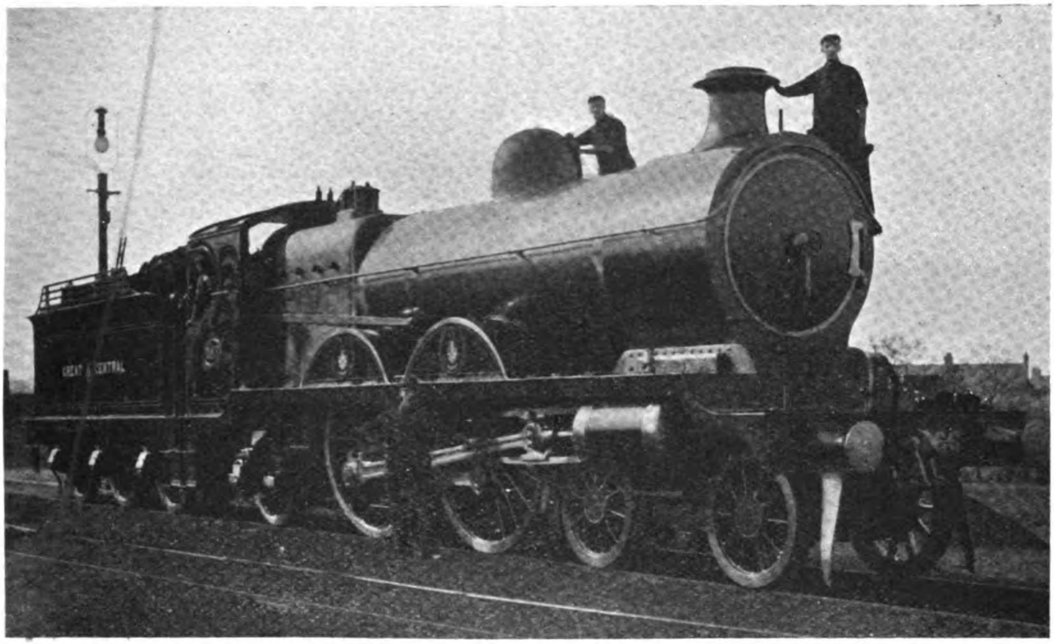


FIG. 3.—ENGINE NO. 266 AT NEASDEN SHEDS PRIOR TO TAKING THE "SHEFFIELD SPECIAL."

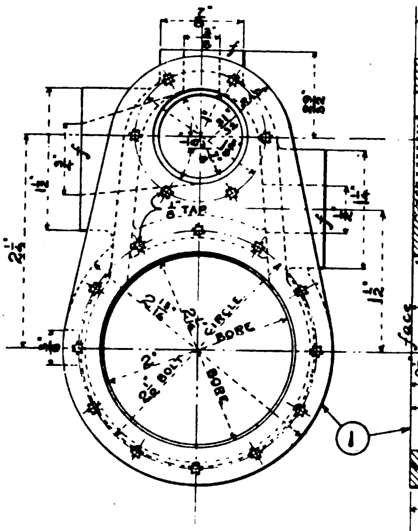
FIG. 4.—3·25 P.M. "SHEFFIELD SPECIAL" EXPRESS FROM MARYLEBONE, PASSING NEASDEN AT OVER 50 MILES PER HOUR.

A Design for a Model Automatic Cut-off Steam Engine.

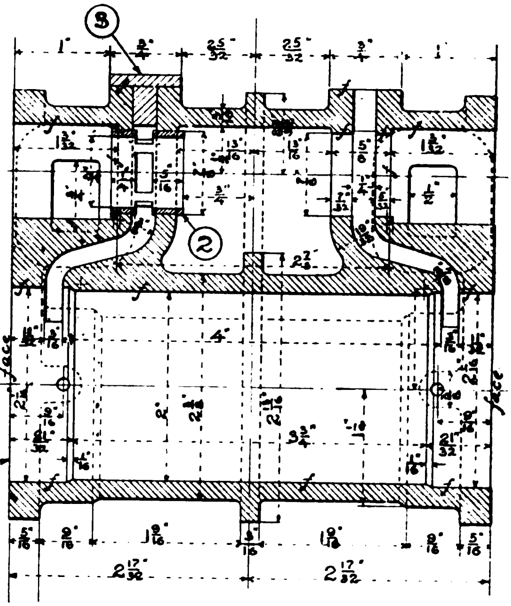
By P. D. Johnston (U.S.A.).

(*Continued from page* 515.)

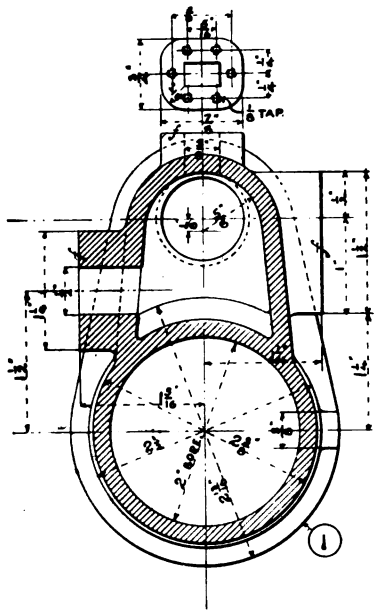
No. 1.—The cylinder and valve chest are included in one casting. This can be made either of cast



End View, Cover removed.



Longitudinal Section.



Cross-section.

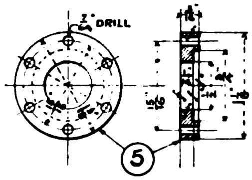
Details of Cylinder and Valve Chest.

iron or of hard bronze. The latter is to be preferred because it is more readily worked; it is easier to get a good casting with ports properly cored; and, lastly, because it resists corrosion.

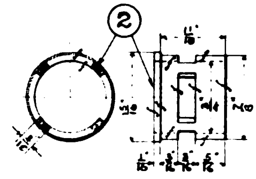
The pattern is not a difficult one to make, and involves no special rigging for properly machining. First, true one end, leaving metal for the final finish; clamp it to a true faceplate and carefully bore to size; then shift so as to bring the valve chest to centre, and bore each end and the seats for the valve bushings. Before removing from the lathe, see that the ports are correct, both as to position and width. Now turn a mandrel to fit the cylinder bore, place cylinder upon it, and face the two ends so that the ports are brought to correct position; also the over-all length to dimension. If a planer or shaper is available, the faces of bosses for exhaust Y and throttle-valve can be faced; also bosses for peep-hole covers, otherwise they can be filed.

The bore can now be "lapped" as follows: Take a piece of hardwood with straight grain, about 1½ ins. long; catch it in lathe chuck, steadying the other end with tailstock centre, and turn to neatly fit bore of cylinder; split this longitudinally through the centre with a saw about 6 ins., and fit a wedge in the saw-cut; put the cylinder on this stick, and while running the lathe apply oil and powdered glass or fine emery—preferably the former—at the same time moving the cylinder back and forward along the stick or "lapp," occasionally driving the wedge as the wood wears away. The cylinder should be reversed from time to time as the grinding proceeds, to ensure parallelism of the bore; and, further, it should be carefully measured. A few minutes of this treatment will give the cylinder a beautifully finished and true bore.

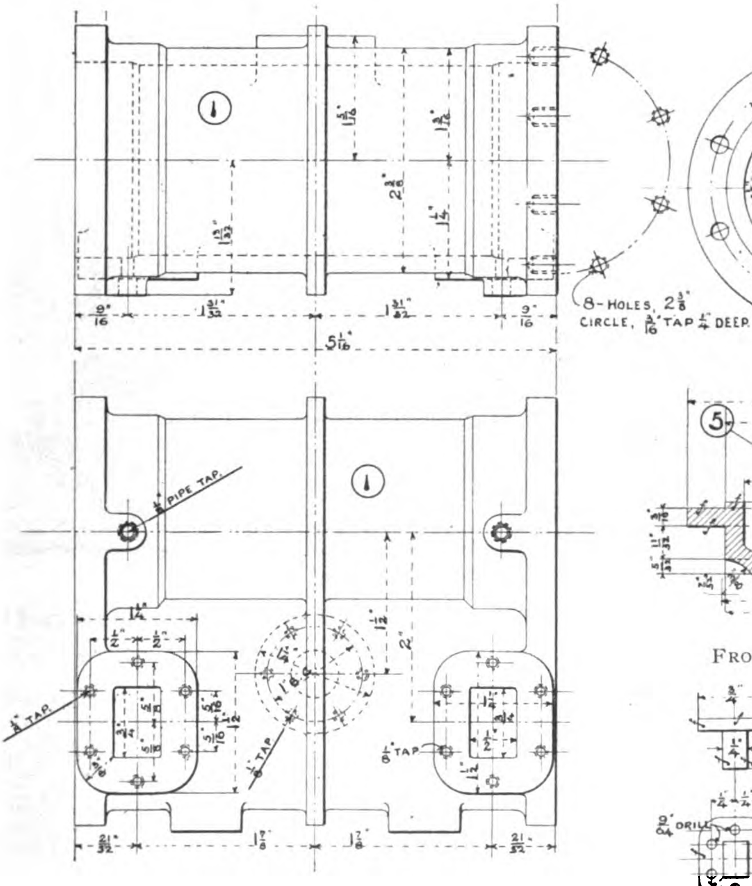
No. 2.—Valve bushings are made of hard bronze. First bore to within ·01 of an inch of size, and mount upon a true mandrel and turn the outside to dimen sion, fitting to the seats in valve-chest, so that they will draw to place, making a tight joint by means of a $\frac{1}{4}$-in. bolt with washers; these washers should be turned with a projection to fit into the bore to ensure their being seated squarely and the bolt pulling centrally. Before removing the bushings from the mandrel, mark with a pointed tool accurately two lines to locate the ports, drill and file the ports to dimension. The bushings can now be drawn to place in the valve chest, using for a lubricant a very thin coat of red-lead in linseed oil, being sure that the opening of the port and not a bar comes opposite the peep-hole. These bushings should be drawn solidly to place to ensure accurate spacing of the ports. The last step will be to lap out the bushings, using the same method as described for the cylinder.



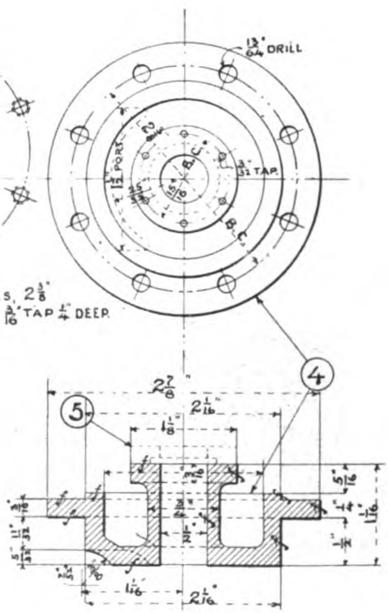
GLAND.



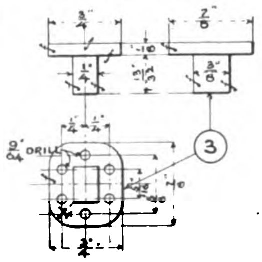
VALVE BUSHINGS.



ELEVATIONS AND PLAN OF CYLINDER CASTING.



FRONT CYLINDER HEAD.



PEEP HOLE COVERS.

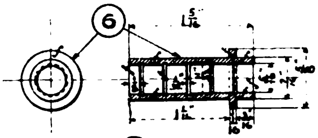
No. 3.—Peep-Hole Covers: Finish to dimensions and fit in place, drilling for bolts at positions shown. These can be used as templates to drilling and tapping holes in steam chest. To do this, put the covers in place, using the drill with which the holes were drilled in the covers; through these holes sink the point of the drill in the steam chest deep enough to ensure the tapping drill following without running, remove covers, run in the tapping drill and tap. Now bolt the covers in place, and with a file dress the edges and bosses to size until they correspond in shape and dimensions.

No. 4.—Front Cylinder Head: Material, bronze, finished where marked *f*, and to the dimensions given. The hole for packing sleeve should first be bored, and a mandrel fitted, and the remaining parts or surfaces should be machined in the lathe. Before removing from mandrel a circle for bolt centres should be marked with a fine tool. After removing from mandrel, space out and drill the bolt holes in the flange. Now fit head to cylinder and through the bolt holes with the drill mark for bolts in cylinder flange; remove head, and drill and tap bolt holes in cylinder flange.

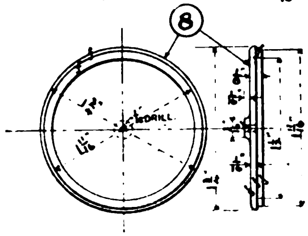
No. 5.—The gland can be finished complete, as far as lathe work is concerned, at one setting.

Catch a rod of bronze in the chuck, bore the hole in centre, and finish completely the face that goes against nozzle of cylinder head; also sink for flange

Sleeve Bush.

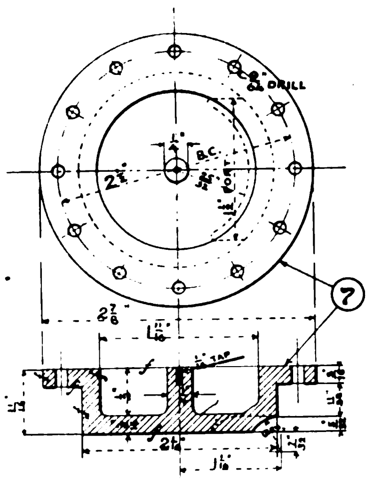


Cylinder Head Cover.



of sleeve, being sure to get the surfaces as nearly perfect as possible. When this is done, cut off with parting tool, lay out and drill bolt holes, and,

Back Cylinder Head.



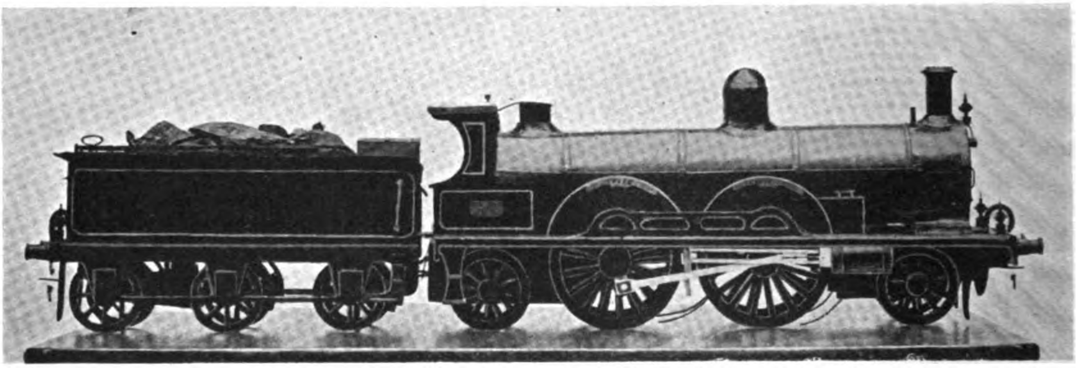
using as template, mark off, drill, and tap holes to match in nozzle of cylinder head.

No. 6.—The sleeve, or floating bushing, should be finished carefully all over of hard bronze. The outside diameter is slightly smaller than bore in cylinder head. The flange should be very carefully finished on both faces, and should be of such thickness that when bolted in place by the gland it will not cramp: it should be capable of movement without being slack. The outside, of course, will be done on a true mandrel. The bore, which is the first operation, must be carefully done, and the grooves for water packing turned in. Finally, the bore should be very carefully lapped.

No. 7.—The back cylinder head should be made of bronze and finished as shown, and to dimensions given. It should be drilled and used as a template, by which to drill the rear flange of cylinder. The 1-16th-in. tapped hole in the centre is for the screw to hold the cover in place.

No. 8.—The cylinder head cover is used only as a finish. It also, by retaining air in the space or dish of cylinder head, forms a good insulation, as dead air is a good non-conductor of heat. It should be nicely polished.

(*To be continued.*)



Mr. N. F. P. Pigott's Cardboard Model Locomotivf.

A Cardboard Model Locomotive.

By N. F. P. Pigott.

I ENCLOSE a photograph of a model which I have just completed. The scale is an inch to the foot, and it is a model of a No. 2,054 "Queen Empress"—one of the 7-ft. 8-wheeled compounds on the L. & N.W.R. The engine and tender are constructed chiefly of cardboard and wood, the length over buffers being 4 ft. 4½ ins. The frames were cut from stiff "strawboard," and the boiler is an old picture tube cut down to required length. The cylinders are empty incandescent gas-mantle boxes, the slide-bars and connecting rod being of scrap pieces of wood. The buffers and funnel-cap are the only parts turned in a lathe, the funnel itself being a cardboard tube with a base moulded out of clay, as is also the base for the safety valve. The dome is built up of clay on a wooden frame. The engine and tender are painted and lined out in standard L. & N.W. colours, the lining being put on in the shape of strips of thin paper painted in proper colours and glued to the engine; this plan being easier for one unused to painting fine lines.

Home Electric Lighting.

By Cyril N. Turner.

(*Continued from page* 447.)

LEAVING cells in a run-down state brings on sulphating to a great extent and spoils them. The acid in a cell must never be allowed to get below the top of the plates; it is well to keep the solution ½ in. above them. When the acid gets low it must be made up with distilled or boiled water, and not with acid, as the sulphuric acid does not waste either by evaporation or electrolysis, except in a very small proportion indeed in comparison with the evaporation of the water. Acid should only be added when the hydrometer shows that the specific gravity has become low when the cell is fully charged.

The spray from an accumulator during gassing having a very corrosive action, no metal work should be unprotected in the accumulator room or cupboard, as the case may be; the bolts that join the lugs of the accumulators together should be well coated with vaseline. Curved pieces of glass are often used to form a spraying screen, and laid across the top of the cell, so that the spray is collected on the glass and drips back into the accumulator again.

Condensation is apt to form on the outside of the cells, and as the acid may also creep over the sides and so form a path for some of the current to leak away through this wet conductor, it was a very general plan to place each cell in a tray about 2 ins. deep, filled with sawdust, which absorbs the moisture, the tray is then stood upon three or four glass insulators which have in them a little resin oil, which does not evaporate (see Fig. 9). By this method perfect insulation is obtained.

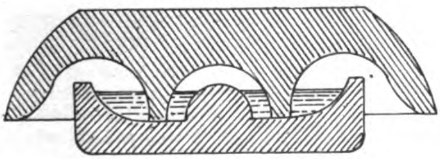


Fig. 9.—Section of Glass Insulator.

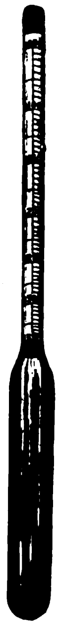


Fig. 10.

A very good and effective way for small installations is to coat the top edges of the glass cell all round with vaseline, as it is evident that the acid cannot creep over the edge of vaseline, and thus electrical leakage is prevented.

No part of the accumulator switchboard should be in the same room or cupboard with the accumulators, for the reason before stated—*i.e.*, corrosion induced by fumes. The specific gravity of the acid is tested by a hydrometer; Fig. 10 illustrates a type in very general use. When charging begins it is noticeable that from some cause or other for a little while the hydrometer sinks a little; however, as the charging goes on its gradually recovers and rises.

If one cell of a battery of accumulators seems lower in capacity than the rest, and nothing internally seems wrong, it should be cut out of circuit

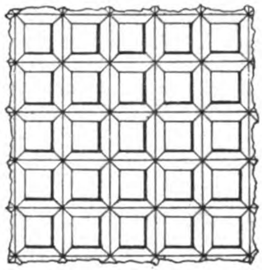


Fig. 11.

Fig. 12.

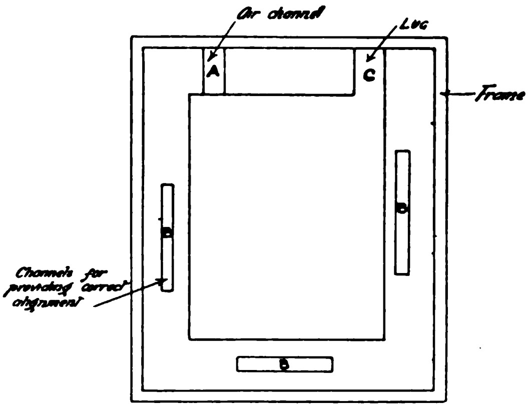


Fig. 13.

Constructing Accumulator Grids.

when the discharge commences; and when the other cells have got down to the same specific gravity, it may then be connected up again for the charge: by this means all the cells are equalised.

If the acid for the accumulators is obtained in a glass carboy which is packed round with straw in a wicker-work crate, it is difficult to keep dust, dirt, and bits of straw from falling into the receptacle for mixing when pouring out. Get a piece of old sacking and cut a hole in it so as to fit tightly over the neck of the carboy, and by spreading the cloth over the basket it prevents the admission of rubbish.

Now for a few hints on accumulator construction. When calculating the dimensions of the plates for the capacity required the amateur should be governed by the standard sizes of glass boxes that are stocked by dealers, as it is next to impossible to obtain odd sizes to suit a random-sized plate, unless specially made, the price in this case being prohibitive for the average amateur.

When the suitable size of the plates is decided, the mould for casting the lead grids can be made. No other way is so cheap when a number of these grids are required, as that given in The Model Engineer Handbook No. 1 on "Small Accumulators."

On the smooth, flat surface of a slab of Keen's or Parian cement (not plaster of Paris, as that is inclined to quickly perish with the heat of molten lead) of sufficient size to allow a 2½-in. margin around the grid, carefully mark out the lines as in Fig. 11, and with a fine chisel proceed to cut away the plaster around the squares, bevelling it off to a depth of 1-16th in. or more, according to the size and thickness of the proposed plates.

A pouring hole is made at C (Fig. 13), which also forms the lug of the plate; an air-hole at A, and a few grooves at B, B, B, or at such places as would be convenient for aligning the other half of the mould when fixing in position for casting.

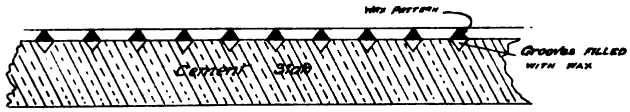


FIG. 14.—SECTION THROUGH MOULD.

To complete the mould an exact counterpart of the half already obtained must be made. This can be easily accomplished by filling up all the grooves (except those marked B) with heated paraffin wax, pressing this into position with the fingers, and scraping it off level with the surface of the mould, thereby forming a pattern of one-half of the grid. When the wax is cool, and perfectly hard, the whole impression may be removed by inserting a pin at one corner. Again the grooves must be filled with paraffin wax and scraped clean and level with the surface. The first impression

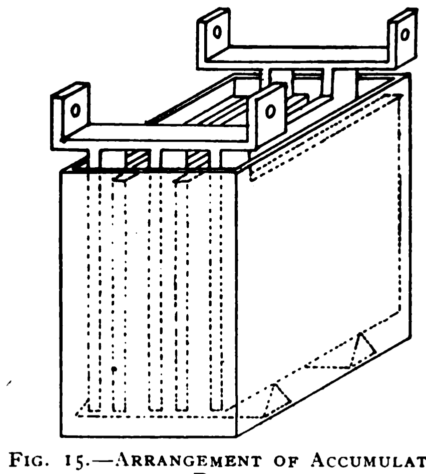


FIG. 15.—ARRANGEMENT OF ACCUMULATOR PLATES.

should be laid on its back on the wax at present in the grooves (see Fig. 14), and the whole mould covered with a thin coat of shellac, care being taken to keep the wax pattern in position.

After building a wall of wood or heavy card-board around the mould to a convenient height, the plaster can be poured in. When the plaster becomes hard and dry (and on no account before) the mould may be taken apart, all wax removed, the halves wired together, and the casting of the plates proceeded with. In casting plates, pure lead must be used, also a clean ladle. Fig. 12 is the section of a grid when cast.

Sufficient grids being cast, the positive plates should be pasted with a mixture of red lead and dilute acid, specific gravity being 1·175.

The paste should be mixed to the consistency of butter (only sufficient being mixed for each plate at the time), and pressed into the grid, which lies on a sheet of thick glass; when that side is evenly pasted it is turned over and the other side treated in the same way.

Negative plates should be pasted with a mixture of litharge and dilute acid (sp. gr. 1·175). The pasting process of the litharge must be done as quickly as possible, as it sets very rapidly, but it must be done well. The plates must now be stood up to dry for a full week, or even longer, in a warm place. This effective drying is one of the chief points to be remembered in the construction of accumulator plates; or else if the immersion of the acid and the "forming" process is started without the plates having first thoroughly dried, the paste falls off the grids. The negative plate need only be pasted up to about 3-16ths in. in thickness, but for the positives it is advisable to coat up to full ¼ in. in thickness. The plates should now be arranged for the cells—of course, having one

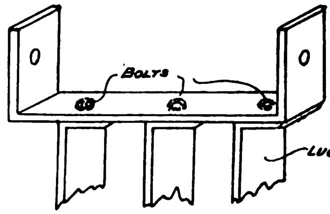


FIG. 16.—CONNECTING LUGS TO TERMINALS.

more negative than the positives, for the reason before stated. The plates should be separated by narrow strips of paraffined wood, ¼ in. to 5-16ths in. square standing vertically. The plates must stand on two bevelled pieces of well-paraffined wood 1½ ins., being none too much clearing space, and they (the plates) should be so arranged that all the positive lugs are on one side and the negatives on the other, each set being coupled to a separate terminal. Fig. 15 will show plainly the arrangement.

Various methods are employed for connecting the set of lugs to a common terminal, the lead lugs in most cases being burned or soldered to a lead strip, but this is a difficult job for the average amateur; the easiest way is for him to join each lug to a common lead strip by bolts (see Fig. 16). There is one advantage in this arrangement, as each plate may at any time be uncoupled and lifted out for inspection if necessary without disturbing the others. These bolts and nuts must be well dressed with vaseline after being screwed up, to protect them from the corrosive action of the acid spray and fumes. The lead strip should be long enough so as to turn up at each end to connect the cells together by bolting the *proper* lug of one cell to that of the next (the end of the lug not used being bent back out of the way).

(To be continued.)

Practical Letters from our Readers.

[*The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a* nom-de-plume, *if desired, but the full name and address of the sender* MUST *invariably be attached, though not necessarily intended for publication.*]

A Model Maker's Machine

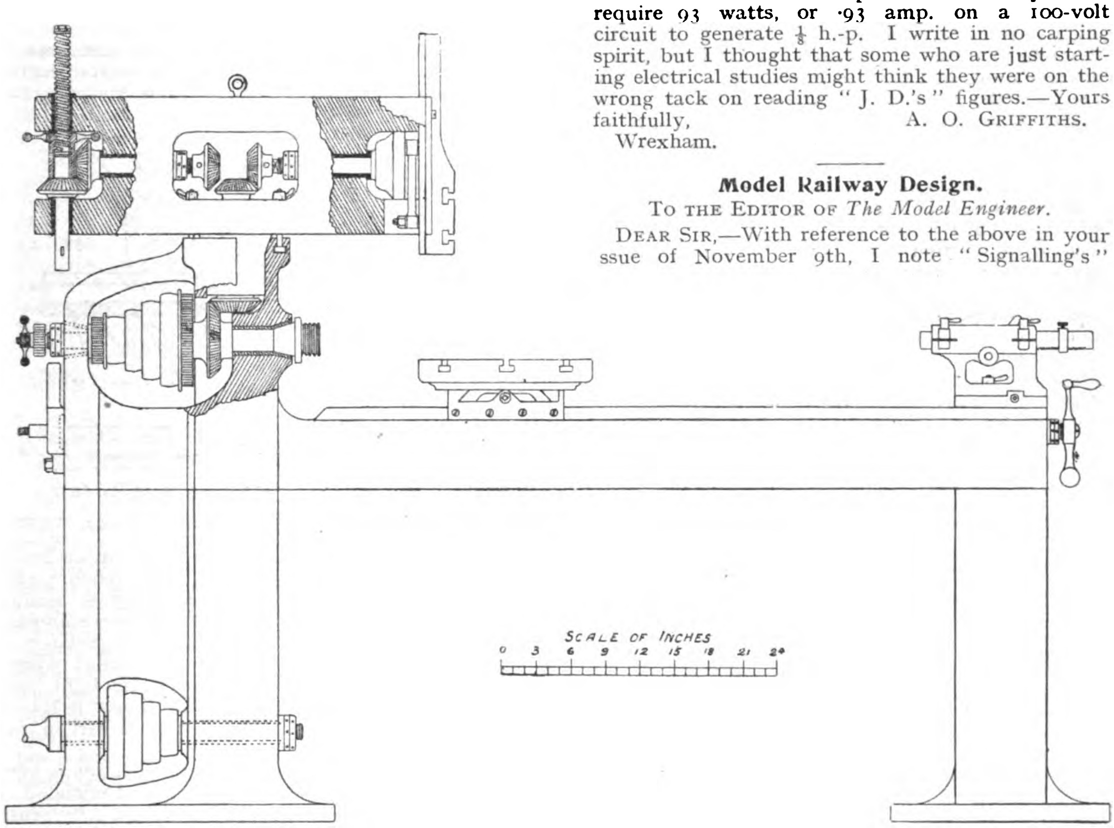
To the Editor of *The Model Engineer.*

Dear Sir,—I enclose a drawing of a machine I have just protected as the "Model Maker's Machine." Should it meet with your approval, I would be glad if you could grant it a little space for publication which might secure me an offer for the design.

I consider it a very handy tool for model makers, also men who are starting in a small way to make motor repairs, as it would be economical and require but little space; it could also be purchased in sections. It will do all the work of a lathe, slotter, driller, vertical and horizontal miller—all working on one bed and by one belt.

I have made further alterations in the design. The pulley pedestal is extended so as to come under the ram of the slotter. The table is to revolve by means of a handle and worm, and can be lifted on and off the slide-rest foundation as required. Another advantage that might be pointed out is the absence of bolts and nuts, which would require spanners to put the combination into and out of gear. By simply unscrewing two thumb-nuts the whole attachment can be lifted clear away from the lathe, if required.—Yours truly,

Dublin. W. F. McCullagh.



Mr. W. F. McCullagh's Design for a Model Maker's Machine.

Rating of an Electro-Motor.

To the Editor of *The Model Engineer.*

Dear Sir,—I write just to correct one slip which occurs in a description of an electro-motor by "J. D." in your issue of November 2nd. He rates it at $\frac{1}{8}$ h.-p., although it only takes ·25 amp. on a 100-volt circuit. A little calculation will show that a motor of even 100 per cent. efficiency would require 93 watts, or ·93 amp. on a 100-volt circuit to generate $\frac{1}{8}$ h.-p. I write in no carping spirit, but I thought that some who are just starting electrical studies might think they were on the wrong tack on reading "J. D.'s" figures.—Yours faithfully, A. O. Griffiths.

Wrexham.

Model Railway Design.

To the Editor of *The Model Engineer.*

Dear Sir,—With reference to the above in your issue of November 9th, I note "Signalling's" diagram for station "B," and am much obliged for the same, but owing to the space available, which is very limited—the distance being only 5 ft. 4 ins. between the points 6 and 12—I cannot very well get all the signals and the trap points into so small a space.

The errors pointed out are as stated, and I think this is owing to a mistake made when printing, as, on referring to my original letter and plan, the latter was correctly drawn, and the remarks placed against the signals accordingly.

Would "Signalling" kindly send me a correct signal diagram for station "A," either through the columns of your paper or addressed to me privately.—Yours faithfully, "Midland."

The Electric Arc Lamp.

To the Editor of *The Model Engineer.*

Dear Sir,—Your correspondent "A. W. M.," in his able article on arc lamps, seems to suggest that no lamp has been made with carbons simply in contact. He says "No lamp is used under these conditions." But surely he forgets the "Soleil" lamp, which has two small carbons projecting through a block of marble, and touching each other in small hollow or crater in the marble. This lamp gives a very soft light; and there are still a few about. Hoping this letter will not offend "A. W. M.,"—Yours truly,

Manchester. E. M. Mumford.

To the Editor of *The Model Engineer.*

Dear Sir,—In reply to Mr. Mumford, my article is intended to be an explanation of the working of electric lamps in which an electric arc is used, and therefore the remarks to which he refers should be regarded as applying to this kind of lamp. A lamp using carbons in contact would not be an arc lamp: this is precisely the point which I emphasise in my explanation.

However, Mr. Mumford is mistaken with regard to the "Soleil" lamp, or "Sun" lamp, as it is also called, from the colour of the light which it gives. This lamp, invented and produced some twenty-five years ago, *is* an arc lamp. The carbons do not make contact; on the contrary, auxiliary means to strike the arc are provided, as the carbons do not touch even for this purpose. The principle upon which the Soleil lamp works is as follows: The carbons are so placed that the arc produced between their points can play across and impinge

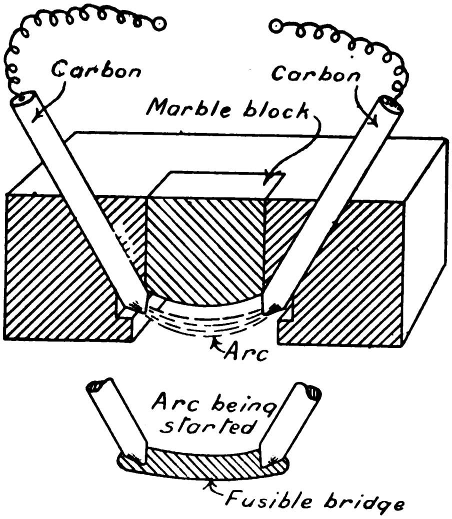


Fig. 1.—Diagram of Soleil Lamp.

against a block of marble or compressed magnesia; the rays of light emitted at that side of the arc are absorbed, and then given out again by the incandescent marble or magnesia, and, mingling with the remaining light of the arc, produce a beam of soft yellow tinged light. The method is like that of the oxy-hydrogen limelight, the electric arc taking the place of the gas-jet flame; the accompanying sketch will explain. The carbons fit loosely in a block of some insulating material of an incombustible character, and feed by gravity or springs as they burn away. They are supported at the lower ends by the insulating material. The arc is started by means of a fusible bridge placed across the marble block between the carbon points before current is switched on.

Modifications of the Soleil lamp have been produced by other inventors. The second sketch will explain a form in which the carbons are placed horizontal. The arc is struck by means of a small sliding rod of carbon, which passes through one of the carbons made hollow for the purpose. The rod is thrust through this carbon until it touches the other one; current then flows; the rod recedes back into the hollow carbon, drawing the arc with it. The arc then transfers to the point of the hollow carbon, and the rod is, for the time, out of action until the arc requires to be started again. Both sketches are sections taken through the centre of the marble block.

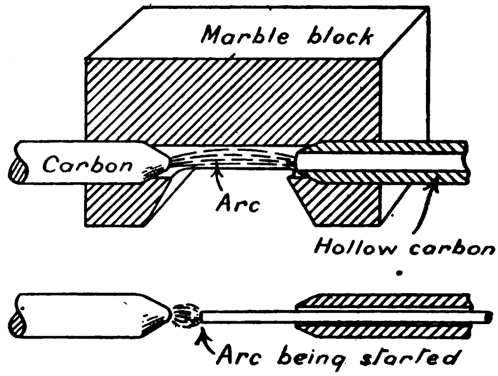


Fig. 2.—Modified Soleil Lamp.

If Mr. Mumford will examine the lamp he refers to when burning, and look at the carbon points through a piece of dark red or blue glass, he may be able to see the arc, and note if the carbon points are separated: if they are in contact, the lamp is either out of adjustment or is some different pattern depending upon incandescence for its light, and therefore not an arc lamp; but I doubt if this is so. The length of the arc is exaggerated in my sketches.

In conclusion, let me say that his letter is very interesting to me. So far from being offended, I thank him for it, and reciprocate the kindly sentiment conveyed. Some features of the Soleil lamp seem to be reappearing in arc lamps of recent introduction. It is certainly an idea having considerable merit, and worthy of attention.—Yours faithfully, A. W. M.

A Reader's Work.

To the Editor of *The Model Engineer.*

Dear Sir,—The photographs herewith are of a model steamboat which I constructed from my own design. I bought the engine and boiler and some of the fittings; but all the woodwork and tinwork I did myself. It took me three months to complete, working at odd times.

The boat is 30 ins. long, 5 ins. mean depth, and has a beam of 4 ins. She was built out of six sections "bread-and-butter" style, each section (starting with the bottom section) is screwed and glued together. I made the deck with ash, and cut two holes in it; one for boiler, as it protrudes a little above the deck, and the other to get at the engine. There is a water-tight cover to the engine-room, which is partly covered by the skylight, which is shown in the photo. The boiler is 3½ ins. by 6 ins., and has one central flue. It is fitted with a pressure gauge working up to 45 lbs., with a safety valve that blows off at 15 lbs., with two gauge cocks, the lower one blowing off into the water.

The engine is slide-valve, and the dimensions are 1 in. by ¾ in.; the total height is 3½ ins. The exhaust steam shoots out just above the water. She is fired by a four-wicked spirit lamp, which holds about half-a-pint, and I can raise steam in nine minutes, from cold water. The spirit lamp is protected by a thin wire gauze which permits enough air and does not let the flames blow back, and so confines all the heat to the boiler. I bought the gun and mounted it. All the turtle-back and gun shield are made of tin soldered together.

The propeller is three-bladed, 1¾ ins. diameter, and is distant from the boat ¾ in.; this revolves at about 1,000 revolutions per minute under pressure of 5 lbs. The boat is steered with a steering-wheel, and has a compass and an engine-room telegraph, which may be seen in the photo. She has two lamps and a lifebuoy, is painted salmon-pink below the water-line and grey above, and, in every way has fulfilled my expectations, going at about two miles an hour under 5 lbs. pressure. The engines I purchased ready for use, and they have been very successful.
—Yours truly,
Hove. B. W. PUCKLE.

THE MILAN INTERNATIONAL EXHIBITION, 1906.—In connection with the exhibition to be held at the end of next year, H.M. the King of Italy will offer prizes to the extent of £1,600 to exhibitors. This amount will be divided as follows:—(1) A prize of £200 for automatic safety couplings for railway rolling-stock. (2) A prize of £200 for the best method of testing high voltage electric currents without danger to the operator. (3) A prize of £400 for the best and most original exhibit of machinery or manufacturing process. (4) A prize of £200 for the best established method of distributing healthy and pure milk in centres of population. (5) A prize of £400 for the best type of popular dwelling adapted to the climate of northern Italy. (6) A prize of £200 for motor boats. In addition to the foregoing, a national prize of £200 will be given to the public institution or private society which, during the last ten years, has been most successful in the work of reclaiming waste lands in mountainous districts, and in the improvement of pasturage. These special inducements to exhibiting will doubtless possess attraction for British manufacturers, inventors, and others, who should, without loss of time, address themselves for further particulars to Mr. Arthur Serena, Hon. Executive Commissioner of the British Section, 1 and 2, Oxford Court, Cannon Street, London, E.C.

The Society of Model Engineers.

[Reports of meetings should be sent to the offices of THE MODEL ENGINEER *without delay, and will be inserted in any particular issue if received a clear nine days before its usual date of publication.]*

London.

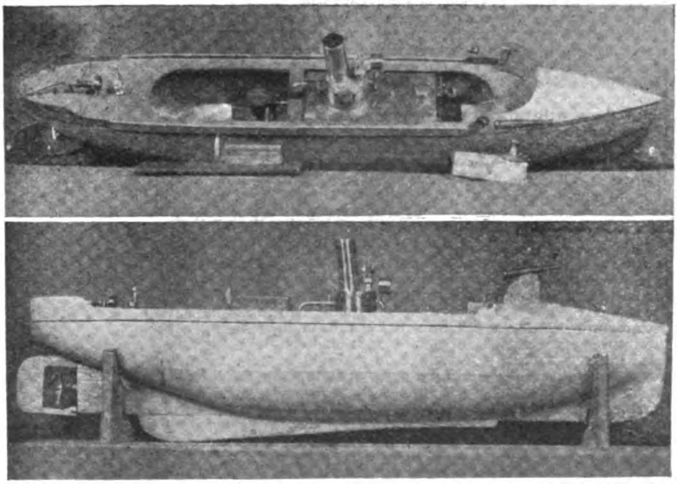
FUTURE MEETINGS.—The next ordinary meeting will be held on Thursday, December 7th, at the Holborn Town Hall. Paper by Mr. J. Glover, "Motor Cars Past and Present."

The seventh Annual Conversazione will be held on Friday, January 12th, 1906.

Readers wishing to join the Society are requested to communicate with the Secretary immediately, so that they may reap the full benefit of their subscription for the new Session just commenced.—HERBERT G. RIDDLE, Hon. Sec., 37, Minard Road, Hither Green, S.E.

WIRELESS NAVIGATION.—An interesting experiment was carried out at Bilbao recently in the outer harbour. It consisted in driving and steering a boat by electric power stationed some distance away; that is to say, the propellers were worked by electric waves transmitted without wires. The inventor, Senor Torres Quevedo, considers it feasible to apply his system to aerial navigation.

THE STANLEY CYCLE SHOW.—The chief features of the Stanley Cycle Show this year would appear to be new two-speed gears and improvements in brakes and accessories. However, the exhibition on the whole was interesting. Messrs. C. W. Burton Griffiths & Co., of Ludgate Square, E.C., had a very fine show of small tools; and Mr. C. C. Wigg, of Canbury Avenue, Kingston-on-Thames, who makes a speciality of castings for small-power gas engines, exhibited two well-made machines of ¼ h.-p. and ½ h.-p., respectively, and several dynamos. Amongst the electrical firms, Messrs. Bowen & Odery's (5, Nelson Street, Greenwich) exhibit, consisting of accumulators, coils, rectifiers, and other ignition accessories, was worthy of note.



MR. B. W. PUCKLE'S MODEL STEAMBOAT.

Queries and Replies.

[Attention is especially directed to the first condition given below and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-hand corner of the envelope "Query Department." No other matters but those relating to the Queries should be enclosed in the same envelope.

Queries on subjects within the scope of this journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied, wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed, and also a "Queries and Replies Coupon" cut out from the advertisement pages of the current issue. (4) Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor,* THE MODEL ENGINEER, *26-29, Poppin's Court, Fleet Street, London, E.C.]*

The following are selected from the Queries which have been replied to recently:—

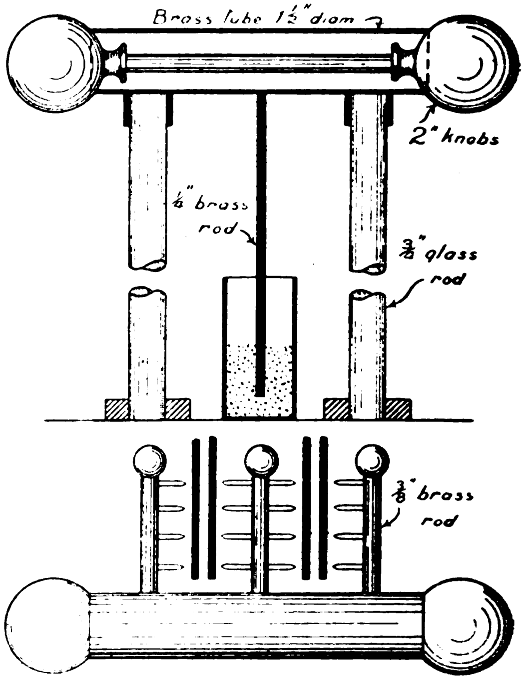
[15,039] **Flickering of Gas from Acetylene Generator.** H. R. S. (Streatham, S.W.) writes: I have an "Ever Ready" acetylene generator. Enclosed is a plan of it (not reproduced). I use this for generating gas for a four-burner jet used in a lantern, but am troubled very much by one fault. I should be much obliged if you could help me. After the jets have been burning for about three-quarters of an hour, they start flickering. This, I have found out, is caused by water accumulating in the pipe below the tap marked D on plan, as when I take off tubing, which connects the generator to jet, and then let the gas escape from the generator by turning on tap D, I can hear the water there; and some of it is blown out. If I blow down the tube and clear the water out, and connect up to jet again, it burns all right. Of course, this is not practicable in the middle of a lantern lecture. I have put a purifier, consisting of tube filled with cotton-wool and bleaching powder, in series between generator and jet, but, of course, this does not prevent the water still accumulating in the same place. I have turned up all the articles in the *M.E.*, and have also read handbook on Acetylene, but cannot find any mention of similar fault with any other generator. Do you think it is because the gas is drawn off too near the surface of water, or could it be got over by bringing tube straight out from generator and making trap to catch water, as written in on sketch, filling tube with cotton-wool? I hope you will be able to suggest something to remedy this, as it is impossible for me to work lantern. I want it for about one-and-a-half hours at a time. This flickering is so bad that it is impossible to use generator as it is now.

The trouble you experience is due to your having too much water in the lower tank. The water level is then too near to the outlet pipe, which becomes wet from the spray caused by the falling carbide and the spitting of the bubbles during generation. The passage of the gas through the pipe gradually carries this moisture with it until sufficient is accumulated in the small passage to cause the trouble you mention. The remedy is obvious—keep the water-level lower. Another effective remedy would be to introduce a few drops of oil, which will at once spread and form a thin film over the surface of the water, and effectually reduce the splashing and spitting, and your trouble will cease. If you grease the inside of the outlet pipe with a little vaseline, by means of some worsted wound round the end of a wire, it will effectually prevent wet from creeping up the pipe. We shall be pleased to hear from you that you have found the oil-film dodge successful. If you use two 30-litre "Kona" burners on your jet, you will find them superior in effect to four of the common nipples, and, being non-carbonising, they can be turned down as low as you like, and for any length of time; and 1 lb. of carbide will keep them in full blast for two hours. We prefer to use these two burners on our four-burner jet. These burners are sold at the "Veritas" Works, 83, Farringdon Road, E.C. There is no need to purify the gas when using "Kona" burners.

[14,995] **Accumulators.** "NOVICE" writes: I wish to make a battery of accumulators for lighting a 50-volt circuit, and as I have plenty of electrical power, I thought of forming the plates from solid lead sheets, say, 3-16ths-in. thick. I require a battery capable of 20 amps. discharge (maximum) for five hours. (1) What size plates and how many per cell positive and negative? (2) What size glass boxes and where to obtain wholesale? (3) How long to form? What current and how many reverse charges? Also how many charges and discharges? (4) How do you burn plates together, and how separate same? I understand that I first charge (for how long?) then discharge through a resistance (lamps then charge again reversed, then discharge as before: but do not know quite when to discontinue reverse charging?

(1) You will need at least 5 sq. ft. of positive plate surface to stand a discharge rate of 20 amps.; ten positive plates, each 6 ins. by 6 ins. (2) Any of our advertisers can supply you. (3) Some considerable time. The slower the better. Charging current should not exceed 6 amps. per square foot positive plate surface. (4) Discontinue when capacity of cells enables them to be discharged *usefully* *i.e.*, when you can get an appreciable current from them for a few hours.

[14,502] **Wimshurst Machine for X-ray Work.** H. S. (Devonport) writes: I have constructed a Wimshurst machine, following generally the description in your issue of November 17th, 1904, with the following exceptions:—Four glass discs, 21 ins. diameter, well shellaced; thirty-two tinfoil sectors on each. Each sector 3½ ins. long by ⅞ in. at widest end. The conductors, collectors, jars, etc., are arranged as shown in sketch. The brasswork was polished, and then black lacquered; the jars well varnished with shellac and filled 2 ins. up with small shot; tinfoil pasted outside to the same height, but not on the bottom. With the jars disconnected, I obtain a torrent of sparks 2 ins. long. Connecting the jars gives two loud, vivid sparks at each revolution, varying from 2½ ins. to 4 ins. long. The negative discharging ball is 2 ins. diameter, and the positive ½ in. diameter. A low vacuum bianodic



ARRANGEMENT OF WIMSHURST MACHINE.

tube connected to the outer coatings of the jars, and the spark-gap regulated, glows continuously, and gives a good radiograph of a mouse in one-and-a-half minutes, but a much under-exposed radiograph of the hand in three minutes. As these results appear to indicate a lack of efficiency somewhere in a machine of this size, I should be grateful for a few hints from you as to how I could improve matters. I have your sixpenny handbook on X-rays, and have also Gray on "Electrical Influence Machines." I might mention that the discs simply bristle with light, and sometimes (but rarely) sparks pass from the collectors to the neutralising brushes. I cannot detect any visible brush discharge from the conductors in a dark room, but a strong "breeze" seems to fly from them. The machine has twice changed its polarity.

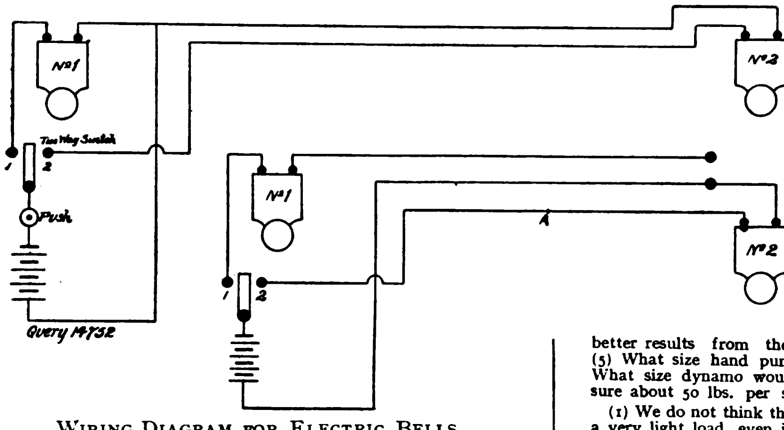
We would suggest a few experiments which might improve your results. Try varying the capacity of your jars, which can be temporarily accomplished by decreasing the amount of shot in them. Try varying the position of the neutraliser. It does not sound right that sparks should ever pass from it to the collectors. Also try a good drying by very slow and gentle warming in front of a fire. Possibly your sectors are too near together. Sometimes wiping the discs carefully over with a soft rag wetted in methylated spirit, and then thoroughly drying, greatly improves matters. You must remember that the exposure necessary for a radiograph depends not only on the length of spark obtainable, but on the quantity of electricity the machine is capable of forcing through the tube in a given time. You do not state whether the vivid sparks obtained with the jars connected take place at each revolution of the discs or of the handle. If the former, the tube ought to work very well; if the latter, the machine is probably not quite powerful enough to give very short exposures.

[14,946] **Spark Ignition for Old Slide-valve Gas Engine.** C. C. (Oxford) writes: I have a 2 h.-p. horizontal slide-valve gas engine, and I want to make it into a spark ignition. Will you kindly tell me the position the spark plug is usually fixed in slide engines? Also what is the price of magneto machine suitable for this size of engine as described in Runciman's book on "Gas and Oil Engines"? I also want to know if I can do away with any of the ports by stopping them up when spark ignition is fixed? If you know of a book dealing with slide engines, please let me know.

The plug would be placed in position as near the original ignition port as possible, the precise position depending upon the design of engine, and could only be settled by personal inspection. You could do away with the ignition port if using spark ignition. The magneto machine, as described in Runciman's book, is, we believe, manufactured by several makers, the principle being more or less the same in each case, but constructional details differing. The price would be a few pounds. Any of our advertisers, such as Ford, of Stalybridge, Yorks, or Blake, of Kew Gardens, would quote you, however. There is no modern book devoted exclusively to slide engines, but many give a brief account of them.

[14,752] **Electric Bell Wiring.** W. L. (Blaina) writes: In reply to your answer to my query in the August 31st issue of the *M.E.*, it is not quite what I want. You see, the bell No. 1 is rung by forming a cross on two wires somewhere on the circuit, so that your sketch would not do for that. What I want to know is, how to put a bell on the other end of the circuit on the two wires without forming a cross, and thereby ring bell No. 1 (as you will see by sketch). This is my present circuit. Please let me know how I can ring bell No. 2 from bell No. 1 with the same battery. It does not matter if I have to put bell No. 1 out of action when I want to ring bell No. 2.

Perhaps this arrangement may suit you. By means of the two-way switch you cut off either bell. If the switch is on stop 1, No. 1 bell rings when the push is pressed; if it is on stop 2, then No. 2 bell rings. Or the following as an alternative. Run a third wire (A) to the No. 2 contact of the two-way switch. No. 1 bell would be then as previously worked by you, and No. 2 bell would be cut in when wanted, and worked from the switch.

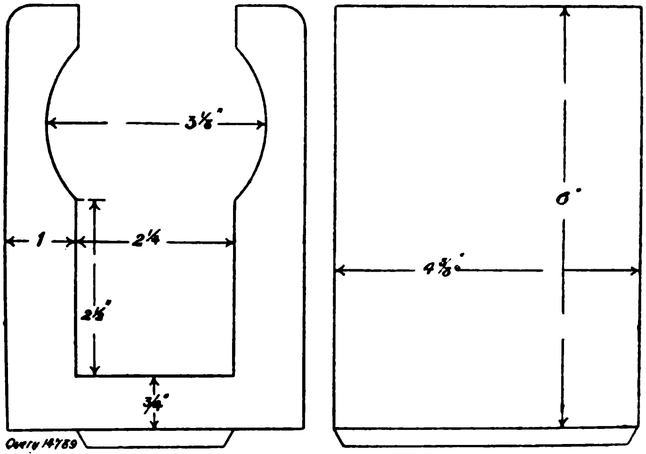


WIRING DIAGRAM FOR ELECTRIC BELLS.

[14,789] **300-watt Dynamo for Lighting, and Windmill for Driving Same.** C. M. (Priddy) writes: I enclose rough sketch of overtype dynamo castings, and shall be much obliged if you will answer the following queries. (1) How much wire, size for armature, and magnet coils to light six 16 c.-p. lamps at 25 or 50 volts pressure? Which do you think most suitable for the size? (2) What kind of armature, size, and rough sketch, if possible? (3) Would it be possible to drive dynamo by windmill? If so, what size vanes, etc.? I may state that I live on a mountain, with wind to spare.

(1) A 400-watt machine, as Fig. 12 in our handbook, would answer your requirements. The one shown in your sketch would hardly develop 400 watts—about 300 would be as much as it would do. Wind armature with 1 lb. No. 20 S.W.G., and field-magnets with 8 lbs. No. 21; this should give about 50 volts. (2) Use a cogged drum armature. (3) You would need about 1 h.-p. A windmill for this power should have (approximately) 400 sq. ft. of sail area. This is counting a wind velocity of about 30 ft. per second.

[14,939] **Undertype Motor.** W. L. P. (Southampton) writes: (1) I have a motor as sketch (not reproduced); fields are wound with No. 18 wire, and armature (tripolar) with No. 24 wire (I do not know the quantities). When connected up to the reversing switch, as sketch, it will go all right in one direction; but when reversed, it will barely go half the speed. How can I remedy this? (2) What would be the amount of current required, and at what pressure,



FIELD-MAGNETS FOR 300-WATT DYNAMO.

to drive the motor at its best? I know it takes a lot of current. Could I re-wind the fields so as not to use so much current; would re-winding make any difference in the power?

(1) We should say it is some mechanical fault which is answerable for this. Possibly the brushes or the gearing to whatever you are driving. (2) Try winding fields with No. 20 S.W.G., instead of No. 18. This would be more economical. It should not take more than 1½ amps. at 6 or 8 volts.

[14,711] **Vertical Boiler.** S. R. (Merthyr Tydfil) writes: I have a 6-in. by 12-in. central-flue boiler, without tubes. I intend using the boiler to drive an engine 1¼ ins. by 2¼ ins., the steam being superheated before entering the engine by passing a pipe down the chimney. (1) What kind of fuel would maintain the highest pressure? (2) I find a great deal of heat escapes through the chimney. Would it be of any use to fit baffles, and (if so) where? (3) The exhaust pipe from engine is 5-16ths in. What size should I reduce the nozzle to in order to induce sufficient draught for the boiler? (4) Should I get better results from the boiler if a long chimney were used? (5) What size hand pump would be suitable for boiler? (6) What size dynamo would a 1¼-in. by 2½-in. engine drive (pressure about 50 lbs. per square inch)?

(1) We do not think that the boiler will run the engine except in a very light load, even if the steam is highly superheated in the manner you propose, and the only thing you can do to improve it is to fit some "Field" tubes in the crown in the manner suggested in our issue of April 15th, 1902 (page 189). (2) A baffle is shown in the sketch above referred to. A baffle alone would do no good; you must provide more heating surface. (3) The nozzle may be about 7-32nds in. diameter. (4) No; see above. (5) A lever pump ⅜ in. or 11-32nds in. diameter will suffice. (6) With a boiler having about four or five times as much heating surface as the present one, the engine should be able to manage a 30- to 40-watt dynamo.

[14,708] **Electro-motor for Driving.** W. S. (Basingstoke) writes: (1) Would you kindly let me know if the electro-motor (No. 1) described in your issue of June 15th, under the heading of "Model-making for Beginners," can be used as a dynamo? (2) If so, what would the output be? (3) Would the model beam engine described in your handbook, "Simple Electrical Working Models," work it?

(1 and 2) Doubtful, unless the magnet poles were fitted with iron pole-pieces to partially embrace the armature, and a suitable winding used. Even then it might not excite; in any case, the output would be exceedingly small. If you want to make a dynamo, try one of the designs given in our handbook No. 10, or buy a set of castings. (3) Practically speaking, no.

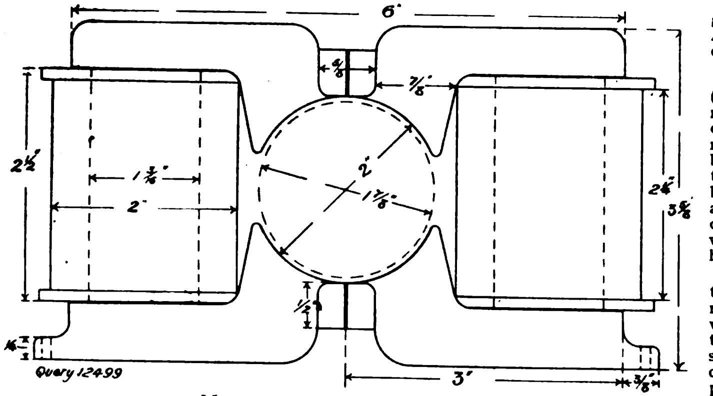
[14,727] **Proportions of Dynamos of Different Types.** H. T. (Doncaster) writes: (1) Please state what size Manchester type field-magnets would be required to produce the same current as an "Ironclad" type in Chapter VII in your book, "A.B.C. of Dynamo Design?" (2) The armature is wound for the "Ironclad" type. Please state also the windings for the "Manchester" type magnets. Will you send rough sketch of same? (3) Please say if old wringer frames and wheels are suitable material for dynamo castings.

(1 and 2) The 500-watt size, as Fig. 12, page 20, of our Handbook No. 10, made to the 500-watt scale given on page 23. If your armature is wound for 50 volts, then you should take the 50-volt magnet winding as given on page 50 of same handbook. (3) Depends upon the quality of the iron; in all probability the results would not be so good as if pig iron was used, of soft, grey kind; but they could be used, and the machine would give some results—perhaps good enough to satisfy you.

[14,640] **Dynamo.** T. R. (Butley, R.S.O.) writes: I will be much obliged if you will answer me the following questions: (1) Will the small dynamo, drawings of which are enclosed (not reproduced) be suitable for the arrangement, as in Question 12,888—will same windings do? In the above question you advise me to get the 10-watt size, as Fig. 9, page 18, of your handbook "Small Dynamos and Motors." There doesn't seem to be much difference between Fig. 9, as above, and the enclosed drawing, except the yoke, being in one piece in one, and in three pieces with two joints, in the other. If same windings will not do for dynamo enclosed, please advise suitable windings. Motor is finished and working well.

The dynamo to your sketch is very much smaller than the 10-watt size (Fig. 9) of our handbook; we doubt if it will excite as a dynamo. Perhaps you did not notice that Figs. 9 and 10 on page 18 of our handbook are half-size; that is, you must read double on the scale. If you care to try your machine as a dynamo, the field-magnet should be wound with No. 26 gauge s.s.c. wire. You do not make it clear if it has an armature fitted, and of what type. If drum, it should be wound with No. 30 s.s.c. wire; about 1 oz. will be the weight; if shuttle, it should be wound with No. 28 s.s.c. wire. Field coils to be joined in series with each other, and in shunt to the brushes. Test with a very small lamp—3 or 4 volts and 1 c.-p., or less; speed about 5,000 r.p.m.; must be determined by trial. The machine would work as a motor, if it may fail as a dynamo. It would be more likely to work as a dynamo if fitted with a laminated shuttle armature, and not a drum. Clearance should be very small.

[12,499] **Winding for 20-watt Dynamo.** G. H. W. (Hyde) writes: I am making a dynamo enlarged from the Manchester type illustrated on page 21 of your book, "Small Dynamos



Manchester Type Dynamo.

and Motors." I enclose a rough drawing of it, marked with the measurements to which I am working. The magnets are of soft grey cast iron, and the armature of Swedish iron stamping, 1¾ ins. diameter by 1¾ ins. long. The machine is constructed to produce 10 volts at 2 amps. (1) What weight and gauge of double cotton-covered wire shall I require for (*a*) the field-magnets, (*b*) the armature? (2) Is it necessary to have the field-magnets magnetised or not, and, if so, which is the best source to magnetise the same? (3) Give a diagram for the winding of the field-magnets in shunt, and the connections to brush-rocker.

(1) Armature to be wound with No. 25 D.S.C. copper wire—get on as much as possible—about 4 ozs. will be required. Core should be of cogged pattern; eight cogs, with two coils wound into each slot, will be suitable. Field coils to be wound with as much wire as you can get on—No. 23 gauge s.c.c. copper wire; about 1½ lbs. total will be the weight. Run at about 3,000 r.p.m. (2) You may find this machine start up all right without magnetising from an external source of current; but, if not, use an accumulator or bichromate battery, capable of giving at least 4 volts and 1 amp. Whilst the current is on, tap lightly on the field-magnet with a hammer. If you run it as a motor from such a battery, it will have the effect of magnetising the field-magnet, and the direction in which the armature runs will be the direction in which you must drive it as a dynamo. (3) You will find a diagram of connections and direction of winding the field on page 12 of "Small Dynamos and Motors" (Fig. 2). The armature should run as close as possible to the pole faces.

[15,027] **Resistance for Arc Lamp.** C. W. H. F. writes: I have made the small arc lamp described in the *M.E.* of January 1st, 1903, Vol. VIII. and I wish to run it from the mains. The current available is at 210 volts pressure, and lights a 4-lamp electric radiator. The current required by arc lamp is 45 volts 5 amps. (1) What resistance should I require? (2) Would German silver wire or lamp resistance be best and cheapest? (3) Is resistance inserted in circuit in parallel or series?

(1) A variable resistance of from 10 to about 15 ohms. A number of query replies were published on this matter soon after the appearance of the article in question. Please look them up. (2) G.S. wire. (3) Series.

[15,025] **Partitions in Secondary Cells.** R. B. A. (Fife) writes: I have several glass cells which I want to use for accumulators, size 5½ ins. by 4½ ins. by 2½ ins. I want to put in a partition to divide each cell in two; I see by your handbook No. 1 that sheet ebonite is the proper material to use for the partition, but I would like to know how to fix it to the glass. Will wax or pitch do?

It will not be an easy matter to make water- or acid-tight partitions in a glass cell. We advise you to use the properly made ones, as the slightest leakage from one compartment to the other will make the voltage drop to that of one cell—*i.e.*, 2 volts. You might try roughening the surface of the glass with hydrofluoric acid, and then using wax to fix the partitions. The cell would have to be very carefully handled.

[15,022] **Small Arc Lamps.** J. B. (Greenock) writes: I contemplate making about twenty arc lamps, to work off a 112-volt continuous current circuit, about the same size as the one described on page 356 of Vol. VIII (April 9th, 1903), and I will be very pleased if you would answer the following questions: (1) Will it be necessary to connect the lamps in groups? I wish to do without resistance if possible. (2) If so, how many lamps in one circuit? (3) What kind of wire should the magnet be wound with? (4) How many amperes will each lamp take? (5) From whom can I get the carbons?

(1) Allow about 45 volts for each lamp. That means you could run two in series—or even three at a pinch. (2) You will find it best to use a small resistance in circuit with each group. (3) Copper wire. (4) Three or four. (5) Apply to some of our electrical advertisers. Any of them would probably supply you.

[14,993] **Armature Connection.** E. B. (Wolverhampton writes: I want to build a dynamo of 30 volts 5 amps; but instead of putting copper wire on the armature I want to put a wire made of some metal or material, or that will not be affected by the intense field of force between the two poles of the field-magnets, so that it may be driven from a small h.-p. engine. Would aluminium wire do? Or some other similar metal or any material that would be a conductor. I want to drive the dynamo with an engine 1-16th h.-p.

We presume your idea is to make it appear that a small engine is driving a fairly large dynamo? Any conductor would act as copper does when cutting lines of force, but few metals have the high conductivity of the latter, and are at the same time comparatively cheap. If you run the dynamo on open circuit it will not take much power to drive it. Notwithstanding the above, we cannot say we quite grasp what you are driving at. Kindly comply with our rules in future.

[15,048] **Books on Engine Design and Drawing.** T. F. S. (Sussex) writes: Would you kindly advise me the best way to learn mechanical drawing; there is no technical school or class here. I am engaged in an engineer's workshop all day. Also, could you recommend a good book on engineering matters for me to read?

The next best thing to actual personal instruction is to get hold of a good book on the subject, and work through it step by step, making sure you understand one sentence before you pass on to the next. Our handbook on "Mechanical Drawing Simply Explained," 7d., post free, will be useful to you at first. After this obtain "Engineering Drawing and Design," by S. H. Wells, price 3s. 3d., and 4s. 9d., post free, the two vols. respectively. Your last request is worded rather vaguely. It depends upon how much you know already of engineering what books will be most suitable. If you let us know more definitely what you wish to read up, we shall be pleased to offer you what assistance we can in the matter of choice of books. Meantime we enclose our book list, which may assist you somewhat.

[15,047] **Small 23-volt 150-watt Motor.** N. W. G. (Edinburgh) writes: Would you kindly assist me with the following: Having bought an old overtype motor, rated 1 h.-p. on 100 volts, 1·5-amp. circuit, speed 1,000 r.p.m., I wish to rewind it for 230-volt circuit. The armature is of the cogged gramme ring type, with eight slots 2 ins. long, 3½ ins. outside diameter, 1½ ins. inside diameter, and commutator has sixteen segments. The two field-magnets (3 ins. diameter by 2 ins., weight 2 lbs.), are quite intact, and I enclose sample of wiring. Will it be possible to re-wind armature for 230 volts, and if so, what gauge of wire and weight would do for same: also can I use the old field-magnets? How do I connect up wires to commutator, and also from field brushes to magnets? I have your book on small dynamos and motors, but it does not go beyond 100 volts.

Yes, you could convert the machine to run at 230 volts. Wind armature with No. 32 S.W.G., and field magnets with No. 27 S.W.G., and connect in shunt to the brushes. The rated output you mention is much above what you may expect to get out of motor. Are you sure it is not ⅙th or ⅛ h.-p.?

[14,812] **Model Steamer Machinery.** N. P. (Newcastle-on-Tyne) writes: I am busy with a steamship, but have just got the engine finished. It has two cylinders, each 1 in. diameter, 2 ins. long, and 1½-in. stroke; and do you think it will drive a boat 3 ft. 6 ins. long? The cylinders are single-acting, oscillating type. What kind of boiler, and of what size, do I need? I thought of having a water-tube boiler, but it is too expensive; so I would like to make one 5 ins. diameter, 14 ins. long, with a 2-in. flue tube; and do you think this would do? If so, please send me a price for one like it, as low as possible; if not, tell me of one that would do.

We presume the engine has ¾ by 1½ cylinders. We do not advise a water-tube boiler, as the high pressure at which these should work would not suit your engine. We would, therefore, recommend a plain 5-in. by 10-in. cylindrical boiler, with a furnace tube 2½ ins. diameter, and about ten water-tubes; fired either by a methylated spirit burner (vaporising), or a benzoline blowlamp. A rectangular boiler like that shown on page 38 of "Model Boiler Making" (Fig. 12), with about three water-tubes in the crown would work very well. This might be fired by a plain spirit lamp.

[14,816] **G.C.R. Atlantic Locomotive.** J. M. (Chiswick) writes: Could you tell me if there has been published in an engineering paper the drawings of the Great Central Railway Atlantic type loco (say No. 267)? If not, perhaps you could inform me as to its leading dimensions (distances of wheel centres), and whether the general dimensions and design of motion, boiler, tender, etc., corresponds with the 6-coupled type as illustrated in detail in the December 30th, 1904, number of the *Engineer*?

You will find an outline drawing (dimensioned) in our issue of September 1st, 1904. The motion, and the front part of the engine generally, boiler, and tender, are the same as that used in the 6-coupled locomotives; indeed, the two types of engine were built so that in case of one proving markedly superior to the other, it could be converted.

[14,801] **Semi-Flash Boiler.** R. A. writes: Would you kindly tell me if I could make a boiler similar to Mr. Nicole's, and to stand a pressure of 40 or 50 lbs. per square inch.? If so, what diameter and length tube should I have to use for generator? Should I have to have a blowlamp to get above pressure, or could I do it with a spirit lamp?

Yes, such a boiler could be made and would work well, but, like other types of boilers, must be of sufficient size, and have sufficient heating surface for the duty required from it. You give no information as to the dimensions or type of engine you wish it to drive. A spirit lamp, gas ring, or "Primus" paraffin stove, can be recommended as fuel. A blowlamp would concentrate the flame too much on one spot.

New Catalogues and Lists.

F. Darton & Co., 142, St. John's Street, London, E.C., have sent us their new novelty list, which comprises small electric motors, dynamos, motor fans, armature stampings, small power gas and oil engines, volt and ammeters, medical coils, bells, batteries, accumulators, telephones, electric light accessories —such as lamps, pushes, switches, etc. The list, which is fully illustrated, will be sent to readers of this journal upon application.

D. Monninger, 124-126, Clerkenwell Road, London, E.C.—We have received leaflets descriptive of the workshop appliances supplied by the above firm, *i.e.*, self-centreing chucks, twist drill grinder, treadle grinding and polishing machine, cramps, shafting, pulleys, plummer-blocks, couplings, etc.

If Mr. Fred. Stark, of Clitheroe, will send his full address to The Universal Electric Supply Co., they will be pleased to forward their catalogue, as requested.

The Editor's Page.

OUR recent competition on "How The Model Engineer has Helped Me" brought us a number of interesting letters, and the prizes we offered have been forwarded to the successful competitors. Curiously enough, one of the most striking communications on this subject was sent us quite apart from the competition, and, with the permission of the writer, we reproduce a portion of this letter herewith, suppressing names and places for obvious reasons. We think, however, that our correspondent's experience should form a valuable object-lesson to others who may be battling against adverse circumstances. They show, what we have often pointed out, that real grit and perseverance will always bring a man to the top. Here is his letter:—"It was about four years ago that I first caught sight of The Model Engineer in a shop window in Liverpool, and I was at that time an apprentice engineer at a large shipbuilding and engineering works in that district. I had had a very good general education, and had passed the matriculation examination of London University in the first class in June, 1898. Having been given my choice of a profession, I chose engineering, and entered the works above referred to as premium apprentice in March, 1899, where I remained until February, 1902. During this time I attended evening classes in engineering subjects, but my experience was the same as that of many others—I found that after working hard during the day my brain was too dull to understand most of the things I was taught in the evening. At the time I bought my first copy of your paper; you had just announced the competition for a design for a 'Model Steam Travelling Crane,' and I determined to have a try for it. Although I worked hard at it during the evenings, I did not succeed in finishing it, and I remember working at it till eleven o'clock the night I sent it off. Then followed some weeks of patient waiting, followed by a pleasant surprise when I saw that my name was among those who were 'recommended.' I became a regular subscriber to your paper and I found many things in it to interest me, but at the same time there was a good deal I could not understand, as I had no knowledge of electricity beyond the 'horseshoe magnet and iron filing stage.' The next competition I entered for was the 'Model Steam Engine and Direct-coupled Dynamo.' Although I had such a scanty knowledge of electricity, I determined to have a try for it, and bought the little book on 'Dynamo Design.' Needless to say, I was not successful, for I had no clear notion of what a dynamo actually was; I had, of course, seen several, but did not understand how they worked. It was just at this time that a breakdown occurred in my health, and it became evident that I could not continue at the works.

In the course of four or five months, however, I was again in a fit condition to look out for something to do. It was just at this moment (1902) that they established a Faculty of Engineering at London University and proposed to confer the degree of B.Sc. in engineering, and so I was advised to try and get this degree, if I could, in the hopes that it might enable me to obtain an appointment with some engineering firm on shore, instead of going to sea. Having already passed my matriculation, I was able to register as an internal student in the Faculty of Engineering and to enter on a day course of study at a technical institute in London. In July, 1903, I sat for the first intermediate examination that was held in engineering, and was successful in obtaining a pass. For several reasons it was deemed advisable that I should go to one of the large colleges to study for my final examination. While I was studying for my intermediate, I was successful in winning one of your competitions, and during the summer holidays I wrote an article which you were good enough to publish. By this time, I could understand practically everything that was published in your paper and, in fact, I was able to criticise some of the articles which appeared. THE MODEL ENGINEER still continued to interest me as much as ever, and I found a deal of useful information scattered among its pages. In October, 1903, I entered —— College, London, and began to study for my final. I studied both mechanical and electrical engineering, and made such good progress during the year that I obtained two first prizes and one second prize in the junior classes. During my summer holidays, I wrote two or three further articles for your pages. It was during the following year that I was so busy I had very little time to read THE MODEL ENGINEER, and for a space of three or four weeks I could find nothing in it of any use or interest to me, and several times the idea occurred to me to give up taking it in, but every time this thought occurred to me it was followed by others. I thought of how THE MODEL ENGINEER had interested and amused me in the weeks gone by, and how from the very first it had encouraged my efforts and led me on to greater things, and when I considered all these things, I thought it would indeed be a shame to give it up. And so I continued to take it in, and in a week or two I was amply rewarded, for I found something which interested me a good deal, and so it has gone on—scarcely a week passes now but what I find some news which is interesting and instructive to me, and every Friday evening the first thing I do when I come in is to ask for my MODEL ENGINEER. In July last I sat for my final examination, and was successful in obtaining my B.Sc. degree with first-class honours. I have since obtained a very congenial teaching appointment in mechanical engineering."

Answers to Correspondents.

L. V. P. (Chippenham).—We have some drawings in preparation which will be published shortly. Meantime, see "Gas and Oil Engines," by W. C. Runciman, 7d. post-free.

A. C. (New Cross).—We have no letter of yours in hand.

W. H. C. (Tring).—Kindly comply with our Rules. See head of Query columns. We advise you to apply to the makers of the cells for the information you require on that point.

F. K. (Derby).—A sand blast is usually employed, but a coat of hydrofluoric acid will, no doubt, answer your purpose.

E. B. (Kelbrook).—See the article on cleaning Primus burners in our issue of October 1st, 1903.

F. A. S. (Detroit, U.S.A.).—We thank you for your interesting letter, which shall be inserted as space permits.

Notices.

The Editor invites correspondence and original contributions on all amateur mechanical and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected or not, and all MSS. should be accompanied by a stamped addressed envelope for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

This journal will be sent post free to any address for 13s. per annum, payable in advance. Remittances should be made by Postal Order.

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HOW TO ADDRESS LETTERS.

All correspondence relating to the literary portion of the paper, and all new apparatus and price lists, &c., for review, to be addressed to THE EDITOR, "The Model Engineer," 26—29, Poppin's Court, Fleet Street, London, E.C.

All correspondence relating to advertisements and deposits to be addressed to THE ADVERTISEMENT MANAGER, "The Model Engineer, 26—29, Poppin's Court, Fleet Street, London, E.C.

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Contents.

[*The asterisk* (*) *denotes that the subject is illustrated.*]

THE

Model Engineer

And Electrician.

A JOURNAL OF PRACTICAL MECHANICS AND ELECTRICITY.

EDITED BY PERCIVAL MARSHALL, A.I.MECH.E.

VOL. XIII. No. 242. DECEMBER 14, 1905. PUBLISHED WEEKLY.

Three Steam Models.

By WM. WOOD.

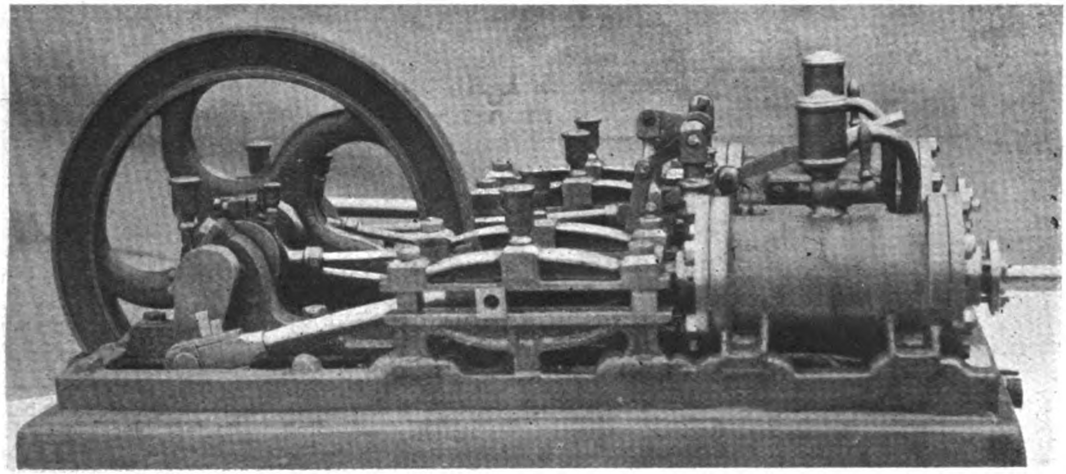


FIG. 1.—A MODEL REVERSING HORIZONTAL STEAM ENGINE.

THE photograph (Fig. 1) reproduced herewith represents one of the three models to be briefly described which I have constructed as spare time would permit. It is a two-cylinder, steam-winding engine, fitted with reversing motion, the mechanism for which can just be seen in the illustration above. The cylinders are each bored out to 2 ins. diameter, and the stroke is 3½ ins.; steam ports are ⅞ in. by 5-32nds in. and, exhaust ports are ⅞ in. by 5-16ths in.

On page 555 a few detail sketches of this engine are reproduced. The connecting-rods (Fig. 4) are mild steel forgings, 6½ ins. long, and turned all over. The crankshaft, which is also of mild steel, is 9½ ins. long by ¾ in. diameter, with keyways cut in the centre 1 in. long (see Fig. 8), to take the flywheel, which is 10 ins. diameter; ¾-in. keyways also are cut at each end for the cranks. The shaft runs in plummer blocks, which have split bushes.

In Fig. 5 are shown the oil cups, which are of brass. Referring to the piston-rod, which is not shown in the drawings, this is 12 ins. long by ⅝ in. largest diameter, turned down to ¼ in. at one end, and screwed ¼ in. Whitworth to take the crosshead The details of straps, bushes, and keys, and also of the mild steel crossheads, will be seen at Fig. 3. The piston-rods work through the cylinder covers, whereby the piston itself is steadied. The latter is of the marine type, and, as will be seen on reference to Fig. 7, the parts which are of cast iron are joined by means of three 3-16ths-in. countersunk screws. The engine bed is of cast iron, and its dimensions are:—Length, 21 ins.; breadth, 16 ins.; depth, 2½ ins.; and the weight of casting is 50 lbs.

The vertical engine illustrated in Fig. 10 has cylinders of cast iron in one piece, which are 1-in. bore by 2-in. stroke. The steam ports are 5-16ths in. by 3-32nds in., and exhaust ports are 5-16ths in. by 5-32nds in. With the exception of cylinders and eccentric bands (which are brass), all the parts are steel, and patterns were all made by myself. The flywheel is 5 ins. diameter. The two front pillars are of $\frac{3}{8}$ in. diameter mild steel, turned down for 6 ins. in the centre to $\frac{1}{4}$ in. diameter, screwed at each end $\frac{1}{4}$ in. Whitworth for a $\frac{1}{2}$ in., leaving a shoulder of $\frac{3}{8}$ in. depth, by the same diameter.

The crankshaft for this engine is a built-up one. My method was as follows :—I obtained four pieces of mild steel $1\frac{1}{4}$ ins. by $\frac{1}{2}$ in. by $\frac{1}{4}$ in., and, putting them all together, bored the holes in both ends $\frac{3}{8}$ in. and $\frac{1}{4}$ in. I then put a length of $\frac{3}{8}$-in. steel rod, 9 ins. long, through the $\frac{3}{8}$-in. holes, and through the $\frac{1}{4}$-in. hole small pieces of $\frac{1}{4}$-in. steel. After sweating the parts together, with a hacksaw I cut off the pieces between the cranks, and polished the crankshaft up with No. 0 emery cloth. The connecting-rods are of the marine type, with split bushes and steel slipper guides. The cylinder covers are studded with six $\frac{1}{8}$-in. studs in each.

I might just mention that the small water-tube

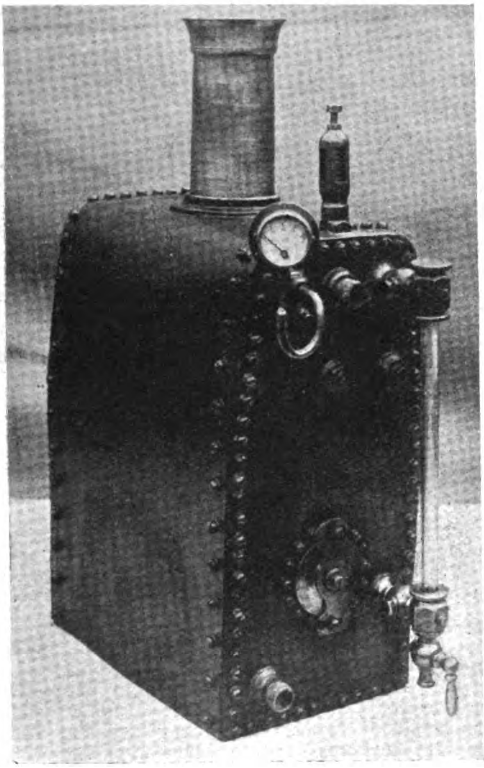


Fig. 11.—Model Boiler.

boiler which is shown in Fig. 11, is constructed from the design given in this Journal of February 4th and 25th, 1904, by Mr. D. W. Gawn. It has been tested to 100 lbs. pressure, and is fired with coal fuel.

An induction regulator, which is believed to be the largest piece of apparatus of the kind in the world, has been installed in a Montreal sub-station. It has a capacity of 5,000 amps. at 2,400 volts, being designed to raise or lower the pressure 10 per cent.

Twin Flexibles.

In his notes on the above subject, published in the *Electrical Review* recently, Mr. Donald Smeaton Munro says :—" Many wiremen, in preparing the ends of the flexible for attaching to

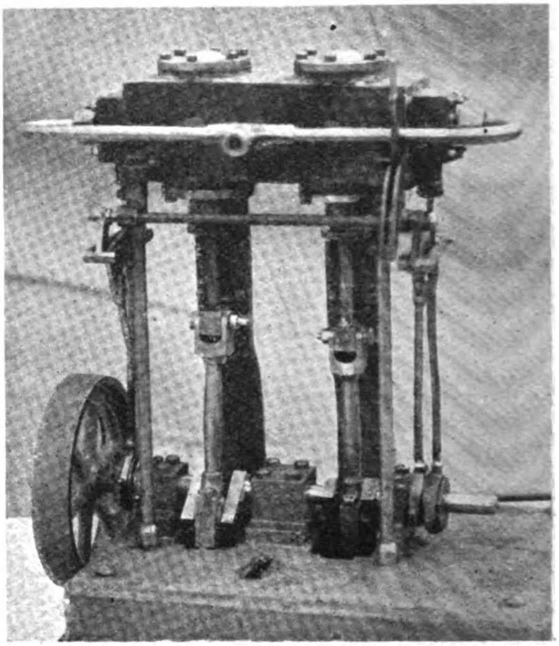


Fig. 10.—Model Vertical Engine.

lampholders or other fixtures, burn off the insulation rather than risk paring it off with a knife, and, perhaps, severing a few of the strands. When this is done the copper wires have to be carefully wiped free from the black burnt rubber deposit before entering them into the contact blocks of holder, ceiling-rose or plug, otherwise heating is sure to take place. The deposit also hinders the proper soldering of the wire ends.

It is generally best to solder together the ends of the strands to prevent the small single wires from fraying out. At the same time these soldered ends make a better surface for the gripping contact of the little screw-points or heads. This soldering, however, is generally neglected in the hurry of present-day work, with the consequence that loose broken or overlooked ends frequently cause troublesome short circuits. Some fitters do not solder these contact-ends, for the reason that it takes time. Soldering also has the disadvantage that the separate strands just above the solder are made hot, and sometimes left brittle at the point where the more flexible loose strands merge into the stiffer soldered part; they are apt to break off for this reason, and because of concentration of bending point.

Some time ago the present writer hit on a simple expedient of plaiting the strands, thus getting the advantage of the soldered ends without the trouble and risk of heating and tinning. The wire may be interlaced (ordinary three-way plaiting) during

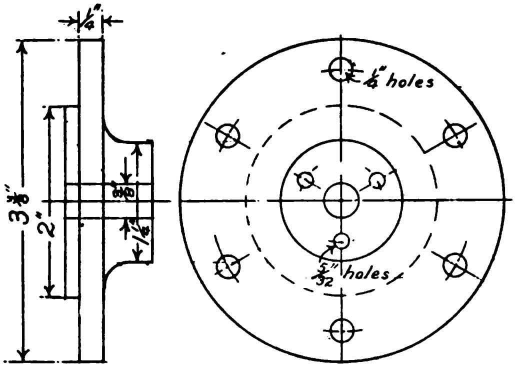


Fig. 2.—Cylinder Covers.

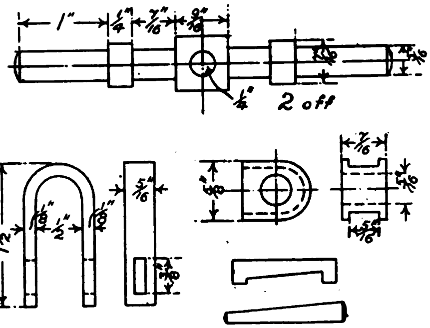


Fig. 3.—Crosshead Details.

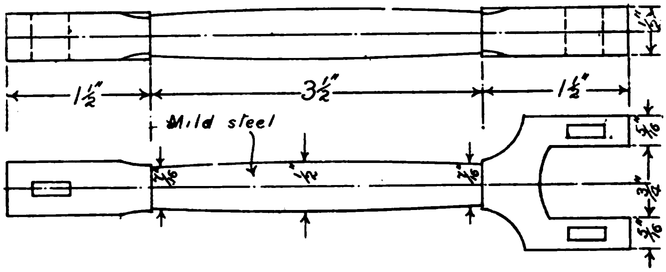


Fig. 4.—Connecting Rod.

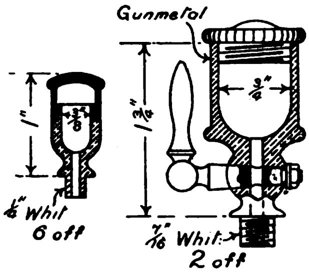
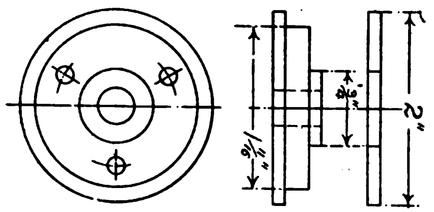


Fig. 5.—Oil Cups.

Fig. 7.—Piston.



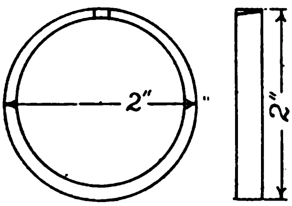


Fig. 6.
Piston Ring.

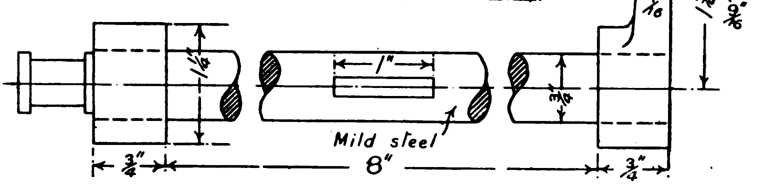


Fig. 8.—Crankshaft.

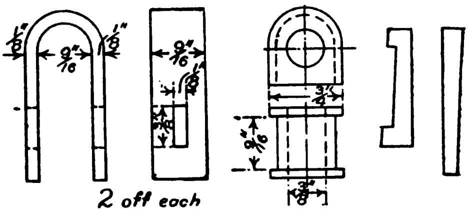


Fig. 9.—Details of Connecting-Rod Big Ends.

DETAILS OF MR. WM. WOOD'S MODEL HORIZONTAL STEAM REVERSING WINDING ENGINE.

(*Scale:* Half Full Size.)

For description see front page.

manufacture, or the ends may be quickly plaited by the user after they are bared. The first method only adds very slightly to the initial cost, and the second can be done in much less time than it takes to solder the ends; and there is then little risk of a broken strand projecting far enough away from its neighbours to do any harm.

Workshop Notes and Notions.

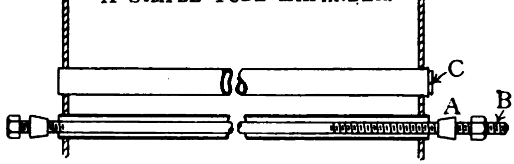
[Readers are invited to contribute short practical items for this column, based on their own workshop experience. Accepted contributions will be paid for on publication, if desired, according to merit. All matter intended for this column should be marked "WORKSHOP" *on the envelope.]*

A Simple Tube Expander.

By Fred Wilson.

Following the method of simple tube expanding, given by a contributor to this page in the issue of September 28th last, herewith is given a sketch illustrating a method which I have employed for my model boilers. A is a ferrule turned from gas-tubing, and is 1-64th in. smaller at little end, and 1-64th in. larger at big end,

A Simple Tube Expander.

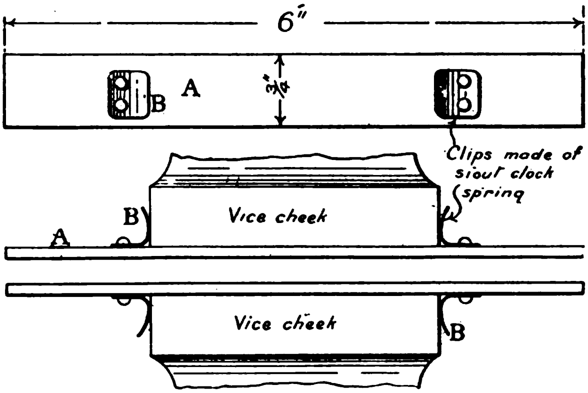


than the inside diameter of tube to be expanded. B is a long bolt screwed down for a good way, and, therefore, will do for boilers of different lengths. Now, by placing ferrules in the two ends, and tightening the bolt, the ferrules expand the tube and keep it steam-tight. At C a ferrule is shown forced in its place.

False Vice Cheeks.

By "Scribo."

When filing long, thin delicate work in the vice, longer than the vice cheeks, it is very apt to buckle. Here is a device which will be found very useful for the sort of work mentioned. The adapters A A can easily be made from two files, the length of which will be governed by the width of vice cheeks. The one here shown is very suitable for a 3-in. cheek. The files should be ground smooth on the face and edges, and two holes drilled at each end to take the rivets for the clips B B, which should be made from strong clock spring about ½ in. wide; they should be well tempered, and hold the files A A to the vice firmly. The rivets that hold clips B B should be filed flush with the inside faces of A A. This is a very useful tool for thin sheet metal working.



False Vice Cheeks.

A Handy Disc-Cutter and Drill.

By F. Mayer.

A very handy tool for drilling large holes in sheet-metal and cutting discs and washers is made as follows: From a piece of 1-in. square rod cut a piece 1½ ins. long, and square up both ends. For cutting discs of holes ½ in., ¾ in., 1¼ in., and 1½ ins., mark off one end of the square rod as Fig. 1, and drill a 5-16ths hole through it; from each side drill two ⅛-in. tapping holes running into the 5-16ths in. hole. These holes should all be the same distance apart and the s me distance from the edge. Now take a piece of 5-16ths rod to fit the hole, and on one end turn a pivot 3-16ths in. in diameter and ⅝ in. long. From a piece of ⅜-in. by 3-32nds-in. cast-steel make a

Fig. 1.

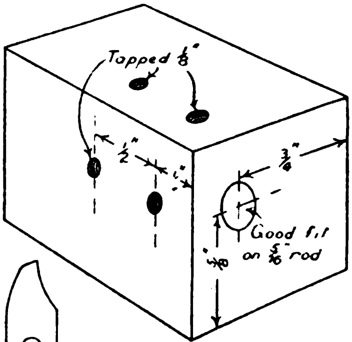
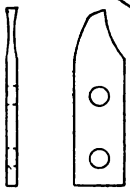


Fig. 2.



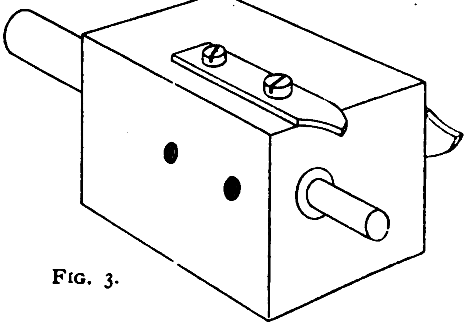


Fig. 3.

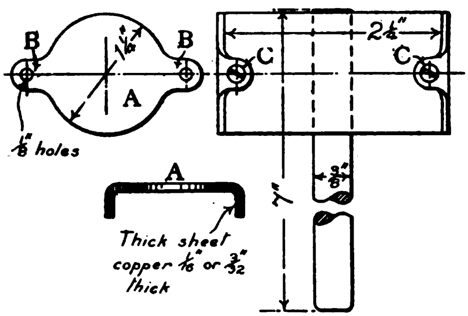
Details of Disc Cutter and Drill.

cutter as Fig. 2. This cutter must be hardened and tempered to a dark straw colour, and is then ready to be put together. With two ⅛-in. screws screw the cutter on one of the faces of the block. To cut a 1½-in. disc the cutter must be screwed on that face of the block which is ¾ in. from the centre of the hole. In Fig. 3 the finished tool is shown with two cutters on. This will cut a washer with a large hole. The dimensions given in the sketches can be altered to suit your particular purpose. Sometimes it is convenient to substitute a twist or fluted drill for the pivot. The tool can be held in a brace, but is much more convenient when held in the chuck in the lathe or drilling machine.

A Copper-faced Hammer.

By "Scribo."

As a good heavy copper hammer is a rather expensive item to the amateur, I give here a method of fitting a copper face to the ordinary hammer thus having weight. In the drawing shown herewith is a hammer specially made for the faces, but it can be fitted quite easily to the ordinary hammer. A is a piece of copper plate of any thickness, say, up to ⅛ in. Describe a circle same diameter as

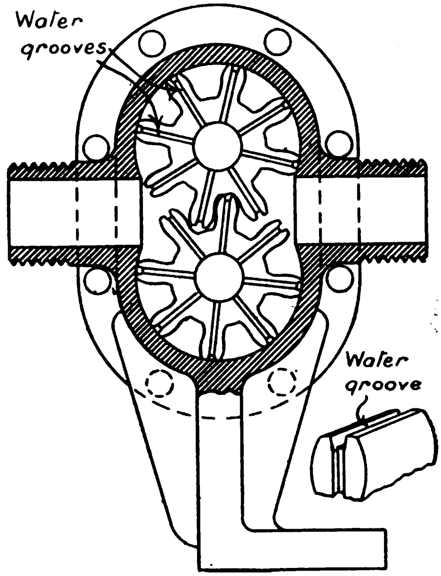


Details of a Copper-Faced Hammer.

face of hammer, and leave two ears (B B), into each of which should be drilled ⅛-in. hole. The ears are then bent over as shown, and placed on the hammer face; two screws then go through the holes at C C, and are screwed right into the hammer, which should be tapped to receive them.

The Latest in Engineering.

The Albany Rotary Pump.—Speaking from The Model Engineer point of view, one of the most interesting of the smaller exhibits at the recent Motor Show at Olympia is the patent "Albany" rotary pump. This pump is primarily intended for cooling the water circulation of automobile cylinders, and is, therefore, obtainable in comparatively small sizes. The construction is simplicity itself, the mechanism consisting of two toothed wheels, which, in some of the pumps, are fairly long, like large pinions. There are no valves, the action of the toothed wheels creating a partial vacuum on one side, and forcing the water out at the other. There is also no packing whatever, the tips of all the teeth and the sides being provided with grooves, as shown in the accompanying sketch. In these grooves the water collects, and creates a permanent seal all the time the pump is working. At the exhibition a pump was shown working against 100 lbs. pressure, and we were informed that a very fair lift could be obtained on the suction side. The mechanical efficiency of the pump should be high, and owing to its extreme simplicity the commercial utility of the invention is evident to most. There are many purposes for which model



Section showing Water-sealed Grooves in Rollers.
The "Albany" Motor Pump.

engineers might use such a pump, and the average well-made model steam engine with a cylinder, say, anything over 1½ ins. by 1½ ins. stroke, should drive a small pump very well indeed.

A Large Cochran Boiler.—Messrs. Cochran and Co., Annan, Ltd., have recently completed a donkey boiler for use on board ship, which is interesting on account of its immense size. It is, in fact, the largest boiler of the type ever turned out of the firm's works. The boiler has the following principal dimensions: Diameter, 8 ft. 6 ins.; height, 17 ft.; heating surface: tubes, 888 sq. ft.; plate, 112 sq. ft.; total, 1,000 sq. ft. Great area, 42 sq. ft. working pressure, 100 lbs. per sq. in.; number of tubes, 264; length, 5 ft. 4½ ins.; diameter, 2½ ins. The furnace contains two fire-holes side by side. The smokebox doors also are made in halves, on account of their size. The tubes are in vertical and horizontal rows. Forty stay-tubes, 2½ ins. in diameter, are included. No lock-nuts are fitted, the stay-tubes, like the plain tubes, being expanded tight.

How It Works.

II.—A Resistance.

By A. W. M.

IN electrical engineering the term "resistance" means usually an opposition offered to the flow of a current in a conductor by virtue of some physical property possessed by the material of which the conductor is made. For instance,

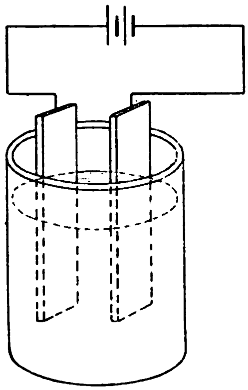


FIG. 1.

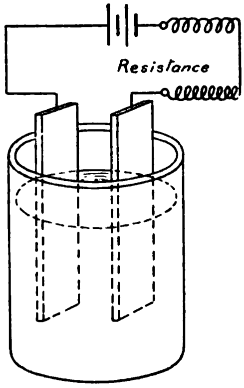


FIG. 2.

wires made of copper, German silver or iron, would each offer a different value of opposition to the passage of an electric current. To define clearly what he means an electrician would use the term ohmic resistance, because the electrical unit used to specify the value of such resistance is called the ohm, the name being taken from that of a celebrated scientist. He might also use the words, "the resistance, as measured in ohms" as an alternative expression, because there are other physical effects which may oppose the passage of the current, in addition, and are called by other names.

Though it is a common practice to divide materials into two classes, and call them conductors and non-conductors or insulators, all materials are conductors in a greater or lesser degree. A large bar of copper may only have a resistance of a very small fraction of an ohm, and a piece of ebonite may have a resistance of millions of ohms, yet they will both permit the passage of electric current. There is no need to trouble one's imagination with ideas as to what an ohm is like; it is sufficient to merely regard it as a unit of comparison or valuation to assist in making electrical calculations. This property of resistance is made use of to a large extent for the purpose of controlling the flow of electric current, the particular piece of apparatus containing the material through which the regulated current flows being generally called a resistance. Resistances are, in general, used for one of three purposes: To regulate the amount of current which is flowing through a circuit; to determine the voltage which shall exist at the terminals of some piece of electrical apparatus; and, thirdly, for making tests and measurements in which the value of the resistance in ohms is the thing taken into account, the actual values of volts and amperes affected by the resistance being incidental and not reckoned in actual figures.

To regard the matter from an elementary point of view: Suppose you have a jar containing water in which is immersed a pair of metal plates (Fig. 1); if you connect an electric battery to the plates a current will flow through the water from plate to plate; the amount of current will depend upon the resistance which the water between the plates offers to the passage of the current (neglecting the resistance of the connecting wires and the battery itself). Suppose that the amount of current which is flowing is greater than that required for the particular purpose, how can it be reduced in value, assuming that the battery is inaccessible, and that the number of cells cannot be reduced? One way would be to increase the distance between the plates in the jar, but this may not be practicable. Another way would be to place a resistance in the circuit from the battery in the form of a length of wire (see Fig. 2), and to make that wire of such a length that the current flowing was reduced to the value desired. But why will the current be reduced? The reply is, because, when a certain voltage is applied to a circuit the amount of current which it will force through the circuit will depend upon the amount of resistance which the circuit offers to the passage of the current; hence, if you add resistance to the circuit the voltage cannot send so much current through it. The more resistance you put in the less will be the amount of current flowing, until you finally break the circuit by disconnecting one of the wires, and thus put in an infinite amount of resistance, when the current will drop to nothing. This is an example of the use of a resistance to regulate the amount of current which is flowing through a circuit, and its action

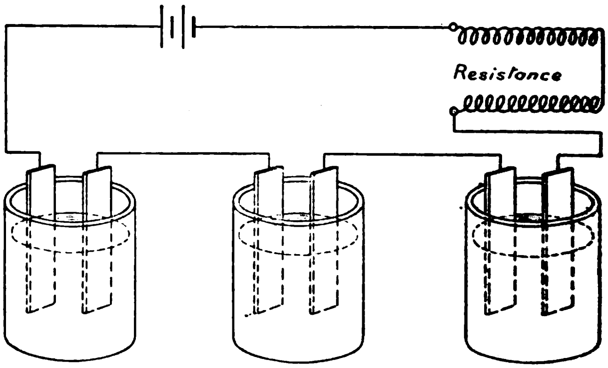


FIG. 3.

depends upon the fact that if the voltage of the source of current is not altered, the current will vary according to the total resistance of the circuit through which it flows; all parts of the circuit will be affected alike, because the current will have the same value in every part of the circuit. Supposing three jars to be joined in series (Fig. 3) instead of one, and five amperes to be flowing through the resistance, these five amperes would also flow through each jar; any alteration in the resistance would affect each jar and the battery as well, because no more current is generated in it than that which flows out at its terminals. There may be wasteful local currents generated, but they need not be considered for the purpose of this explanation. Resistances used for regulating the current in the field coils of dynamos belong to this class. When it is desired to regulate the voltage which is to exist at the terminals of a motor or lamp, or other piece of apparatus, the resistance may or may not have the effect of altering the value of the current which is flowing through the circuit, its action depending upon the circumstances of the case. As before, we will assume that the voltage of the battery or other source of current does not alter, and suppose that an arc lamp requiring 45 volts and requiring a current of 10 amperes is to be connected

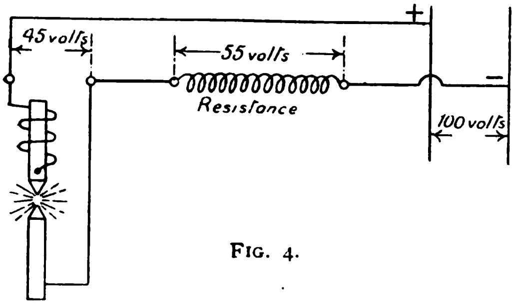


FIG. 4.

to a supply main having a pressure of 100 volts. We do not now wish to reduce the current, but to ensure that the pressure at the terminals of the lamp shall be 45 volts ; this means that the difference in voltage between that required by the lamp and that of the mains must be dealt with in some way. A ready method is to connect some resistance in series with the lamp (Fig. 4). This resistance must, therefore, be so proportioned that it will absorb 55 volts when a current of 10 amperes is flowing through it. The resistance depends for its action upon the fact that when a current flows through a wire or strip of metal a certain number of volts are lost or expended in forcing the current through the wire, the actual value of these lost volts depending upon the resistance of the wire measured in ohms, multiplied by the value of the current flowing in amperes. If the current has a fixed value, therefore a fixed number of volts will be absorbed by the resistance ; in the case under consideration the resistance should have a value of 5½ ohms, because 5½ ohms multiplied by 10 amperes equals 55, which would be the number of volts required to get the 10 amperes through the resistance, independently of the arc lamp, which absorbs on its own account the remainder of the 100 volts' pressure available at the mains. If the current was variable, such as might happen if a motor was substituted for the arc lamp, it would then be necessary to re-adjust the value of the resistance for every change in the value of the current, because, if the number of amperes flowing was less, then there would be a smaller number of volts lost per ohm of resistance, so that the number of ohms would have to be increased by switching in more resistance wire if the volts at the motor terminals were to be kept constant ; if the number of amperes increased, then it would be necessary to decrease the number of ohms in the resistance by switching out some of the resistance wire, because there would be a greater number of volts lost per ohm of resistance, consequently there would be a drop in the voltage at the terminals of the motor if the resistance was kept at the same value with the increased current.

A resistance of fixed amount intended to absorb a certain number of volts will only do this when one definite value of current is flowing, and it must be designed according to this value of current. If from any cause the amount of current flowing through the resistance alters, then the number of volts absorbed will alter also. For instance, when charging an accumulator through a resistance, if the value of the resistance is adjusted to permit the correct amount of current to flow at the commencement of the charge, it will be necessary to reduce the amount of resistance as the charging proceeds, if the number of amperes flowing is to be kept constant, as the voltage of the cell will steadily rise, and therefore less volts will require to be absorbed by the resistance. Suppose a ten-cell accumulator, requiring a current of two amperes, has been run down to 1·8 volts per cell, and is to be charged from a supply of 100 volts' pressure, at the commencement of the charge the accumulator will give a pressure of 18 volts, leaving 82 volts to be absorbed by the resistance, which then should have a value of 41 ohms to pass 2 amperes (neglecting the internal resistance of the accumulator, which would be very small); very soon the voltage of the accumulator would rise to 2 volts per cell, so that the resistance would only require to absorb 80 volts, and therefore should be reduced to 40 ohms ; if not reduced, the current would fall to such a value that the 41 ohms absorbed 80 volts only—that is to, approximately, 1·95 amperes.

It cannot, therefore, be said of any resistance that it will absorb so many volts unless the current which is to flow through the resistance is also stated.

If the wire or strip of which the resistance is composed is of the same sectional area throughout

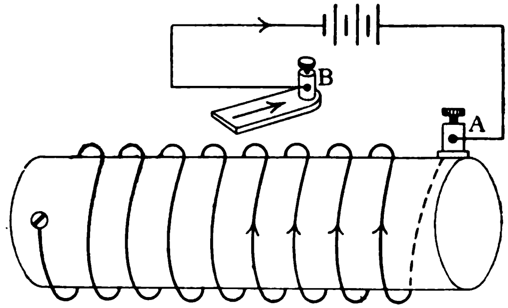


FIG. 5.

its length it will absorb a uniform number of volts per foot or yard, or whatever unit you care to take, of its length for any given current which flows through it. For example : No. 25 gauge German silver wire has a resistance of, approximately, 1 ohm per yard of length ; if a current of 1 ampere was sent through 20 yds. each yard would absorb 1 volt, and the whole length would absorb 20 volts. If 2 amperes were sent through it each yard would absorb 2 volts, and the whole length would absorb 40 volts, and so on. The following rules may be called the theory of resistances :—

1. The current which will flow through any

resistance is equal to the volts applied to the terminals of the resistance, divided by the value of the resistance in ohms. Example: If a resistance of 50 ohms' value is connected to mains having a pressure of 100 volts, a current of 2 amperes will flow through it.

2. The volts which will be absorbed by any resistance are equal to the current flowing through it, multiplied by the value of the resistance in ohms. Example: If a current of 2 amperes flows through a resistance of 50 ohms the resistance will absorb 100 volts.

3. To find the resistance in ohms which must be used on a circuit of given voltage in order that a current of a certain desired value shall flow through it, divide the given voltage by the desired amount of current, and the quotient gives the value of the resistance in ohms. Example: What resistance must be used on a circuit of 100 volts in order that a current of 2 amperes shall flow through it? 100 volts divided by 2 amperes gives 50 as the quotient, which is the number of ohms to which the required resistance must be made.

These rules will only be strictly correct if the current is continuous; if the current is alternating, and the wire or strip is coiled up, the result will not be quite the same, though approximately so, unless the coils are wound in a particular way, or non-inductively, as it is called. As it is usually possible to adjust a resistance by removing some of the coils, it is not worth the trouble of going into more complicated calculations; the coils will always give a slightly greater resistance to the passage of alternating current.

Commercial resistances are frequently made of wire or strip metal enclosed in a frame or box, and when intended to be adjustable are provided with some means of altering the amount of wire, the wire is sometimes embedded in enamel or sand, and cannot be seen. Fig. 5 is a diagram of a common form of resistance. The wire is wound tightly round a cylinder or frame of heat-resisting insulating material; one end is fixed to a terminal A and the other end secured by a screw; a sliding spring is attached to the second terminal B, and presses upon the wire, being arranged to slide along a rod parallel to the axis of the cylinder; current enters at A and flows along the resistance wire until it reaches the spring contact, at which point it flows away through terminal B, any resistance wire beyond this point being for the time inactive. By moving B nearer to or farther from A, more or less of the wire is cut out of action, and consequently the value of the resistance in ohms altered to the desired amount.

(To be continued.)

To prevent the freezing of the cooling water for petrol motors, mix with the water from 20 to 25 per cent. of glycerine.

Traction Notes on Road and Rail.

By Chas. S. Lake.

The Leicester Motor Fire Engine.

As was promised in the last issue of these Notes (The Model Engineer, November 23rd), further particulars are given herewith of the chemical motor fire engine supplied to the Leicester Corporation by Messrs. the Wolseley Tool and Motor-Car Co., Ltd., of London and Birmingham (to whom the writer is indebted for the accompanying photograph). As already stated in The Model Engineer for the date given above, the chassis carries a horizontal 24 h.-p. four-cylinder motor, with cylinders $4\frac{1}{2}$-in. bore by 5-in. stroke, the carburettor being of the float-feed spray type, having one jet for the four cylinders.

Electric high-tension ignition by means of accumulators and induction coils, with tremblers, are employed, a spare set of accumulators coupled to a two-way switch being carried to obviate failure of the electrical ignition arrangements in the event of one battery running down unexpectedly. The cooling is on the well-known standard Wolseley system, hot water being taken direct from the engine to a battery of radiators arranged in the place of the usual bonnet, these radiators being cooled by a current of air induced by a high-speed fan driven from the motor. The water is afterwards drawn from the radiators back into a tank, and from there to the engine. A four-speed and reverse sliding gear transmission is fitted enclosed in an aluminium box. The friction clutch is of the

Fig. 1.—Steam Motor Omnibus.

For description] [*see page* 488.

leather-faced cone type, mounted on the crankshaft carrying a "Renold" silent chain driving the gear-box countershaft. All speed changes are made by means of a single lever, and the forward gears give speeds of 7, 11, 15, and 20 miles per hour respectively.

The firemen ride at the sides of the body portion and on the rear platform, on which latter sufficient space is provided for the accommodation of three men. In the centre of the rear platform of the body is the chemical extinguisher, and above it on a reel 160 ft. of hose. On each side of the rear step is a large hand chemical extincteur, which can be carried by one man. The framework of the engine, as a whole, is built of channel steel section, and the wheelbase is 9 ft. 6 ins., the track or gauge being 4 ft. 9 ins.

FIG. 2.—WOLSELEY FIRST-AID CHEMICAL FIRE ENGINE.

RAIL MOTOR-CARS.

For the moment there appears to be a lull in the construction of steam rail motor-cars in this country. Not that the railway companies employing such cars are in any way receding from the attitude they have taken up in regard to them, but, presumably, on account of the fact that their immediate requirements in this direction have been satisfied. The Great Northern are just about ready with some cars which have been built at the Doncaster Works; and the L. & N.W.R. are also proceeding with the number of cars comprising the original order, but there are no signs of further developments at present. This is, perhaps, not to be wondered at, seeing that practically all the British railway companies now have rail motor-cars at work, whereas, in 1903—or only two years ago—people were debating as to whether the South-Western had done a wise thing in bringing out what was the first modern vehicle of this description to be tried in this country. Such rapid development as this is not associated with any other phase of railway working.

BOOM IN MOTOR OMNIBUSES.

Those of us who live in London, or whose daily occupation necessitates our presence there, all the week round, have become so accustomed to the hum of the motor omnibus as to pay little attention to it. Nevertheless, one has only to look about them to discover that, as yet, the horse-drawn vehicles are by far the more numerous; but although the transition process from ancient to modern methods is slow, it is of a certainty a sure one; and now we are informed that a great development of the motor omnibus movement will take place at the New Year.

The secretary of the London Motor Omnibus Company states that the profitable working of the motor omnibus is already a proved fact, the daily takings of a vehicle being found to average £8. The report just issued shows that since the "Vanguard" omnibuses began running in March, the average daily run (including all breakdowns) has been 114 miles. The maximum run of a horse omnibus is 70 miles a day, whilst the maximum for a "Vanguard" is at present 130 miles, this being done on the Elephant and Castle to Cricklewood route.

A large number of new motor omnibuses, slightly larger than those now in use, will be put on the streets in January of next year. They will seat thousand miles on the London streets without any serious trouble arising.

THE PRODUCTION OF PLATINUM.—About 95 per cent. of the world's supply of platinum comes from the Ural Mountains. In 1902 this amounted to 6 tons, in 1903 the production only reached 5¾ tons, and in 1904 it was further reduced to 4·7 tons. Recently additional sources of the mineral have been discovered. A portion of the ore is exported, but most of it is refined before being sold.

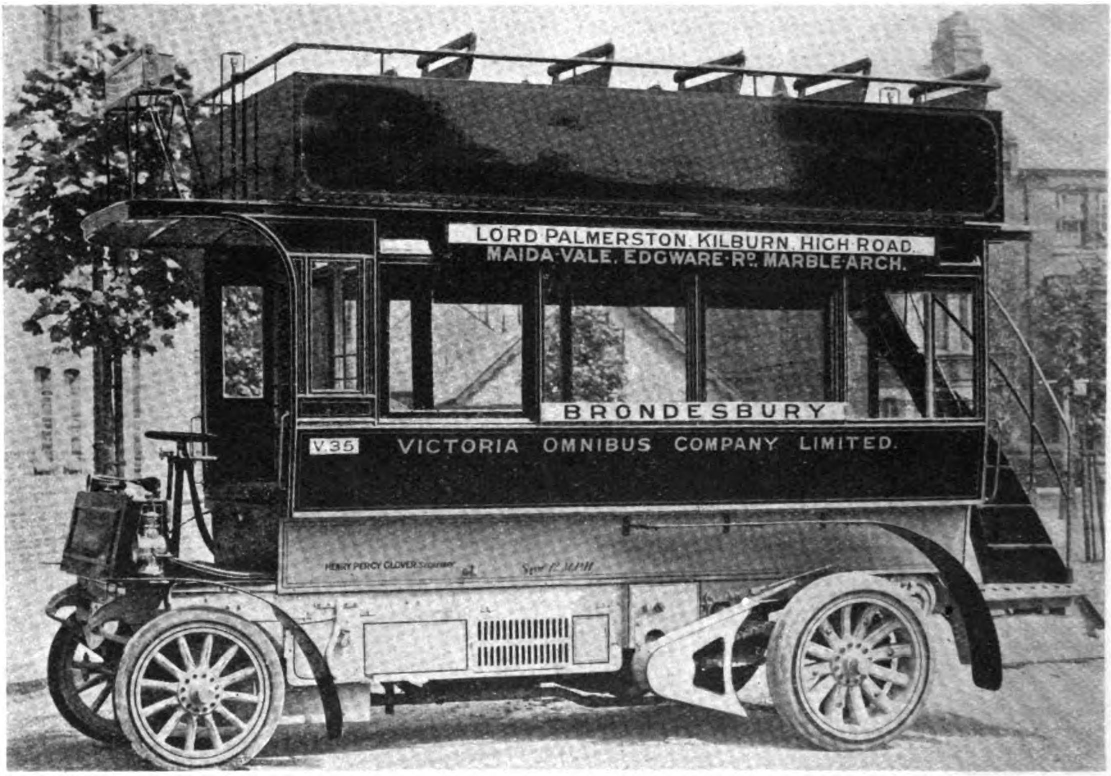


FIG. 3.—MOTOR OMNIBUS FOR THE VICTORIA OMNIBUS CO., LTD

(*Built by Messrs. Moss & Woodd.*)

40 passengers, as compared with 34, and the horse-power will be 30, instead of 24. New services will be inaugurated to South and East London, so that Brixton and Clapham, Stratford, and Bow residents will be enabled to "motor" to the City, instead of having to be content with other modes of travelling.

The illustration (Fig. 3) shows a particularly substantial looking motor omnibus built by Messrs. Moss & Woodd, of Kensal Rise, W., for the Victoria Omnibus Co., Ltd. In this design, as will be noticed, the long forecarriage is conspicuous by its absence, the wheelbase being thereby reduced. This 'bus has given complete satisfaction since being put to work a few months ago. It has covered several

ELECTRICITY IN JARROW SHIPYARD.—According to *Electricity*, a new system of overhead traction has been adopted at the shipyard of the Palmer Company at Jarrow. Electrically-propelled carriages travel in mid-air over the berth on which the battleship *Lord Nelson* is being constructed, and a vast amount of material is easily conveyed beneath three cable ways to any part of the vessel. So far, the plant has worked exceedingly well, and a considerable saving has, it is stated, been effected. The success of the experiment has been such as to induce the directors to erect a second similar structure, which will be a good deal larger than the present one, and will cover two berths 700 ft. in length.

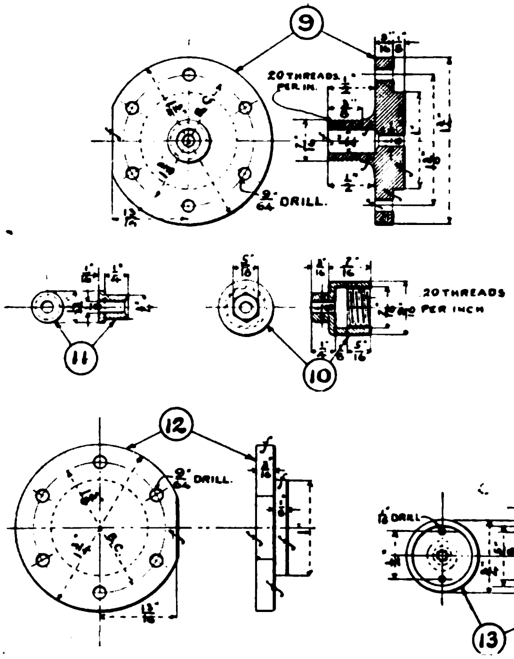
A Design for a Model Automatic Cut-off Steam Engine.

By P. D. Johnston (U.S.A.).

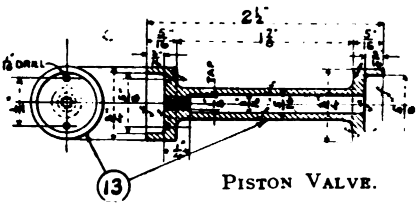
(*Continued from page* 542.)

No. 9.—Steam Chest Cover: This, with parts Nos. 10, 11 and 12, should be of bronze, finished all over as shown, and requires no special directions.

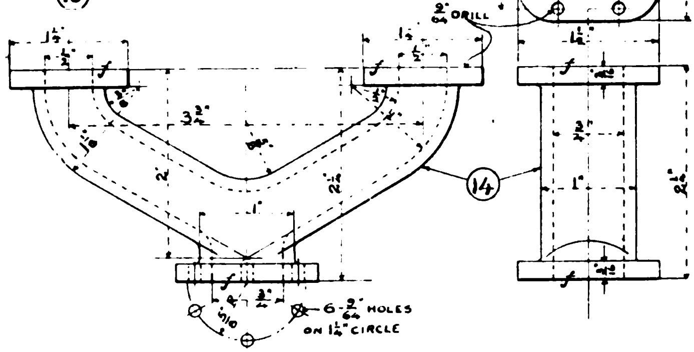
No. 13.—The piston valve should be made of hard bronze, carefully finished to dimensions, and fitted to bushings in the cylinder by lapping. This operation can be handily done as follows:—



Steam Chest Cover Details.



Piston Valve.



Exhaust Y Casting.

Take a piece of brass 1 in. thick, 1¼ ins. wide, 3½ ins. long, and bore a hole lengthwise through it. This hole must be carefully bored of a size that will just allow the valve to pass through. Put three 3-16ths-in. screws in, and then split with a saw lengthwise through the thick side. With the valve on a true mandrel running in the lathe, and the block over it, and supplied with powdered glass and oil, the valve can be quickly ground down to fit perfectly in its bushings. As the valve is ground away, the lap can be carefully closed up by means of the screws. The valve is bored with a hole larger than the valve stem, except at the back end, where it is tapped to receive the valve stem, the object being to make the connection as elastic as possible.

No. 14.—The exhaust Y is a simple casting, and can be made either of cast iron or bronze. It is finished on the faces of the three flanges, bored for bolts, and used as template for bolt holes in the flanges or underside of cylinder. After these holes are tapped, the Y is bolted in place, and the edges of flanges and the bosses dressed by filing to match, after which it can be removed.

No. 15.—Piston is made of bronze, and in order to make it hollow without difficult coring, it is made in two parts, one pattern serving for both. The two parts are to be carefully fitted together as shown, and are then well soldered. Ordinary soft solder will serve for this purpose, but silver or hard solder would be better. After the parts are properly joined, the hole for piston-rod is to be bored, and the piece mounted on a mandrel and completely finished. The grooves for packing rings must be accurately finished, so that a good job may be made in fitting the rings. The piston is made very long to form a good bearing, thus ensuring a good fit after long service.

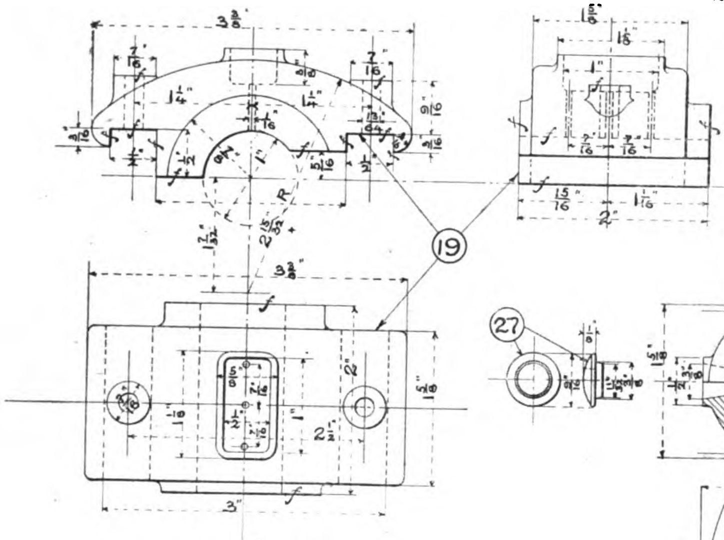
No. 16.—The bed is made of cast iron of the form and dimensions given. While this may appear a difficult part to make, it is really quite simple, and offers no special problems either in pattern-making or finishing. While the drawing does not call for it, still it would be well to allow for planing on the bottom, as this will facilitate the other operations of finishing by giving a true base to work from in scribing and laying out from a surface plate.

At the main bearing end of the bed a lug is cast on, which is to be removed after all the work is finished by means of saw and file.

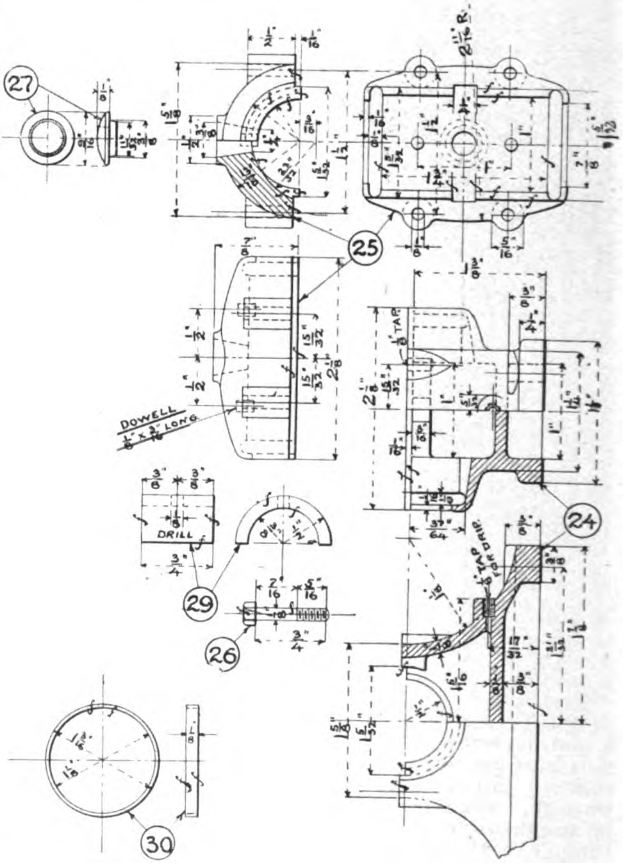
First lay the bed on the platen of a planer or other true surface, and with scribing block mark the true height of centre line on the back end, as well as the lug at the front end. Next mark the centre line through the guides at both ends, place centres, and swing the bed in the lathe, and face to fit front cylinder head. Next plane out the main bearing, and fit the cap and quarter box, and bolt them in place. Now lay out and bore for shaft, being sure that the bore is accurately located and square to the centre line of the engine; then face both sides of bearing square to the shaft. The next operation is the planing of the guides, being careful to get them accurately aligned. The final operations are the boring for the neck of the cylinder-head and the cylinder bolts, using the head as template for

carefully test all lines with reference to the centre line, and being assured that all is correct, the lug may be cut away from the front or main bearing end.

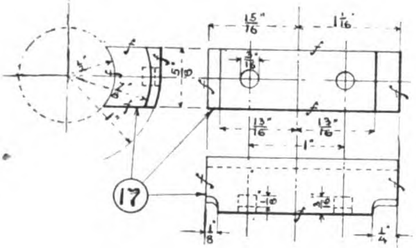
No. 17.—Quarter-box, material cast iron, is to be finished all over to sizes given. It can be worked down on either a planer, shaper, or milling machine, but in the absence of either, by careful filing. Two holes are to be bored, spaced to take the adjusting bolts No. 18, and these holes partially filled by steel buttons lightly fitted and driven in.



Main Bearing Cap.

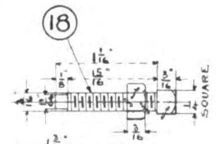


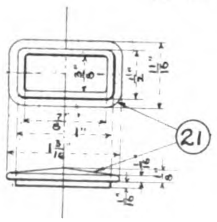
24—30.—Outboard Bearing Details.



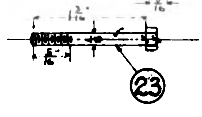
Quarter Box.

Adjusting Bolts.

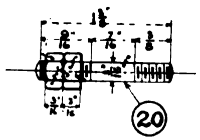




Oil Cup Covers.



Guide Bar Bolts.

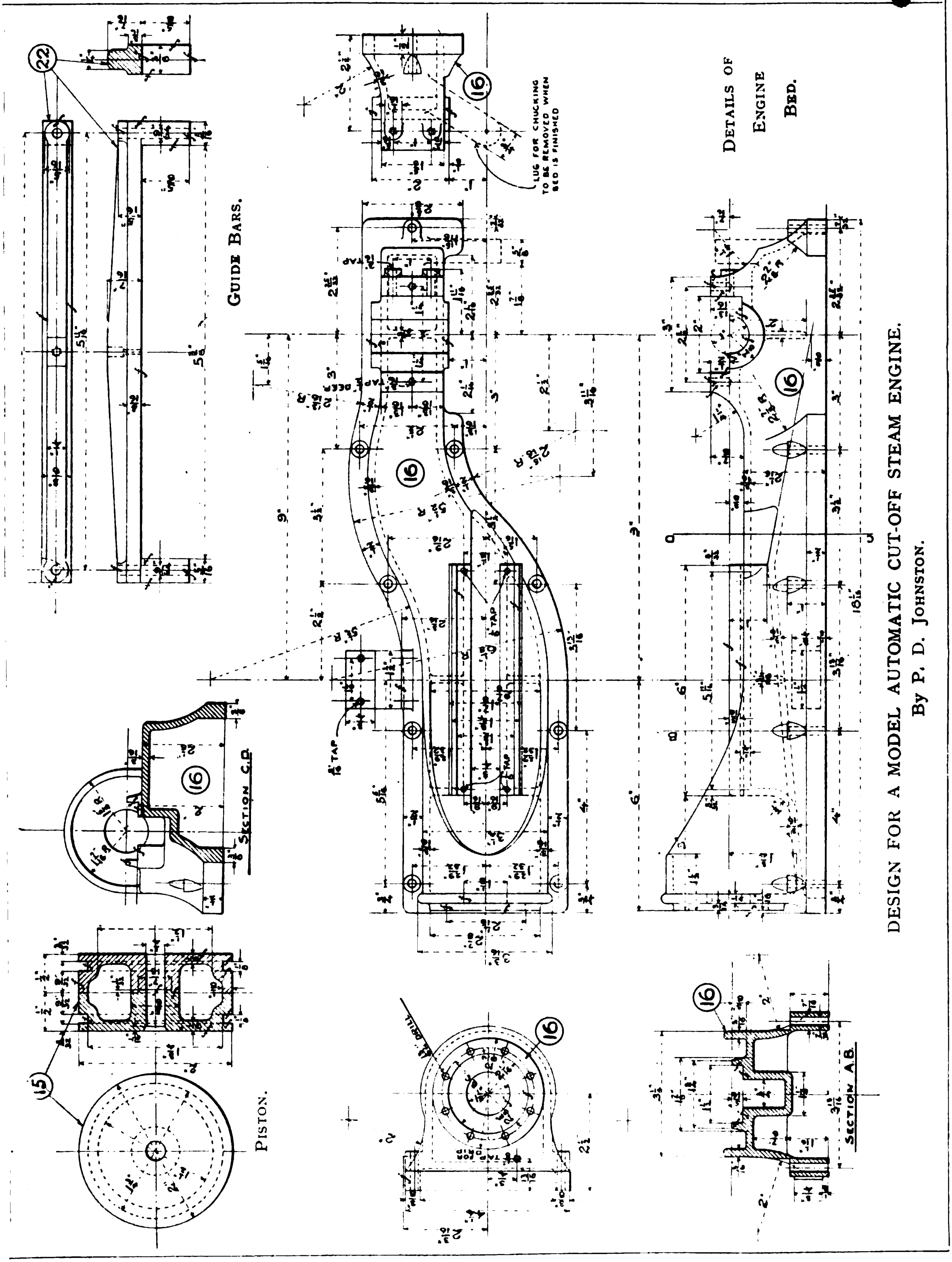


Studs for Main Bearing.

the latter, also drilling for holding-down bolts. The tapped holes for the guide-bar bolts can be put in later by drilling through the guide-bars. Now

No. 19.—The main bearing cap or binder, made of cast iron. This is cast from a pattern, and is to be fitted to place between the jaws of the main frame. The fit should be a neat one, and, when completed, the bolt and oil holes are to be drilled. The fit must be such that when drawn down by the bolts the cap will hold the quarter-box in place. After this fitting is done, the shaft bearing can be bored as described under No. 16.

No. 20.—Studs or bolts for main bearing are simple studs of steel, fitted with nuts as shown.



DESIGN FOR A MODEL AUTOMATIC CUT-OFF STEAM ENGINE.

By P. D. Johnston.

No. 21.—Oil-cup cover is a simple piece of cast iron, and need not be made from a pattern.

No. 22.—Guide-bars are made of cast iron, right and left. One pattern will answer for both, as the rounding of the end blocks to clear the crosshead can be done with a file after the planing of the bars is completed. The blocks at each end of the bars should be left full in height until the crosshead No. 43 is finished, and then are to be reduced so that when bolted securely in place the crosshead will slide freely under the bars, but without slack or lost motion.

No. 23.—Guide-bar bolts are simple hexagon head tap bolts made of steel, and are to fit neatly in the holes bored in guide-bars.

The outboard bearing is made up of Nos. 24, 25, 26, 27, 28, 29, and 30. Nos. 24 and 25 can be made either of cast iron or bronze. Patterns must be made with proper allowance for finish where the two parts are fitted together, and for boring where the liners are fitted. Nos. 26 and 27 need no explanation.

No. 28, the bottom liner, is to be made of white or Babbitt metal, finished as shown, except in the bore.

(*To be continued.*)

Notable Models at South Kensington Museum.

I.—Some Slide-valve Models.

(*Continued from page* 520.)

THE first of the models here illustrated shows Paxman's expansion gear, patented and introduced by the well-known firm of Davy Paxman & Co., Colchester, in 1885. This gear has a main slide-valve with through steam ports, driven by an eccentric, which works between the port face of the cylinder and a stationary plate also having through ports, whilst on the back of this plate slides a double-ported cut-off valve. The variation of cut-off is performed by the governor through an ordinary link motion with two eccentrics, so that the position of the link determines the advance and travel of the cut-off valve. This method differs from the others in that it is not the relative motion of the two valves which governs the cut-off, but simply the motion of the expansion valve sliding over the ports of a stationary plate.

Hartnell's excellent expansion valve gear is used by the inventor in connection with his governor for automatically varying expansion. The main valve has the ordinary through end ports combined into a single chamber provided with a multiple ported back face, upon which slides a gridiron plate driven by a separate eccentric. In this way all the back ports are used in admitting steam at each end of the cylinder, whilst only a short relative travel is employed. The cut-off is varied by altering the travel of the gridiron valve, and this is effected by the governor moving a die block in a rocking link, as shown in the model, but not illustrated in the accompanying photograph. (Fig. 5).

The next example (Fig. 6) is a "back-plate expansion valve." No inventor's name is mentioned in connection with this, but the type is stated to have been introduced in its simplest form so long ago as 1839. The main valve has ports through its ends, and a face on its back on which slides a flat plate driven by a separate eccentric. In later practice the cut-off plate is also provided with ports, as shown in the model. Variation in the point of cut-off is effected by moving a block in a link rocked at one end by the expansion eccentric, thereby altering the travel; the longer the travel the later being the cut-off. By connecting the block with a governor the degree of expansion employed may be automatically adjusted to suit the load on the engine.

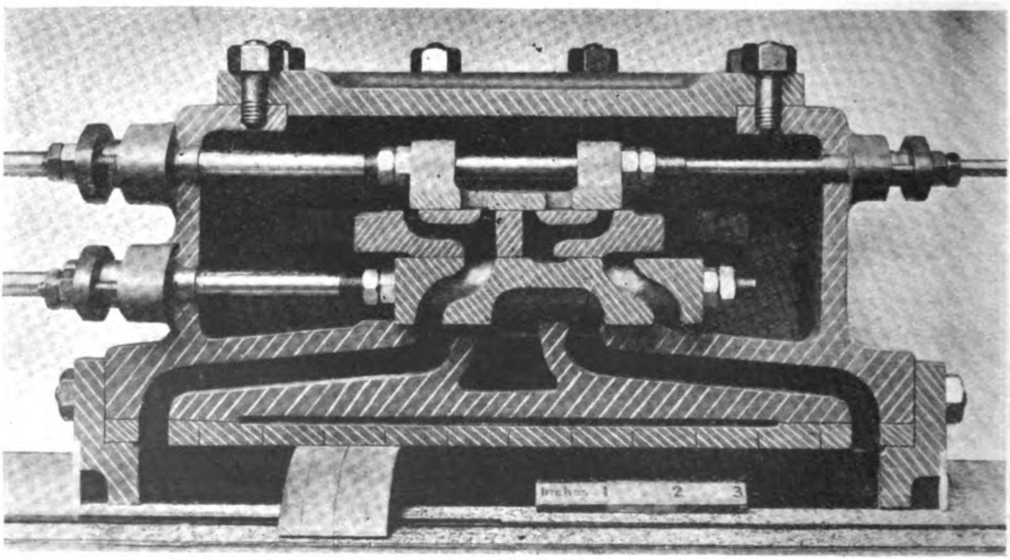


Fig. 4.—Paxman's Automatic Expansion Valve.

On the other side of this case of slide-valve models are eight sectional models of the common slide-valve showing various modifications introduced since its original application by William Murdoch, 1781-6, in his models of a steam carriage and an oscillating engine, both of which are in the Museum. As a sliding-valve may continue its movement after it has closed any particular passage which it controls, it may be arranged to open or shut others. This facility led to its replacing the four-beat valves originally necessary in early double-acting engines, whilst its simplicity and quiet working soon led to its general adoption in all forms of the steam engine. The first of the models of plain slide-valves shows the construction of the long D valve patented by W. Murdoch in 1799, and deriving its name from the cross section resembling a letter D (see Fig. 7). The valve—now,

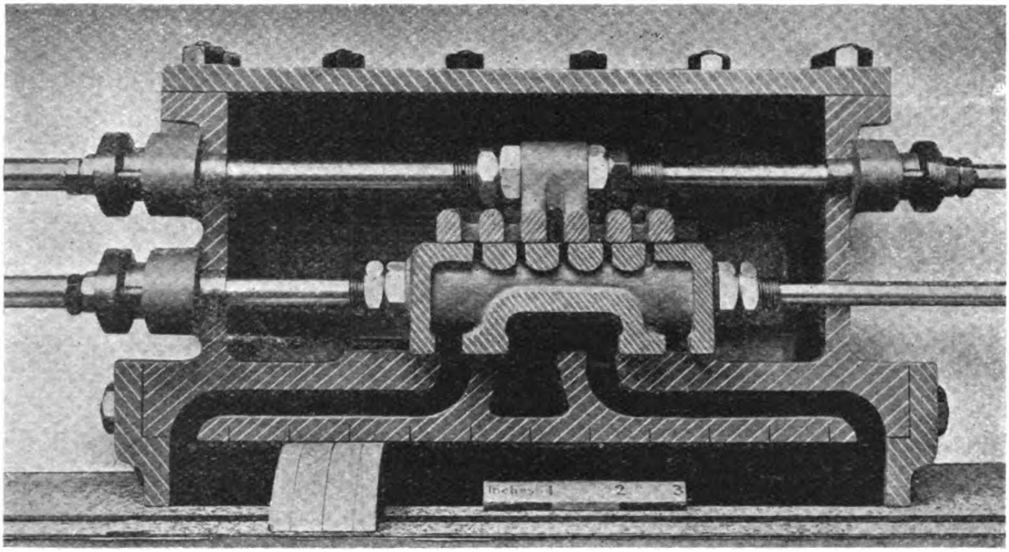


Fig. 5.—Hartnell's Automatic Cut-off Valve.

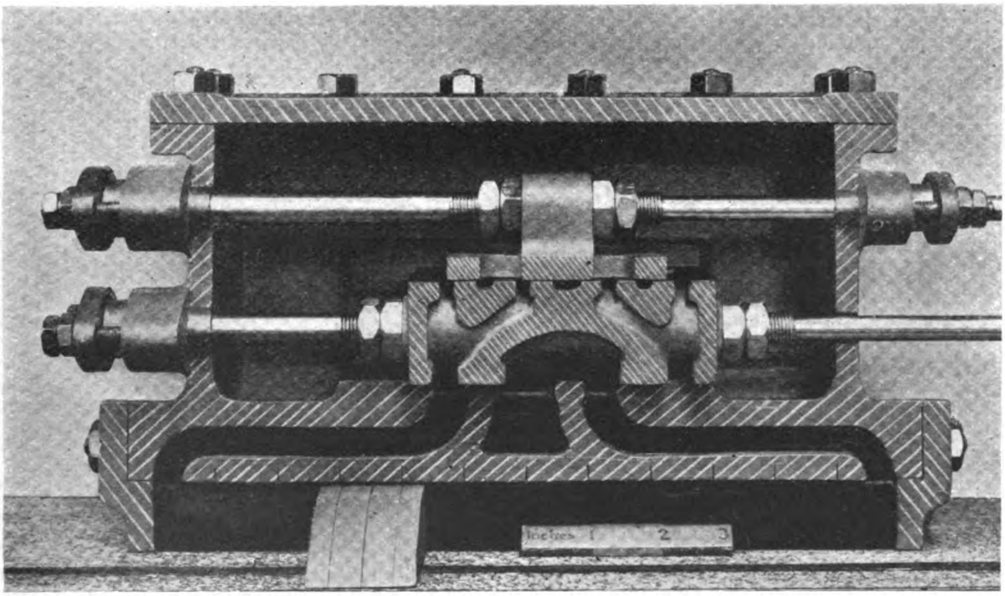


Fig. 6.—A Model of another form of Backplate Expansion Valve.

of course, somewhat of a curiosity—consists of a semi-circular tube enlarged at the ends and sliding on a flat face provided with a port at each end leading into the cylinder; the valve is contained in a steam chest of similar shape, into which at mid-length the steam is admitted, whilst the exhaust pipe is connected to one end. The valve itself divides the chest into two portions, leakage between which is prevented by hemp packing held in two recesses and pressed upon the enlarged ends of the valve by blocks adjusted externally by screws. The axial hole through the valve leaves both ends of the chest in communication with the exhaust pipe, but across this hole is a bridge piece to which the valve-rod is secured. By this the valve is moved, usually by an eccentric on the engine crankshaft, and in this way the ports in the cylinder are alternately placed in communication with the steam supply and the exhaust pipe. This valve is balanced as regards the steam pressure, and gives very short and direct passages, but from its length and shape is rather liable to warp and so become leaky. It was often of great size, especially in the early forms of the marine engine.

The short D valve (Fig. 8) follows the long D. In this latter modification two short semi-circular pistons are employed, connected by rods, steam being admitted to the centre of the chest and exhausted from each end by separate pipes. In its action and system of packing it is virtually the same as the long D, but lighter and less liable to warp. In both forms there is a good deal of trouble in keeping the packing steam tight at the corners of the D.

(*To be continued.*)

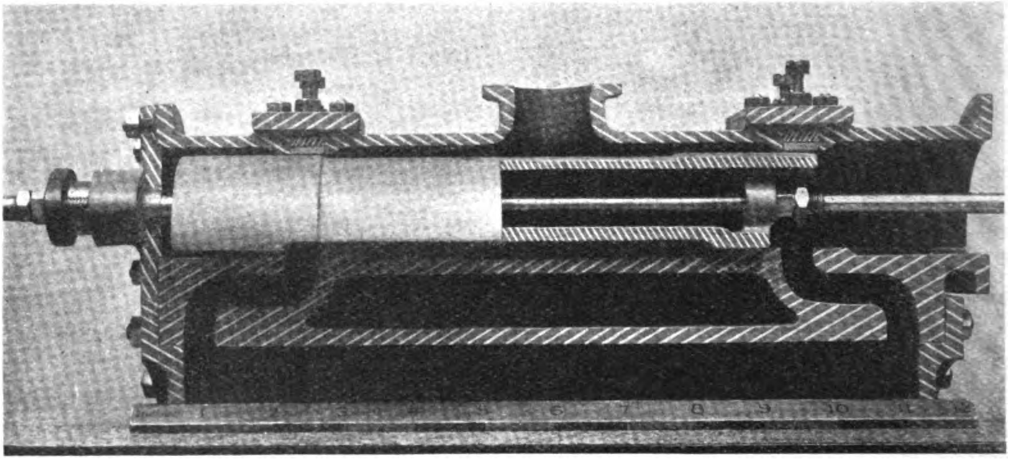


Fig. 7.—Murdoch's Original Long "D" Slide Valve.

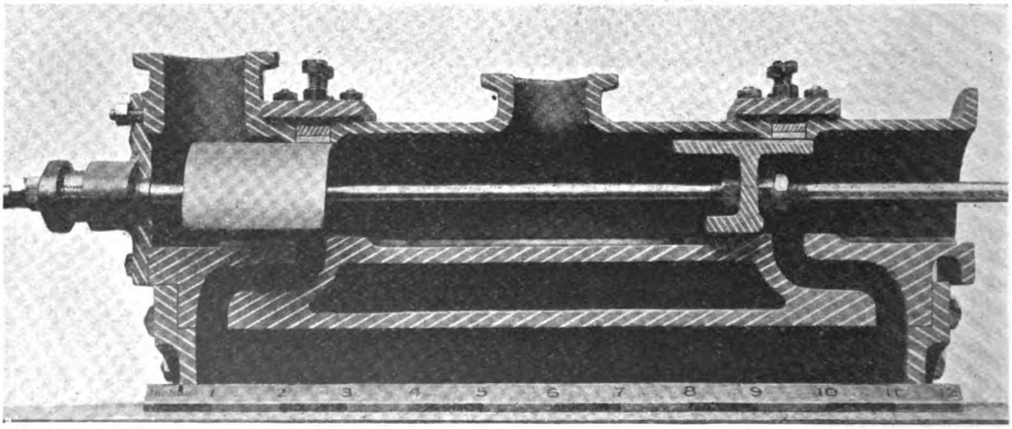


Fig. 8.—The Short "D" Slide Valve.

The new Seaham harbour and docks built by Messrs. S. Pearson & Son, Ltd., were opened recently, having taken nearly six years to complete. The dock is 1,000 ft. long by 450 ft. wide, and occupies an area of 10 acres. The gateway is constructed of concrete, faced with masonry, and is 65 ft. wide, with a depth of water on the sill of 25½ ft.

Simple Apparatus for Wireless Telegraphy.

By "Erg."

THE wireless telegraphy receiving apparatus here described responds perfectly to the transmitter (Fig. 1) placed 15 ft. away. Moreover, it is well within the skill of the average amateur to construct, and forms an interesting piece of apparatus when finished.

The transmitter (Fig. 1) will be considered first. The coil has a core 5 ins. long by ½ in. diameter, of No. 24 soft iron wire, bound round with tape and wound with two layers of No. 20 S.W.G. D.S.C. wire. An ebonite tube, 1-16th in. thick and 5⅜ ins. long, forms the insulation between primary and secondary. The secondary consists of 1¼ ozs. of No. 40 S.W.G. s.s.c. wire wound on a bobbin 3⅜ ins. long and 1⅜ ins. in diameter over cardboard ends. Waxed tissue paper is used between each layer of wire. When wound it was finished in the manner I described in THE MODEL ENGINEER for January 19th, 1905.

The usual contact is fitted, and a condenser of fifty sheets of tinfoil 4 × 1 in shunt circuit. Secondary coil ends of ebonite 1½ ins. in diameter and 3-16ths in. thick. The coil is supported by the main insulating tube on two ebonite standards.

With one bichromate cell having elements 6 × 1¾ the coil gives an ¼-in. spark between two ½-in. brass balls. The tapping key needs no explanation. The radiating plate or antenna is a piece of zinc 6 ins. in diameter; it should be taken about 1 ft. 8 ins. from the coil, and can be supported at the far end on an insulated stand.

The receiving apparatus is mounted on a stand made by screwing two pieces of well-planed mahogany or similar wood together to form a T, the size depending on the constructors, bell and batteries; but it should not be less than 10 ins. high. The apparatus consists of the relay, coherer, and bell; also used as the decoherer.

The coherer consists of a glass tube 1¼ ins. long by ¼ in. in diameter. Two brass discs, A A¹ (Fig. 2) are soldered on to the wires B B¹, 1-16th in. thick, to form the plugs. The wire passes through the ebonite plugs C C¹, which are pieces of ebonite tube ¼ in. external and 1-16th in. internal diameter. Silver filings with a trace of iron filings are used between the plugs, which are between an ⅛ in. and 1-16th in. apart. However, they can be easily adjusted to any distance. The ebonite standards, D D¹, on which the terminals E E are mounted are built up of ebonite tube ⅝ in. external and ⅜ in internal and ⅝ in. and ¼ in. outside diameters respectively. Fig. 2 should explain details; the radiating plate is shown in its wrong plane.

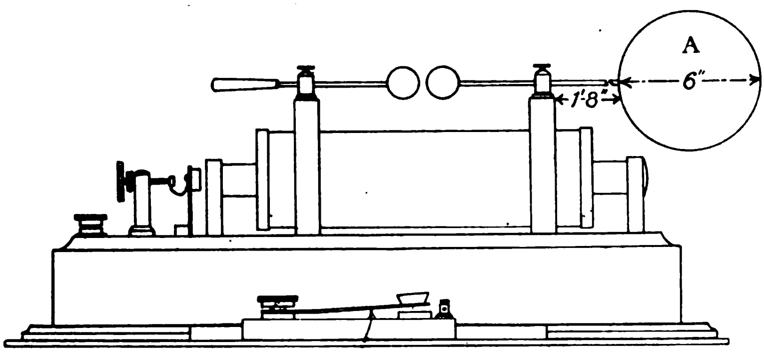


FIG. 1.—THE TRANSMITTER.

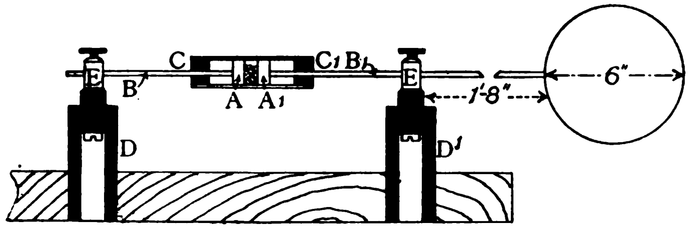


FIG. 2.—THE COHERER.

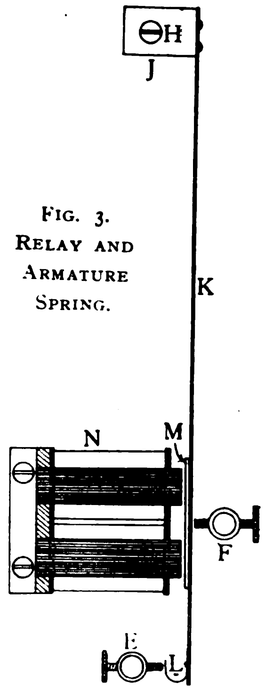


FIG. 3. RELAY AND ARMATURE SPRING.

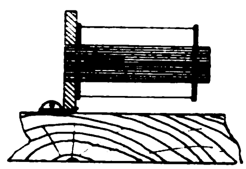


FIG. 4. ELEVATION OF RELAY-MAGNET.

The magnet for the relay has poles built up of No. 24 iron wire, and wound with 1½ ozs. of No. 40 on each pole. The armature spring (Fig. 3) K is of the thinnest brass, very little thicker than foreign note paper. Should the armature M stick through residual magnetism, it should have a piece of stamp paper stuck on its face. A small piece of copper, L, is soldered on to the armature spring to form a contact with the screw E. Platinum is not necessary if the contacts are kept clean. The screw F is to prevent chattering. The distance of the armature M from the poles of the magnet N is adjusted by the screw H through the block J.

Fig. 5 shows receiving apparatus assembled. G bell, H wire to tap coherer C upwards. This is important, and does not seem to be generally known, considering the number of diagrams and photographs showing the decoherer tapping downwards. This tends to cake the filings after some little use, but when tapped upwards they are shaken up and driven apart each time. J is the radiator; A B are batteries. Choking coils may be put in between battery and coherer, if required. I find they make no difference in this apparatus, although

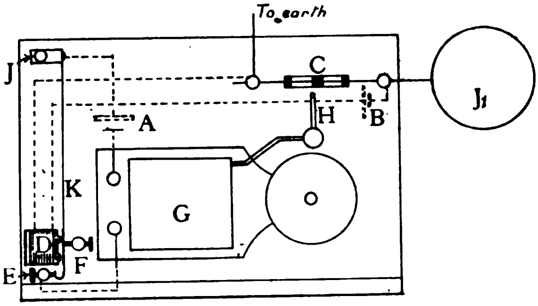


FIG. 5.—RECEIVING APPARATUS.

they improve a larger apparatus that I have. The illustrations given herewith I think will explain all details.

Should any readers require fuller information, I will be pleased to furnish it through the pages of THE MODEL ENGINEER.

Practical Letters from our Readers.

[*The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a* nom-de-plume, *if desired, but the full name and address of the sender* MUST *invariably be attached, though not necessarily intended for publication.*]

Electricians in the Royal Navy.

TO THE EDITOR OF *The Model Engineer*.

DEAR SIR,—We, as naval electricians, having read the article in THE MODEL ENGINEER, entitled "Electricians in the Royal Navy," with great interest, and being constant readers of your valuable paper, would like to give to your readers a correct account of the advantages and disadvantages of an electrician's life in the Navy. We must say that we consider the aforesaid article is not only very misleading, but entirely wrong in many points. In the first place, we hardly think that a peaked-cap and brass buttons (which we admit are smart) would be attraction enough for a young ambitious man whose main object is to secure a good position and to advance himself in a profession which he is in love with. We also think that the title "Electrician," which the *Electrical Review* thinks is misleading, is more deserved by us than by many so-called electricians on shore.

The writer of the article was evidently unaware that every electrician, before being sent to sea, has to undergo a twelvemonths' course of instruction on H.M.S. *Vernon* torpedo depot ship before being accepted into the service, and it depends on his abilities and qualifications, both theoretical and practical, whether he is sent to sea, or sent outside again, at the end of that period. The course we are put through is the same as laid down for torpedo instructors, the practical portions being more advanced, and consists of the following subjects:—Elements of the theory of electricity, electrical measurements; the theory, construction, repair and maintenance of telephones, bells, ordinary telegraphy, batteries (primary and secondary), testing by means of Sullivan's galvanometer, Wheatstone's bridges, condenser, Varley's loop, Poggendorf's method, Blavier's test, the recalibration of voltmeters and ammeters, testing of dynamos, motors, re-winding of armatures (the various methods of winding same), various controllers for motors, electric light and wireless telegraphy (Marconi's system), the service method and also the various methods of tuning for secret communication. Here we must admit that our principal duty on board a battleship, as far as wireless is concerned, is mainly to repair the instruments, as there are special men for sending and receiving, who get a course in the Morse code; but the electrician has the job of putting all the gear up and getting it in working order. We also have a course of torpedoes. The majority of electricians are young men who have served their apprenticeship at works like Armstrong, Whitworth & Co., Vickers, Sons & Maxim's, and other large engineering firms, as fitters and turners, and none but a first-class mechanic is able to pass the examination, as 90 per cent. of candidates learn to their cost. If this does not make us of more value than a T.I. we leave it to your readers to form their own opinions.

Our duties at present, on an up-to-date ship, consist of the following:—If it is a battleship or new first-class cruiser, she will carry three electricians, one of whom would have charge of the dynamos from the engine-couplings, switchboards, motors, motor transformers, various controllers, boat and shot hoists. Electrician No. 2 would be responsible for the repair and maintenance of the bells, batteries and fire control, wireless instruments, telephones, and testing instruments. Electrician No. 3 would have charge of the torpedoes and gyroscopes, and be responsible for their proper maintenance and repair, and would be the person responsible for their proper adjustment before being run. He would also be responsible for the adjustment of the gyros. Our friend evidently knows a little about gyros. We have heard a saying, and it is very true in electrical work, that a little knowledge is a dangerous thing. He overlooks the fact that it is impossible to properly adjust a gyro at sea unless in sight of land, and, therefore, gyros are very seldom adjusted on a ship unless in emergency or for instructional purposes, but are left until the ship gets in dock or harbour. As for one electrician being kept specially for gyros, the idea is ridiculous, and has never been known, except on the *Vernon*, where the gyros are adjusted for the torpedo boats.

With reference to the T.I. being the Torpedo Lieutenant's right-hand man, he is more the Torpedo Gunner's right-hand man than anything else. It is the electrician who is acknowledged as the Torpedo Lieutenant's right-hand man, and in the majority of cases he takes his orders direct from the Lieutenant, the Torpedo Gunner having nothing whatever to do with him. As regards the title of "Instrument Maker," we do not wish for that at all; we have quite enough to do to keep the dynamos, motors, and numerous other gear in efficient working order to find time to make instruments or endless terminals and ebonite bases. We would also like to point out that at "general quarters," "fire stations," and other critical times, one electrician has charge of the switchboard, while the others go to the seat of danger and cut away the circuits that are in danger or are damaged, and connect up temporary circuits to keep the ship in as efficient a condition as possible, while the T.I. and his staff join up yard-arm groups and temporary lamps in case of fire or collision, so that the men can see to work; in battle they would be in the submerged flat ready to fire torpedoes if opportunity offered; if not, they would help the electrician to repair the electrical gear as far as possible and work the motors. Regarding the disadvantages we would point out to your readers that we have a lot of prejudice to fight against at present, which makes it rather hard for a young man coming from civil life into the service. He must be possessed of a strong will, and be prepared to face a lot of discomfort if he would succeed in the service; if not, he had better stop on shore and persevere there, as there are quite as good prospects opening up outside as in the Navy for the right kind of men. In conclusion, we would like to say regarding our rating, that we are as much chief petty officers as any other C.P.O. in the Navy, and we have it impressed upon us, too, if we happen to have to visit the quarter-deck for any misdemeanour. We would also like to point out to your readers that the pay is 5s. 6d. per day, and not 5s., as stated.

If you can see your way clear to publish our letter we shall be more than satisfied, as we do not wish any of your readers to be misled by wrong accounts, and if we have been instrumental in giving your readers some idea of an electrician's life in the Navy, we shall feel that we have done our duty, and duty stands first and foremost in H.M. Navy.—Yours truly,

"TWO NAVAL ELECTRICIANS."

Model Sailing Yacht Design.

To THE EDITOR OF *The Model Engineer.*

DEAR SIR,—Your issue of April 27th last contains a model of a 42-ft. rater by Mr. Kitchingman, of Lowestoft. I would esteem it a favour if that gentleman would give me some further particulars as to fashioning the stem, stern, and keel. Does the lead ballast run the whole length of the keel, or only between the shaded parts of Sections C and 4?—Yours truly, SUBSCRIBER.

To THE EDITOR OF *The Model Engineer.*

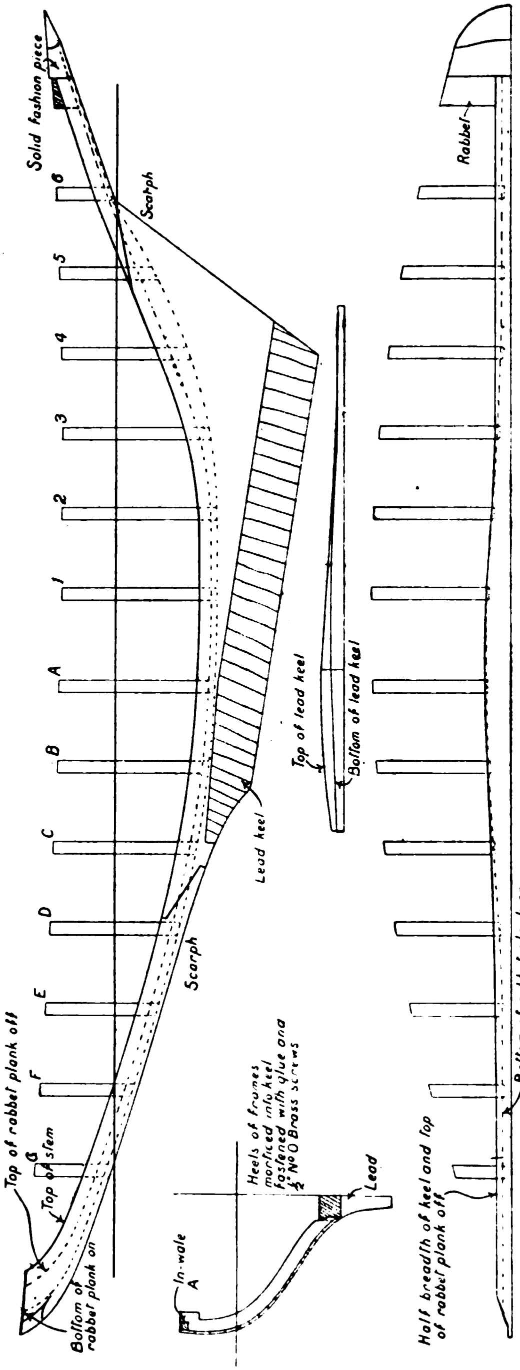
DEAR SIR,—In reply to "Subscriber's" letter *re* 42-ft. linear rater model yacht, I may say that the lead keel extends from the end of sternpost aft to Section C forward, as shown on the drawing of the keel and rabbet lines which I enclose herewith, and which will more clearly explain the fashioning of stem, stern, and keel.—Yours faithfully,

Lowestoft. R. P. KITCHINGMAN.

Mirrors for "Half Models."

To THE EDITOR OF *The Model Engineer.*

DEAR SIR,—I have a half-model of a steamship which is fixed on to a mirror, causing it to look



KEEL AND RABBET LINES FOR 42-FT. LINEAR RATER MODEL YACHT.

when reflected in the mirror like a complete model. In consequence of this mirror becoming damaged it becomes necessary to resilver it, or replace it with a new one.

Now, this mirror appears to be silvered on the side nearest the object reflected therein, otherwise, in the case of an ordinary looking-glass, the model would appear (instead of a complete boat) like two halves of a boat with the thickness of the glass between. I have seen an expert to-day, who tells me that he can do anything in the way of silvering, but a glass silvered on the front side and burnished would still be useless as a reflecting surface, even if I could get it burnished—an operation which he himself could not perform.

I should be very grateful to you if you can clear up this mystery for me. There is a mirror such as I require staring me in the face, containing, in fact, the reflection of my own puzzled face on its surface; and yet people who get their living making mirrors say that it is impossible to make one.—Yours faithfully, E. F. R.

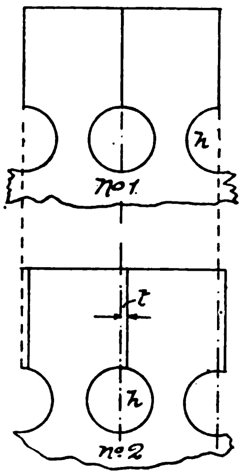
Model Turbine Construction.

To THE EDITOR OF *The Model Engineer*.

DEAR SIR,—In model turbine wheels constructed on the German toy principle, the pitch of the blades is equal to the width of these plus the "kerf" of the saw-cuts. This pitch is too great, and, as pointed out by Mr. Bredin Naylor in the *M.E.* for November 9th, leads to loss of efficiency.

The following method has occurred to me, which

CONSTRUCTION OF MODEL TURBINE BLADES.



allows the pitch to be reduced whilst keeping the blades the same width. Two identical discs (Nos. 1 and 2) are first marked out and the rings of holes *h* in each are drilled; No. 1 is then finished off in the ordinary way. In No. 2 the radial saw-cuts are made off the centre by a distance *t* equal to the thickness of the metal. The two discs are now riveted together, the vanes of one being between the vanes of the other, and the result is a wheel with a pitch one-half that of a single disc wheel. The object of displacing the radial cuts in No. 2 is to keep the tips of all the vanes in line. Were it not for this arrangement, the vanes would be "staggered." By using thin brass, reducing the width of the blades, and using two or even three discs, a very efficient wheel could be made, and the pitch would approximate to the cross-section of the steam jet.—Yours truly, H. H. HARRISON.

Queries and Replies.

[Attention is especially directed to the first condition given below and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-hand corner of the envelope "Query Department." No other matters but those relating to the Queries should be enclosed in the same envelope.

Queries on subjects within the scope of this journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied, wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed, and also a "Queries and Replies Coupon" cut out from the advertisement pages of the current issue. (4) Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor,* THE MODEL ENGINEER, *26–29, Poppin's Court, Fleet Street, London, E.C.]*

The following are selected from the Queries which have been replied to recently:—

[14,698] **Milling Cutters.** "NOVICE" (Lynn) writes: (1) Wanting some mild steel, I sent to the ironmonger's for same; they replied they kept spring steel, but did not know if that was the same as mild steel. What I want to know is—is it the same, or whereabouts does it stand between iron and cast steel. Would it answer the same purpose as mild steel—is it easy to work in the lathe, etc.? What I want it for is to make a set of mandrels for the lathe. Also, what is Bessemer steel? Any information you could give on the above would be appreciated. (2) Mr. Cook's article on Speed of Milling Cutters, in the *M.E.*, I am somewhat confused. In the first-mentioned article the sprocket wheel has 8 teeth, and driver on crankshaft 11 teeth. Using a 2-in. cutter; and surface speed of 156 ft. per minute, it requires $\frac{156}{\cdot 2618 \times 2}$ = about 300 revolutions for brass. As sprocket makes 11·8 revolutions to crankshaft, it will require 300 ÷ 11·8, or about 218 revolutions, which is impossible with ordinary treadle motion. Might not a larger driver and smaller sprocket be applied with advantage, as with wheels as in metal-worker, working shaft at 60 revolutions, a speed of $\frac{3\cdot 1416 \times 2 \times 60}{12}$ = about 31 ft., which is only about equal for speed on cast steel? I have worked above upon 2-in. diameter cutter, but in practice would use, say, 1½-in. or less, which would mean a proportionate increase in speed. In conclusion, I have a cycle list before me, in which I can get sprocket wheels ½-in. pitch as low as 14 teeth, chain wheel 60, and 7 and 40 1-in. pitch, giving 75 by 52 respectively for crankshaft.

Our contributor, Mr. Chas. W. Cook, replies as follows: (1) Spring steel is not the same as mild steel, and does not work easily in the lathe. It is neither as brittle nor as hard as cast steel, but is much tougher, possessing more elasticity than the latter. The querist should make his mandrels of mild steel or Bessemer steel, which is the same thing, Bessemer being a variety of mild steel obtained by the Bessemer process invented by Sir Henry Bessemer. In regard to Query No. 2, I do not quite understand the questions asked; but I may say that the speeds given in my article on Speeds of Cutters are, approximately, correct, and are those used by myself on similar work. If, however, the querist is unable to obtain the higher speeds, he must get as near as his wheels or gearing will allow him, or, obviously, alter his gear to run faster.

[15,103] **Small Low-voltage Motor Windings.** H. S. (Bloomington, Indiana) writes: Will you answer the following? (1) Will a motor built to dimensions given for model electric motor of this gear, with solid cast-iron, instead of laminated armature, be successful? (2) If so, will you kindly advise me as to the winding suitable for a 4-volt circuit (series wound), 5 or 6 amps.? Mr. Snelling, who writes in the current number of "Two Useful Petrol Engines" generously offers to give further information. I am sure I am not alone in wishing you would publish detail drawings of such a small water-cooled motor as is illustrated in the current number.

You *could* use a solid armature of cast iron, though, of course, a laminated one would be somewhat better. The motor would run quite successfully. (2) Windings for a 4-volt 6-amp. machine of the "Simplex" type, as described in our handbook "Small Dynamos and Motors" would be: Armature, 4½ ozs. No. 17 S.W.G. (or 5 ozs., if you can get it on); field-magnet, about 1½ lbs. No. 18 S.W.G. copper wire. We always make allowance for our foreign and Colonial readers with regard to the Query Coupon, which has to be sent with query. We note your other remarks, and will endeavour to comply with your wishes.

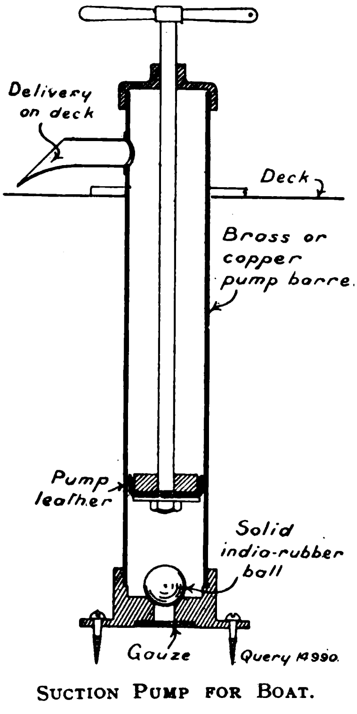
[14,884] **Running Small Dynamo from Oil Engine.** G. H. (Portadown) writes: Would you kindly answer me the following questions?—(1) What size of dynamo (volts and amps.) would a ½ h.-p. oil engine drive? (2) How many lamps would the dynamo light, and what candle-power would they be? (3) What size of tank would be required for the oil engine? (4) What bore and stroke would a ½ h.-p. oil engine be?

(1) A 60-watt machine—say, 15 volts 4 amps. (2) Would light about four 4 c.-p. lamps, or eight or ten 2 c.-p. lamps. (3) Depends upon how much oil you require to store. (4) This, also, depends upon make and design. Anything from 2 × 3¼ to 1¾ × 2½.

[15,072] **Running Small Motor from the Mains.** M. E. M. (Finchley) writes: I should be very much obliged if you will kindly answer the following questions. I have a "Twencent" electro-motor which I want to run off our electric light main, so I tried running it through four 16 c.-p. lamps, in parallel, but the motor shows no sign of going. How is this? Would it be better to re-wind this motor to suit voltage, which is 250? If so, what size wire, and how much should I want, and would I need any resistance in circuit?

You do not state what current motor is supposed to take, or what size it is. Windings for high voltage motors are given in our handbook—"Small Electric Motors," 7d. post free. A small resistance might be required for starting if you run direct from the mains. Perhaps motor takes a lot of current at low pressure. Try adding more lamps in parallel, or, use, say, 32 c.-p. lamps instead of 16 c.-p.

[14,990] **Pump for Boat.** A. B. (Derby) writes: I am wishing to make an ordinary suction pump for a sailing boat, barrel 18 ins. by 2 ins., one valve at bottom, and one in plunger, water being delivered from top of barrel on to deck. Strong brass



SUCTION PUMP FOR BOAT.

or copper tubing would be rather expensive, could you suggest about how much, or, better still, any alternative for barrel? Any sort of design or general arrangement, especially for valve in plunger, would be welcomed.

We would suggest a pump constructed as shown in the accompanying sketch. We can advise only brass or copper tubing for the pump barrel; brass preferably, as copper, being rather soft, is likely to be easily dented. The pump "bucket" may be a cylindrical block, with a cup leather, which forms valve and packing combined; the foot valve may be a solid india-rubber playing ball, as shown.

[15,084] **Armature Leakage.** J. B. (Slough) writes: On winding a small drum armature recently in four sections, I accidentally short-circuited one section to the shaft; however, upon testing it, it excited itself at once without trouble, and lit some lamps; also ran well as a motor. What I want to know is—as the field-magnet winding is well insulated, and does not leak to the carcase, and brushes are insulated: (1) What difference, if any, will there be in output? Will it pay me to re-wind leaking coil? The stated output of machine was three 8-volt lamps; this it did, but the speed seemed excessive, probably between 5,000 and 6,000 r.p.m.

If there is no apparent difference in behaviour of machine, we should say there is no need to re-wind it. How do you know you "shorted" one of the armature conductors? The only means of finding the extent of the fault is by trial or test.

[15,086] **Increasing Voltage of Small Dynamo.** C. M. (Pinner) writes: Could you give me your advice on the following subject? I have a dynamo wound to give 14 volts. It has Siemens H-armature wound with No. 21 gauge. I want to know if it is possible to wind armature so as to increase output to about 20 volts without re-winding field-magnet, and what wire should I use? Could I fit another armature so as to charge small accumulators? If so, which do you think best to use in place of the one I have now?

You will probably find that if you increase speed about 25 per cent. you will get the required voltage, without overheating the machine. Or you could fit a drum armature as described in "Small Dynamos and Motors," which would do for charging cells. You do not give winding of field-magnet or output of machine.

[15,092] **Engine for Driving Small Dynamo.** P. G. F. (Harrow) writes: I have a dynamo of 12 volts; the speed required to drive it is 2,500 r.p.m., and the power required ½ h.-p. Kindly tell me (1) What would be the best way to drive it; whether a gas engine, oil engine, or steam engine (the latter for preference), also about what would be the price for either of the above engines? (2) Would it be better to get a small engine and increase the speed by pulleys? If so, kindly give me an illustration of how they should be arranged. Kindly tell me where is the best place for getting engines to drive dynamos?

We should say a small gas engine would be most economical and convenient. Any of our advertisers dealing in such goods would send you prices on application. A gas engine running at, say, 450 or 500 revolutions, would take a flywheel of about 1 ft. diameter. Thus, to get 3,000 revolutions on dynamo, the latter would have a 2-in. pulley.

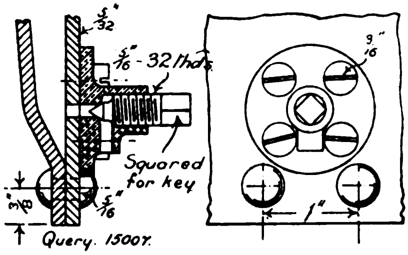
[14,658] **Steam Ports.** J. H. H. (New Zealand) writes: I am still only a novice in model engineering, and shall be glad if you will give me a little advice as to how best to bore the steam inlets (ports) to the cylinders for a model locomotive. In all the designs the inlets are shown to be *rectangular*, yet the making of mine in this form seems to me to be difficult, unless, of course, they can be "cast in."

Where the ports are not cast in, as in the case of gun-metal cylinders for locomotives up to about ¾-in. scale, there are several methods of cutting the ports. The simplest is, perhaps, to drill holes down from the port face, the holes being exactly the width of the ports and the number being as large as the length of the port will allow. For instance, for steam ports which would, if rectangular, measure ½ in. by 3-32nds in., four 3-32nds in. holes could be drilled, side by side. The exhaust ports being *three* 9-64ths in. holes. The exhaust passage is formed by a single 3-16ths-in. drill. To connect the steam ports to the ends of the cylinder, four 3-32nds-in. holes can be drilled on the slant from the end face of the cylinder to meet at nearly right angles, the holes forming the steam ports. The better method is to slot-drill the ports on the face and to connect these ports to the ends of the cylinder with as many holes as can conveniently be arranged in the space available.

[14,489] **Spark Coil Trouble.** H. C. (Blackpool) writes: I should be glad if you would kindly tell me what is wrong with my coil. The coil in question is wound with two layers of No. 20 on primary and 2 ozs. of 36 on the secondary. The two windings are insulated from each other by a layer of waxed paper, and each layer of the secondary is insulated from the next by a layer of tissue paper. The faults are:—(1) When the current is switched on, the coil will not start working itself, the armature requiring a slight jerk or twitch. (2) No shock can be obtained from the primary; and (3) after about five minutes' working of the coil the armature will stop, and when re-started, coil will only work for about another five minutes; and so on. The armature spring is just a piece of brass spring without any platinum, but the contact screw is platinum tipped. The core of is rolled iron, and was bought from the Universal Electric Supply Co. I have tested the windings for continuity, and can get a ring through both with a magneto machine. All connections are correct, and are quite clean. I have tried several kinds of batteries, and with two dry cells can get a fair shock from the secondary. The coil is of the ordinary pattern with brass draw tube. I am making motor described in Nos. 73 and 74 of the *M.E.* I have some No. 20 wire by me, which I should like to use, if possible. Please say if this could be done, and, if so, how much would be required. I have about 1 lb. No. 20. No. 24 wire is directed to be used. Would you also please say where I could obtain 9-32nds silver steel rod, and brass tube 9-32nds inside diameter, required for motor?

It is necessary to have a contact piece of platinum on the spring, as well as at the end of the screw. The fact of faulty working is due to corrosion of the brass by the spark: a film of oxide forms on the surface, and prevents the current from passing. (2) Are you sure that you have made proper connections for primary shock? (See Fig. 7, page 19, of our Handbook No. 11). You should get a shock, even if a very weak one; to make it stronger wind on more primary wire or use a more powerful battery. *Re* motor. If you use No. 20 gauge wire, the motor will work just as well, but will require more current at lower voltage. It will be, therefore, more suitable for working from such a battery as the bichromate pattern, and not from dry cells. We advise you to wind with No. 20 gauge, and try the motor from, say, a couple of quart-size cells. The same weight of wire should be put on; but if you only put on 1 lb., the motor will still work well, but will not be quite so powerful. To get best results, the armature wire should be smaller than that on the magnet. For steel and brass tube, try Smith & Sons, St. John's Square, Clerkenwell, London.

[15,007] **Vertical Multitubular Boiler.** D. W. (Abertillery) writes: I have a vertical multitubular boiler with plugs too high to properly drain it; there is no ring dividing shell and firebox, therefore it seems a difficult job to cut a screw with a tap.



BLOW-OFF COCK FOR MODEL BOILER.

We quite understand your difficulty, and should think that a blow-off cock of the pattern shown in the accompanying sketch would be quite easily arranged. There should be no trouble in tapping 3-16ths-in. or ¼-in. holes for the studs. You do not give the size of the boiler, therefore we have designed the blow-off for a 12 by 24 vertical boiler.

[14,495] **Motor for a Model Electric Train.** H. H. (Birmingham) writes: I should think it a favour if you will help me in the following. I have a small motor which has an H armature, but I should like it a self-starter—can I do it by putting in a tripolar armature? It is home-made. If this won't do, please tell me what kind I can make for the purpose. Will it drive the car I have sketched, made of brass and gunmetal? And will you tell me how to insulate the wheels? I should like it to move along and be regulated from a switchboard. Can I make it reversing as well without touching the motor? And how many batteries shall I want, and what size wheels shall I require? I am making brass railway lines—shall I use cogs or band?

Motor can be made self-starting if fitted with a tripolar armature. The field coils should be connected in series with the armature. It should drive this car, if you take care to make all spindles to run easily. For reversing, you must fit a switch on the car, which will change the direction of current in the armature, but not in the field-magnet. To reverse from a distance, you must excite the field-magnet separately by means of a small battery on the car; then reversing the current in the line will reverse the motor. To insulate the wheels, fit them with ebonite bushes, so that there is no metallic connection between the wheels and spindle. Collect the current off the rims of the wheels by means of soft brushes pressing very lightly. Use toothed gearing for preference; gear down in a ratio of about 4 to 1. Car wheels may be of any convenient diameter, but rather small than large. For battery, try two bichromate cells in series.

[14,984] **Miscellany.** F. S. (Littlehampton) writes: (1) Would it be possible to make a model radiator as sketch? If so, where could I buy the lamps? (2) How are they wired? (3) One switch would do, would it not? (4) Would an accumulator give enough current? With reference to your article on "Home Electric Lighting," you do not state whether you require cast-iron turnings or wrought-iron turnings for the Bennett tin-pot cell. I should be glad of your valued assistance with regard to a model searchlight. I have made a model boat, 3 ft. long, on which I wish to put a searchlight. (1) Should I fix it on the bridge? (2) How could I make it so as it would turn about? (3) How would you make the reflector, and how would you fasten the lamp in? (4) What battery would you use?

(1) Try some of our advertisers, such as Whitney, or Thompson, Greenwich. (2) In series or parallel, according to their voltage and voltage of supply. (3) Yes. (4) Only for small lamps. It would not be much use for actual use. *Re* battery. Either can be used, preferably wrought. *Re* searchlight. (1) Yes. (2) Fix it on pivots. (3) A silvered watch glass would do; or one of polished metal. Fix it in slight recess top and bottom of enclosing shell. (4) One or two bichromate cells—depends upon voltage of lamp.

[14,923] **Ejector for Watering the Garden.** W. H. S. (Grimsby) writes: Would a simple injector, fixed to a boiler of sufficient power, force water through an india-rubber tube, say, 20 ft. long, to use for watering a garden? If so, what would be pressure on an ordinary garden hose.

An injector (or ejector, to use the proper term for the device) does not make an efficient force pump. However, the convenience and simplicity of the thing may compensate for its wasteful consumption of steam. See "Locomotive Injectors," by Inspector, price 2s. 6d., post free 2s. 9d., for a very good explanation of the principles of the action of an injector; also the paper by H. H. Harrison, read before the Society of Model Engineers, and published in the *M.E.*, June 18th and 25th, 1903.

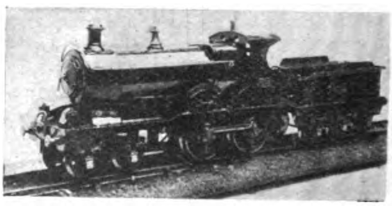
The News of the Trade.

[The Editor will be pleased to receive for review under this heading samples and particulars of new tools, apparatus and materials for amateur use. It must be understood that these reviews are free expressions of Editorial opinion, no payment of any kind being required or accepted. The Editor reserves the right to criticise or commend according to the merits of the goods submitted, or to abstain from inserting a review in any case where the goods are not of sufficient interest to his readers.]

* *Reviews distinguished by the asterisk have been based on actual Editorial inspection of the goods noticed.*

*New Model Locomotives.

Amongst the less expensive model locomotives on the market this season is Mr. W. F. Bond's new model G.W.R. "City of Bath" type engine, illustrated in the accompanying photograph. This model is made for the standard 2½-in. gauge track, and is fitted with a plain cylindrical boiler, with water tubes, which steamed very well at a trial we made. A single inside cylinder, exhausting up the chimney, in conjunction with a slip



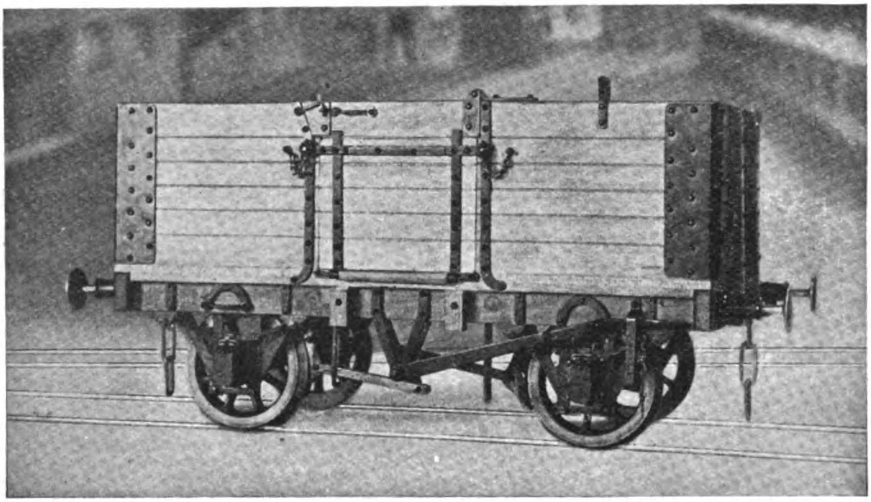
W. F. BOND'S MODEL G.W.R. "CITY OF BATH" TYPE LOCOMOTIVE.

eccentric is employed, and the driving wheels are provided with springs. The spirit tank is stored in the tender, and the whole is painted in correct G.W.R. colours making a very good looking engine. Further particulars of this model may be obtained from Mr. Bond's new catalogue which is now ready, and will be sent to any reader on receipt of one penny stamp. Address W. F. Bond, 245, Euston Road, London. N.W.

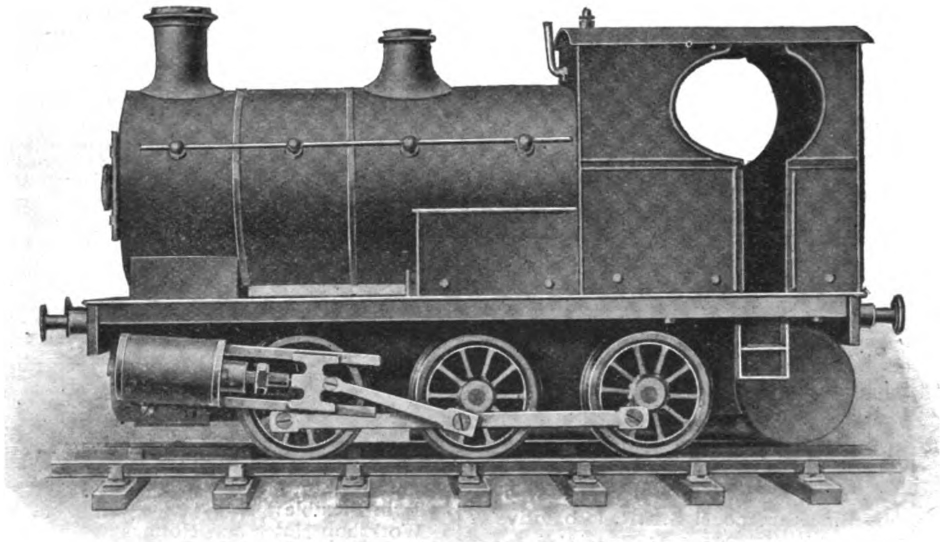
Scale Model Locomotives and Rolling Stock.

Section C of the new catalogue of Messrs. Bassett-Lowke and Co., of Northampton, has just been issued, and is the portion which will, perhaps, be of most interest to our advanced readers. It deals with scale model locomotives, the *M.E.* electric locomotive, rolling stock, permanent way, points, signals, and model railway sundries. We show in the accompanying illustration a new line in model tank engines, this being a six-coupled model of 2-in. gauge. It has been designed with the idea of getting a great hauling power for its size, and we are informed that it will pull about 20 model wagons laden with coal, while it will also ascend steep gradients. The wheels are 1½ ins. diameter, and the cylinders, of the double-acting slide-valve type, are 7-16ths in. bore by ½ in. stroke. The boiler has water tubes and internal fire, and is made for a working pressure of 80 lbs. per square inch. Either finished engines or sets of castings may be obtained. A four-coupled single cylinder tank engine of the same gauge, which will pull a brake van and 15 wagons is also listed. Other tank engines shown are a 3¼ ins. gauge G.W.R. model, a 3¼ ins. gauge L. & N.W.R., and the *M.E.* 3¼ ins. gauge model. The express locos include models of the N.E.R., the M.R.

compound, a 3½-in. gauge "Precursor," and two sizes (3¼ ins. and 3½ ins. gauge) "Atlantic," type models. A full list of motors castings and parts for the *M.E.* Model Electric Loco are given, while several pages are devoted to some excellent model rolling stock designs. From these we select the goods wagon, illustrated herewith, which is the firm's standard type for a 3½-in. gauge: The underframes and bodies are made of hardwood, painted ead colour, and lettered "M.R." in white on the sides, but



MODEL GOODS WAGON: 3½-IN. GAUGE.



MODEL SIX-COUPLED TANK LOCOMOTIVE: 2-IN. GAUGE.

NEW SCALE MODELS BY MESSRS. W. J. BASSETT-LOWKE & CO.

special colouring and lettering can be had to order. The cast-iron wheels are forced on to steel axles, and then turned in the lathe. The bearings are carried by laminated springs, and the buffing springs are also laminated. Altogether, this makes up into a very substantial and extremely realistic-looking model. For full particulars of the foregoing specialities, and of the new features in points and permanent way material and sundries, we must refer our readers to the list itself, which will be sent post free for 3d.

New Catalogues and Lists.

C. W. Burton, Griffiths & Co., Ludgate Hill, London, E.C.—The supplementary list of small tools which we have received from this firm contains prices and particulars of a number of workshop requisites, which will be of interest to model engineers. Amongst other things are illustrated small surface plates, hacksaw frames, adjustable machine vice, ratchet braces; stocks and dies, pin vices, pocket screwdrivers, micrometers, hand and breast drills, universal gauges, steel pocket rules, etc., etc. The list will be sent to all readers upon receipt of stamp to cover postage. We also have to hand an illustrated list of "Sterling" emery wheels, for which Messrs. Burton, Griffiths & Co. are sole agents. Tables of speeds, and prices of various shapes and sizes of grinding wheels are given.

The Editor's Page.

WE are pleased to announce the publication of two new handbooks, which we think will be of interest to many of our readers. The first of these is entitled "Engineering Mathematics Simply Explained," and is written by Mr. H. H. Harrison, whose name will be not unknown to those who regularly follow our pages. Mr. Harrison has realised the difficulty felt by so many engineering students and practical men that it is difficult to get from ordinary mathematical text-books a knowledge of practical methods of calculation, such as are required in every-day technical work and study, without wading through a disproportionate number of purely theoretical problems. In this book he has clearly and simply explained the working principles of arithmetic, algebra, mensuration, logarithms and trigonometry, so far as is required by the ordinary engineering reader, and has also given an excellent chapter on the uses of squared paper, and a further chapter in which an outline of the differential calculus is presented. Although we may be held to be prejudiced in our judgment, we can safely say that we know of no handbook which is so well adapted to suit the requirements of those who wish to learn how to make the simpler calculations to be met with in engineering practice. The price of the book is 1s. 6d., or post free 1s. 8d.

* * *

The other book referred to is No. 5 in our series of Practical Manuals, and is entitled "Practical Dynamo and Motor Construction." This is really a reprint of a number of the articles on electrical workshop practice recently contributed to our pages by Mr. A. W. Marshall, M.I.Mech.E., A.M.I.E.E. It is an excellent guide to the workshop methods and constructive details used in building small machines. The price is 1s., post free 1s. 3d.

* * *

We have received an unusually large number of entries for the "Fortis Vice Competition." These are having careful consideration, and we hope to be able to announce the result in our next issue.

* * *

We are informed by Messrs. Baines Bros., of Gainsborough, that their model G.N.R. locomotive has been accepted by the Board of Education for exhibition in the Victoria and Albert Museum, South Kensington, where it is now on view. We have seen this model, which is a magnificent specimen of workmanship, and we can cordially recommend all model enthusiasts to give it a careful inspection.

Answers to Correspondents.

G. W. R. (Kentish Town).—We have no letter of yours in hand.

READER.—You will find drawings of the 2015 class 6 ft. 10 ins. express 4—4—0 type engines in the *Engineer* for February 15th, 1901. The earlier engines of similar proportions (with 7 ft. 1½ ins. driving wheels), were illustrated in the issue of that journal for September 20th, 1895. Drawings of the compound locomotive No. 1,619 were published in *Engineering* for July 5th, 1901.

S. H. (Sandbach).—"Telegraphy," by Sir W. H. Preece, 6s. 4d., post free. "Telephones: Their Construction and Fitting," by Allsop, 3s. 10d. post free. "Telegraphist's Guide," by Bell and Wilson, 2s. 3d., post free. For particulars, apply to the Secretary, Gresham College, Basinghall Street, E.C.

L. & Y. (Brighouse).—Anything up to 1,200 tons on the level.

"WATTS" (Cumberland).—You will find full particulars of machines of this kind in our handbook —"Small Dynamos and Motors," 7d., post free. Any of our electrical advertisers would supply you with suitable bearings if you state exactly what you require.

Notices.

The Editor invites correspondence and original contributions on all amateur mechanical and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected or not, and all MSS. should be accompanied by a stamped addressed envelope for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

This journal will be sent post free to any address for 13s. per annum, payable in advance. Remittances should be made by Postal Order.

Advertisement rates may be had on application to the Advertisement Manager.

HOW TO ADDRESS LETTERS.

All correspondence relating to the literary portion of the paper, and all new apparatus and price lists, &c., for review, to be addressed to THE EDITOR, "The Model Engineer," 26—29, Poppin's Court, Fleet Street, London, E.C.

All correspondence relating to advertisements and deposits to be addressed to THE ADVERTISEMENT MANAGER, "The Model Engineer, 26—29, Poppin's Court, Fleet Street, London, E.C.

All subscriptions and correspondence relating to sales of the paper and books to be addressed to Percival Marshall & Co., 26—29, Poppin's Court, Fleet Street, London, E.C.

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Contents.

[*The asterisk* (*) *denotes that the subject is illustrated.*]

THE

Model Engineer

And Electrician.

A JOURNAL OF PRACTICAL MECHANICS AND ELECTRICITY.

EDITED BY PERCIVAL MARSHALL, A.I.MECH.E.

VOL. XIII. No. 243. DECEMBER 21, 1905. PUBLISHED WEEKLY

A Model G.E.R. Express Locomotive.

JUST previous to departing for the Colonies, a reader of THE MODEL ENGINEER, Mr. M. S. Campbell, called at our office with an album containing some photographs of the partly finished model G.E.R. locomotive, intimating that his going away would, no doubt, prevent further work to the model for some long time to come. In the interests of our locomotive readers, we embraced the opportunity and asked Mr. Campbell for the loan of the book—some of the best pictures contained therein we herewith reproduce—and also for a few particulars of the construction of the model. With regard to the latter, Mr. Campbell writes:—

"Being one day in the neighbourhood of South Kensington, I visited the Patent Museum there, and, while passing through the locomotive section, was much impressed by an exceedingly fine model of the Great Eastern Railway 'Claud Hamilton' engine. I thereupon decided to make an inch scale of the same, but before proceeding far worked out plans for a model of a later type of the 1870 class, and photographs of the same, as far as the work has gone, were shown to you at our interview.

"Not having a lathe at the time, I started on the boiler, which is made of a 5-in. solid drawn copper tube, 1-16th-in. thick, with twelve ½-in. drawn tubes, tinned and annealed at ends and drifted into smokebox plate and firebox, and turned over. The firebox measures 3 ins. wide, 5⅜ ins. deep, one end 4 ins. deep at footplate end, 5¼ ins. long, inside measurements, fixed to outer shell with sixty-six 5-32nds-in. phosphor-bronze stays, and screwed through both outer and inner firebox and nutted inside and out; the thickness of firebox and outer plates being 3-32nds-in. The inner firebox has six gunmetal cast roof stays, screwed in position with ⅛-in. brass Whitworth screws. There are three 3-16ths-in. longitudinal stays nutted at each end, and the fourth, on right hand side of boiler, is a solid-drawn 3-16ths-in. brass tube, which is connected with blower from footplate. It would be as well if I said I experienced some difficulty with regard to same, as I found the tube split in the middle on two separate occasions, so the third time I annealed the tube to a cherry-red, and so found out the error. The regulator valve is of the Stroudley pattern, and works well, being perfectly steam-tight. The oil heating apparatus is similar as described in your journal previously, being worked by steam sprayed into firebox through a hole below firehole door. I have tested with water at a pressure of 150 lbs. per square inch, and steam at 120 lbs. I find plenty of steam with above burners and valves pressed at 60 lbs. per square inch, blowing off hard and still maintaining this amount with blower slightly on.

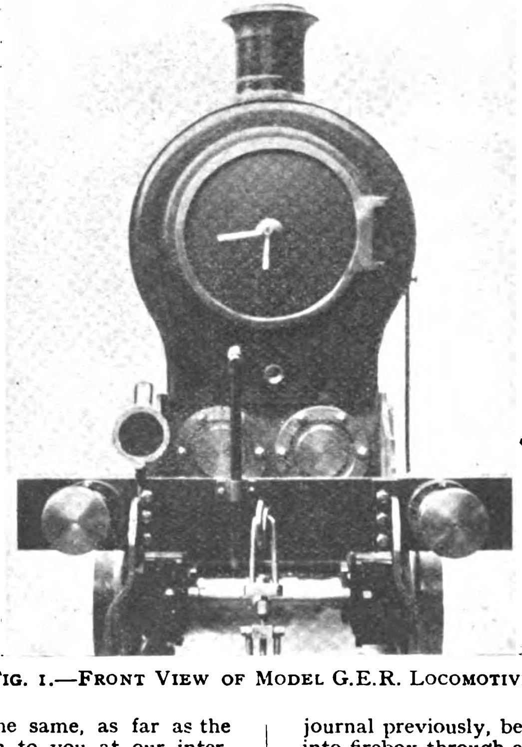


FIG. 1.—FRONT VIEW OF MODEL G.E.R. LOCOMOTIVE.

"The fittings are of the usual type and procured from the Model Manufacturing Co., Addison Road, which I found very satisfactory. I am afraid I am taking up too much of your time describing the foregoing, so will give a brief description of the parts. The main frames are of double shear steel, 3-32nds-in. thick, and although harder to work and more costly, are well worth the extra labour. The smokebox door is beaten out of copper, and the funnel out of 1½-in. solid-drawn copper tube, and top rim turned out of gunmetal and driven on. The crankshaft was an interesting piece of work, and not nearly as difficult as I at first anticipated, being built of 1-in. by ⅜-in. thick Bessemer steel, pinned through at every joint, brazed, and finally turned in lathe, of which I found very little to do, as it almost ran dead true. The buffers are turned out of cheese-headed bolts. The cylinders are cast in gunmetal and are 1⅛-in. bore, by 2¼-in. stroke, with valves underneath as in prototype; size of ports being 1¼ ins. wide by ⅛ in.; exhaust, ¼ in.; the valve rods passing straight through steam chest. The wheels are cast from my own patterns at a local foundry, in iron, and have given a lot of trouble in cleaning the spokes. They were all chilled, and any readers who have experienced the same will appreciate it. The oil for burner is contained in a separate tank in tender and holds about half-a-gallon. The tender itself is made of stout tinplate, it being the second one made, the previous one warping while sweating two cross stays in.

"In conclusion, I hope, Mr. Editor, I have not trespassed upon too much space in your valuable journal, and that the above may prove of interest to other model engineers, especially those who lean towards the building of locomotives."

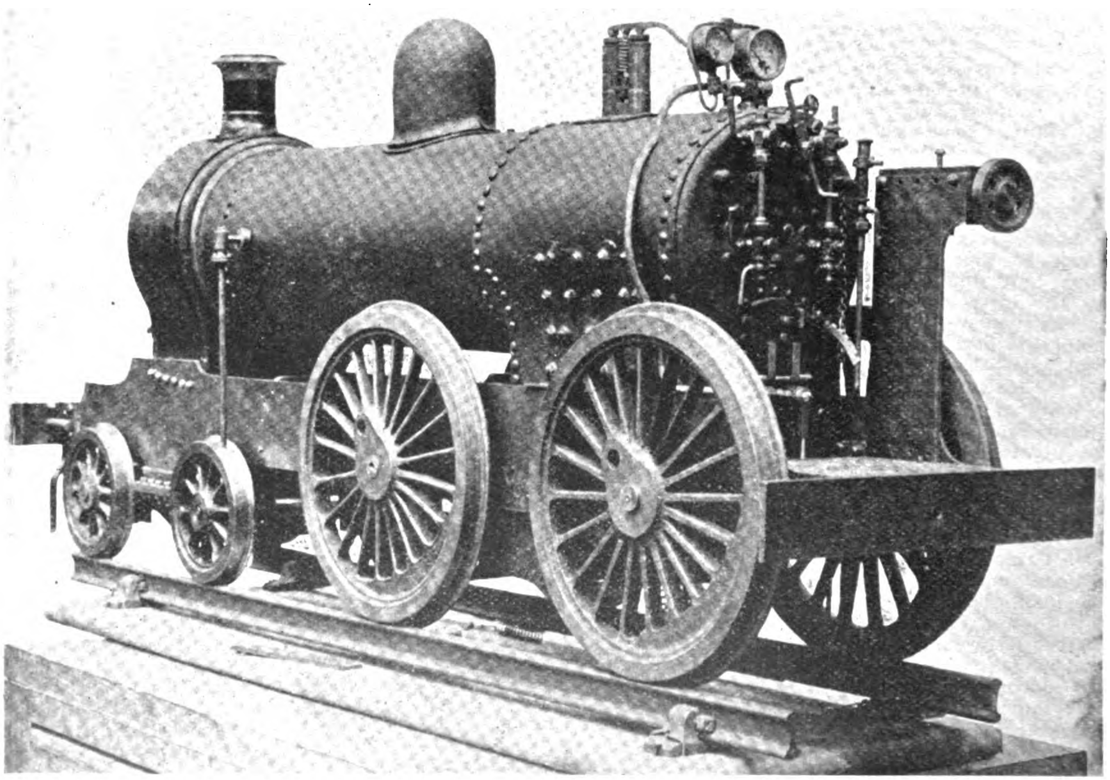


Fig. 2.—Mr. M. S. Campbell's partly-finished Model G.E.R. Express Locomotive.

Fan-driven Ice Vehicle.—Motor ice yachts and ice vehicles of all types will create great interest in America during the coming winter. Among the many machines which will be tested is an English device called an "aero-motor." The idea is that of propelling the sledge by means of a revolving fan or screw. The fan used in the English machine is four-bladed, is driven by a gasoline engine, and may be attached to either a motor-car or to a sledge. The inventor, Mr. J. Bruce MacDuff, expects great things of his machine, and suggests that the aero-motor sleigh may supplant dogs for use in Arctic and Antarctic explorations.

The Latest in Engineering.

A South African Blast Furnace.—The first blast furnace in South Africa has recently been erected near Pretoria, on the line of railway; it is situated in the centre of iron deposits, and in close proximity to coal supplies. The furnace, which will have a weekly capacity of 500 tons of pig-iron, is to be followed by rolling mills and a steel-converting plant. The natural advantages attending this enterprise seem very great, as, in addition to iron ore and coal, there is plenty of limestone, which is required in the process of smelting in the neighbourhood. The ore is of the hematite and magnetite variety, and runs 58 to 62 per cent. of metallic iron. A survey above ground and cross-cutting indicate that there are some 62,000,000 tons of iron in sight.

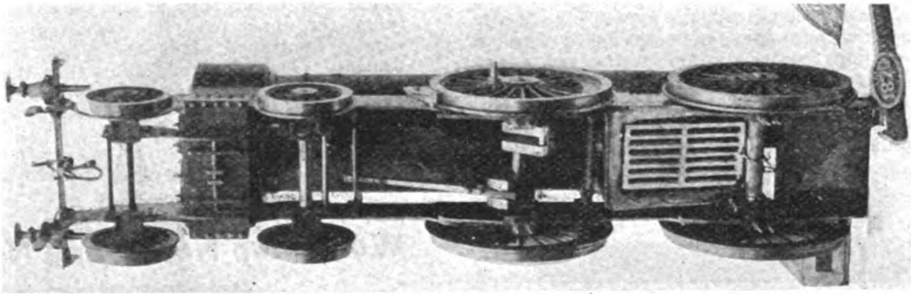


FIG. 3.—VIEW OF UNDERSIDE.

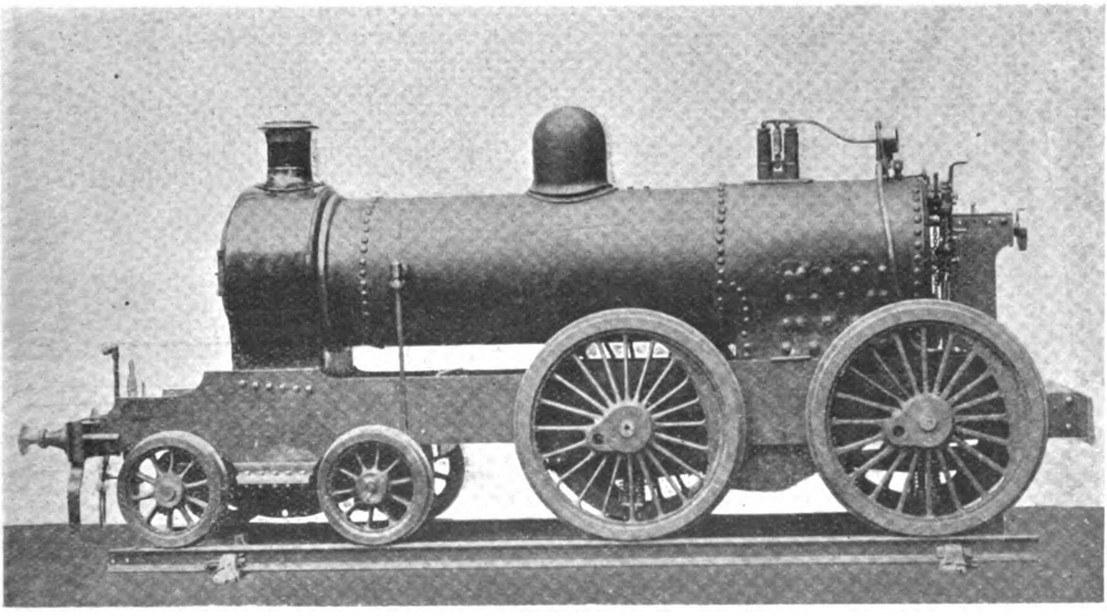


FIG. 4.—A SIDE VIEW OF MR. CAMPBELL'S MODEL G.E.R. LOCOMOTIVE.

A New Heat Engine.—M. Cantor makes an interesting communication with regard to a new principle in heat engines. It is well known that the efficiency of a heat engine depends upon the amount of expansion of the gases employed, that is to say, upon the ratio of the final to the initial volume. Successive expansions extend this ratio in one direction, and initial pressure extends it in the other. But no initial pressure capable of solidifying the gas, and thus reducing it to the smallest possible initial volume, has yet been employed. The author indicates a theoretical method of doing this. The engine contains incandescent oxide of copper, and it is worked by blowing some liquid fuel—say, petroleum—through the incandescent mass. The liquid fuel and the solid oxygen have, therefore, a very small initial volume, the oxygen being reduced to 1-7,000th of its ordinary volume. The metallic copper is re-oxidised by a current of oxygen, and the heat gained in this oxidation may be also utilised. The method as proposed may, of course, not be practicable, but it indicates a path along which further great improvements in the efficiency of heat engines are theoretically possible.—*Electrician.*

Armour-Plate Saw.—The Midvale Steel Company, U.S.A., has added to its new armour-plate works a special circular saw for cutting this hard material. The plate is clamped, and the saw is mounted in a travelling carriage moved by a heavy lead screw, with change gears giving a feed of 0·15 in. to 1 in. per revolution of the saw. The mandrel carrying the saw blade is driven by a worm meshing with a worm-wheel on the back end of the mandrel, while the front end has a solid forged collar to which the blade is attached by

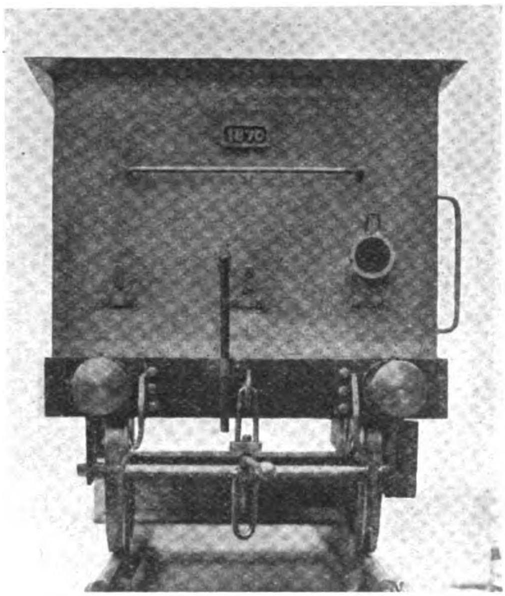


FIG. 5.—BACK VIEW OF TENDER.

For description] [*see front page.*

eight 2-in. bolts. The peripheral speed of the saw is from 10 ft. to 40 ft. per minute. The machine is driven by a 50 h.-p. electric motor at the end of the bedplate. The saw is a steel plate, 70 ins. diameter and 1⅛ ins. thick, with rectangular slots on each side, half the thickness of the plate; the slots alternating on opposite sides. In these are set the cutters, which are raked 20 degs. backward from the radial line, and have an outward inclination of one deg., so as to cut clear of the blade and prevent friction or binding. The cutters are of high-speed forged steel, 5¾ ins. long, 2 ins. wide and 11-16ths in. thick; they project 1½ ins. from the plate or disc, the cutting diameter of the saw being 73 ins. Hardened nickel steel armour plate, 4½ ins. thick, has been cut at a feed of 9 ins. per hour, and 5-in. unhardened nickel steel plate at 40 ins. per hour. The cutters can make a cut of 50 ft. in length without re-grinding.

An Improved Yielding Bearing.—Mr. Carl G. P. de Lâval, Ph.D., and Mr. E. E. F. Fagerström, both of Stockholm, have devised a neat method of permitting the necessary amount of play in turbine shafts or other shafts rotating at a high speed. Each bearing is flexibly supported on two projecting pins, which are rigidly fitted in the frame of the turbine at points immediately above and below the shaft and parallel therewith. Cord or wire is then wound round the upper pin, then half round the bearing, and on to the lower pin, then half round the other side of the bearing, and again round the upper pin. This winding of the cord or wire is continued along the whole length of the bearing. The inventors claim that this admits of sufficient flexibility for the turbine wheel and shafts to acquire a position of equilibrium, and to revolve about axes containing their centres of gravity.

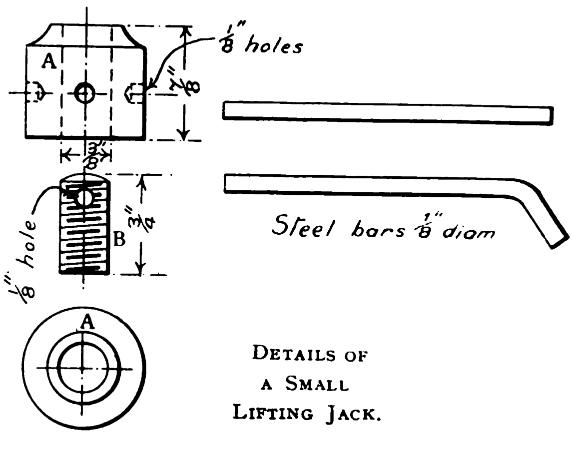
Workshop Notes and Notions.

[Readers are invited to contribute short practical items for this column, based on their own workshop experience. Accepted contributions will be paid for on publication, if desired, according to merit. All matter intended for this column should be marked "WORKSHOP" *on the envelope.]*

Novel and Useful Lifting Jacks.

By "SCRIBO."

For packing and lifting work on the shaper, planer, and other machines, the tools illustrated herewith will be found extremely useful. The construction is very simple. A is a bicycle cone with four ⅛-in. equidistant holes drilled not quite ⅛ in. deep so that they do not go right through.



DETAILS OF A SMALL LIFTING JACK.

B is a piece of a bicycle spindle (the threaded part) with an ⅛-in. hole drilled right through. Two bars should be made of ⅛-in. silver steel, one straight, the other bent slightly, so as to raise or lower the screw when under work or an awkward corner. They should be 2½ ins. to 3½ ins. long. The above is a size of cone easily obtained. Four should be made to complete. The cost will be but a few pence.

A Battery Hint.

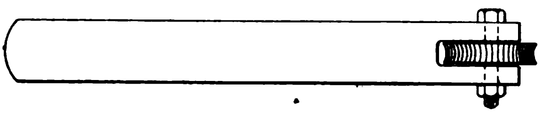
By Frank Abnett.

The following brief instructions will enable anyone to make a simple wet battery out of an old dry one without spending a farthing. First of all, take the cardboard covering off, thus leaving the zinc cylinder; then drill or bore about six holes in the middle of it till you reach the crushed carbon, and also two in the sealed top to allow the gases to escape. Now take a large jam jar and fill two-thirds of it with sal-ammoniac and water; insert the old dry battery, and the wet one is complete.

Simple Milling Wheel.

By "Ex-Apprentice."

A milling wheel can be cheaply and easily made, as shown, in the following manner:—In a piece of wrought iron 6 ins. long by ¾ in. by ½ in. I filed a slot ¾ in. long by ¼ in. wide, parallel to the ½-in. sides; ¼ in. from the end I drilled two ⅛-in. holes, and then took a piece of broken flat file, and, after annealing, ground and filed it roughly into a circle of ¾ in. diameter. I then drilled an ⅛-in. hole through the centre, and turned the outside slightly hollow, and true with the hole. An ⅛-in. bolt passing through the bar and wheel keeps the latter in place. I next cut the wheel by holding a "hob" or master tap between the centres, and pressing the wheel tightly against it as it revolved. The wheel was then hardened, and I was possessed of as good a tool as could be bought at a tool shop.

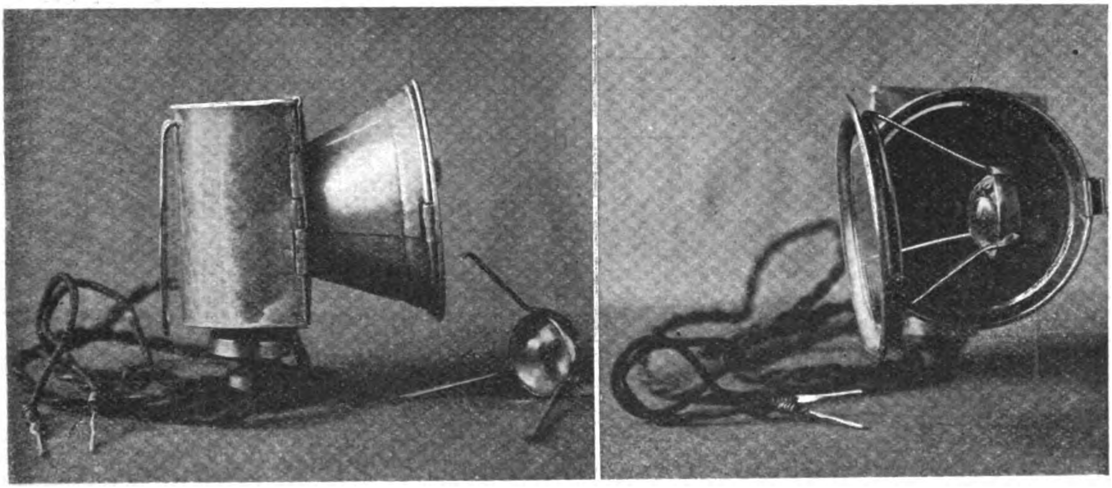


A Simple Milling Wheel.

A Small Searchlight.

By H. Kemp.

Following the recent queries which have appeared concerning searchlights, the two views of a small electric searchlight that I have recently made, together with a brief description, may be of interest to readers of these pages. As can be seen in the photograph, the front of the lamp is part of an oil lamp, and the back was made from an alarm clock case, bent round, one side forming a hinge. The lamp is fitted with a 6-volt bulb, and a brass socket. The principal object of the lamp is the fitting at the back of the door, which is shown plainly in each photograph. It is a small bull's-eye, taken from a flash lamp and a piece of a cycle-wheel spoke, soldered to the bull's-eye in three places, and turned inwards at the other ends, which clip on to the door. The lamp is supplied by two 4-volt accumulators, and gives a splendid light, throwing a beam straight ahead. It would suit for a motor-cycle headlight, or a boat, if it were made in proportion to size of boat. The idea is taken from the motor-car lamps which are so numerous now.



Mr. H. Kemp's Small Searchlight.

The Motor Show at Olympia.

The Motor Show at Olympia has, we understand, been a huge success, and certainly, from a visitor's point of view, there was nothing to cavil at. Manufacturers must have spent an enormous amount of time and money in preparing the exhibits. Some of the work—notably, the chassis by the Napier Company—being finished to the highest degree possible. One of the interesting features was the number of sectional models of petrol motors and ignition devices on view. The motor boat and motor omnibus section of the how were also very fine.

How It Works.

II.—A Resistance

(Continued from page 560.)

By A. W. M.

FIG. 6 is a diagram of an adjustable resistance arranged so that more or less of the resistance wire can be put in circuit by moving a switch. The resistance wire is wound into a number of coils R, which are sometimes placed underneath the slab upon which the switch is mounted, and sometimes arranged upon insulators in a metal frame at the side or away from the switch. The end of one coil and the beginning of the next are joined together and to one of the contact studs upon which the switch presses. When the switch makes contact with stud A current flows in at terminal B to the switch pillar, along the switch-arm to stud A, at which it enters the resistance wire and flows through the coils R to terminal C, where it flows away. When the switch is moved towards terminal C, it presses successively upon each stud in turn, and reduces the amount of resistance wire through which the current is flowing. (See diagram, Fig. 7.) Two of the six coils of resistance wire are inactive, the current, being unable to flow through them as the end A is insulated, flows through the four coils to the right of the switch and out at terminal C. If each coil had a resistance of 1 ohm the total resistance which could be put in circuit would be 6 ohms when the switch was upon contact A; when it was in the position shown in Fig. 7 the resistance in circuit would be only 4 ohms, and this would be reduced by steps of 1 ohm each as the switch was moved towards C; when upon stud D there would be none of the resistance wire in circuit at all; a blank stud at the extreme left permits the switch to break the circuit and cut off the current entirely. There are various forms of adjustable wire-resistance in use, but all work on the method of connecting in circuit more or less of the resistance wire. One form which permits of very accurate adjustment is shown in Fig. 8. The resistance wire is wound on a pair of parallel insulated cylinders, A and B, and is connected at one end to a contact ring C on cylinder B; the end on cylinder A is merely fastened securely; a travelling contact D presses upon the wire, and is moved along by means of a screw geared to B, so that it travels at the same rate as the pitch of the wire along B, current enters at E, and flows along the resistance wire from C, where it leaves through the brush and terminal D; by winding up the wire on the cylinder A it is unwound from B, consequently there is a shorter length for the current to flow through from D to E, and the amount of resistance is reduced; by winding up the wire on B a greater length is inserted between D and E, and the resistance is increased. It will be seen that exceedingly small differences in resistance can be effected by means of this arrangement. In another form, the cylinder A is of metal, and the contact D bears upon its surface at one end. As the wire is wound on to A the resistance becomes less, because each turn on A is cut out by the short-circuiting effect of the metal of the cylinder, only the turns on B and the length connecting the cylinders being passed through by the current. This method prevents the thickness of the wire being altered by reason of the rubbing of the spring D; a screw-driven guide compels the wire coils to space apart on B. If the cylinders are connected by toothed wheels one handle is sufficient to rotate the two cylinders. Other patterns of resistance are in use than those depending upon metallic strip or wire; there are liquid resistances, in which the resistance to the passage of the cur-

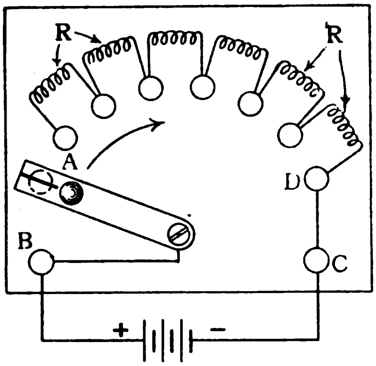


FIG. 6.

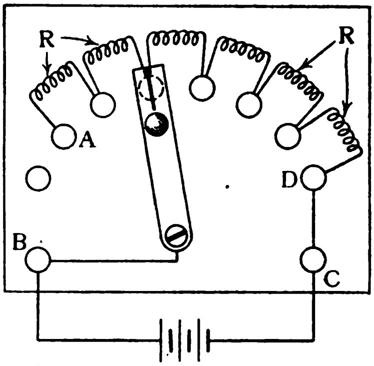


FIG. 7.

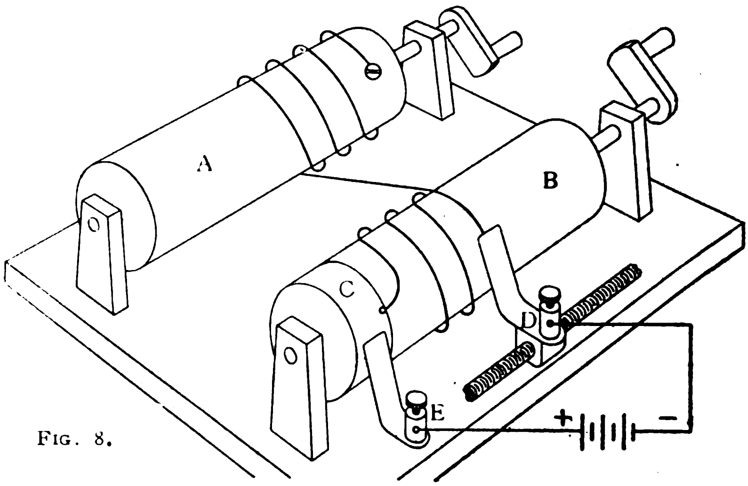


FIG. 8.

rent is due to a liquid inserted in the circuit (see Fig. 9), which is a diagram of one form of such a resistance. The liquid is contained in a jar, two metal plates A and B are immersed in the liquid, plate B is fixed at the bottom of the jar, plate A can be raised and lowered by some convenient means, the wires carrying the current are attached to the plates as shown; current passes in at A through the liquid to B, and thence into the return wire; the liquid between A and B offers a resistance to the passage of the current. By varying the distance between A and B, this resistance is altered in value; the greater the distance between the plates, the greater will be the resistance inserted in the circuit, as the current must pass through a greater length of liquid. When A is lowered, so that it rests upon B, the resistance is all out of circuit, current then passes directly from A to B. It is necessary that A and B are made of

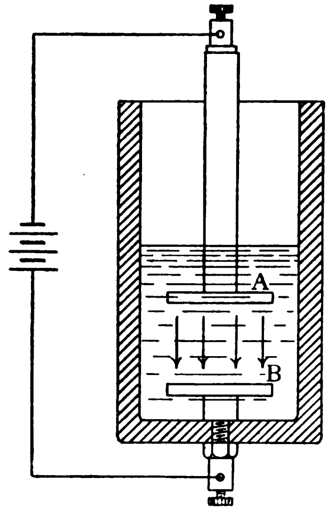


FIG. 9.

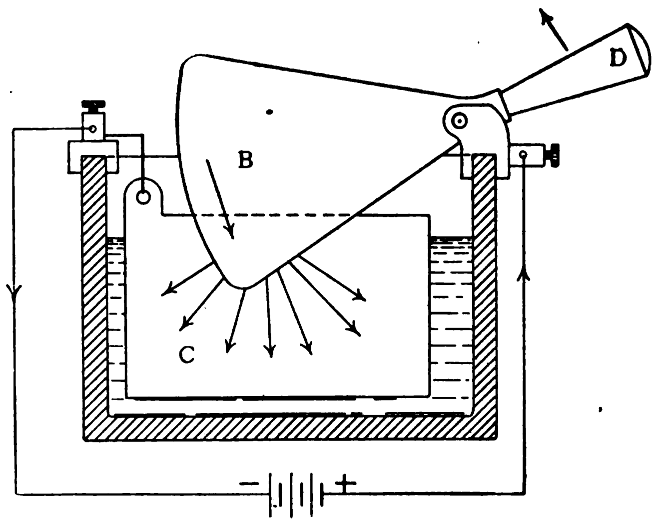


FIG. 10.

some metal which is not acted upon by the liquid, or they will be dissolved. The solution may be acid (in which case the plates should be of lead), or alkaline (in which case the plates may be of iron). Various compositions of liquid are used, according to the practice of different makers; such resistances are used for dealing with large currents and purposes where a very gradual increase or decrease of resistance is required, such as scenic effects in theatres. Another form of such resistance is shown in diagram, Fig. 10. The liquid, as before, is contained in a jar or vat, and a fixed metal plate C is immersed in it; a flat movable plate B is hinged upon a pivot and moves parallel to C, from which it is separated by a short distance. When the handle D is moved so as to immerse B in the liquid current flows from B to C. At the commencement of the movement the resistance offered to the current is greatest because there is only a very small part of B in action, and the current must spread out through a considerable length of liquid in its endeavour to reach C; the plate B is shaped, however, that as it is further immersed its active surface is gradually increased; the current is therefore able to reach C by a shorter path, and the resistance to its passage is less. Finally, when B is at the lowest point it has an active area almost equal to C, and the current can spread out over the entire surface, and has merely to pass across the short distance separating the two plates, consequently the resistance to its passage is at a minimum; to cut out the whole of the resistance B is made to touch a projecting part of C, or may engage in a spring clip which is connected to the terminal of C, so that the current will pass directly from B to C. Several pairs of fixed and moving plates may be used, the moving plates working between the fixed plates. The resistance is increased by raising B out of the liquid, the circuit being broken as the corner of the plate leaves the surface.

There is another form of adjustable resistance which depends for its action upon the quality of the contact between a number of carbon plates. One pattern is shown in diagram, Fig. 11. It consists of a number of discs (D), of carbonised cloth, threaded upon a screwed pillar P, between two metal plates E, F, to which are attached the wires carrying the current, which enters at E, flows through the carbon discs D and away through F. If the nut T is screwed down so as to press the carbon discs more tightly together the resistance to the passage of the current is decreased, as the surfaces will be pressed into better contact with each other; if the nut is slackened so that the discs are pressed less tightly together the resistance is increased, because the surfaces do not then make such good contact with each other, and the current has more difficulty in passing. Another construction of the same kind of resistance is shown in Fig. 12. The plates D are of ordinary battery carbon, placed in a frame and pressed together by means of the screw S; its action is exactly the same as that of Fig. 11. The sides of the frame must be covered with insulating material, so that the current is compelled to pass through the carbon plates. The size of resistance wire or amount of liquid and size of plates in a resistance are always proportioned according to the maximum amount of current which is to flow through it. The resistance obstructs the passage of the current, so that a kind of friction effect is set up in the wire, with the result that the wire becomes hot; this heat representing a waste of energy which is taking place. If the wire is of too small a size the heat is not dissipated so quickly as if a larger wire was used, and the temperature of the wire will continue to rise until the wire becomes over-heated. This heating has also another effect, and that is to increase the resistance in ohms of the length of wire in use; it is, therefore, important to select a

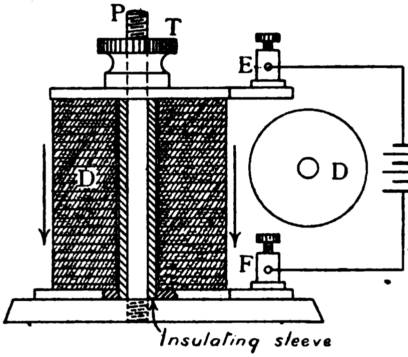


FIG. 11.

size of wire which will carry the current required without over-heating. (Carbon is an exception to this extent, that its resistance decreases with rise of temperature.) When the resistance is used to vary the amount of current, its coils may be proportioned so as to suit the amount flowing at any particular instant. That is, as more coils are switched into circuit they may be of a decreasing gauge of wire, according to the rate of decrease in the current. This plan enables the resistance frame to be made of smaller size.

Incandescent lamps are freqently used as resistances, and follow in working the principles already explained. As an example: Supposing a resistance is required to absorb 95 volts whilst passing a current of 1 ampere to charge a small accumulator

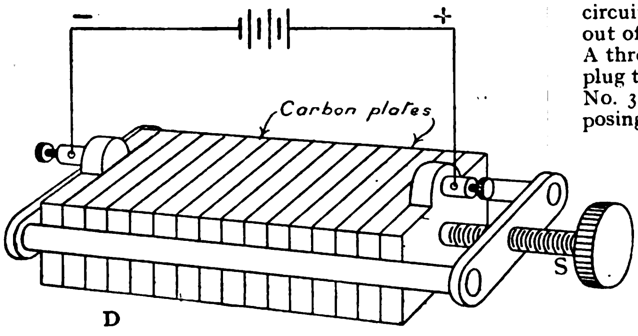


FIG. 12.

requiring 5 volts to charge it, the supply mains being 100 volts; a 95-volt incandescent lamp which takes a current of 1 ampere would serve for such a resistance, but a 100-lamp volt could be used if a slightly diminished current would serve, because the act of placing the accumulator in series with the lamp would increase the total amount of resistance connected to the mains, and consequently the current would be slightly reduced. This would mean that there would be less volts absorbed by the lamp; in fact, the lamp would only absorb 95 volts, and leave 5 volts to overcome the resistance of the accumulator. If you vary the current flowing through a given resistance, you vary the volts absorbed by that resistance.

Resistances used for electrical testing and measurement are frequently of the forms shown in Figs. 7 and 8, and of the plug adjustment pattern. In this latter arrangement the resistance wires are made into coils and placed in a box upon the lid of which is arranged a series of brass blocks separated by small air gaps (see Fig. 13), which is a diagram of a box containing three resistance coils.

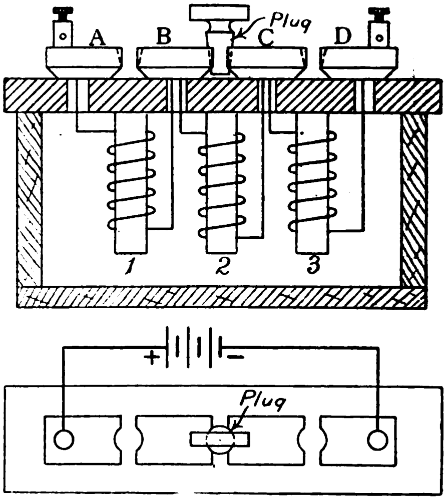


FIG. 13.

The amount of resistance is varied by connecting adjacent pairs of the blocks with brass conical plugs, which are thrust into holes prepared for them, thus cutting any or all of the coils out of circuit. In the diagram the centre coil is cut out of action in this way, current flowing in at block A through coil No. 1 from block B to C, through the plug thus passing by coil No. 2, then flowing through No. 3 to block D, and thence to the battery. Supposing each coil to represent 10 ohms, then the resistance in circuit would be 20 ohms; if the plug was removed, the resistance would be thus increased to 30 ohms; if a plug was put into each of the holes there would be practically no resistance in circuit, as all coils would be cut out. The blocks are made of ample size and the plugs fit well, therefore their resistance is so small that it may be usually neglected. The resistance of each coil in ohms is marked on the box near the hole across which it is connected. In actual practice the coils are wound in a special manner, the wire being doubled on itself and then wound on the reels, so as to avoid what is called "inductive effect"; Fig. 13 is only to be regarded as a diagram. For very heavy currents and resistances, having a very small value in ohms, copper may be used, but metals having a much higher specific resistance are usually employed—such as iron wire, a given length of which would have about six times the resistance in ohms as the same length of copper wire of equal gauge, or German silver, which has, approximately, 13½ times the resistance of copper. There are also special resistance wires made by various makers—such as Eureka wire, which has about 30 times the resistance of copper, and increases its resistance very little with increase of temperature. This alteration of resistance with increase of temperature does not matter much with resistances used for controlling dynamos, motors, lamps, etc., and may usually be ignored, but it becomes of great importance with resistances used for testing and measuring purposes. These resistances are, therefore, generally marked with the number of degrees Centigrade or Fahrenheit, etc., at which they are correct. Unless used in an atmosphere which is warmed to this particular temperature, the resistance of the wire would not correspond to the number of ohms marked on the box or scale.

The amount of electrical energy absorbed in a resistance is found by multiplying the current flowing through it by the volts absorbed, or the current squared by the resistance in ohms (C^2 R). The result gives the energy absorbed in watts. For example, a resistance of 5 ohms, carrying a current of 10 amperes, would absorb 50 volts; therefore, 50 multiplied by 10 gives 500 watts of energy absorbed, or by the C^2 R rule, 10 by 10 amperes multiplied by 5 ohms also gives 500 watts of energy absorbed by the resistance. It is this absorption of energy which causes the resistance wire to become hot, and as the heat is not generally utilised it is therefore wasted energy. An arc lamp, for instance, may require about 40 volts at the arc to produce the light, and takes, say, 10 amperes of current; to work such a lamp from a 100-volt supply it will be necessary to absorb the 60 volts not required by means of a resistance. The total amount of energy taken from the mains is 1,000 watts; of these 600 watts will be wasted in the resistance and lamp coils, and only 400 watts be useful in producing light. It will be understood from this that except when used for the particular purpose of heating, a resistance is an uneconomical piece of apparatus, but it is so convenient a thing to use in very many cases that the loss of energy is countenanced by electrical engineers.

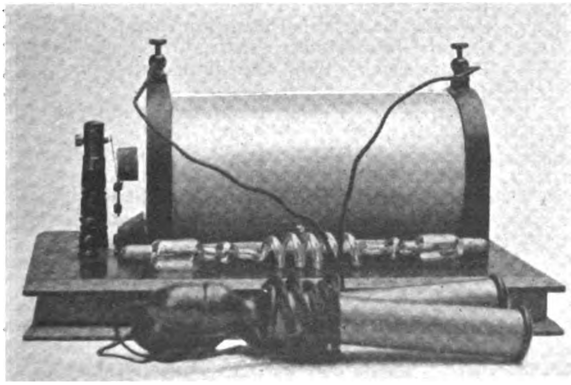


Fig. 1.—Mr. R. V. Borner's Spark Coil.

An Amateur's Electrical Work.

By R. V. Borner.

The models here described were made in my spare time. The dimensions for the spark coil shown in the first photograph were taken from the *M.E.* Handbook No. 11, to give ½-in. spark. The secondary is wound in four sections and afterwards soaked ih paraffin wax, the whole being enclosed in a fancy covering. The contact-breaker is of the vertical type, and was made from the spring of an old electric bell so as to retain the platinum contacts. The pillar is mounted on a piece of turned ebonite so as to give the required height. This coil gives the full ½-in. spark and lights 6-in. Geissler tubes easily.

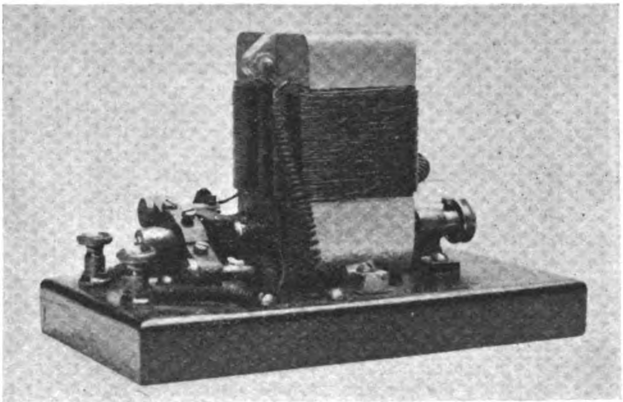


Fig. 2.—A Small Undertype Dynamo.

The dynamo shown in the second photograph was made from data given in Handbook No. 10, to the 10-watt scale. The field-magnet is cast in halves to facilitate winding, from patterns I made myself, castings required very little filing, the joint being surfaced. The armature is an 8-cog drum, built up of stampings, and is wound in four sections for a four-part commutator. The wire used throughout is No. 22 D.C.C., 1¾ ozs. for armature, and 6 ozs. for field-magnet, to give 5 volts 2 amps. The machine works well, lighting four 5-volt lamps easily when driven from the wheel of a sewing machine stand.

I find the dynamo very handy for use with the coil when giving shocks, as the strength of the shock can be regulated by the speed of the dynamo.

To clean tarnished zinc apply with a rag a mixture of 1 part sulphuric acid with 12 parts of water. Rinse the zinc with clear water.

Marine Engineering and Shipbuilding Notes.

By Chas. S. Lake.

A Steamer's Troubles in the Suez Canal.

The latest issue of the *Nautical Magazine* contains a highly interesting account of a notable passage through the Suez Canal of a steamer homeward bound from the East with a cargo of rice. The steamer in question entered the Canal in the early hours of the morning, and shortly afterwards was signalled to make fast in a "siding," to allow the outward bound Bibby liner *Derbyshire* to pass. In carrying out the necessary manœuvres, the propeller fouled the bank on the port side of the Canal, and as a result the engines became "locked," so that they could not be worked, either ahead or astern. After the propeller had been disengaged it was found that it would not turn, and therefore the vessel was made fast, and tugs were signalled for to tow her to Port Said, at the western extremity of the Canal. During the time she was lying helplessly in this position awaiting the arrival of the tugs, an Austrian Lloyd boat from Suez, in passing too rapidly, sheered alongside, and scored a plate on the starboard bow so deeply for about 16 ft., that it had to be condemned, replaced, and paid for later on. Just before 11 o'clock at night the tug *Robuste*, of the Canal Company's fleet, arrived on the scene, and the steamer having been cast off from the bank, started off behind the tug at midnight. Without the use of her own engines, it was soon found that the steamer would not steer, and she zig-zagged across the Canal from bank to bank in the most alarming fashion. Fearing further damage as a result of the erratic course she was pursuing, it was quickly decided to stop. The steamer was, therefore, made fast to the bank again to await daylight, having covered about 1·9 miles as a result of an hour's towing. As soon as daylight came, preparations were made for a fresh start—this time, with cables run out astern and streaming aft as a drag, when it was found she would steer tolerably well. Very slow progress was made, however, as the cables had to be taken in on passing a "station," to avoid damaging the water service pipes and telegraph cables, and when night fell the vessel was tied up to the bank again to await the return of daylight. Next day a strong wind was blowing, and this affected the steering to such an extent that the boat was as often as not sheering across at right angles to the course it was sought to pursue. Eventually, however, she reached Port Said without any serious mishap occurring, and after being made fast in her allotted berth, divers were engaged to examine the propeller. This they found had all four blades badly bent, and the spare blades on board were about to be called into requisition when one of the divers appeared above water with a request for permission to cut a small piece off one of the damaged blades, so as to get it into proper position on top for taking it off the boss. This request, although simple enough in itself, was indirectly the cause of the whole character of the proceedings which had been decided upon being altered.

Instructions were given for the divers to report as to whether it would be possible to cut away the portion of each blade where it fouled, so as to allow of the vessel sailing with clipped blades for the rest of the passage. This course the divers reported favourably upon, and the work was at once started. It took from Friday, at 1.30 p.m., until the following Tuesday, at 3.30 p.m., to cut the damaged portions away, the pieces cut off the blades measuring 12 ins. to 15 ins. long, and about 5 ins. deep at the middle part, where the metal was about 1½ ins. thick.

The engines were then turned, first by the turning gear, and then by steam, to ascertain whether clearance of the propeller had been effected. All was found right, and the necessary certificate for seaworthiness having been obtained from the British Consulate, the steamer proceeded down the harbour to sea under her own steam at about 8 p.m., without its having been necessary to disturb a single bag of cargo. Had the repairs been carried out in the usual manner—viz., by tipping the vessel so as to bring the propeller boss into a fair position for working at—the cargo would have had to be unloaded and re-loaded, and endless delay and expense would have been occurred.

The writer once met with a somewhat similar experience to that described when serving in the s.s. *Clan Cameron*, homeward bound from India. The vessel, shortly after entering the Canal at Suez, ran aground, and remained fast. All efforts of the tug *Rapide* to get her off failed until a large portion of the cargo had been jettisoned into lighters. Singularly enough, it was in endeavouring to get to a "siding"—as in the above case—that the steamer took to the ground, and as it was only just sufficient room was left to allow the Messageries Maritimes' mail steamer *Armand Behic*, bound for Marseilles, to pass. On getting under weigh again, after fourteen hours' delay, the *Clan Cameron* was unfortunate enough to have to follow the Russian man-o'-war *Dimitri Donskoi* through the Canal. The ironclad swayed across the Canal from side to side, and prevented the *Clan* liner from getting to Port Said until several hours later than would have otherwise been the case, which fact, added to the already great loss of time, resulted eventually in the ship being still cruising up Channel in a heavy fog on Christmas Day, instead of snugly berthed in Tilbury Dock. Such are the pleasures of sea-going.

Trial Run of the World's Largest Turbine Liner.

The largest vessel propelled by turbines ever yet constructed recently left Gourock *en route* for Liverpool, on her maiden voyage. This was the *Carmania*, of the Cunard line—a veritable floating hotel driven through the water by turbines. Her principal dimensions are as follow :—Gross tonnage, 20,000; length over all, 675 ft.; breadth, 72 ft.; depth (to shelter-deck), 52 ft. Every modern luxury is available for passengers by the *Carmania*, including electric heaters and cigar lighters, baths with "needle and showers," a daily Marconi newspaper, etc.; whilst their safety is amply secured by the fitting of the vessel with the Stone-Lloyd system of bulkhead doors, which render the ship unsinkable. The captain, by turning a handle, can close every door in 15 seconds. In the culinary department the equipment includes a special roaster, which accommodates six joints at a time, the spits being revolved by electricity; dishes are machine-washed at the rate of 8,000 an hour. Sandwiches, etc., are cut by machines, and cold rooms are provided for fish, game, meat, and vegetables.

The *Carmania* has accommodation for a total of 3,100 passengers. She is only 5 ft. less in length than the recently completed *Amerika*, of the Hamburg-American line. Her contract speed is 18 knots, but on trial she attained a maximum of 20·7 knots, and maintained a speed of 19·75 knots for six hours. Parsons turbines are employed, and it is estimated that the vessel will only require 2,800 tons of coal to carry her across the Atlantic. The *Carmania* is a si ter ship to the *Caronia*, also of the Cunard line. The latter vessel is, however, fitted with reciprocating machinery.

THE END OF THE "ENCHANTRESS'S" OFFICIAL CAREER.

That famous steam yacht, the *Enchantress*, so long associated in everybody's mind with the Lords of the Admiralty, has completed her career as a unit of the Navy, and has been sold to Lieut. Mansfield Cumming, Vice-Commodore of the Motor Yacht Club. She has been towed to Southampton, deprived of her engines, boilers, etc., and for the next three years (perhaps longer) will be used as a floating club-house on Southampton Water. She is fitted with a magnificent saloon, and will therefore be a great acquisition to the club in connection with their social, sporting, and competitive events.

A Design for a Model Automatic Cut-off Steam Engine.

By P. D. JOHNSTON (U.S.A.).

(*Continued from page* 566.)

No. 29 is made in two parts, of white metal finished all over, except in the bore. Holes are to be bored to take the dowels as shown.

The various parts are now assembled, and the cap bolted down, and the bearing secured to a knee plate in the lathe, the hole for shaft properly centred and the liners bored to size for shaft.

The oil ring No. 30 can be turned from the end of a rod of brass.

The connecting-rod is made up of parts Nos. 31, 32, 33, 34, 35, 36, 37, 38, 39, and 40.

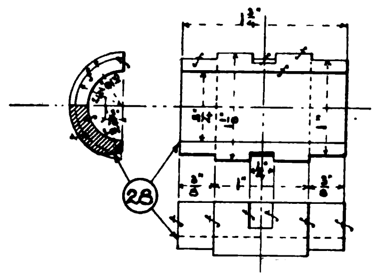
The connecting-rod is shown in two views completely assembled, and is of the usual type, having strap with wedge adjustment for the wrist-pin end. The length from centre to centre is just six cranks, or three strokes—a common proportion for horizontal engines.

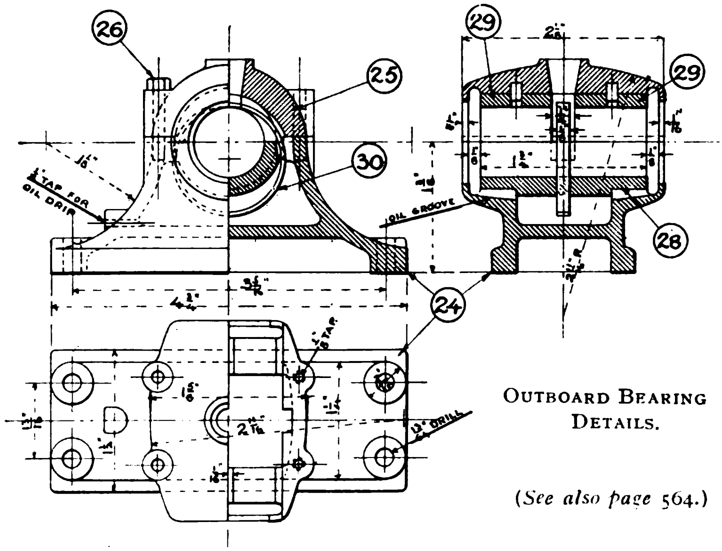
Piece No. 31 is to be forged from mild steel to the form and dimensions given. The forging should first be centred, and then faced to correct length in the lathe, after which the body of the rod should be turned; also the T end.

If a milling machine is available with index centre, the remaining portions of the rod can be accurately machined. The strap, No. 32, also a simple forging of steel, can be machined by milling, and fitted to the rod end, clamped in place and drilled for the bolts. These bolt holes should be reamed and the bolts nicely fitted to make a good job.

Nos. 33 and 34 should be made in one casting, of brass or bronze, completely fitted and bored, and the wedge block No. 35 properly fitted and drilled for the bolts, the holes for which can be drilled, tapped through the bolt holes already drilled in the strap, thus ensuring correct fitting. The wrist-pin boxes can now be sawn apart with a very thin watch-spring saw.

The crank-pin boxes, Nos. 38 and 39, should be made in one casting, and after they are machined and finished can be cut apart. Or they may be made separate, soldered together, finished as one piece, and then separated by heating. The bore for the crank-pin should first be bored, and all the other finishing done with reference to the bore. The holes for the bolts should be carefully bored in the brasses, and those in the T-end of rod bored to match. The brasses should be clamped in





OUTBOARD BEARING DETAILS.

(*See also page* 564.)

place, and the bolt holes reamed, and the bolts (No. 40) carefully fitted. Suitable oil grooves should be cut in both wrist and crank-pin boxes.

Now that all machining is done, the various parts of the rod should be nicely polished, and, later, the unfinished parts painted.

No. 41.—Piston-rod is made of Tobin bronze, because of its non-corrosive qualities, as well as its tensile strength. This can be purchased hard drawn and polished and exact to size, and needs only to be fitted to piston and crosshead. The rod should, however, be purchased before the sleeve or bushing No. 6 is made, so that this piece can be lapped to a nice fit on the rod.

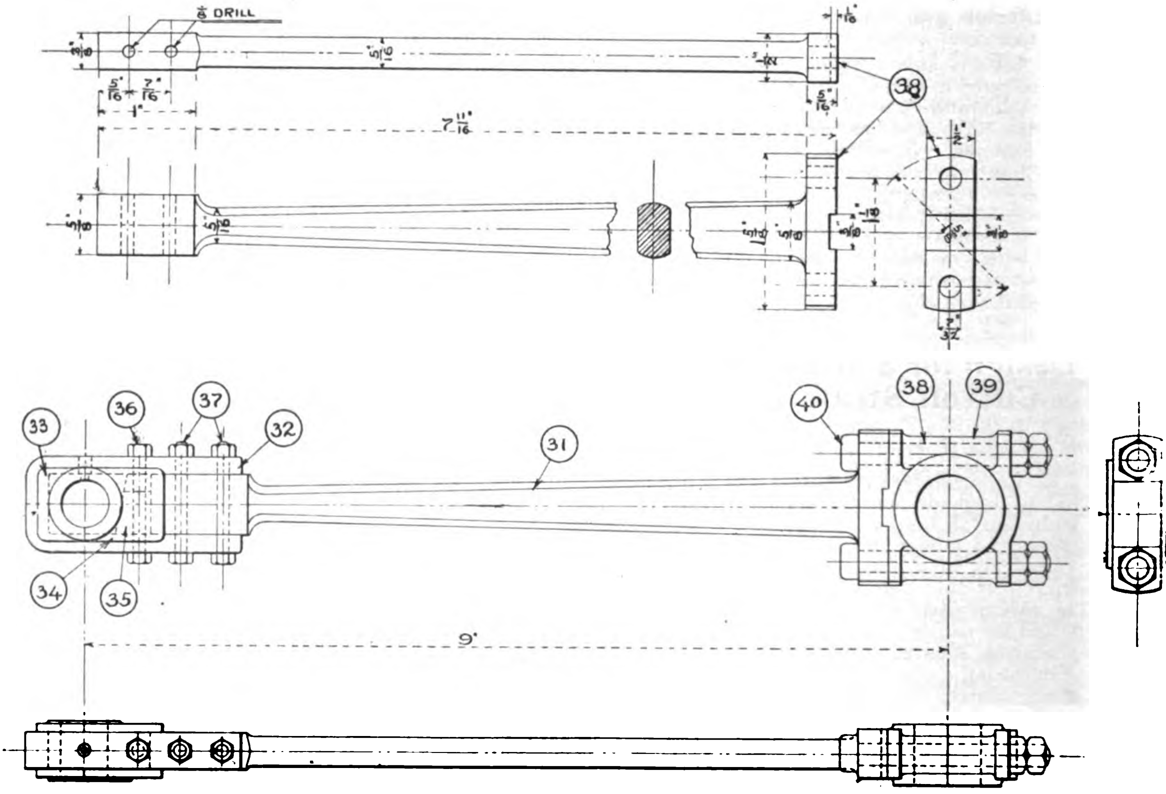
No. 42.—Piston-rod nut is a simple hexagon nut, with extension to cover the thread on the piston-rod. It needs no special description.

No. 43.—Crosshead is made of cast iron from a very simple pattern, with wrist-pin of steel. The casting should be planed or milled all over to dimensions, and fitted to the guides in the bedplate by scraping to ensure nice fitting and smooth running, after which it should be carefully centred for piston-rod by scribing block and surface plate. It should now be clamped to a proper angle-plate in the lathe, and bored and threaded to fit the piston rod ; or, if preferred, the crosshead can be bored and tapped, and the rod fitted to it. The oil holes can now be bored and the cross grooves cut. The seat for the wrist-pin should now be filed out, working carefully to the planed faces of the crosshead.

No. 44.—Wrist pin is made of mild steel properly turned, and ends faced to nicely fit in crosshead, after which it must be fitted by filing so that it will drive nicely to place in the crosshead without springing the latter. It should now be flattened top and bottom as shown, carefully driven to place, and a drill run through crosshead and wrist-pin, after which the hole is to be reamed, and the pin or bolt (No. 45) fitted to drive nicely in place, the bolt finally to be finished flush with the surface of the crosshead by filing and the completed crosshead nicely polished.

The rocker and parts, Nos. 46, 47, 48, 49, 50, 51, 52, 53, 54, and 55, are simple pieces, and need no explanation further than to say that proper care must be given to insure the two holes being parallel.

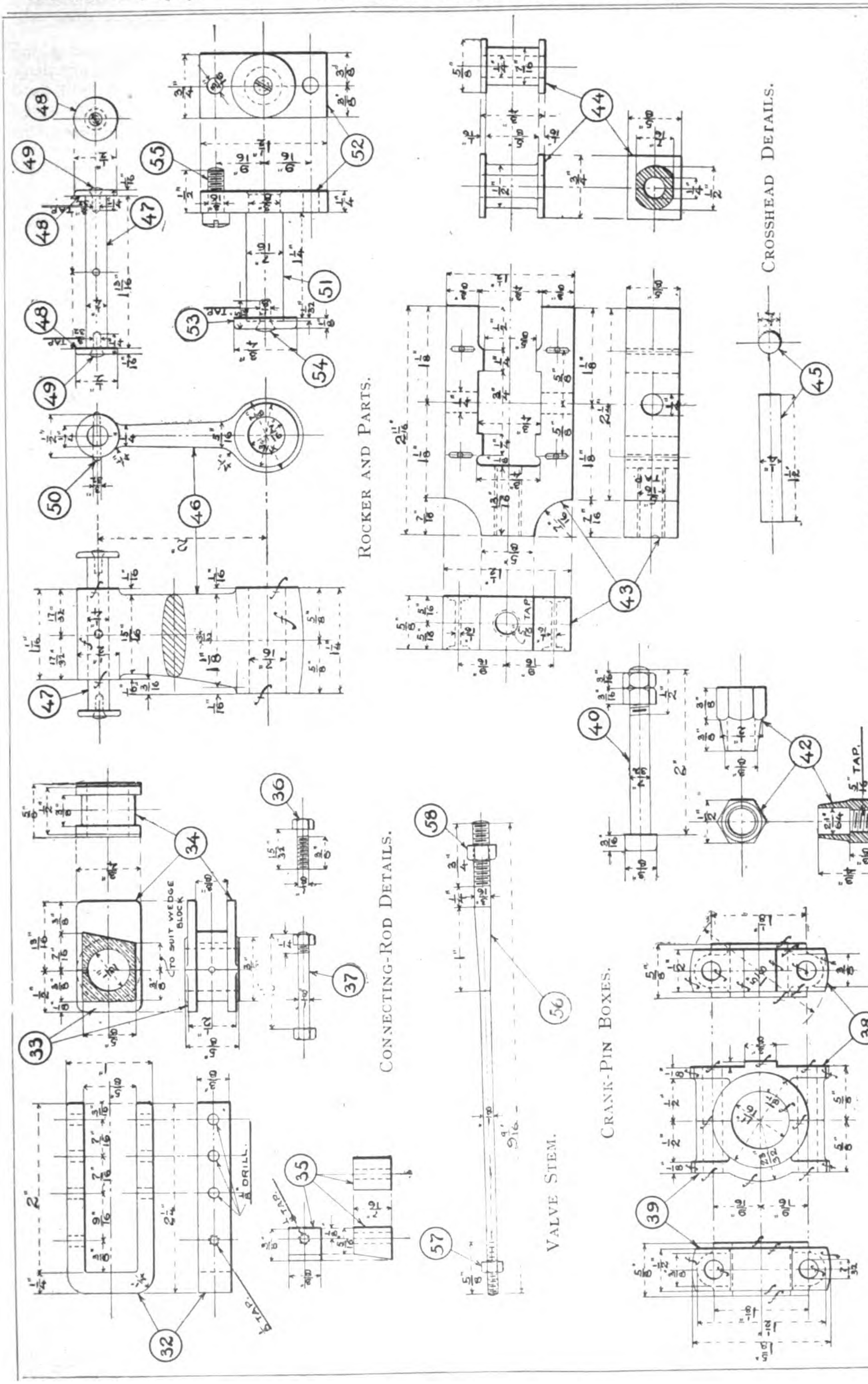
No. 56.—Valve stem, Tobin bronze. This can be bought hard drawn and finished to size of large end. It should be turned to size to pass through the stuffing-box, and cut to length and threaded on both ends as shown ; the lock nuts Nos. 57 and 58 fitted.



Connecting-Rod.

No. 59.—Eccentric rod is a forging from mild steel, and no directions are needed beyond those given on the drawing for this or the lock nut No. 60, or the bolts No. 61.

Nos. 62, 63, and 64.—Knuckle joint or rod end. Two of these are required—one for valve stem, and one for eccentric rod. These are simple pieces, and if the drawing is followed, further directions should not be necessary. By screwing the ends back and forth on the rods, ample means for adjusting the valve are provided ; and once the adjustment is arrived at, the lock nuts are set up tight to prevent accidental movement.



DESIGN FOR A MODEL AUTOMATIC CUT-OFF STEAM ENGINE.

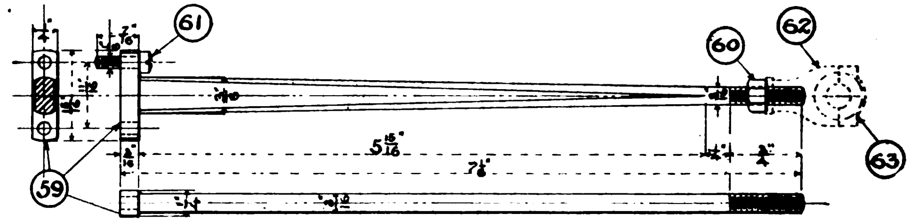
By P. D. Johnston.

(For description see page 587.)

No. 65.—Piston rings are made of hard bronze of spring temper, carefully fitted to the grooves in the piston so that they will not bind, and yet not be slack.

The piece from which they are to be made must first be rough-turned to about 1-32nd in. over size. It is then bored to size, and eccentric to the outside carefully faced one at a time, then cut off about 1-32nd in. full of finished width. Now catch in the chuck a piece of cast iron, and turn a chuck or

ECCENTRIC ROD.

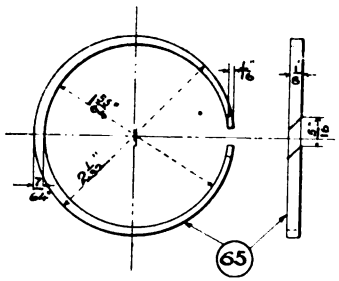


mandrel carefully shouldered to take the finished face of ring, and on this mandrel finish accurately to width.

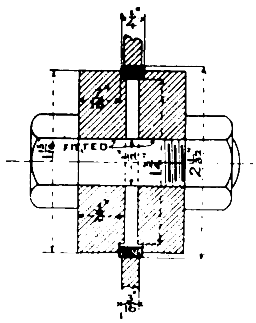
The rings can now be split through the thin side with a saw, cutting at the angle of 45°. They are now to be finished on the outside to fit the bore of cylinder. A simple way to do this is as follows :—

Take any piece of waste metal 3-16ths in. thick, and bore in it a hole 2⅛ ins. diameter. Into this spring both rings, having cut away with a file enough of the ring to allow of its entering the hole. Take

PISTON RING.

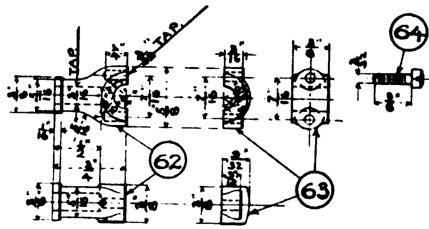


METHOD OF FITTING PISTON RINGS.



two pieces of cast iron ½ in. thick, and bore a ½-in. hole in the centre of each. Mount on a ½-in. bolt, properly centred, and turn to 1 15-16ths in. diameter, with a shoulder on each 1 11-16ths ins. diameter, as shown in the sketch above. By means of the ½-in. bolt the rings are to be securely clamped between the two discs, after which the rings can be withdrawn from the piece into which they were first compressed. If the clamping discs are well fitted and drawn up hard, they will hold the rings while they are being turned. The rings must now be turned to the size of cylinder bore, and nicely finished.

I have seen statements in THE MODEL ENGINEER to the effect that rings on small pistons are not effective, and I must take issue with those who hold this opinion. I think that where the rings



ECCENTRIC ROD END.

have not performed well, the cause of this failure is due to improper fitting. I have successfully used rings as small as ⅝ in. diameter, and in important work; also have always used them in my model engines, which have been many, and have always found them to give good results.

(To be continued.)

Home Electric Lighting.

By CYRIL N. TURNER.

(Continued from page 544.)

THE acid should not be put into the cells until all is ready to commence charging, so that everything should be got into absolute working trim before the acid is put in. The positive main of the supply must be connected to, the positive terminal of the accumulator. Should it so happen that the two wires cannot be traced with absolute certainty from the dynamo to the cell separately, it is necessary before connecting same to accumulators to make sure which wire is the positive one. This is readily ascertained in the following way :—The dynamo should be run at a slow speed, and taking the two ends of the supply wires, dip them in a mixture of salt and water, keeping them about ¼ in. apart while doing so, and watch for the following results. The wire from which rises the most bubbles is the negative, therefore the other is the positive. Another way is by means of pole-finding paper, which can be obtained from any dealer in electrical goods; with this paper directions are given for using same. Some paper, when moistened and the two wires applied to it a little distance apart, while dynamo is running, has a brown mark left on it where the positive wire has touched, but as there are various kinds of pole-finding paper, giving different results, it is impossible to detail them all here, so follow the directions accompanying the paper.

Having ascertained the polarity of the wires, and attached the positive one to the positive lug at one end of the series of cells, and the negative wire to the negative lug of the last cell, taking care to make good contact between wires and lugs, charging may begin. The first charge given to an accumulator should last three times as long as the theoretical length of time required to charge it, as this first charge is a "forming" charge, the meaning of which is this:—The plates during the first long charge are gradually converted in character by the current, the positive plate being formed into peroxide, and the negative into finely-divided or spongy lead; when this is attained the plates are in working order. This forming process is rather an awkward task for the average amateur to arrange, as it necessitates keeping the dynamo (if power is used) running for at least twenty-four hours, or whatever longer period the cells in question may require; but this should be done if possible, as upon this first charge the success and full capacity of the accumulators largely depend. If this forming charge must, from sheer force of circumstances, be carried out by two, three, or four charges, with intervals between them, a longer time in the aggregate must be allowed, and the lapse of time between these charges should be minimised as much as possible.

For small accumulators the "forming" is readily done by connecting up with the Daniell cells described in the next chapter, and no attention is required beyond maintaining the supply of copper sulphate as the crystals become dissolved. The accumulator, after the few first charges, will not be found to have acquired its full capacity, but this will improve with every subsequent charge. When the forming process is proceeding the positive plates will gradually turn to a dark, rich chocolate colour all over, and the negatives a slate colour. These are the colours that plates should acquire and ever afterwards retain, if in good condition. Various contributors to THE MODEL ENGINEER have described a simple method of making a solid accumulator.

Molten lead is poured in a thin stream from a height of about 6 ft. into a pail of cold water, from which it is recovered in the form of light flakes; some of this is mixed with a paste of litharge and dilute sulphuric acid, and forms the negative element, and is tightly packed round a porous pot standing in the centre of a jar. Another lot of the flaky lead is mixed with red lead and dilute sulphuric acid and packed into the porous pot itself, forming the positive element, a strip of lead being first inserted in each case, forming lugs, and when set, dilute acid (1·175 sp.g.) is added until the elements are covered by it. The "forming" charge is then given, and when the positive material in the porous pot has turned a rich dark brown, and the negative material in the outer cell to a slate colour, and bubbling and "gassing" takes place, the process may be considered complete. The writer has made large cells of these with success, and their capacity was very considerable, but owing to the porous pots eventually splitting, and thereby causing internal shorts which could not be removed, they had to be discarded.

Convinced, however, of the practicability of this system, if the breakage could be overcome or provided for, I decided to try again, re-using the positive and negative material from these discarded cells. A large porous pot was chosen and numerous ⅛-in. holes drilled through its body and bottom. A strip of stout white flanelette was then obtained an inch wider than the height of the pot, and wrapped around it four or five times and secured with narrow bands, about ¼ in. wide, cut from sheet lead. This flannelette projected ½ in. above and below the pot. The bottom was likewise covered with the same material. The pot was then virtually in a bag of four or five layers of the stuff. It was then stood in the centre of an outer stoneware jar and the negative material packed and moderately rammed around it, a strip of stout lead having, of course, first been put in as the negative conductor, with its outer end projecting about 6 ins. above the jar to act as the lug.

A similar strip of lead was then put inside the porous pot and the positive material put in and moderately rammed; 6 ins. of this lead strip also projecting above the porous pot and being the positive lug. The acid solution was then poured in until the porous pot was covered. This new cell charged up very well and has now been about a year in use and is in every way a great success. The pot has not cracked, and while the flannelette permits free circulation of the solution, it prevents any possibility of short-circuiting of the elements, and the acid seems to have had no destructive effect on this covering material, so far.

Small Lighting by Primary Batteries in conjunction with Accumulators.

Most of the very simple primary cells, as made by beginners have, at best, a very limited scope of usefulness for intermittent lighting. For instance, unless Daniell cells are inconveniently large, they are of no use for lighting direct to lamps; other batteries of more powerful properties—such as the bichromate—cannot be left idle without detriment, except by first removing the zinc, owing to local action setting in. There are a few exceptions—such as the Edison-Lalande, the Gordon, and Bennett's tin-pot cell, for instance; but if Daniell cells are used in conjunction with accumulators splendid results are obtained. The battery of such cells is always in circuit with the accumulators, thus slowly, surely and constantly charging the latter, which are therefore always kept in good condition, and ready at any moment to light lamps suited to their capacity by the mere turning on of a switch.

The following is a brief description of an installation of Daniell cells of a modified type to be used in conjunction with accumulators. They will be capable of supplying from 7 to 8 amp.-hours each day—*i.e.*, will light one ½-amp. lamp for about fourteen hours or two such lamps for seven hours. This is a most suitable installation for amateurs where a few bedrooms are desired to be lighted by small-voltage electric lamps. As three primary cells will be required to charge each accumulator cell, the requisite number of such cells may be easily arrived at by the voltage of the lamps intended to be used. Take 8-volt lamps, for instance. We shall require four accumulator cells; and as three Daniell cells are necessary to charge one of these, it follows that we shall require twelve cells to keep the four accumulator cells going. The outer cells may be the 7-lb. earthenware jam-jars already mentioned; in each of these is stood a porous pot about 9 ins. by 3½ ins., about 2½ ins. off the bottom; and the top of these porous cells should be coated with vaseline; the actual bottom should be also coated. Now put them in a warm place where the vaseline will soak into those parts. The fault of just dipping their ends in paraffin wax is that if they are not heated the wax instantly "cakes" on the pots, and although to all outward appearances it is all right, it is deceptive, as such a coating is merely superficial, and as soon as the pots soak in the solutions the wax is dislodged and peels off.

When the vaseline has soaked into the pores of the ends of the cells, take some thick string and bind round the pots in an open spiral with bare spaces; each is now placed in and against the side of its respective containing vessel. Now make a small spiral of bare stout copper wire, put this in the space between the porous cell and the outer jar, leaving one end about 4 ins. out of the cell for connection; now pack this space with broken carbon (coke will do if harder ca bon cannot be obtained), free from dust, and about the size of large peas, up to within 2 ins. of the top of the outer jar. A piece of zinc about 8 ins. by 2 ins. by ¼ in. will be required for each porous pot, a ¼-in. hole being bored through close to the top, through which is passed a piece of wood to rest across the top of the porous pot, thus supporting the zinc. Fig. 17 will clearly show the complete arrangement. Connect the cells together in series and to the switchboard, so that as soon as the solutions are added the current may be switched on to the accumulators if the voltage is correct.

Now make a saturated solution of sulphate of copper, and nearly fill the outer cells with this, and then add crystals to keep the solution saturated. Fill each porous pot nearly full with a solution of common salt and water of the strength of 2 ozs. to the pint. The cells should be connected now to a small lamp for about a quarter of an hour, after which they may safely be switched on to the accumulators. Fresh copper sulphate crystals must be added each week, at the same time drawing off the porous pot solution, and filling up again with fresh. The easiest way to do this is with a syringe. The zincs might with advantage be cleaned by scrubbing with water once a month. The object of string round the porous pot is to act as a sort of cushion and so prevent the carbon from making too hasty contact with it, as otherwise the copper deposit binds the carbon to the porous pot and cracks it.

Another good wrinkle is to put a piece of perforated thin sheet lead round the porous pot instead of string. A lug or strip of thin lead can be used at the terminal, thus dispensing with the wire (see Fig. 17); the advantage of the lead being that the porous pot can then always be withdrawn for cleaning, which is impossible when the carbon is packed round the string.

The following are the details for another primary battery suitable for charging accumulators, the charging being done when convenient, and not (as in the case of the Daniell cells) being always in circuit. Outer jar is a 7-lb. glazed jam-jar with wide neck; porous pot about 6½ ins. high by 3 to 3½ ins. in diameter; two carbons 7 ins. long are bolted together and placed in the porous pot. These plates should stand on a-½ in. layer of small pieces of carbon at the bottom, so that the top of the plates protrude 1 in. above the top of the porous pot; now pack round these plates broken carbon, sprinkling at the same time a little oxide of manganese amongst it, fill up to within ½ in. of the top, and seal with pitch, leaving a ½-in. hole for pouring in solution. In the outer jar put a piece of thin clean sheet iron encircling the porous pot. A carbon "shunt" wrapped in brown paper may as well be placed in circuit as shown in Fig. 8.

The mixture for the inner pot is 3 ozs. bichromate of potash; 6 ozs. of boiling water to dissolve

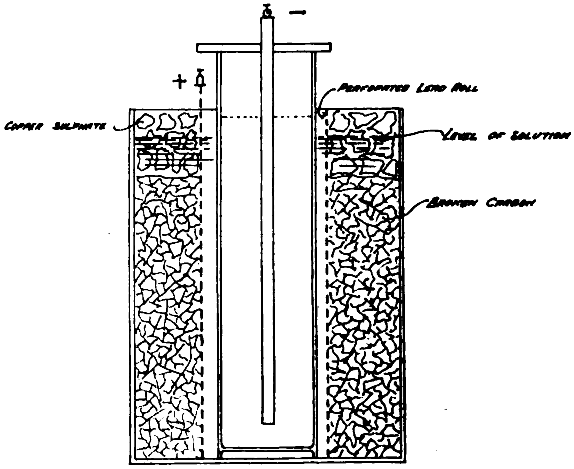


FIG. 17.—A DANIELL CELL.

the crystals, and now add 6 ozs. of sulphuric acid slowly, stirring well all the time. This must be allowed to become cold before putting into the porous pot. Solution for outer jar, 5 ozs. of common salt to the pint of water. Voltage of cell when freshly charged is 1·40, but usual working rate is 1·10. If sal-ammoniac solution is used instead of salt, the voltage is increased. Ordinary "tins" may be cut up and used instead of pure sheet iron, but as there appears to be local action with the tin the salt solution must be renewed after a short time. When the tin coating has come off and the sheet iron left bare the best results seem to be obtained. The charging rate into the accumulator varies from 1·5 amps when the cell is first made, falling somewhat as the solutions gradually exhaust. The low voltage is rather a disadvantage, but the initial cost of these cells being very low, and their upkeep giving very little trouble, the sheet iron being exceedingly cheap, their cost of maintenance is small, as zinc is the chief expense in other primary batteries.

These cells will charge accumulators up to about six hours with little polarisation, and the simple addition of about a teaspoonful of sulphuric acid to each porous pot renews their voltage almost to their maximum pressure. Their capacity in amp.-hours varies with the size of the cells. It is cheaper to use salt in the outer cells rather than sal-ammoniac, even at the cost of adding an extra cell or so to increase the total voltage. The constancy of these cells can be judged from the fact that an ordinary Leclanché converted into one of the above, and put into circuit with an electric bell in an outhouse, continued ringing the bell for nearly three weeks continuously.

The local action on open circuit is hardly appreciable, so that the iron need not be drawn out, but the amalgamation of the solutions must be prevented as much as possible. The best way is to keep the solution in the outer jar a little longer than that in the inner pot. Obtaining the chemicals at retail price, the charge per cell is just under 3d. A little salt should occasionally be added to the outer solution to freshen up. On recharging the inner cell, ½ oz. of oxide of manganese should be added to the solution before pouring in.

(To be continued.)

The Society of Model Engineers.

[Reports of meetings should be sent to the offices of THE MODEL ENGINEER *without delay, and will be inserted in any particular issue if received a clear nine days before its usual date of publication.]*

London.

The seventh Annual Conversazione will be held at the Holborn Town Hall on Friday, January 12th, 1906.

Readers wishing to join the Society are requested to communicate with the Secretary immediately, so that they may reap the full benefit of their subscription for the new Session just commenced.—HERBERT G. RIDDLE, Hon. Sec., 37, Minard Road, Hither Green, S.E.

A Model Vertical Steam Engine.

By H. A. COOMBS.

THE following is the description of a model engine that I have made in my spare time during the last twelve months. All the patterns and castings were made by myself. For the

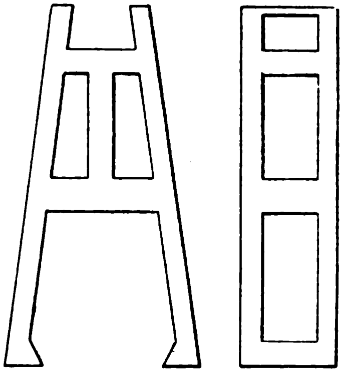


FIG. 1.—FRAME.

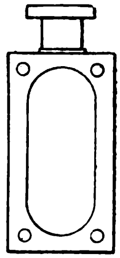


FIG. 2.

CYLINDER.

cylinder I cast a lump of brass 2 ins. diameter and 2⅝ ins. long, with the steam chest (2¼ by 1¼) on one side. I drilled a 1-in. hole through the centre, and then bored it out to 1½ ins. in the lathe. This was then put on a mandrel and the ends turned up to receive the flanges, which were driven and well sweated on. The steam ports were next drilled and cut with the chisel, and dimensions are: ⅛ in. by ⅜ in.; exhaust, ¼ in. by ⅜ in. There is nothing special about the covers, each being fixed by means of six screws. The steam-jacket was cast solid, with a boss on one end for the stuffing-box. This was put in the lathe, and the stuffing-box drilled and turned up. After this, the centre was drilled and filed out, leaving plenty of room at the four corners for drilling holes right through for bolting on to the cylinder face (see Fig. 1).

The frame (Fig. 2) is very rigid; it is cut out of sheet steel, and well soldered at the four corners. It is enamelled green outside, and black inside. The crankshaft is cut from a solid piece of mild steel, has square webs, as shown in the photograph, and is eased where it runs in the bearings. Eccentric and straps are of brass, giving the slide-valve a travel of ⅜ in.

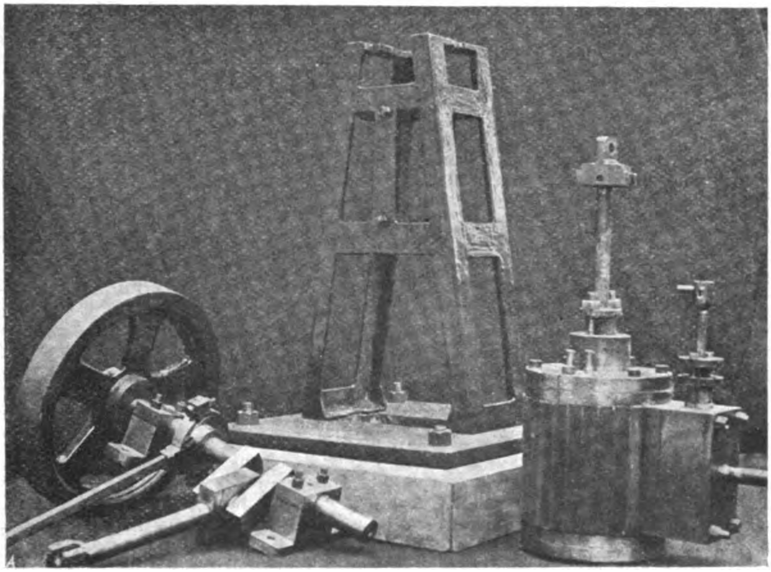


FIG. 3.—MR. H. A. COOMBS' MODEL VERTICAL ENGINE: PARTS READY FOR ASSEMBLING.

Bearings were cast in one piece, and ⅛-in. holes drilled right through for bolting the top of bearing to the bottom. Then the hole for crankshaft was drilled, bearings sawn in two, bolted together, and then the drill was run through again. The bed is a piece of ⅜ in. steel plate, polished and bolted to a piece of slate 1½ ins. thick, with four ½-in. bolts. The flywheel, which is 5 ins. diameter, is a wheel from a large steam valve. The boss and rim are turned up bright, and the spokes filed up and enamelled green.

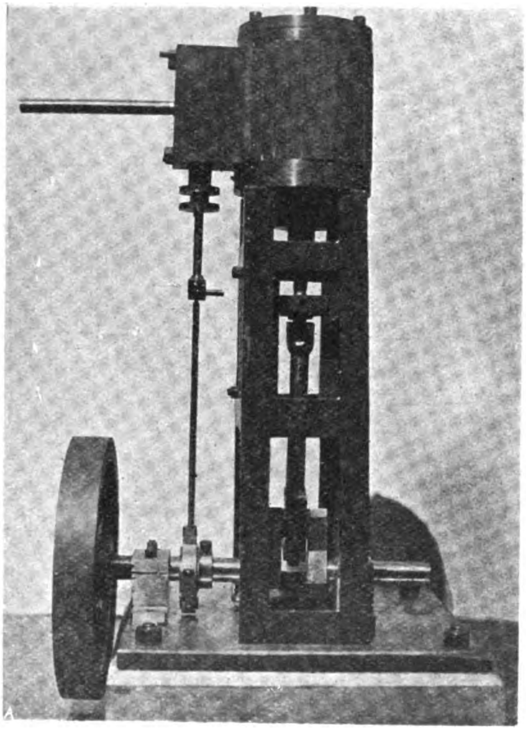


FIG. 4.—MR. H. A. COOMBS' MODEL VERTICAL STEAM ENGINE.

With a good supply of steam, the engine will run at a terrific speed, and cannot be stopped by holding the free end of the crankshaft.

ELECTRIC TRACTION ON THE METROPOLITAN.—One of the standard "steam" trains, as used on the Aylesbury and Verney Junction services of the Metropolitan Railway, has been adapted for working electrically. A motor bogie with the usual controlling apparatus has been substituted for the ordinary carriage bogie under the brake compartment at one end of the train, and large observation windows have been fitted at this end for providing the driver with a clear means of outlook. At the other end of the train one of the central corridor motor carriages as used on the electric trains is attached, so that the train, whilst retaining the compartment type of carriage (except for the one end coach), is able to travel by means of electrical traction over the Baker Street to Uxbridge section of the railway. This is quite a new plan, and the first train so fitted is now being tried experimentally.

For the Bookshelf.

[Any book reviewed under this heading may be obtained from THE MODEL ENGINEER *Book Department, 26–29, Poppin's Court, Fleet Street, London, E.C., by remitting the published price and the cost of postage.]*

FOWLER'S ELECTRICAL ENGINEER'S YEAR BOOK, 1906. Manchester: Scientific Publishing Co. Price 1s. 6d. net.; superior binding, 2s. 6d. net. Postage 3d.

Every edition of this well-arranged pocket-book makes it more useful to those for whom it is primarily intended. Owing to the rapid developments made in electrical science, we can hardly enumerate the many additions and emendations, but it will suffice to say that, in all cases, the information provided will prove very acceptable. The book now contains lengthy sections dealing with alternator design and turbine-driven generators, together with notes on insulation materials used for electrical machines, and all the recent alterations to the Government regulations affecting electrical engineering. The excellent directory of electric light and power stations throughout the country has, as far as possible, been brought right up to date. In all, some fifty pages of new matter has been added to the book.

Practical Letters from our Readers.

[The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a nom-de-plume, *if desired, but the full name and address of the sender* MUST *invariably be attached, though not necessarily intended for publication.]*

Carbon Terminals.

TO THE EDITOR OF *The Model Engineer*.

DEAR SIR,—In reply to "Practical's" comment upon my article in the *M.E.* for October 5th, I should like to know how he proposes to drill directly a triangular or hexagonal hole. His suggestions are not much good if he does not explain how to carry them out.

I should also like to say a word to Mr. J. A. B. on his reply to me on "Carbon Terminals," in the issue of November 2nd. When a terminal is once fixed to a cell or carbon it is not generally required to be removed until the cell is either worn out or broken.

Washers, few or many, are not required if the terminals are bought or made the right size in the first place. With regard to the "time, labour, and cost." First, Mr. J. A. B.'s time, two minutes on each terminal, might be saved; secondly, the labour, two minutes on each, added in quantities of thirty terminals, would mean one hour's work, which also might be saved; thirdly, I can buy my terminals ready-made for 1½d. each, thus saving 1d. on each, and also I am not forced to have a nut, worth ½d., with each which I do not require. I, therefore, get my terminals for exactly half the cost of Mr. J. A. B.'s. It also seems to me that if Mr. J. A. B. kept profit and loss accounts he could place his profits to the credit of his esteemed hobby.—Yours truly, ALFRED GAIN.

Oxford Street, W.

Model Automatic Railway Couplings.

To the Editor of *The Model Engineer*.

Dear Sir,—Knowing the difficulty experienced by owners of model locomotives and cars, in coupling and uncoupling same, I herewith submit drawings of an automatic car coupler. Fig. 1 shows construction for small models—A piece of spring metal, B a piece of metal soldered to A, C a piece of sheet metal bent as shown, soldered to A and fastened to underpart of car.

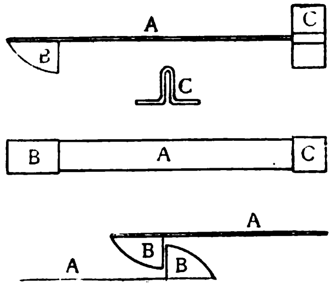


Fig. 1.—Construction of Coupler for Small Models.

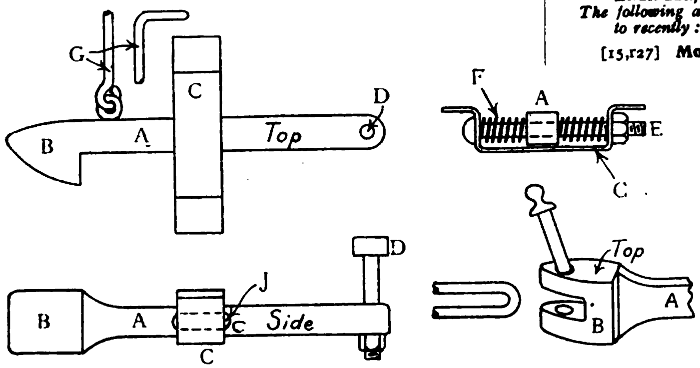


Fig. 2.—Details of Coupler for Large Models.

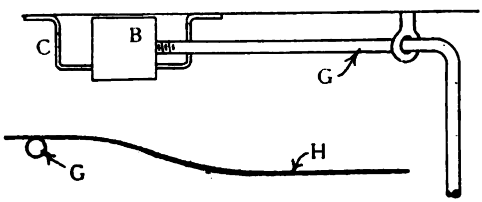


Fig. 3.—Method of Uncoupling without Handling.

Fig. 2 shows coupler for large models—A the shank and B the head, cast in one piece; C piece of sheet metal upon which A rests and moves from side to side, D pin through back part of A and fastened to under-frame of car; E bolt through sides of C and also through slot J in A; F, side control springs; G, a rod fastened to coupler and extending out to side of car so that cars may be uncoupled by hand.

Fig. 3: by extending rod G down to engage with movable piece shaped as H, cars may be uncoupled without handling same. A sketch is also given to show how coupler may be made to couple with a link coupler.

If this coupler is used on large railway cars or very large models, it should be fitted with springs at rear end of shank to ease shock in starting train.—Respectfully yours, F. A. Schulz.

Detroit, Mich., U.S.A.

Queries and Replies.

[Attention is especially directed to the first condition given below and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-hand corner of the envelope "Query Department." No other matters but those relating to the Queries should be enclosed in the same envelope.

Queries on subjects within the scope of this journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied, wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed, and also a "Queries and Replies Coupon" cut out from the advertisement pages of the current issue. (4) Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor,* The Model Engineer, *26-29, Poppin's Court, Fleet Street, London, E.C.]*

The following are selected from the Queries which have been replied to recently:—

[15,127] **Model Steam Engines and Boilers.** F. K. writes: Kindly let me know if a model horizontal boiler, if made to same dimensions as the locomotive boiler, Fig. 22, of "Model Boiler Making," would suit the two cylinders mentioned—1¼ ins. by 2 ins.—or does that boiler only apply in the case of a model loco? (2) What size locomotive boiler would be necessary for 1¼ ins. by 2¼ ins. cylinders; would you let me have length and diameter of barrel, number and size of tubes, size of firebox, etc.? (3) Would a model with two cylinders, say 1¼ ins. by 2¼ ins., have the same power as an engine with one cylinder, 2½ ins. by 2 ins. stroke; if not, what would the difference be?

(1) A locomotive boiler on a locomotive will generally evaporate more water than a similar generator on land. However, if you use the exhaust steam in the same way as in the locomotive, to induce a strong draught, you will find the boiler run the engine very well. You can increase the grate area by not pinching-in the firebox. The firebox may be as wide as the barrel. (2) We would advise a boiler with a barrel 7 ins. diameter by 13 ins. long. Firebox should be 7 ins. wide by 9 ins. long, outside dimensions. The tubes may be ½ in. outside diameter, and about sixteen in number. (3) Theoretically you can compare the power by comparing the cubic capacity of the cylinders of each engine. The cubic capacity of two 1¼ by 2¼ cylinders

= 2 × area of 1¼ ins. circle × 2¼
= 2 × 1·227 × 2·25
= 4·5 × 1·227 = 5·5 cub. ins.

The cubic capacity of one 2½ × 5 ins. cylinder = area of 2½ ins. circle × 5 = 4·9 × 5 = 24·5. The powers are as 5·5 to 24·5, or about 1 to 4½. So you will have to use nine 1¼ × 2¼ cylinders, instead of two.

[14,888] **Connections for Charging Accumulators.** T. J. (Grimsby) writes: I have lately made a charging board for charging motor ignition accumulators. It is wired as sketch (not reproduced). Is this right? The voltage is 230. What lamps shall I require to use for 20 amp.-hours' accumulator; also for 40 amp.-hours' ditto? Two 16 c.-p. lamps do not show any current on the ampere-meter, which is for 5 amps. Would the ampere-meter register anything less than 1 amp.? If the wiring is not correct, will you kindly give diagram?

Your sketch of wiring is quite correct. The ampere meter ought to give some indication that a current is passing through if it is of the "moving iron" pattern, which has a small piece of soft iron moving inside a solenoid. The needle would not give much of an indication for less than 1 amp.; it depends upon the quality of the instrument. About 1-5th of the maximum reading is about the point at which the indications are worth anything. Try connecting the + pole to the other terminal of the ampere-meter, so that the current passes through it in the reverse direction. For a 20-amp.-hour accumulator a charging current of about 3 amps. would be about right. Six 32 c.-p. 230-volt lamps in parallel would pass about this amount of current if of average efficiency; a 40 amp.-hour accumulator would require about 6 amps.; 12 32 c.-p. lamps in parallel would be required. Of course, you can charge at a lower rate of current if you please; the cells will then take a longer time in charging.)

[15,011 **Model Locomotive.** G. V. S. R. (London) writes: I have just completed a locomotive boiler for ½-in. scale locomotive. It has 10 tubes and cross water-tubes in the firebox. What I want to know is—(1) What type of firing arrangement is most suitable? (2) Whether a water-pump could be employed from axle? (3) Will single cylinder, ⅝-in. bore, 1-in. stroke, be suitable to drive wheels 2½-in. diameter, as I have made a 1-in. throw crank for same. The driving wheels will be coupled. (4) Will I be able to maintain a good boiler pressure, and what pressure shall I have to work at to supply cylinder.

(1) A plain spirit lamp will give good results with little trouble. However, if the boiler does not steam, try a vaporising burner. (2) A pump may be used, but we would suggest gearing down two or three to one. (3) Employ a ⅝ by 1 cylinder. (4) If the draught arrangements are good, pressure may be anything up to 30 lbs. We would advise you to study "The Model Locomotive," by H. Greenly, before proceeding with the locomotive. Price, post free from this office, 6s. 4d.

[14,932] **Vertical Boiler.** V. T. H. (Shoreham) writes: Will you kindly tell me if a 10-in. by 20-in. vertical steel tubular boiler, with thirty-seven ⅝-in. metal tubes and 11-in. by 8½-in. firebox, working pressure 80 lbs. per sq. in., will drive a vertical condensing engine 2½ ins. bore, 3-in. stroke? If not, would it drive it by converting the engine into a tandem compound by putting a 1½-in. bore H.-P. cylinder on top?

The boiler provides about 750 sq. ins. of heating surface, and, under best conditions, should evaporate enough water to run the engine at the required pressure at about 100 to 120 r.p.m. This may be too slow, and if a higher speed is attempted, the pressure will drop. If you turn the engine into a compound, the speed may be increased to about 300 r.p.m., the pressure maintained being about the same—viz., 80 lbs. per sq. in.

[14,941] **Electric Furnace.** H. M. (York) writes: Will you kindly tell me how to construct an electrical furnace to melt about 12 ozs. of silver, and smaller quantities of gold or platinum. I should like it to take about 5 amps. or less, if possible, on a 230-volt circuit.

We cannot give you complete details you require, as it is beyond the scope of our query columns. We advise you to study the subject so as to get some idea as to what you are attempting to do. Read the book—"Electric Furnaces," by J. Wright. You could make some experiments by using a pair of ordinary electric light carbons arranged to slide through the walls of a fireclay furnace (see sketch). The carbons could be connected to the wires by metal clamps. Use carbons about 10 mm. diameter. You will require a resistance consisting of about 4 lbs., No. 18 bare German silver wire, made into coils and put in series with the carbons. To start the arc bring the carbons together for an instant, and then pull them about ¼ in. apart. For melting gold and silver, you could try the furnace described in THE MODEL ENGINEER for September 21st, 1905, page 275. 5 lbs. of No. 18 gauge German silver wire would be the resistance to use in series with this. For melting platinum it is necessary to use the electric arc.

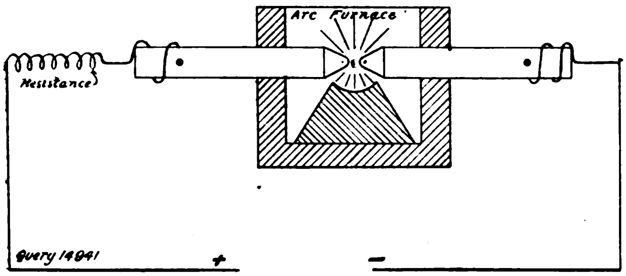
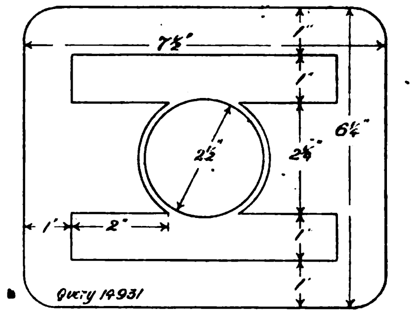


DIAGRAM OF AN ELECTRIC FURNACE.

[14,395] **Weight of Bar Iron.** W. T. writes: Please state what would be about the weight of 1 ft. of wrought iron, 12 ins. long, 6 ins. diameter.

The weight of a bar 6 ins. diameter and 1 ft. long is given as 96·2 lbs. for steel, 94·2 lbs. for wrought iron. Assuming that 1 cubic ft. of iron, on an average, weighs 480 lbs., a bar of the dimensions above would be 480 by ½ by ½ by ·7845 by 1 = 120 by ·7855 = 94·25, which agrees with the above.

[14,931] **Windings for Avery-Lahmeyer Dynamo.** H. A. (Eaglescliffe) writes: I should be much obliged if you will let me know how much wire, and size, I shall require to wind armature and field coils of a Lahmeyer dynamo I have got castings for.



AVERY-LAHMEYER DYNAMO FIELD-MAGNETS.

I give sketch of same herewith. I want it to give 25 volts and as many amperes as possible.

Armature: No. 20 S.W.G. about 9 ozs.; F.M.: No. 22 S.W.G. Get on as much as you can.

[15,195] **Transformers; Armature Construction.** G. H. H. (Manchester) writes: I am constructing a small Manchester type dynamo on the same lines as the one I saw described in the *M.E.* about last December, namely, with laminated fields in two separate C-shaped pieces, bolted together with an iron plate. The armature will be about 1¼ ins. in diameter by 2 ins. long. I want to know if you consider a plain ring armature—such as a piece of wrought iron pipe, wound with, say, three layers of 22 D.C.C. copper wire—would excite? I mean apart from the fact of armature being solid ring, and not laminated, which (though it is not the right thing) I think will answer my purpose. Will the fact of armature having no teeth, and being three thicknesses of No. 22 wire, and the air-gap 1-32nd in. from the field-magnet, prevent it from exciting, do you think? Though I think I've seen one in "ours" at some time or other which worked all right, I should rather like to know what the relation of length of armature to diameter is. Does it follow that the longer the armature is the more current you can obtain from it at a given speed (the voltage remaining the same)? And also the more power you can obtain from it running as a motor? Or does it mean the longer the armature is, the diameter remaining the same, the slower the speed is for a given output of current acting as a generator? I should like you just to give me some rough idea, if possible, of the relation between the two, please. *Transformer.*—Will you just tell me why it is that if an alternating-current generator is working on a load of transformers only, why do not the primaries of these, which certainly don't offer much resistance—being thick wire generally—form a, practically speaking, dead short to the generator? As there can't be much total resistance in a series of these primaries, I take it there is no "loading" effect on a primary when current is taken from secondary. Is it that the primary, being wound inductively, offers a choking effect to the current as a shocking coil, and so keeps current down? But if this was so, why don't the coils on the armature of an alternating current generator, being wound inductively, offer this same choking effect? I apologise for asking all these questions, but shall be much obliged if you will just briefly answer me.

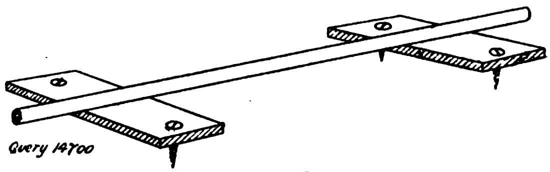
It is doubtful if a plain armature of this size will excite in field-magnet made entirely of wrought iron as a dynamo; it would work all right as a motor. You will find so small a diameter ring very awkward to wind, owing to the small internal space. As regards relation of length to diameter, this is always a compromise; the larger the diameter, the more turns of wire you can get on; the greater the length, the more magnetism you can get through for a given diameter, and the less proportion will the dead wire at the ends be to the active wire on the outer circumference. The current depends upon the size of wire used—the larger the diameter of the wire the heavier the current. The voltage depends upon the number of turns of wire, upon the amount of magnetism, and upon the speed: increase of any one of these, or all, will increase the volts. The greater the voltage as a dynamo, the slower will it run as a motor, compared with a given voltage of the source of current. You will find the theory explained in the "A.B.C. of Dynamo Design," price 1s. 2d. post free. *Re* transformer. When no load is connected to the secondary winding, the primary exercises a choking effect, due to its self-induction, and practically chokes back nearly all the current. As the secondary winding becomes loaded, it reacts upon the primary by mutual induction, and wipes out the self-induction of the primary in proportion to the load. At full load the self-induction of the primary is diminished and full-load current flows into it. What really happens is that the counter electro-motive force set up in the primary coils by the action of the alternating current is almost equal to that of the mains at no load, and therefore scarcely any current flows in them. As the secondary is loaded, it opposes the magnetising action of the primary, and reduces the back E.M.F., permitting more current to flow in proportion to the load, and therefore the power exerted by the secondary coils. It is a matter of back pressure, due to the current being a fluctuating one. If the primary of such a transformer is connected to a continuous current main, it forms, as you say, almost a dead short-circuit. If you were to take out the iron core of a transformer, its coils would almost form a dead short-circuit, even with alternating current. The coils of an alternator armature do possess self-induction when wound on iron teeth, though not to the extent of a transformer, owing to the air-gap and other reasons; and to this self-induction is due the fact that such alternators can be short-circuited without danger of burning out the armature coils, the self-induction making it impossible to get more than a certain amount of current out of the winding.

[15,001] **Steam Engine Plant.** R. S. McP. (Edinburgh) writes: I am thinking of making a small electric plant for myself. I wish a dynamo to drive a small lathe, and also charge three 18 c.-p. accumulators. Would you oblige me with the following?—What size of boiler? What pressure? What size of cylinder? What kind of dynamo? I wish it to drive two small motors which drive a small saw and driller.

To charge the accumulators and drive the lathe at the same time an engine of about 1 i.h.-p. will be required. The type of engine, boiler and dynamo may be anything, so long as they are of good design and well made. Your queries do not admit of a definite reply. The dynamo should have an output of about 250 watts.

[14,700] **Controlling Electric Locomotive Motor and Fixing Rails for Same.** C. H. A. writes: I have a model electric locomotive. Can you tell me how I can make a controller from the switchboard, having 10 volts running from the dynamo? Can you tell me how to fix wire for live rail on to wooden sleepers? Do you think the wood might act as a conductor after a time when it gets damp? I want the car to run over the wire as smoothly as possible.

The best thing to do is to arrange a resistance in series with the motor, so that you can adjust the voltage. This will give variation in speed. To reverse from the switchboard it is necessary to excite the motor field-magnet by means of a battery carried on the locomotive, so that the field current is quite independent of the live current, which is to flow through the armature only. The live current can then be reversed in direction at the switchboard, and will reverse the motor armature. You will find particulars of reversing switches and resistances in our handbook No. 14. We do not think you need fear leakage across the wood, but as a precaution give it a good coating with shellac varnish. To fix live rail on to sleepers, solder a strip of brass under it at intervals of each sleeper or as frequently as advisable, depending upon the stiffness of the rail, (see sketch) and screw the strip to the sleepers.



Fixing Live Rail to Sleepers.

[14,688] **Coherer; Battery for 1-in. Spark Coil.** A. S. (Dublin) writes: (1) Would a glass tube 3-16ths in. or ⅛-in. bore give as good results in a coherer similar to that described by Mr. Schneider in your issue of August 10th? I find it difficult to drill the one-eighth ebonite plugs. (2) What battery power is needed for a 1-in. spark coil? Would three bichromate cells in series be sufficient? If an accumulator is used with the coil for three hours a week, what would be the voltage required, and what time would elapse before it required recharging?

(1) The trial is easily made: but it is better to keep to the dimensions given. To make the ebonite plugs, drill the holes in ebonite of a larger diameter than ⅛ in., say ¼ in. diameter, or larger, and then turn it down to size to fit tube. (2) Depends very much upon the coil. Try three bichromate cells in series; they should be of at least 3-pint capacity each. *Re* accumulator. This must be found by trial; we cannot say exactly what current your coil takes; besides, the current will vary very much with the manner in which the coil is used. You should not completely discharge an accumulator, nor let its voltage run below 1·8 volts per cell.

[14,158] **Electric Light Wiring for House.** W. A. A. (Walmer, Kent) writes: Will you kindly give me—(1) the necessary wirings for the installation sketched (not reproduced)? A lamp would be needed in the rooms named. Please give the disposition of switches etc. (2) What size wire would you use for the mains, the dynamo being 25 volts at 4 amps.?

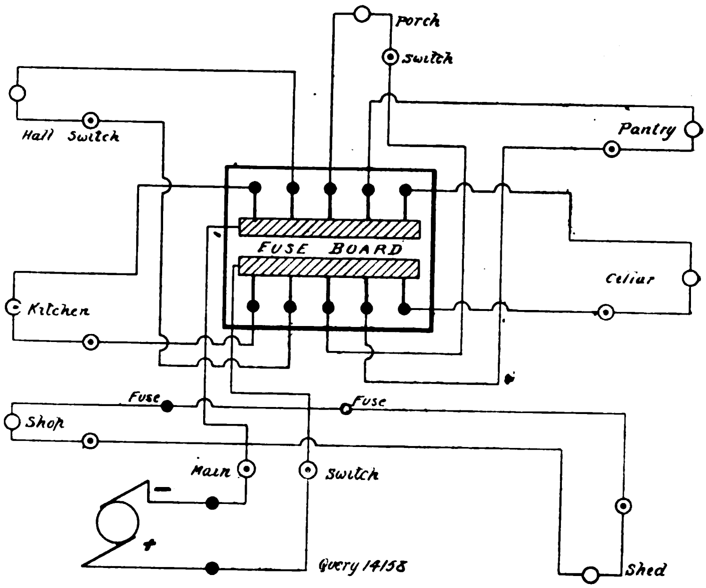


Diagram of Wiring for House Lighting.

You should run a pair of mains to a central distributing board, say, placed in the hall, and group the fuses there, running branches to the various lamps from this board. Mains to fuse-board to be No. 14 gauge wire, or 7-32nds stranded. Branch wire to be No. 18 gauge wire. (See diagram above.)

[14,721] **Model Searchlight.** H. J. (Wallsend-on-Tyne) writes: Is it possible to make (or have made) a model searchlight, giving a powerful light in proportion to size—say, from 1 in. to 2 ins. diameter? And what power would be given off from a 2 c.-p. lamp? Also, could you tell me what is the actual light in an ordinary searchlight, and the light given off. How many times is the light multiplied?

The only way to make such a small searchlight is to use an ordinary incandescent lamp at slightly higher voltage than it ought to be run at, so as to obtain a very brilliant light. Of course, such a lamp will not last very long. A 2½ c.-p. lamp would give a good light under these conditions—it is a matter for trial. You should get the highest candle-power lamp you can in the space; about half a volt excess on a 6-volt lamp would be ample. You should use an adjustable resistance to prevent burning out the filament, though you would probably spoil several lamps in a short time at first. It is not possible to state accurately the candle-power of a searchlight; they vary in size—10,000 c.-p. would be an approximate estimate of a big searchlight.

[14,730] **Small Dynamo Failure.** J. H. (Roundhay) writes: I should be much obliged if you could tell me the cause of a dynamo I have made not working. The field-magnets are as per sketch (Fig. 1). The top and bottom yokes are each 9½ ins. by 2 ins. by ½ in. The pole-pieces are made of 2 ins. wide by ½ in. thick iron bent to shape, and then turned out in the lathe. The cores are each 1½ ins. thick round iron, and are wound with 1½ lbs. No. 22 S.W.G., D.C.C. on each core. The armature is of the plain ring type. *Size of the iron wire ring is 2 ins. in length and ¾ in. thick, and is over-wound with three layers of No. 20 S.W.G., D.C.C., divided into twenty coils, and the finishing end of each coil is joined to the commencing end of the next coil all round the arma-

ture. There is about ¾ lb. of copper wire on the armature. The commutator is made out of a brass tube 2 ins. in diameter by 1¼ ins. long, and is divided into twenty parts, each part being connected to one of the armature coils. The brushes are of the usual type fixed to a rocker. I have connected the dynamo up as follows:—The end of the last coil of the left field-magnet to the left-hand brush, and the last, or outside, coil-end of the right-hand field-magnet to the right-hand brush, the two ends of the bottom layers of each field-magnet coil being joined together. I then connected a battery to the terminals of the machine, and ran the armature at about 2,500 r.p.m., but could get no current. I afterwards wound some fine iron wire over the armature, with the same result as before. I have tried every way I know. Do you think the machine is proportioned properly, and that the wire is the right size? I have tried each coil separate, and the armature, and there are no broken wires. If the machine is made right, what should be the output under full load?

The failure of this machine to excite is probably due largely to insufficient residual magnetism. It is very doubtful if you will be able to do much with it as a dynamo; we expect the battery used to excite the magnet was too weak. Try it again, with a battery of about six bichromate pattern cells in series as a separately excited machine, the brushes being entirely disconnected from the field coils. Connect a 10-volt lamp to the brushes, and see if you get any result. Also try it as a motor, with field coils connected in shunt to the brushes from the same battery. If it runs as a motor, it will show that there is nothing wrong with the workmanship. It should be driven in the same direction as that in which it runs as a motor. To improve this machine, and give it a chance to work as a dynamo, you should fit new cores made of cast iron, each 1 in. by 2 ins., in place of the present round ones, and wind them with the No. 22 gauge wire; also fill in the corners between yoke and pole-pieces with some iron corner pieces to give the magnetism a better circuit to the armature. With this alteration, you may get about 15 volts and, say, 5 amps., at about 3,000 r.p.m. The voltage can be adjusted by running at higher or lower speed. Good joints should be made between the cores and yokes, and the cores well magnetised by running the machine as a motor from a good strong battery. There would be no harm in increasing the weight of wire on the field coils, but it would be well to use No. 20 gauge for the extra wire, so as not to make the resistance of the field coils too high.

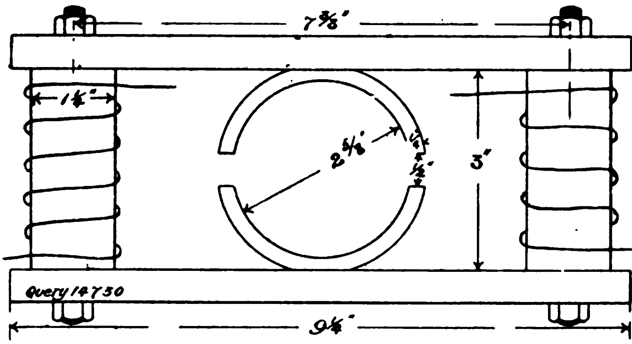


Fig. 1.—Manchester Type Dynamo.

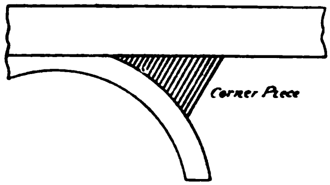


Fig. 2. Corner Piece fitted to Reduce Magnetic Resistance.

[14,956] **Running 8-volt Lamps from Small Dynamo.** J. B. (Slough) writes: I should feel obliged if you will answer a few questions *re* small dynamo. I am putting in a cog-drum armature made from stampings; eight cogs, 5-16ths in. square, insulated with shellac and silk, and wound with 2½ ozs. No. 22 s.s.c. wire, 1½ ins. diameter by 1½ ins. long, and copper commutator. Armature is wound in four sections; mechanical details are perfect; bearings, good fit, etc. I have "Small Dynamos and Motors" and "A.B.C. of Dynamo Design," and gather that the output will be about 10 volts 2·5 amps. at 3,000 r.p.m. (1) What I want to know is, can I use 8-volt lamps and drive slower, and the number of such (ordinary) I can light continuously? I thought of 8-volt lamps, as they are considerably cheaper than higher voltages; but I am not particular. All I want to do is to get as much light as possible from machine. I have plenty of power to drive it. (2) Method of procedure of charging 4-volt 20 amp.-hour motor cycle accumulator from machine. What resistance would be needed? I want to use as heavy a charging current as is safe, as in the evening I have only time to run engine for about 3½ hours at a stretch.

(1) Yes. About three 8-volt, 2 c.-p. lamps could be run in parallel from your machine. (2) Methods of charging such accumulators have been given quite recently in the Query columns, to which please refer.

[14,930] **Windings for Kapp 100-watt Dynamo.** F. G. (Currgah Camp) writes: Please give required amount and size of wire for Kapp dynamo fields as follows:—25 volts 4 amps; armature diameter, 2 ins.; armature length, 3½ ins. Fields: thickness, 11-16ths in.; length, 3½ ins.; height, 2 ins. of winding space. Will the above machine give the named output? Fields are of cast iron.

(1) Armature—No. 22 S.W.G.; about ⅝ lb. or 10 ozs., if you can get it on. Field-magnets, 2½ lbs. No. 23. Yes, should give 100 watts. Field-magnet core might be a shade more than 11-16ths in. If possible, a good ¾ would be better. The sample wire you enclosed is No. 22 bare S.W.G.

[14,911] **Hydraulic Engine.** J. McI. (Paisley) writes: I am desirous of driving a 6-in. screw-cutting lathe, and have determined to make, during the spare hours of this winter, a three-cylinder water engine. of the "Brotherhood" style. I estimate (though not an engineer) that it would be well to provide for about 2 to 3 h.-p., to allow for fall in pressure of water supply, friction, and other items. Will you kindly tell me how I am to arrive at the number of revolutions the engine will run at per minute, and also how to calculate the horse-power it will develop? I intend driving the engine from the house supply pipe, ⅜ in. internal diameter, the pressure being 78 lbs. per sq. in. taken with pressure gauge. I had an idea that an engine with three cylinders, 1¾-in. bore by 1½-in. stroke, would run at about 200 revolutions and develop about 2½ h.-p., but I should be glad to have a definite knowledge how to calculate the revolutions and horse-power correctly.

We do not quite grasp what you mean by "to provide for about 2 to 3 h.-p." Do you mean provide an engine which on a service where the losses due to friction of pipes would be smaller would develop 2 or 3 h.-p.? If you know the pressure at the engine, then the usual formula may be applied to get the i.h.-p.

$$\frac{\text{P. L. A. N.}}{33{,}000} = \text{h.-p.}$$

$$\frac{\text{Mean press.} \times \text{length stroke in ft.} \times \text{area of piston} \times \text{no. strokes per min.}}{33{,}000}$$

$$= \frac{\text{Pressure, say, } 33 \text{ lbs.} \times 1\tfrac{1}{8} \times 2{\cdot}4 \times 200}{12 \times 33{,}000} \times 3 \text{ cylrs.}$$

$$= \text{Total i.h.-p.} = \tfrac{1}{20} \text{ h.-p. per cylr.} \times 3\,;$$

$$= \tfrac{3}{20} \text{ or } \tfrac{1}{8} \text{ i.h.-p.}$$

If a pressure of about 65 lbs. can be obtained at the engine, then the horse-power will be one-third. We do not, however, think the loss of pressure would be so great as 45 lbs. which allowed in working out above and that 60 to 65 lbs. would be obtainable at the engine at the maximum speed. Therefore, there is every possibility of your being able to run the lathe if there is not much loss in transmission. Everything depends on the length of ⅜-in. pipe necessary. The common velocity of water in large mains is about 3 ft. per second, and the loss of pressure in 1,760 yds of pipe is given as about—

$$\frac{108}{\text{diam. of pipes in inches}} = \text{loss of pressure in lbs. per sq. in.}$$

The speed of the water in your engine would be in the 1¾-in. piston (2·4 area of piston) about—

$$\frac{3 \times 5}{4} \times \frac{200}{12 \times 60} = \text{ft. per sec.}$$

$$= \frac{25}{24} = 1 \text{ ft. per sec.;}$$

and as the proportion of pipe area to piston area is as area of 1¾ ins. to area of ⅝ in. = 2·4 is to ·3, the speed will be—

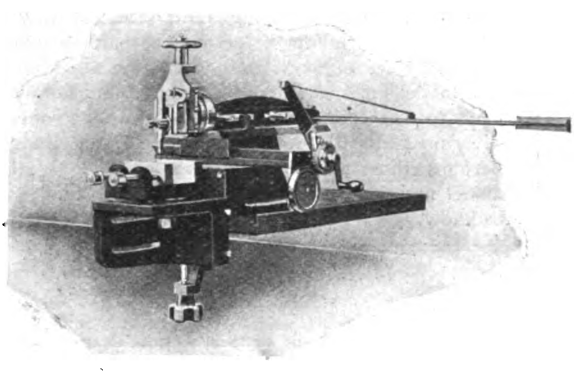
$$\frac{2{\cdot}4}{{\cdot}3} \times 1 \text{ ft.} = 8 \text{ ft. per sec.,}$$

which is fairly high in comparison with the speed in large mains, but, we venture to think, is not fatal to your scheme. With about 20 yds. the loss of pressure would be—

$$\frac{108}{\frac{1}{2}} \div \frac{1760}{20} = \frac{54}{55} \times 2 = 2 \text{ lbs. loss of pressure per sq. in.}$$

With the higher speed of 8 ft. per second and with the necessary bends, we would not estimate it at less than 10 lbs. loss.

[14,951] **Dynamo Driving.** A. E. writes: (1) What output from dynamo (sketch not reproduced) and number of revolutions per minute? (2) Will engine 1 in. by 1 in. cylinder ½ in. by 3-32nds steam ports, 5-16ths exhaust do; vertical high speed, supplied with 100 lbs. pressure on boiler gauge delivered to engine through ¼ outside, 5-32nds inside diameter. Drop of pressure unknown, but length of pipe about 1 ft. 6 ins.? (3.) What B.H.P. will engine develop at flywheel. (4) Also the size of boiler to drive same? I have got your valuable book on boiler-making, but cannot determine which type will suit. I wish to be able to leave plant for some hours running with automatic regulating devices, which I wish to experiment with. I rather think the Cornish type would suit, but would like your advice and other details you may think fit.



Mr. Edward Hine's New Shaping Machine.

(1) The dynamo will give out about 12 watts at 3,000 revs. per minute. (2) Yes, quite well. We would advise you to keep the length of pipe down to the lowest possible; not, however, from reasons of wire-drawing only, but because of the condensation likely to take place in such a length of exposed piping. (3) About 1-12th i.h.-p. at 500 revs. per minute. The brake horse-power would be about 1-20th b.h.-p. (4) We would advise any multitubular vertical boiler having about 350 sq. ins. of heating surface. Probably a Primus fired generator (two burners), measuring about 6 ins. diameter by 12 ins. high without water-space firebox, but with 12 to 15 tubes ½ in. outside diameter would do very well. A Cornish boiler is expensive to make (if copper is used,) and must be set in brickwork or other similar material to obtain the best value from the heat of the fire.

[14,811] **Model Vertical Boiler.** F. J. H. (Reading) writes: Would you kindly oblige me with the dimensions of a vertical boiler suitable to drive a horizontal engine; cylinder 1-in. bore, 1½-in. stroke. I have a piece of 4-in. solid-drawn brass tube, 1-16th in. thick. If this cannot be used for the outer shell, kindly send me (1) thickness of plate, (2) diameter of boiler, (3) height of boiler and size of firebox and centre flue, size of cross-tubes in firebox; also sizes of feed pump suitable for the boiler.

We presume from your sketch (not reproduced) that your boiler will be fired by liquid or gaseous fuel, the depth of the firebox being so small. If you only require the engine to run a few models, or do other light work, then the boiler fired by a 3-in. silent Primus paraffin burner would do the work quite comfortably. The water-tubes should be ½ in. outside diameter, and about five in number. They should be silver-soldered in, and be inclined as much as possible. Should you want to get more power out of the engine, we would advise a number of vertical flue tubes ½ in. diameter. These should be screwed into the firebox crown, as it will not be possible to have them expanded, owing to the presence of the water-tubes. If solid fuel is to be used, then dispense with the water-tubes, and employ at least twelve flue tubes ½ in. or ⅜ in. diameter. The size of the shell should be 5 ins. by 10 ins. The size of the feed pump, which will just keep up the supply, will depend on the work to be done by the engine and the size of the boiler. If you fit the engine with a pump having a 5-16ths-in. plunger and ⅜-in. stroke, you will be on the safe side. Adjust the supply by a by-pass valve in the delivery pipe. For 4-in. barrels use 1-16th in. thickness of plate, 5 ins. diameter, 5-64ths in., and 6 ins., 3-32nds in.

[14,954] **Steam Engine Particulars.** A. C. L. (Coventry) writes: I have nearly completed a steam engine, 2-in. bore, 4-in. stroke, and shall be obliged if you will kindly answer me the following:—(1) Size of boiler, and best kind of fuel to use to drive engine at 250 r.p.m. (2) Brake-horse-power of engine. (3) Will it drive a 3-in. B.G. Lathe. (4) What size pump required for boiler. I have been a reader of the *M.E.* for nearly three years, and have always found it a great help.

(1) A boiler with about 1,200 to 1,400 sq. ins. of heating surface will be required, and we would advise, if the type can be conveniently employed, a vertical multitubular about 18 by 30 ins. high, with about twelve to sixteen tubes, 1¼ diameter. (2) About ½ i.h.-p. at 50 lbs. boiler pressure. (3) Yes, quite easily. (4) The pump should have a plunger at least ½ in. diameter and ½-in. stroke, and a by-pass cock on the delivery to adjust the feed.

The News of the Trade.

[The Editor will be pleased to receive for review under this heading samples and particulars of new tools, apparatus, and material for amateur use. It must be understood that these reviews are free expressions of Editorial opinion, no payment of any kind being required or accepted. The Editor reserves the right to criticise or commend according to the merits of the goods submitted, or to abstain from inserting a review in any case where the goods are not of sufficient interest to his readers.]

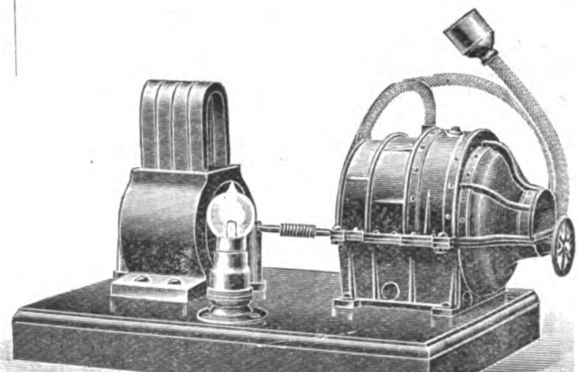
* *Reviews distinguished by the asterisk have been based on actual Editorial inspection of the goods noticed.*

A New Hand Shaper.

We have received from Mr. Edward Hines, of Griffin Engineering Works, Norwich, some particulars of a new hand-shaping machine he has lately introduced. The general arrangement of this tool is shown in the accompanying illustration, from which it will be seen that the machine is intended for fixing to the work-bench. The stroke is adjustable, and extends to 6 ins., while there is an automatic traverse feed having a range of 8 ins. The table is adjustable, and is fitted with a screw vice for holding the work. We have not seen one of these machines, but have no doubt that it is quite up to the standard of the high-class tools for which this firm is noted. Prices and further particulars may be obtained on application. Mr. Hines recently sent us a pretty novelty in ornamental turning in the shape of a very cleanly-cut thistle bud. He makes a special cutter for producing this pattern, which will, no doubt, be of interest to those of our readers who practise ornamental lathe work.

A Miniature Electric Light Plant.

From The Universal Electric Supply Co., 60, Brook Street. C.-on-M., Manchester, we have received a new sheet of seasonable novelties. The items listed include a model water motor, electric torches and pocket lamps, scarf pins, coils, batteries, and a cheap pocket voltmeter. One of the more important lines we illustrate herewith in the form of a small water-driven central station plant, which comprises a dynamo driven by a water-motor, and connected to a small lamp, which it lights up. The set is provided with a rubber tube for connecting to a water tap. The list will be sent post free to any reader on application. We are informed that a number of the prices in this firm's regular lists have lately been reduced, without any alteration in the quality of the goods.



The Universal Electric Supply Co.'s Miniature Electric Light Plant.

The Editor's Page.

THE FORTIS Vice Competition, recently announced in our columns, brought an unusually large number of entries, and, perhaps owing to the nature of the problem our readers were set, the judging has been somewhat difficult. No very great scope for brilliant originality is possible in the design of a vice bench; rigidity, simplicity of construction, small cost of materials and suitability for the work the bench is intended for, being, in our opinion, the chief objects for the competitors to secure. Some of the entrants favoured old wringing machines, chaff-cutters, and the like, as the basis of their designs Benches made in such a way would, no doubt, serve their purpose excellently; but designs founded on the use of these materials could hardly be considered by the judges, as they are merely adaptations of structures intended for entirely different uses, and not always easily available for the bench builder. No one design came up to our highest expectations; but we consider the best to be that prepared by

Mr. H. V. BOOTH,
4, Whittaker Street,
Radcliffe,

who sent in excellent drawings in detail for a plain, straightforward, and useful amateur's vice bench; and we have, therefore, selected him for the first prize of a parallel vice, value 18s. 6d. We recommend for the second prize of a vice, value 10s.

Mr. JOHN D. ELAM,
Park House,
Littleport Street,
King's Lynn,

whose design we shall publish, together with the first-named. The third prize (value 5s. 6s.) is awarded to

Mr. DAVID E. PATTERSON,
35, Calder Place,
Roman Road,
Motherwell, N.B.

The bench suggested by Mr. Patterson has several interesting and novel points, but the main construction involves the use of iron steam barrel, and we are not quite sure whether it would prove rigid enough. We, however, think it worthy of publishing, perhaps not in its entirety, and we will endeavour to submit it to our readers at an early date, together with some of the interesting features contained in several of the other designs sent in in connection with the competition.

* * *

We can highly commend the entries of Messrs Herbert T. Warner (Shipston), F. P. Blackford (Hove), and H. S. Grove (Montreal), and also specially mention the designs of Messrs. H. S. Cowper (Redcar), H. Fuller (Horsham), W. F. Manley (Torquay), James Bryson (Portobello), Albert Hind (Mansfield), T. Green (London), H. Temple (Birmingham), and J. Killick (Cheltenham).

We have no doubt that our steam readers will have been following with special interest the extremely pretty design for a model automatic cut-off horizontal engine, which is just now running through our pages. Mr. P. D. Johnston, the author of this design, is not only an engineer of exceptional ability and of long experience in the designing and building of big engines, but takes a keen interest in high-class model-making. Our readers will have noted the excellence of both the design and the drawings, and also the extremely thorough and practical way in which the description of the various parts is given. This is a piece of work well worth the attention of any model engineer, and if sufficient entries were likely to be received we should be pleased to offer a silver medal for the best model built to this design. Perhaps those who are thinking of building this model and who would like to enter, will kindly let us know.

Notices.

The Editor invites correspondence and original contributions on all amateur mechanical and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected or not, and all MSS. should be accompanied by a stamped addressed envelope for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

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Contents.

[*The asterisk* (*) *denotes that the subject is illustrated.*]

THE

Model Engineer

And Electrician.

A JOURNAL OF PRACTICAL MECHANICS AND ELECTRICITY.

EDITED BY PERCIVAL MARSHALL, A.I.MECH.E

VOL. XIII. No. 244. DECEMBER 28, 1905. PUBLISHED WEEKLY

A 1¼-in. Gauge Model Locomotive.

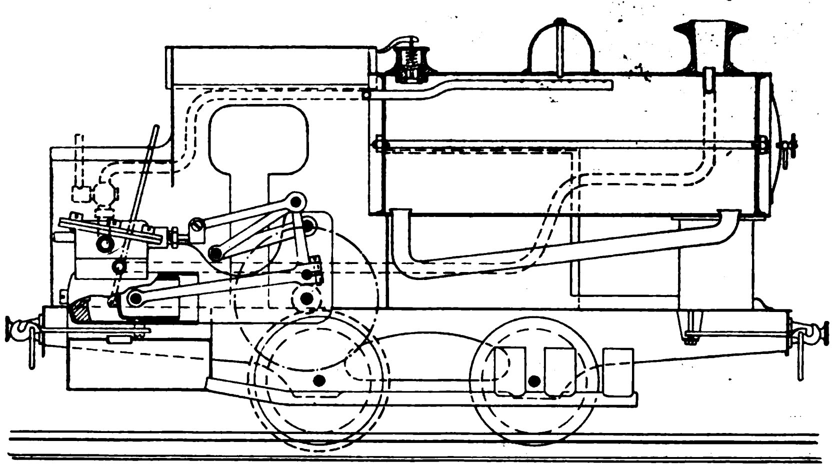


FIG. 1.—LONGITUDINAL SECTION OF MR. W. MARLEY'S MODEL LOCOMOTIVE.

THE following is a description of a small locomotive which I recently completed for my brother's model railway. The locomotive was made to run on a gauge of 1¼ ins. (No. 0), with very sharp curves. The frames were taken from an old engine which had been relegated to the scrap heap, and are made of thick tin, with imitation springs, etc., pressed in them. The boiler is made of a piece of 3-64ths-in. seamless brass tube, 1½ ins. diameter, 4 ins. long, and has four brass water-tubes 3-16ths in. diameter. The ends are of brass, 3-64ths in. thick, soldered in and held together by an ⅛ in. brass stay passing through the centre of the boiler. On completion, the boiler was tested to 100 lbs. per sq. in. with water and 75 lbs. per sq. in. with steam. The safety valve is set to blow off at 30 lbs. per sq. in., which is more than enough to slip the driving wheels. The engine is a single-acting slide valve, placed horizontally inside the cab and bunker, and has the valve on top. The cylinder is ½-in. bore by ½-in. stroke, taken from an old hot-air engine, with valve chest, etc., sweated on. The steam port is 1-16th in. by ¼ in., and the exhaust port ⅛ in. by ⅛ in.; the exhaust steam is turned up the chimney. The valve gear is a modification of Klug valve gear, driven from the crank-pin, and works very well. The engine is geared into the driving wheels by cog-wheels taken from an old clock, the reduction of speed being in the ratio of 6 to 1. The steam cock and reversing lever are in the bunker, and can be seen in the drawing. The whole of the side tanks, cab, etc., can be removed by taking out four screws, thus providing ready access to the engine. The locomotive easily pulls a train of a dozen trucks and carriages weighing about 4 lbs. round the line continuously, the engine making about 1,000 r.p.m. The boiler keeps up a pressure of 10 to 15 lbs. per sq. in., and the water lasts for about a quarter of an hour. If more trucks be added the train overturns at the curves. The engine will pull 10 lbs. in a truck weighing ½ lb., but if further loaded, the driving wheels just slip. Other dimensions are: Frames—length, 7¾ ins., width, 2⅝ ins.; height of boiler, centre line from rails, 3 ins.; height to top of funnel from rails, 4 5-16ths ins.; diameter of driving wheels, leading wheels, 1 1-16th in.; coupled wheelbase, 2¼ ins.; length over buffers, 8½ ins.; heating surface, about 12 sq. ins. weight of engine, 1½ lbs. Boiler fired by spirit lamps with two burners. The locomotive cost about 2s. 6d. to make, more than half of this being spent on the paint. I also made the bogie

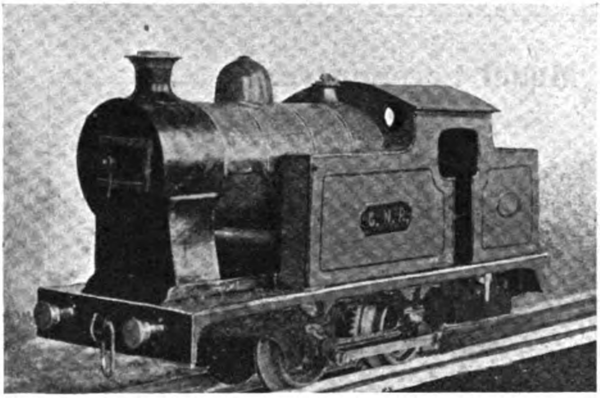


Fig. 2.—Mr. W. Marley's Model Engine.

truck and 4-wheel truck shown in the photograph. The 4-wheel truck has a scale capacity of 30 tons, and the bogie truck 33 tons of coal, the scale being ¼ in. to the foot.

Workshop Notes and Notions.

[Readers are invited to contribute short practical items for this column, based on their own workshop experience. Accepted contributions will be paid for on publication, if desired, according to merit. All matter intended for this column should be marked "Workshop" *on the envelope.]*

Hints on Soft Soldering.

By H. H. Copus.

The following few hints, gathered from my experience in soft soldering may prove of use to fellow readers of the *M.E.* For a flux I use a saturated solution of chloride of zinc and water with a little sal-ammoniac added; ½ oz. of chloride of zinc will make sufficient to last an amateur a considerable time. Once I had a piece of ½-in. brass tube to solder into a 1¼-in. copper tube. The only means for doing this were a small soldering iron, the solution described above, and a kitchen fire. After trying three or four times without success, I tried placing it in the fire till it was nearly the melting point of the solder. By this means I had very little trouble in getting a perfect joint. At another time I had a hole in a tin vessel to solder, but try as I would the solder would not cover the hole, but formed a little ridge all around the hole. Adding more solder only aggravated the trouble. I managed it at last by tinning the soldering bit about ¼ in. longer than the diameter of the hole, and having the soldering bit only just hot enough to melt the solder. I drew the bit over the hole seeing that the tinned part of the bit touched each side of the hole. By this means a satisfactory joint was made. The proper temperature of the soldering bit is most important. It should be only just hot enough.

A Handy Screwdriver.

By "Ex-Apprentice."

A very handy and simple screwdriver may be made in the following manner:—A piece of ¼-in. or ⅜-in. round steel about 10 ins. long is taken, and the two ends are then drawn out to form flats at right angles to each other, as shown in Fig. 1. It is then bent over 1½ ins. from each end, and

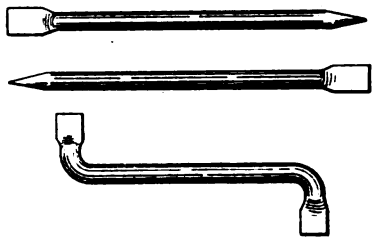


Fig. 1.

Fig. 2.

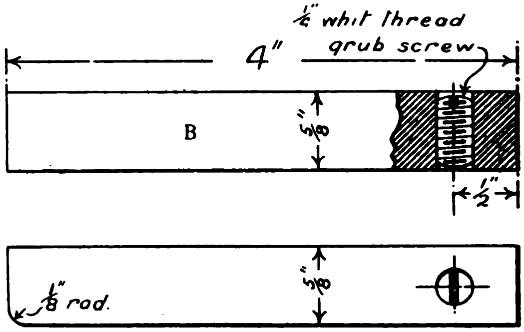
A Handy Screwdriver.

we have the finished screwdriver, as shown in Fig. 2. It may then be filed nearly to an edge at each end, and hardened to a dark blue. This latter process, however, is not necessary.

An Adjustable Packing Block.

By "Scribo."

For raising pieces in the shaping and drilling machine especially, this tool will be found very useful. It needs little explanation. The block B should be planed perfectly true and square, and one end rounded off to an ⅛-in.radius so as to allow



An Adjustable Packing Block.

it to lift up and bed well; at the other end a ¼-in. Whitworth hole is drilled and tapped, and a grub-screw let in, the length of which should be slightly less than the width of block. They should be made in pairs, and can be used as ordinary parallel strips by letting the screw in flush with the two surfaces, The size here given will be found a useful one.

Notable Models at South Kensington Museum.

I.—Some Slide-valve Models.

(*Continued from page* 568.)

THE common slide-valve used in the locomotive is next shown, but is so well-known that it is unnecessary to describe it. A curious point in its history is that it was patented in 1802, by Matthew Murray, two years before a locomotive ever ran upon rails. Up to recent years, it has been almost the only type of slide-valve used in locomotive practice. The model shown has Richardson's relief frame on the back of the valve, a device which is much used by American locomotive engineers. Four strips are arranged in a rectangle and fitted into a recess formed on the back of the valve, the bars overlap at the ends and are notched into one another. Flat springs are used to hold them against the specially prepared inner face of the steam chest cover. When the bars are carefully fitted the pressure of steam holds them against the walls of the recess and against each other, so that steam cannot enter the enclosed area. The area of the balancing recess is usually ·5 to ·6 of that of the valve.

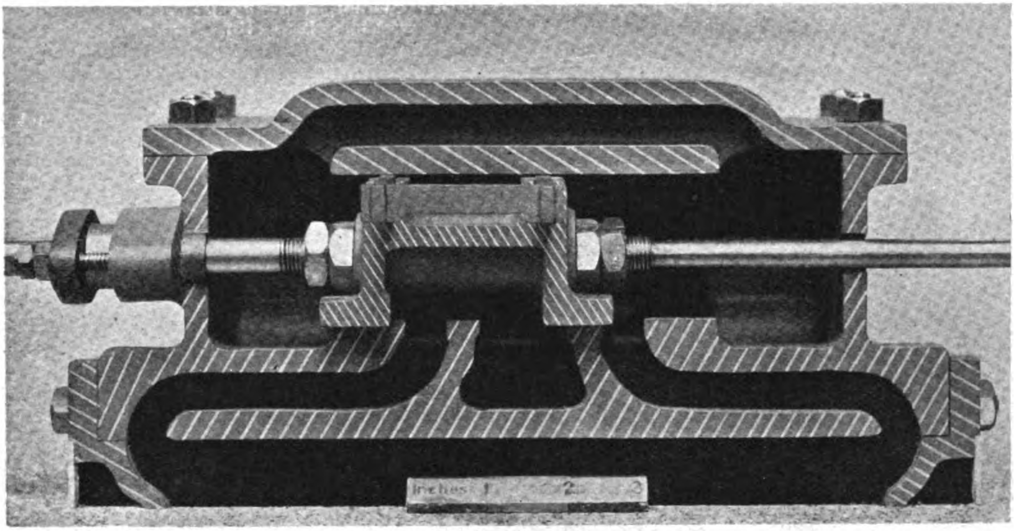


Fig. 9.—A Model of the Common Locomotive Slide-Valve fitted with Richardson's Balancing Strips.

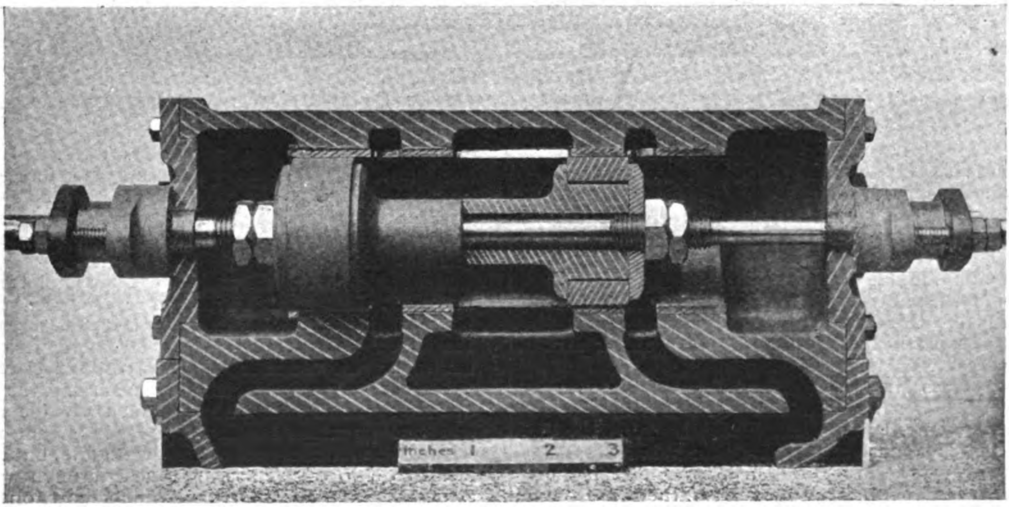


Fig. 10.—The Piston Valve.

Next comes the piston valve (Fig. 10), also a very old invention, for it was used by Murdoch in models about 1781-6, and by Sharp, Roberts & Co., in bell-crank locomotives in 1833. It hardly needs description, being now so largely used, but in brief, it consists of two pistons rigidly connected together and sliding in short cylinders having ports round them. The pistons may be solid, or composed of rings. The model shows a valve with solid floating rings, as now commonly used owing to the slight wear of the faces. Valves of this kind are made for admission of steam at the inner or outer edges, but unless the waist is made tubular the ends of the chest must in some other way communicate with each other. Such valves are perfectly balanced and require very little power to drive them. Short ports may be obtained by placing the pistons a good way apart.

Hackworth's valve (Fig. 11) has a box at each end, faced over but pierced with ports corresponding with similar ports formed through an extended and overhanging cylinder face. Steam enters each of these boxes from below, and passing through the outer ports, enters the cylinder through the inner one. The system gives two steam openings similar to those of a double-ported valve. It may be made triple-ported, but in either case it gives a somewhat lighter valve than the ordinary multi-ported slide, and is also partly balanced during the greater part of the stroke.

Next comes Mr. W. C. Church's valve, patented in 1872 (Fig. 12). Two distinctive features are apparent. One, largely anticipated by Mr. F. W. Webb in 1869, consists in making the valve circular and free to rotate in a bridle or loop formed in the spindle, with the object of preventing the face from grooving or wearing unevenly. The outer edges of the steam ports are struck with a radius slightly greater than that of the valve, so that, though the ends of the ports open first, the lead is of uniform radial width. The second peculiarity is a raised bearing in the centre of the exhaust space to increase the bearing surface of the valve without adding to the area acted on by the steam pressure. Owing also to the top of the valve being perforated, steam is free to enter the recess above this bearing piece, so that the unbalanced area is reduced.

Trick's valve, shown in Fig. 13, is a modification of 1854 in the locomotive slide-valve. A passage is formed through the valve from end to end over the back of the exhaust opening, while the cylinder face is made shorter than usual and the steam port opening wider. These alterations secure that the valve, in its travel, overshoots the edge of the face, so that while admitting steam in the usual way at one end, there is also an admission from the other by the passage over the back. The valve gives the double and quick opening to the steam of a double-ported valve, without being so large and cumbersome. The model shown is fitted with a modern form of relief ring on the back, consisting of three metal rings with coned surfaces fitting into each other; the upper rings are split and tongued, and the pressure of the springs at the back forces the rings outwards and so keeps them tight sideways, in addition to holding the lower ring against the valve. This method of balancing is much used in marine practice.

A double-ported valve (Fig. 14) completes the series. Valves of this type were introduced about 1856, when the simple flat valve had got to require too much power to drive it in large engines. By increasing the number of ports, the travel of the valve can be reduced without contracting the port opening. The face upon which such a valve slides has two openings leading into each steam port, with the usual exhaust port in the middle, but there are also two transverse passages through which steam is being admitted to the inner port, opening at the same time as it is in the ordinary way by the outer one. These two ports give the same passage way as a single one open to twice the extent, whilst opening and closing are more promptly performed. These valves, being large, are usually fitted with relief frames; the model shows one of the earliest forms, consisting of a ring fitted in a

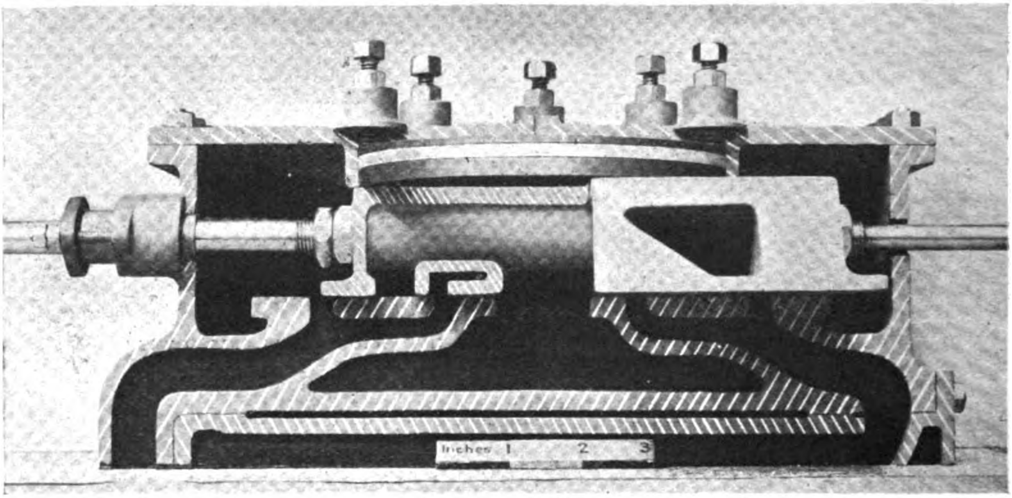


FIG. 14.—THE DOUBLE-PORTED SLIDE-VALVE, AS USED IN MARINE PRACTICE.

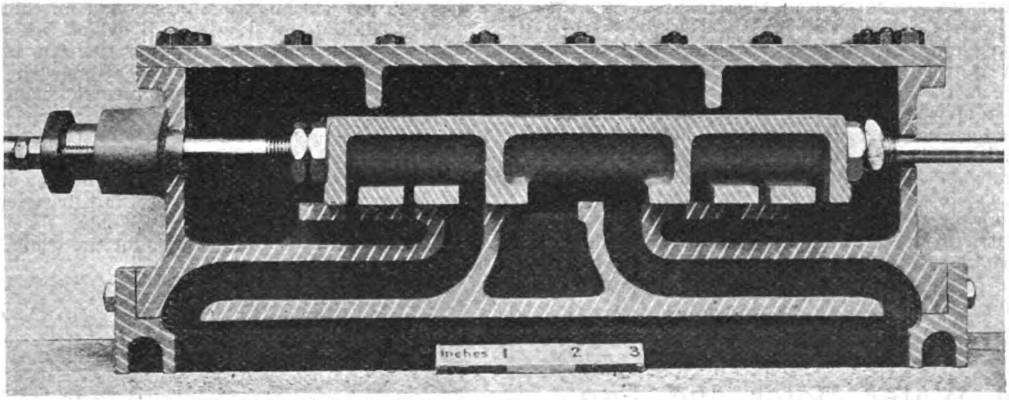


FIG. 11.—HACKWORTH'S MULTIPORTED SLIDE-VALVE.

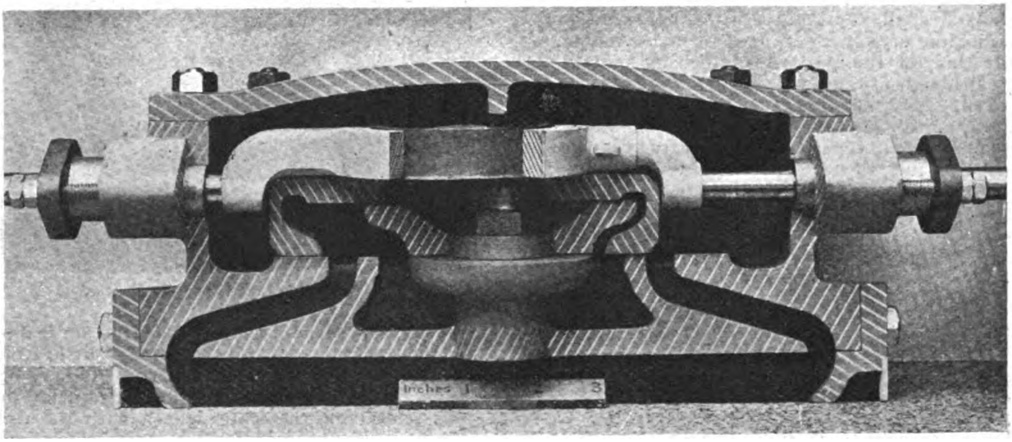


FIG. 12.—MR. W. C. CHURCH'S PATENT SLIDE-VALVE AND BUCKLE.

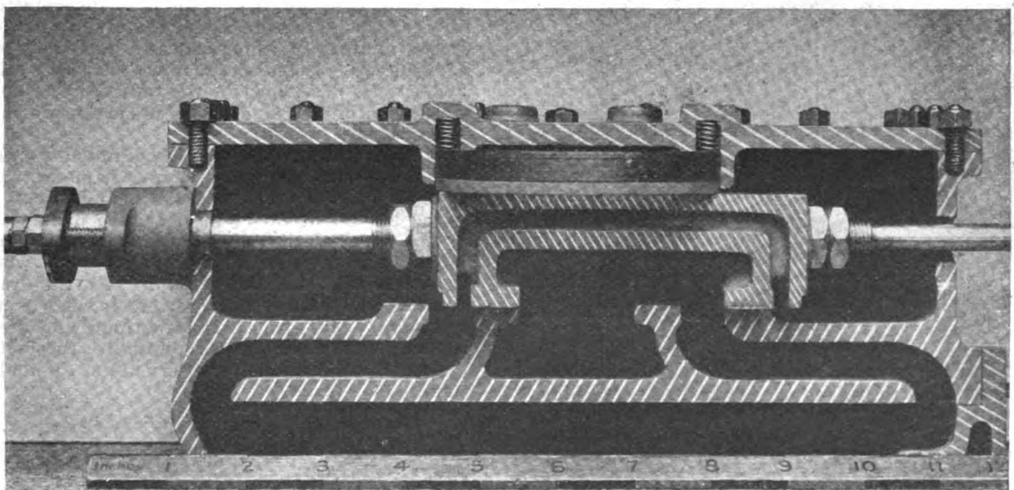


FIG. 13.—A MODEL OF TRICK'S SLIDE-VALVE, FITTED WITH MODERN TYPE OF CIRCULAR RELIEF FRAME.

circular groove formed in the steam chest cover and pressed against the flat back of the valve by springs and adjusting screws. The ring is kept tight in the groove by soft packing compressed between the main ring and an auxiliary ring behind it, on which the springs act. The various types of slide-valve just described are not yet in the official catalogue. Many other examples which are may be found close by, their numbers ranging from 157 to 185 in Part I of the latest catalogue—that of 1901. The whole collection here described is a little to the left of the Rocket engine, and forms a most complete and valuable record of the progress made in this indispensable branch of steam engineering.

A Water Motor and Fan.

IN giving a short description of the above, I hope I shall be aiding a little those amateurs who, like myself, are in need of such a machine. I built this for the purpose of melting metals at home, although usually a simple draught furnace is employed. Now, an amateur generally wants but a small quantity of metal melting at once, and as a draught furnace always takes nearly the same quantity of fuel to heat it, it is much more economical to use a fan, for by this means the amount of coke burned corresponds to the amount of metal melted. The water motor (A, Fig. 1) is 10½ ins. diameter outside of the buckets; these latter are a design of my own; at any rate, I have

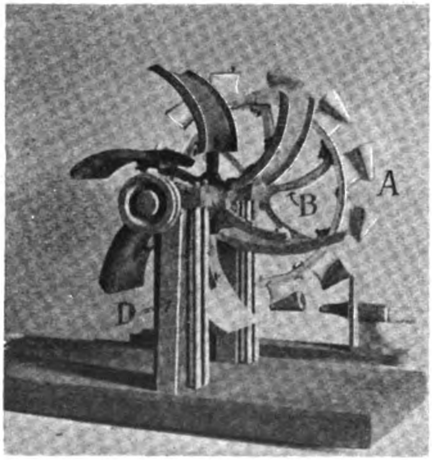


FIG. 1.—WATER MOTOR AND FAN: CASING REMOVED.

never seen any of the same shape, and I consider they offer as little resistance to the back splashing water as possible. They are cast in white metal, and are bolted on to the periphery of the wheel by one bolt to each joint formed by the curved base of the bucket. The wheel B is a brass casting, and is secured to the shaft (a piece of ½-in. round iron) by a split pin. The bearings C are 1¼ ins. long, held down by four bolts, each of which runs right through the baseboard—a piece of 1¼-in. thick oak—thus holding the standards B, which are also of oak. I used thick tinplate for the fan blades; these are flanged, as shown, to strengthen them. The flanging operation will produce sufficient bend if properly manipulated; they are 3 ins. broad, when flanged, by 4½ ins. long. The spider on star, on which the blades are bolted, is a brass casting, with a boss or hub 3¼ ins. long; that is, long enough to allow sufficient clearance (⅛ in.) between the blades and the fan casing on each side.

I made patterns and castings for the whole affair

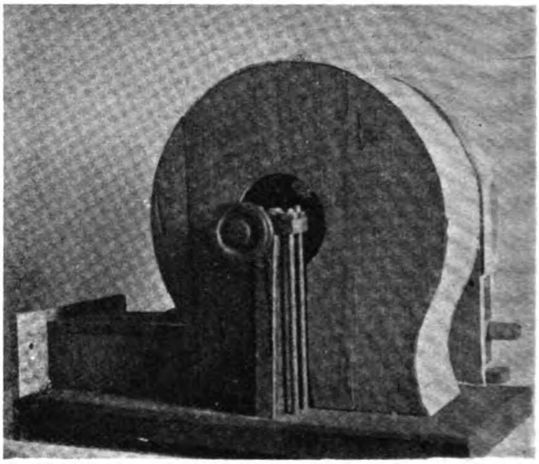


FIG. 2.—GENERAL VIEW OF FAN AND MOTOR.

myself, and without the aid of a lathe, for if the holes in the castings are carefully cored, a little trimming with a file is all that is necessary. As may be seen from the photograph, the same pattern for the fan has served for the water-wheel, with the rim and the bo s shortened.

Reference to Fig. 2 will give an idea of the casings. They are of ⅜-in. oak. Care must be taken that the casing for the motor is made watertight; this can be accomplished by daubing the joints with a mixture of white lead and linseed oil before screwing up. Brass screws must be used. A full inch bore is necessary for the outlet. The bore of the nozzle, of course, depends upon the pressure of water; in my case it is ⅛ in.

The fan casing does not need much comment. The holes at the sides are 3½ ins. diameter, the air outlet 2¼ ins. square, and the blades sweep clear of the baseboard by 1½ ins. I have melted 6 lbs. of cast iron, with the assistance of this fan, in about an hour, with a "hatful" of coke, whereas it used to take quite three hours with the draught furnace, and burned twice as much coke over the operation. My furnace is something like a small cupola, with three tuyeres, close to the bottom, although, of course, I use crucibles to hold the metal.

A LOCOMOTVE testing laboratory is to be built in Germany at the Grunewald Works, on similar lines to that of the St. Louis Exposition. It is to be in charge of the well-known locomotive designer, Professor Von Borries.

The Latest in Engineering.

Protecting Steel Work.—Copper sheathing for protecting steel work is to be tried by the Pennsylvania Railroad Company in its train shed at Jersey, N.J., where it has been found that the gases given off by the locomotives are attacking the steel frames and galvanised iron coverings. The fact that such destructive action is noticeable in a structure of such height and so well ventilated is interesting in itself. Copper will be stretched over places where repairs are necessary, and the refacing of the structure will go on from time to time. The expectation is that the whole of the structure will have received a new lining in about two years, at a total cost of about £100,000.

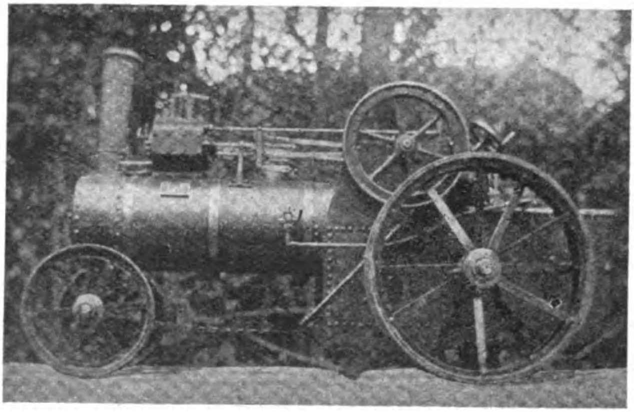
A Smoke Preventer.—A new form of apparatus for the prevention of smoke from steam boilers and for improving the evaporative efficiency is now being introduced. It resembles, in one respect, several other appliances which have been moderately successful, namely, in the use of a jet of steam in the furnace and on top of the fuel. But by a novel mode of construction, the apparatus superheats the steam, and then sprays it over the whole surface of the fire. The difficulty of imparting to the steam the necessary high temperature without exposing the heating medium to the fierce heat of the furnace, forms an interesting feature of the Longsdorf system. The essential feature of this apparatus is a cast-iron or cast-steel saddle-shaped chamber, placed inside the furnace above the dead plate and surrounding the opening for the firing door. On top of this superheater is fixed, pivotally, a triangular-shaped casting called a "gas-head." This contains a number of carefully disposed perforations through which jets of steam are blown on to the fire. The supply of steam is drawn from the boiler by a ½-in. pipe provided with a stop-valve and enters the superheater, through which it has to take a zig-zag course, owing to the baffles, before it reaches the "gas-head." One of the advantages of the Longsdorf system is that it requires extremely little alteration to be adapted to existing boilers.

The fire door requires no openings for air, and the ash-pit is left open, so that the air to support combustion is practically all drawn through the fire. It would appear, too, that the amount of steam used for the jets, owing to its being superheated, is insignificant. The results obtained during a test show that the equivalent evaporation from and at 212° Fah. per lb. of dried fuel amounted to 8·44 lbs. The Leicestershire coal used at this test was of a smoky nature, and with the apparatus not in use yielded dense smoke after stoking. With the "gas-head" in action, the smoke was prevented, and the chimney-top was clear throughout the test, except on about three occasions, when very faint brownish-grey vapour was noted for a few seconds. As regards smoke prevention, the apparatus proved successful, and the economical results realised are also satisfactory, in view of the calorific value of the coal, which is 12,776 B.T.U., and also considering the fact that the boiler had no economiser attached. The makers of this apparatus are Messrs. Frank Jordan and Co., 15, George Street, Mansion House, London, E.C.

A Model Traction Engine.

THE photograph herewith illustrates a model traction engine which was made by a bricklayer. It took him two years to make, in his spare time. The boiler is 22 ins. long, including smokebox; the barrel of same is built from a piece of solid-drawn copper tube, 18 ins. long by 5 ins. dia., with a 7-in. piece cut out and nearly half the diameter.

The outside firebox plates are carried upward to take crankshafts and backward to take main axle and intermediate gearing shafts. The inside firebox is 6 ins. by 4½ ins. and 6 ins. deep, and ¾ in. above centre line of boiler, with ⅜-in. water space



A Model Traction Engine.

all round, the tube, 2½ ins., running through barre of boiler. The flue tube was used because it was to burn coal—the smaller ones are not effective. The boiler is also fitted with steam pressure gauge, water gauge, and feed pump; also mud-hole door for cleaning out, which is riveted with copper rivets; firebox is stayed with 3-16ths-in. stays; boiler plates are 3-32nds in. thick.

The engine cylinder is a correct model of the usual traction engine type, with double Ramsbottom safety-valve on top, steam-jacketed all round. The bore of cylinder is 1½ ins. by a 2-in. stroke. The guide for the crosshead is the four-bar type. The reversing gear is of the Stephenson link motion; the flywheel is 7 ins. in diameter. The driving road wheels are 12 ins. diameter; front, 6¾ ins. diameter. The engine is steered in the usual way by worm and pinion; the gear wheels are brass, and hand-cut.

The total length of engine is 33½ ins.; weight, ¾ cwt. The boiler is tested to 150 lbs. per sq. in., and the safety-valve blows off at 60 lbs. pressure. The engine will drive a 15 c.-p. dynamo giving 10 volts.

Notes on Locomotive Practice.

By Chas. S. Lake.

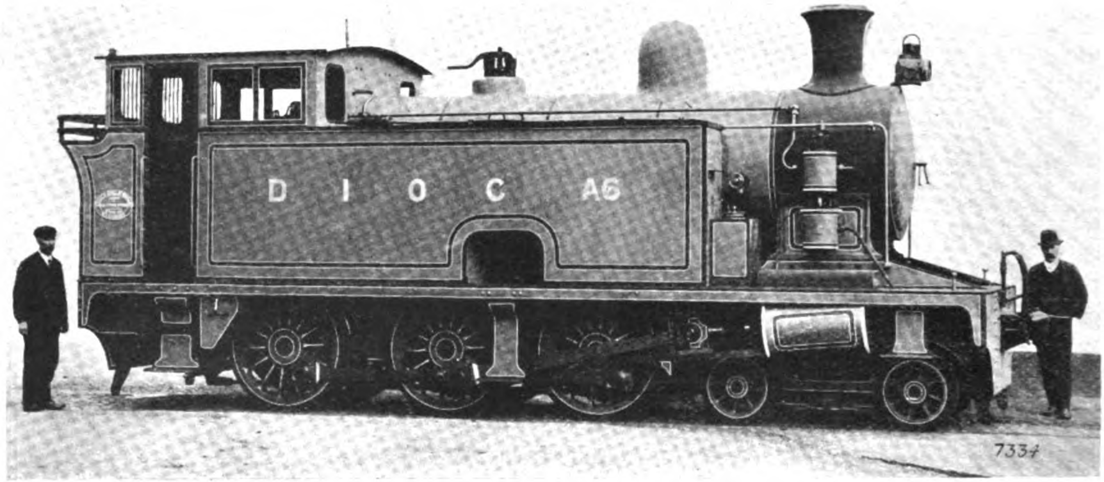
British Locomotives for Abroad.

The two locomotives recently built by British firms for service abroad, which were mentioned in the last issue of these Notes, are illustrated herewith. The first is a 4—6—0 type tank engine of large proportions, built by Messrs. Andrew Barclay, Sons & Co., Ltd., of Kilmarnock, N.B., for the Dunderland Iron Ore Co., who own mines in Norway. The cylinders are located outside the frames and drive the middle pair of coupled wheels. Valve gearing of the ordinary link motion type is employed inside the frames, the steam chests being at the sides of the cylinders. The boiler is of large proportions for this class of engine; it is 4 ft. 5 ins. diameter, and contains 194 tubes of 1¾ ins. diameter. These are 11 ft. long, and they provide 977·6 sq. ft. of heating surface, to which has to be added the 95 sq. ft. of the firebox, or a total of 1072·6 sq. ft. The grate area is 16 sq. ft., and the boiler carries a working pressure of 160 lbs. per sq. in. Other dimensions are as follows:—Cylinders, 18 ins. diameter; piston stroke, 26 ins.; coupled wheels (diameter), 4 ft. 2 ins.; bogie wheels, 2 ft. 3 ins. diameter; total wheelbase, 20 ft. 1½ ins.; rigid wheelbase, 10 ft. 6 ins.; capacity of water tanks, 1,500 gallons; weight in working order, 58 tons 10 cwt.

The second locomotive is the large "Decapod" freight engine, built by Messrs. Robert Stephenson and Co., Ltd., of Darlington, for the Argentine Great Western Railway Co. This is the engine for which special transportation methods had to be employed between Darlington and Liverpool, as mentioned on page 537 of The Model Engineer for December 7th. Of the ten coupled wheels, the middle pair are the drivers, and it will be noticed that the cylinders are placed in a horizontal position outside the frames, with the steam chests above them, Walschaerts gear being employed for actuating the slide-valves.

This is an immensely powerful locomotive, as the dimensions given will show. It has a large Belpaire pattern boiler, ample cylinder capacity, and adhesion weight, and a relatively high working steam pressure. Therefore, it is not surprising to learn that it can exert a tractive force of 33·819 lbs. The cylinders are 19½ ins. diameter by 28 ins. stroke; coupled wheels, 4 ft. 3 ins. diameter; fixed wheelbase, 19 ft.; total wheelbase, 27 ft. 2 ins.; bogie wheels, 2 ft. 6 ins. diameter; heating surface (tubes), 2,246 sq. ft.; firebox, 194 sq. ft.; total, 2,440 sq. ft.; grate area, 36 sq. ft.; working pressure, 180 lbs. per sq. in; weight on coupled wheels, 70 tons 17 cwt.; weight on front bogie, 8 tons 3 cwt.; total weight in working order, 79 tons 10 cwt.

The tender runs upon two four-wheeled bogie trucks with 3 ft. diameter wheels, spaced 5 ft. apart; the total wheelbase being 16 ft. The tank capacity is 4,000 gallons, and 670 cubic ft. of fuel space is provided. The tender, in working order, weighs 45 tons 7 cwt., so that there is a total weight on rails (engine and tender) of 124 tons 17 cwt. The gauge of the Argentine Great Western Railway is 5 ft. 6 ins. The writer is indebted to the builders of the respective engines for the foregoing particulars, and also for the photographs illustrating the same.



4—6—0 Type Tank Locomotive for the Dunderland Iron Ore Co.

Another New Departure on the G.W.R.

Another type locomotive is to be added to the already long list on the Great Western Railway. There is, at the present time, completing at Swindon Works, a four-cylinder "simple" engine of the "Atlantic" type. The inside cylinders are placed forward of the bogie centre line for driving the leading coupled axle, whilst the outside cylinders are placed at the back of the bogie centre line and will drive the second coupled axle. The cranks are equally set, viz., one at each quarter of the revolution, the outside cranks being at 180 degs. to those inside. The cylinders will be $14\frac{1}{4}$ ins. diameter by 26 ins. stroke; boiler pressure, 225 lbs. per sq. in., and coupled wheels, 6 ft. $8\frac{1}{2}$ ins. diameter. The engine will resemble somewhat (in respect of cylinders and wheel arrangement) the Cole system compounds in America. The four $14\frac{1}{4}$ ins. diameter cylinders may be regarded as about equal to two of 20 ins. diameter by 26 ins. stroke, so that the engine will be one of great power, especially in view of the high boiler pressure employed.

Fast Running in the United States.

A locomotive of the "Atlantic" type, belonging to the Pennsylvania R.R. recently covered a distance of 257·4 miles at an average speed of 74·5 m.p.h. At the time it was hauling a special train comprised of four cars, the train weighing (with engine and tender) 420 tons. The engine has $20\frac{1}{2}$ by 26-in. cylinders, 6 ft. 8 ins. drivers, and 2,640 sq. ft. of heating surface. The occupants of the train—railway officials attending the American Railway Association at Chicago—speak of it as a "comfortable" ride.

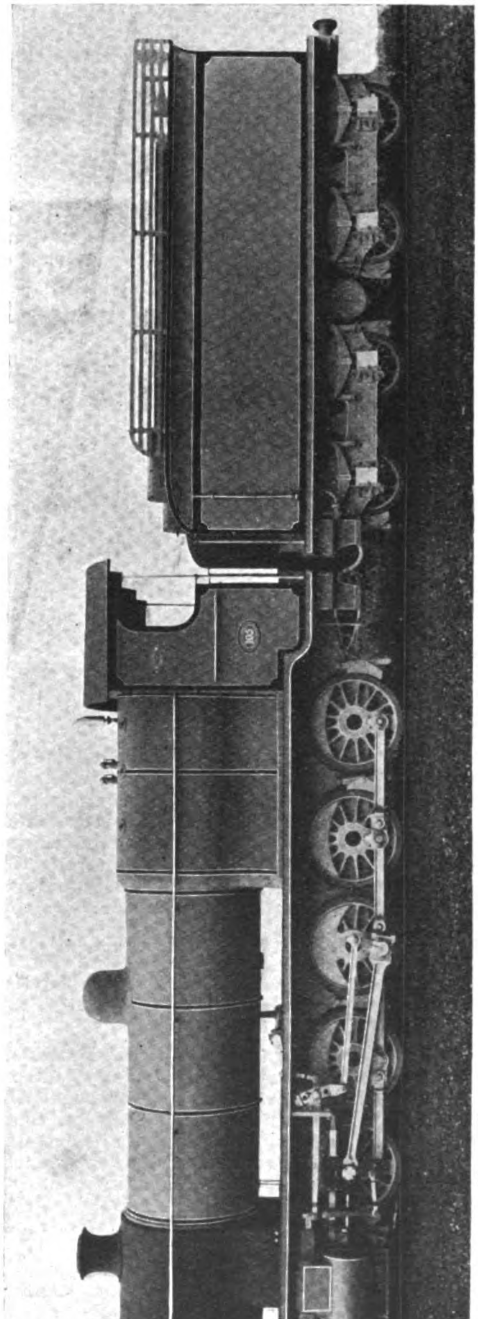
For the Bookshelf.

[*Any book reviewed under this heading may be obtained from* The Model Engineer *Book Department, 26-29, Poppin's Court, Fleet Street, London, E.C., by remitting the published price and the cost of postage.*]

Electric Traction. By Professor R. H. Smith, A.M.I.C.E., etc. London: Harper & Bros. Price 9s. net. Postage 6d.

The progress of invention in electric traction has been so rapid that unless a book on the subject is right up-to-date, engineers find such to a great extent useless. Professor Smith's able work contains particulars of the very latest developments in this absorbing branch of electrical engineering, and therefore cannot be criticised on this score. Both the arrangement and the scope of the book are excellent; at the same time, the author keeps strictly to his subject. The opening chapter provides a general survey of the problems involved in electrical traction on common roads, railways, and on the rivers and canals.

The five chapters following this deal with tramways in their various phases, including general considerations, the economics of electrical traction as applied to street tramways, technical conditions—and, passing into detail, describe the overhead, conduit and surface-contact systems. Electric railway work comes next, with descriptions of deep-level, surface, and shallow railways of the Metropolis now in course of construction and in actual operation. The large share in the development of electrical railway development and the designing of



New Ten-wheels Coupled Locomotive: Argentine Great Western Railway Co.

locomotives and other equipment, with which the foreigner must be credited, is also treated very fully, and is exceedingly interesting and instructive. It comprises chapters on the Berlin railways, the direct-current and high-tension alternating installations in Italy, together with another of the Swiss three-phase railways and the high-speed experiments on the Zossen-Marienfelde line in Germany. The book is produced in a praiseworthy manner and comprises 442 pages. It contains over 300 illustrations and 14 tables. The information it provides appears to be exceptionally accurate, even in small and not all-important details. On the whole, we have not the least doubt that it will prove of immense value to the profession.

THE JUNIOR INSTITUTION OF ENGINEERS' RECORD OF TRANSACTIONS for 23rd Session. Edited by Walter T. Dunn, F.C.I.S. London: Percival Marshall & Co., 26-29, Poppin's Court, Fleet Street. Price 10s. 6d., postage 5d.

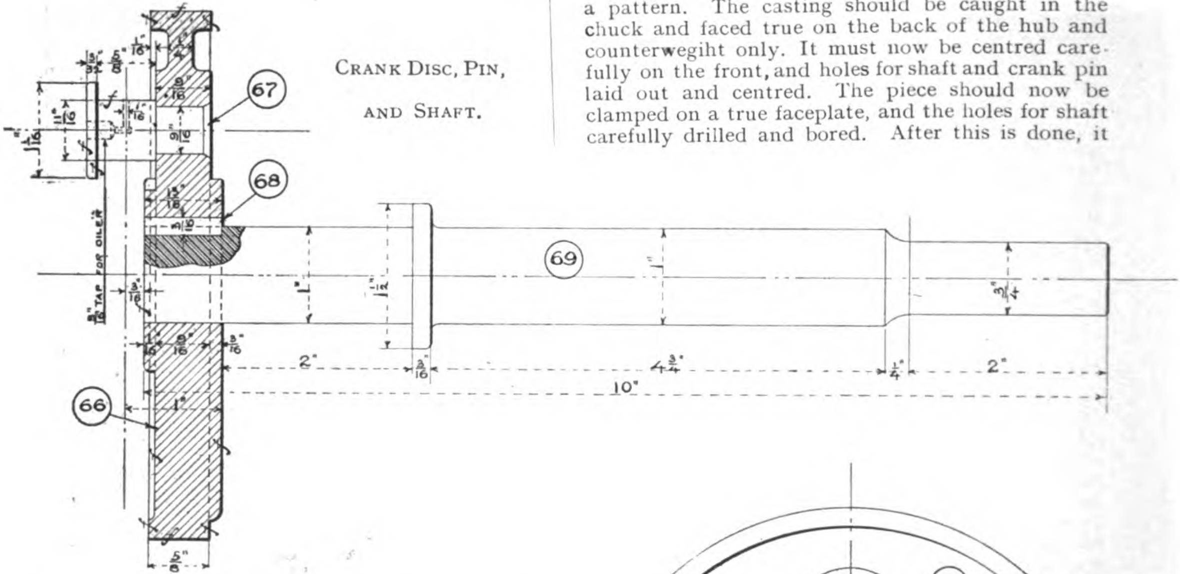
The Record of the Transactions of this flourishing Institution for the twenty-third session is an exceedingly interesting and instructive volume. The subjects of the papers include "Fires on Shipboard: Their Causes and Methods for Prevention and Extinction"; "Recent Developments in the Construction of Working Gas Engines"; Mr. J. Fletcher Moulton's Presidential Address; "Producer Gas-power for Factories"; "Notes on Electric Accumulators"; "Heating and Ventilating Small Workshops"; "The Design of a Dry-dock," and "Practical Notes on the Running of Motor-cars and Cycles." These papers are well illustrated with diagrams and folding plates. The book also contains full accounts of the many visits to places of engineering interest and of the Institution's tour in Germany. The papers are well illustrated, several folding plates being included, making the whole volume, within its scope, a really practical work of reference for the engineer and student.

A Design for a Model Automatic Cut-off Steam Engine.

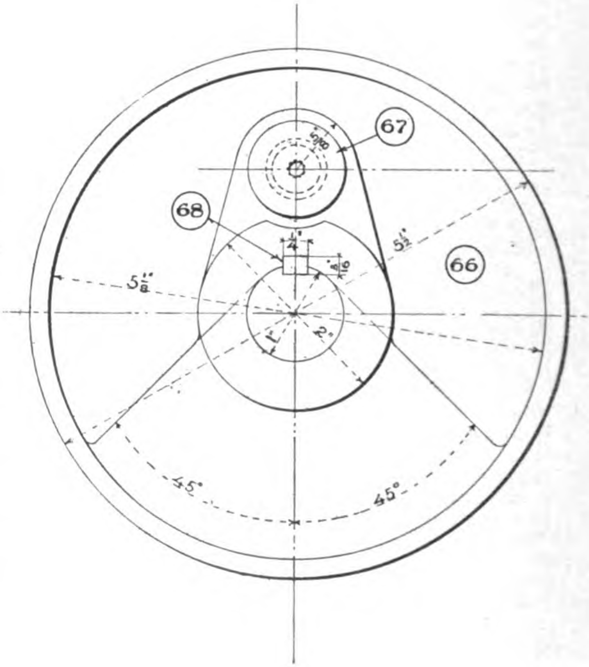
By P. D. JOHNSTON (U.S.A.).

(*Concluded from page 590.*)

No. 66.—The crank disc is made of cast iron from a pattern. The casting should be caught in the chuck and faced true on the back of the hub and counterwegiht only. It must now be centred carefully on the front, and holes for shaft and crank pin laid out and centred. The piece should now be clamped on a true faceplate, and the holes for shaft carefully drilled and bored. After this is done, it



CRANK DISC, PIN, AND SHAFT.



ELEVATION OF CRANK DISC.

should be shifted and the hole for crankpin bored. This treatment, if the work has been carefully done, will ensure parallelism on the crank pin and shaft. The keyway can now be cut and the disc can be laid aside and

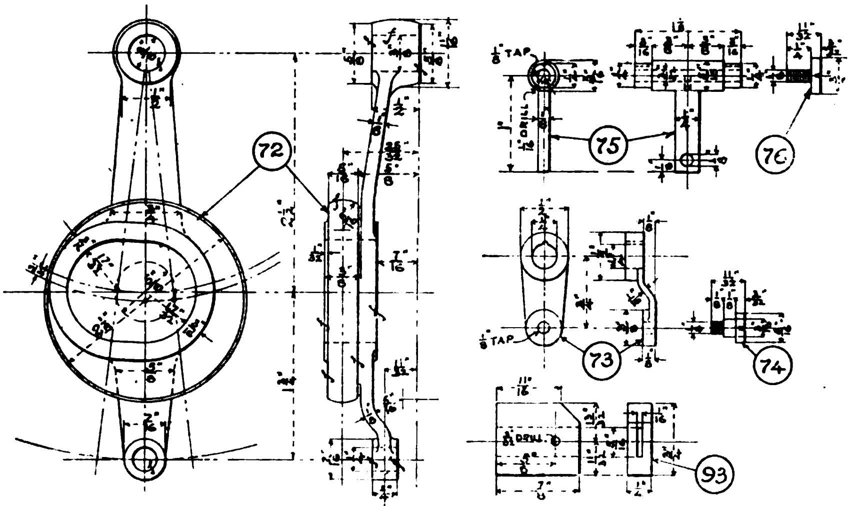
No. 69 (crankshaft) taken up. This is made of mild steel and should be turned carefully to the sizes given, but the collar should be left full in

DESIGN FOR A MODEL AUTOMATIC CUT-OFF STEAM ENGINE.

Specification of Parts: Second Half.

Piece Number.	Number of Pieces Required.	Name of Piece.	Material.	Pattern Number.	Remarks.
60	1	Lock nut for 59	Steel	--	Finish all over
61	2	Bolts for 59	,,	—	,, ,,
62	2	Half-knuckle joint	Bronze	—	,, ,, from bar stock
63	2	,, ,, ...	,,	—	,, ,, ,, ,,
64	4	Bolts for 63 and 64	Steel	—	,, ,,
65	2	Piston rings	Hard bronze	—	,, ,,
66	1	Crank disc	Cast iron	17	,, where marked
67	1	Crank pin	Steel	—	,, all over
68	1	Key for 66	,,	—	,, ,,
69	1	Crankshaft	,,	—	,, ,,
70	1	Governor case	Cast iron	18	,, where marked
71	2	Damper case cover	,,	19	,, ,,
72	1	Eccentric	,,	20	,, ,,
73	2	Damper arm	Steel	—	,, all over
74	2	Pin for 73	,,	—	,, ,,
75	1	Damper	,,	—	,, ,,
76	2	Screw for 75	,,	—	,, ,,
77	1	Long weight arm	,,	—	,, ,,
78	1	Short ,, ,, ...	,,	—	,, ,,
79	1	Shaft for 77 and 78	,,	—	,, ,,
80	1	Screw for 79	,,	—	,, ,,
81	2	Pins for 77 and 78	,,	—	,, ,,
82	2	Spring clip	,,	—	,, ,,
83	2	Screw for 82	,,	—	,, ,,
84	2	Spring link	,,	—	,, ,,
84½	2	1-16th by ¼ screw for 84	,,	—	,, ,, not shown
85	2	Governor spring	,,	—	20 S.W.G. steel wire tempered
86	2	Nuts for 85	Brass	—	Finish all over
87	2	Adjusting bolt for 85	Steel	—	,, ,,
88	1	Stop for 87	,,	—	,, ,, right hand
89	1	,, ,, ...	,,	—	,, ,, left hand
89½	2	3-32nds by ⅜ screw for 88-89	,,	—	,, ,, not shown
90	1	Stop collar	Cast iron	21	,, ,,
90½	2	⅛ by ⅜ screw for 90	Steel	—	,, ,,
91	1	Damper fork	,,	—	,, ,,
92	1	,, ,, end	,,	—	,, ,,
93	2	Weight	Cast iron	—	,, ,, from scrap
94	1	Eccentric link	Steel	—	,, ,,
95	1	Screw for 94	,,	—	,, ,,
96	1	End for 94	,,	—	,, ,,
97	1	Eccentric pin	,,	—	,, ,,
98	1	Nut for 97................	,,	—	,, ,,
99	13	Bolts for 71	,,	—	,, ,,
100	1	½ Eccentric strap..........	Cast iron	—	,, where marked
101	1	½ ,, ,, ...	,,	—	,, ,,
102	2	Bolts for 100 and 101	Steel	—	,, all over
103	1	Band flywheel	Cast iron	—	,, where marked
104	1	Key for 103	Steel	—	,, all over
105	2	Setscrew for 104	,,	—	,, ,,
106	1	Crank-pin oiler............	Brass	—	,, ,,
107	1	Flange for 106	,,	—	,, ,,
108	1	Stand for 106	,,	—	,, ,,
109	1	Drip for 106	,,	—	,, ,,
110	1	Throttle body	,,	22	,, where marked
111	1	Stuffing-box	,,	—	,, all over, turn from bar
112	1	Gland for 111	,,	—	,, ,, ,, ,,
113	1	Throttle valve	,,	—	,, ,, ,, ,,
114	1	Lever for 113.............	Steel	—	,, ,,

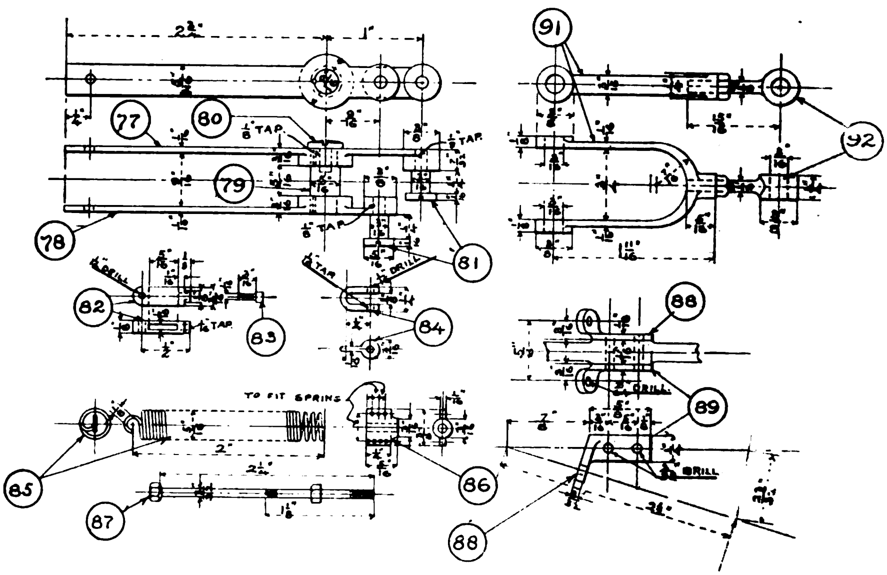
width, to be finished after the crank disc is in place. The seat or fit for the disc should, for this size, be made ·002 larger than the bore of the disc and the keyway cut, also keyway for flywheel. The disc may now be heated until it has expanded sufficiently to allow the shaft to be pushed to place, being



Details of Governor Parts.

careful to get the keyway properly aligned. After it has cooled, the shaft may be swung in the lathe and the disc properly finished on the periphery; edges and hubs, also the collar on shaft may be faced to proper distance from the hub of disc, so that the shaft will correctly fit in main bearing of the frame. In fitting the key (No. 68), great care must be exercised, as it is quite easy to throw the disc out of truth.

No. 67. — The crank-pin is made of mild steel, turned, drilled, and tapped as shown. It must be nicely fitted so that it can be *forced* to place by means of a vice or a screw jack. When securely seated in place, it should be carefully riveted over at the back and finished flush. This must be very carefully done, as it is easily possible to throw the pin out of alignment.



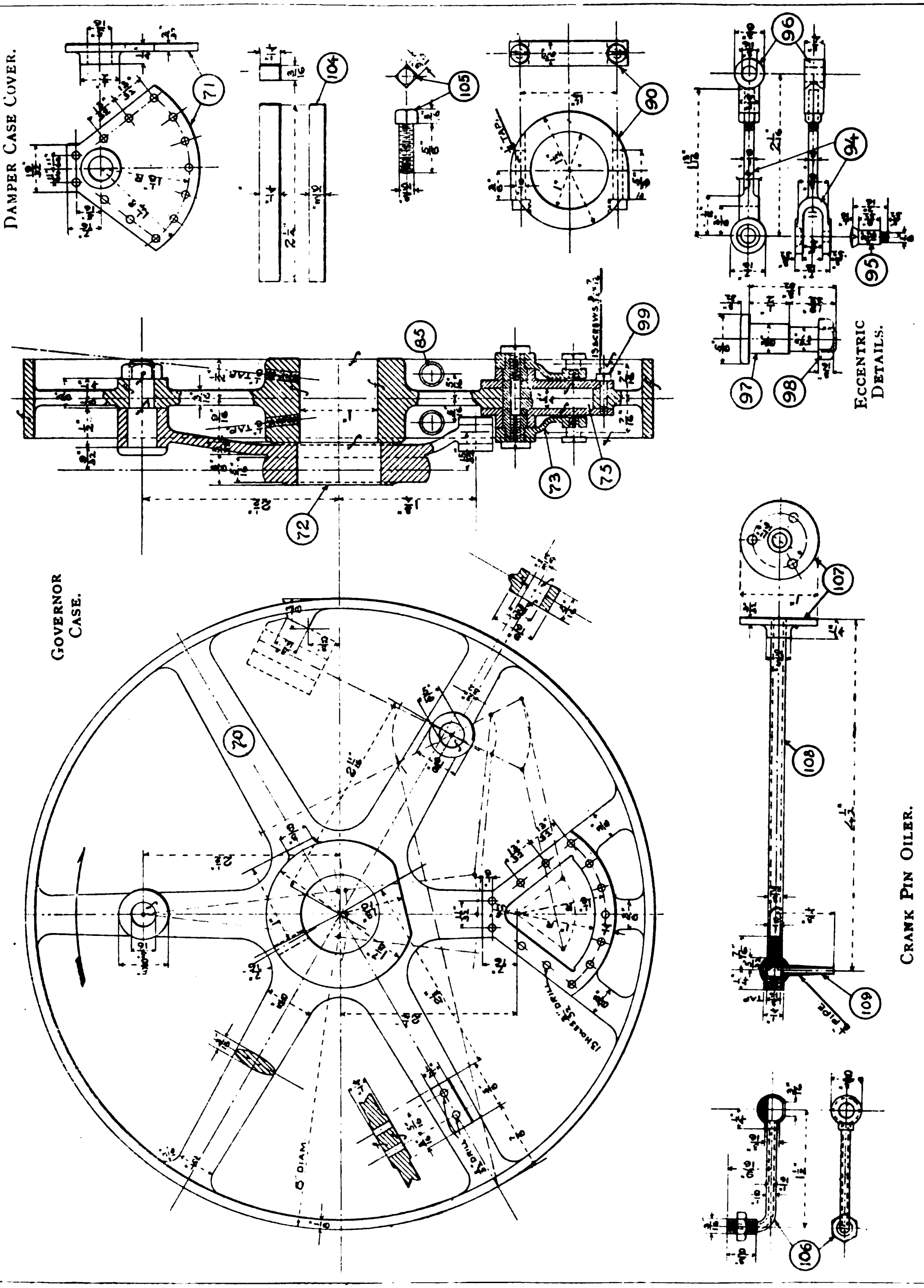
Details of Governor Parts.

The Governor (parts Nos. 70 to 79 inclusive), is of the class known as "shaft governors," in which the weights are actuated by centrifugal force with springs to supply the counteracting force.

As stated at the beginning of this article, this particular design has been used by the writer in a number of engines of comparatively large sizes with most satisfactory results. A more simple form of this type of governor could have been designed, but this would not have been in keeping with the purpose of the writer—to design an engine that would not only call for careful work on the part of the model maker, but would, when completed, be a credit to him.

The drawing of the wheel or case also gives the skeleton of the governor, and a section in connection with this shows clearly the relation of the several parts to each other. It is believed that the drawings are so full in detail that an extended description of the processes of making the several parts is unnecessary. Most of the parts are small and are fully dimensioned, and particular directions as to how each piece is made would be superfluous. The principal parts are the eccentric, weight arms, springs, and connecting links. These are all attached to the wheel or case.

The drawing of the eccentric (No. 72), besides

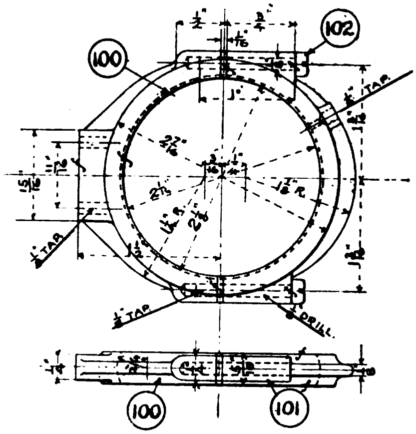


DESIGN FOR A MODEL AUTOMATIC CUT-OFF STEAM ENGINE.

For description [see page 610.

giving the form and dimensions, gives as well the lines for laying out the piece. It will be noticed that the eccentric is not provided with the usual tongue or groove to keep the strap in place, but instead is crowned, while the strap is bored to fit. This construction I have employed for several years, and have found that it makes a durable and flexible connection.

The weight arms are two in number, secured to a common shaft. One arm—the short one—carries a pin through which it is connected to the eccentric by means of link No. 94, while the long arm is fitted with a pin through which it is connected by means of the link or fork No. 91 to the "damper" or dash pot. The other ends of the weight arms carry the weights, which are securely pinned to the arms and have no adjustment. The spring clips are slipped over the arms before the weights are put on, and provide one of the means of adjustment by being moved towards or away from the weights; the other means of adjustment being in varying the tension of the springs.



ECCENTRIC STRAP.

The "damper" is for the purpose of steadying the governor, to prevent sudden and extreme movements of the eccentric, due to the inertia of the valve and other parts. A chamber in form of a sector is formed in one of the arms of the wheel and is closed by two plates or covers (No. 71), each of which carries a bearing for the damper shaft. The damper (No. 75) is a blade made solid with its shaft, and is fitted to just clear its case, so that it can move freely from end to end of its throw without friction other than that of the shaft in the bearings. Near the end of the damper is a hole to allow the oil in the case to pass slowly from one side to the other as the damper is moved. The case is filled with oil through the hole in the shaft, and is retained by the screw (No. 76).

There are two springs (No. 85), one for each arm. These are to be of the form shown. They are attached to the weight arms by means of pieces Nos. 82, 83, 84, and 84½. The other ends being connected to an arm of the wheel by means of parts Nos. 86, 87 and 88, the bolts (87) being used for adjusting the springs.

No. 90 (stop collar) is placed on the shaft between the eccentric and the shaft collar and should clamp the shaft tight so that it will remain as set when the bolts are set tight. It is to be adjusted against the eccentric so that the eccentric can work freely, but without lost motion between the collar and hub of governor wheel.

In such a small piece of apparatus as this governor, it is practically impossible to calculate the necessary spring and weight forces, because the friction is a very uncertain quantity; therefore, it will be necessary to arrive at the correct sizes experimentally.

The first springs should be made of No. 20 S.W.G. steel wire, properly tempered, and the weights of the sizes given. If the engine is to be speeded at 800 revolutions per minute, try various adjustments of tension, also of positions of the spring clips, to determine whether the spring is correct or not. Then try a change in the weights, bearing in mind that both spring and weight forces should be kept well up, as this results in greater power and stability in the governor.

In fitting up this governor, it must be kept in mind that good workmanship is essential to its success; careless fitting will result in poor speed regulation in the engine. This governor controls the speed by varying the throw of the eccentric, and consequently the travel of the valve, and the eccentric must be set so that the valve does not quite open the ports when the weights are moved to the outer extreme of their travel—that is, when they are against the rim of the wheel. When the weights are in the inner position against the hub, the valve should have about 1-64th in. lead.

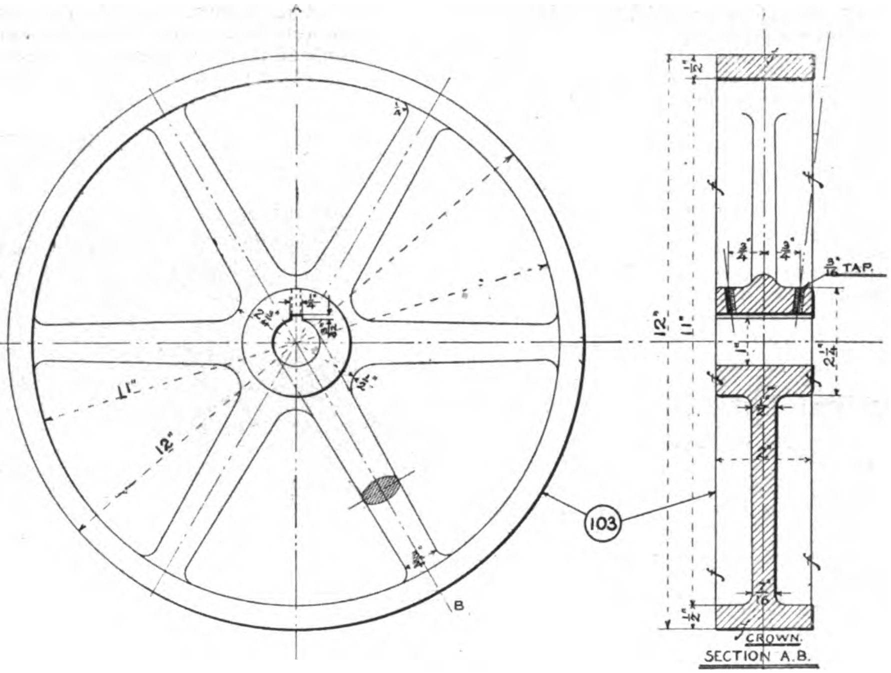
The eccentric is laid out to cause the engine to run "over." The peep holes in valve chest afford means for seeing the valve adjustment.

The eccentric strap and parts Nos. 100 to 102, inclusive, need no explanation, the drawings giving full information. The same may be said with reference to parts Nos. 103, 104, 105, 106, 107, 108 and 109—all of which are fully detailed.

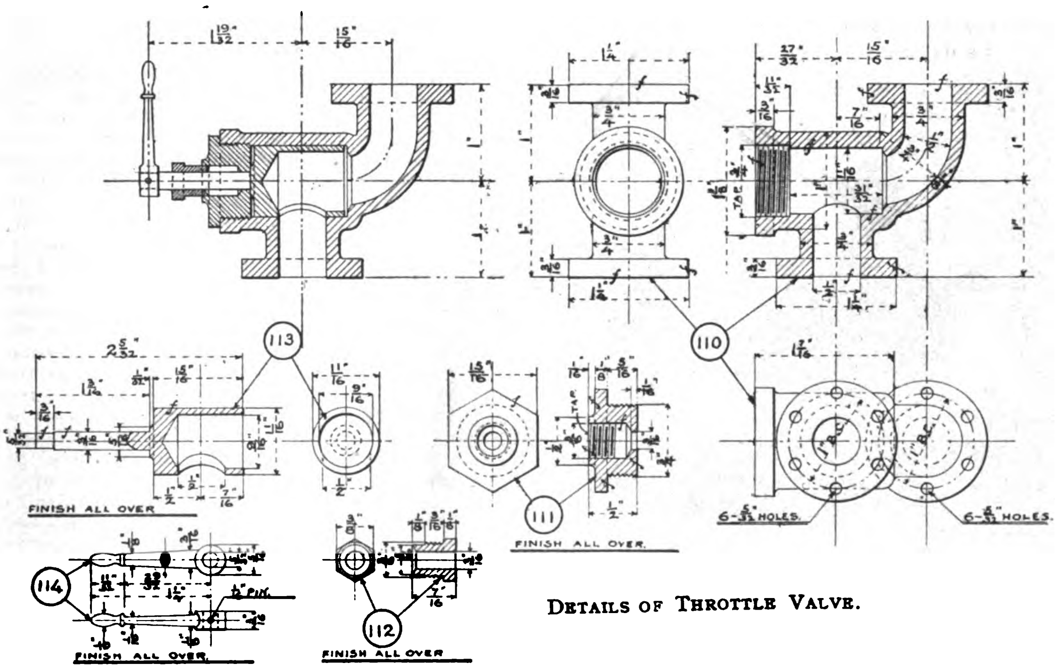
The throttle or starting valve (parts Nos. 110 to 114, inclusive), are fully detailed. I have used this form of valve in several models, also in a few engines of moderate size, and have found it to give satisfactory service. To make a good job, the body and valve should be lapped to a fit. This will ensure a tight valve. When the port through the valve begins to open, the valve moves freely; but the unbalanced pressure due to the opening, together with the friction of the packing on the stem, cause it to remain in any position in which it may be left.

In conclusion, I have said nothing about oil cups, as these can be either made or bought: therefore, I have left the matter of taps for these to the model maker. The same may be said with regard to the various screws and bolts needed in assembling the engine. As the systems of screw threads used in England are not the same as those employed in the United States, I have thought it best to leave this detail to the model maker. I have but one suggestion to make upon this point: Keep the screws, screw heads, bolts, and bolt heads and nuts as small as possible consistent with proper strength, as nothing will mar the appearance of an otherwise good piece of work as disproportionately large bolt heads, nuts, and screw heads.

The several parts of the engine are to be neatly finished where indicated on the drawings, and the unfinished surfaces well filed and rubbed down and finally painted any desired colour, a good one being a dark lead colour or machinery grey without



Details of Flywheel.



Details of Throttle Valve.

DESIGN FOR A MODEL AUTOMATIC CUT-OFF STEAM ENGINE.

By P. D. Johnston.

For description] [*see page* 610.

gloss. There should be no striping or lining, as it is out of place on a machine.

The sub-base or foundation can be made of a hollow casting, or a piece of well-seasoned hardwood, painted to represent stone.

The manner of erecting must be determined by the builder according to the use to which he will put his model. If for exhibition only, then the sub-base for engine and outboard bearing should be mounted on a cast-iron sole plate, thus making the engine self-contained and portable. If, on the other hand, it is intended to use the engine for power purposes, then a foundation of concrete may be built for it. But, as before stated, this must be left to the builder to decide.

Practical Letters from our Readers.

[*The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a* nom-de-plume, *if desired, but the full name and address of the sender* MUST *invariably be attached, though not necessarily intended for publication.*]

Notes from New Zealand.

To the Editor of *The Model Engineer.*

Dear Sir,—Enclosed please find a few photographs which I have taken in my spare time, and which I thought might prove of some interest to you. The photograph of the tank locomotive is one taken a day or two after the completion of the

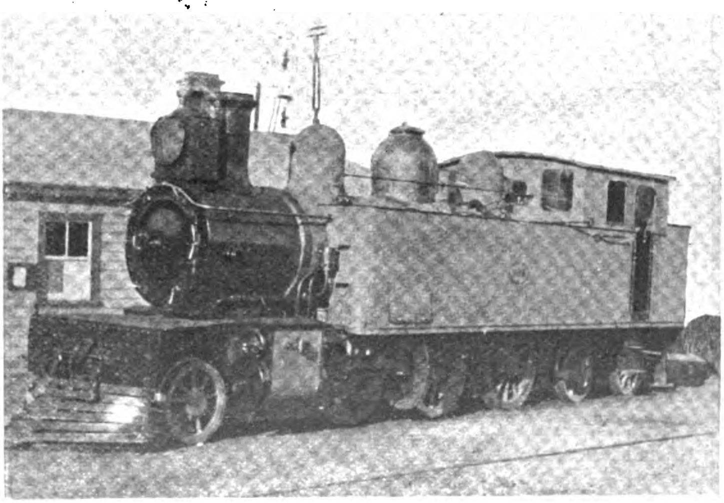


Fig. 1.—Tank Locomotive: New Zealand Government Railway.

trial trip, and which trip, I may add, gave every satisfaction. The engine is one of the twenty designed and ordered by the New Zealand Government, ten of which were built by A. & G. Price, of Thames, Auckland. These engines are fitted with every modern improvement, including air brake, piston valves, air sand gear, etc. The castings of the cylinders form a saddle for smokebox. The valve gear is outside, as may be seen from photograph, and the working pressure is 200 lbs. per sq. in.

The other pictures are photographs of the models

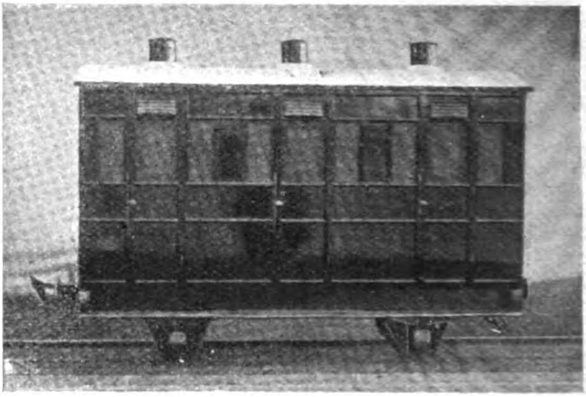


Fig. 2.—Model Coach: New Zealand Government Railway.

made by the Government employees at the Newmarket Works, Auckland. The carriage is a splendid model of the original cars, running on the express between Auckland and Rotorua, a distance of 171 miles, which distance is done by the express here in seven hours, with thirteen stops. The model car is one-quarter size of the real ones. The early locomotive shown was built from ideas obtained from a photograph out of a magazine, and the rest worked out by Messrs. Williams and Taylor, to whom great credit is due for the manner in which they worked to ensure success in the working of the model when finished. The engine ran all right when it was under steam, and it was shown with the old-fashioned car (see photo.) on Labour Day, October 11th. Labour Day is recognised as a general holiday by all working classes in New Zealand towns, and thousands turn out to see the procession of the exhibits of the different trades as they pass along the streets. The engine and two cars were placed in lorries on a suitable platform, the engine running up and down on a little line of rails. Second prize was awarded this exhibit in the procession.—Yours truly, F. N. Hesketh,

Auckland, New Zealand.

Lapping Cylinder Liners, etc., in the Lathe.

To the Editor of *The Model Engineer.*

Dear Sir,—Mr. V. W. Delves Broughton has evidently taken me up wrongly in my last letter. I simply gave an instance of where a lead lap was used, and it happened to be where it was required to take very little off; and from this your correspondent has formed his opinion that my method must be a sort of wholesale lapping process, but if he had read the description thoroughly, I do not think he would have come to this conclusion.

I certainly think that a new piece of steel rod would be required to finish the liner if wholesale lapping had been performed upon it, but if the lapping is done in the manner described, moving the liner back and forward along the lap—which is four times the length of the liner—the wear, if any, would be very even and it would not require to be renewed.

The same piece of rod was used by myself throughout, and a perfectly parallel liner was obtained.

Mr. Broughton is supposing that by my method some of the abrading material would be left in the liner and cause rapid wear, which is quite possible after any lapping, but it greatly depends upon the cleaning, etc., and I mentioned in my description that the liner should be thoroughly cleaned.

If some of the abrading material does happen to be left in after the process of burnishing it would not be left standing out above the surface of the liner to cause rapid wear, but after having used a lead lap the abrading material is more likely to be left standing out above the surface, and cause rapid wear.—Yours truly,

J. T.

The Society of Model Engineers.

[Reports of meetings should be sent to the offices of THE MODEL ENGINEER *without delay, and will be inserted in any particular issue if received a clear nine days before its usual date of publication.]*

London.

AN ordinary monthly meeting of the Society was held at the Holborn Town Hall, on Thursday, the 7th December, Mr. Herbert Sanderson taking the chair at eight o'clock, and fifty-five members and visitors being present.

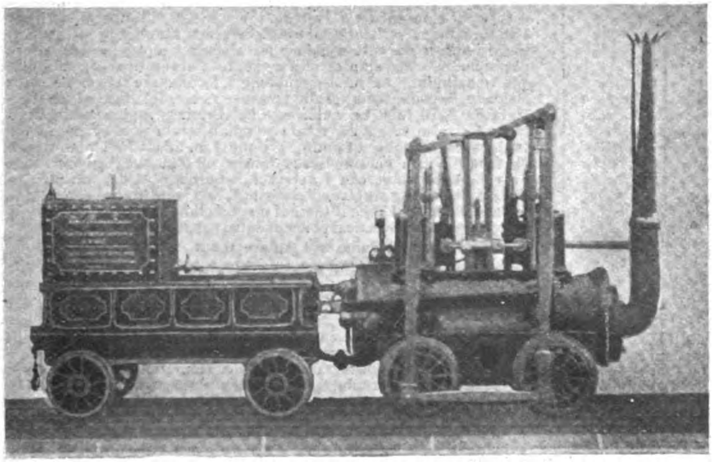


FIG. 3.—MODEL OLD TIME LOCOMOTIVE.

The minutes of the previous ordinary meeting were read and signed, and seven new members elected.

The Chairman announced that the committee had the question of the work-bench and tools well in hand, and it was hoped to have the articles ready for exhibition at the Conversazione, for which latter event he particularly requested the members present to do their utmost to make the display of models and parts a record feature.

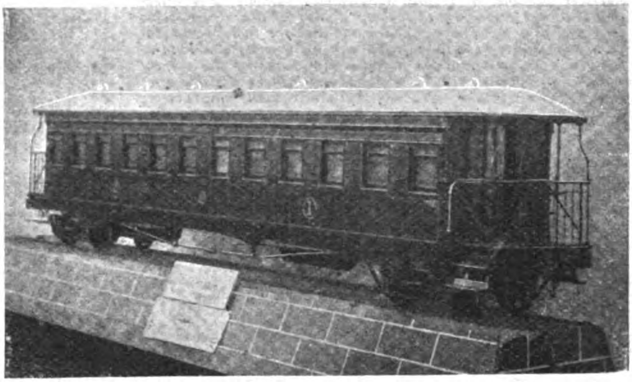


FIG. 4.—MODEL COACH: NEW ZEALAND GOVERNMENT RAILWAY, 1905.

The Chairman then called upon Mr. J. Glover to give his lecture on "Motor Cars, Past and Present." The lecturer, who expressed regret that he had at the last moment been unable to obtain the series of slides most applicable to his paper, was able to interest the members in a short review of the work which, under a great many difficulties, has resulted in the self-propelled vehicle as we know it. The slides which were thrown on the screen showed the great diversity in type and working of motor carriages now dead and gone. On the proposition of Mr. Percival Marshall a hearty vote of thanks was given Mr. Glover for his paper.

Some discussion on the answer to one of the questions placed in the question box ensued, and the meeting terminated at 10 p.m.—HERBERT G. RIDDLE, Hon. Sec., 37, Minard Road, Hither Green, S.E.

Provincial Societies.

Readers in Ayr and district who are willing to join in the formation of a local Society of Model Engineers are requested to communicate with Mr. H. A. Stevens, "Garfield," Ayr, who will arrange to call a preliminary meeting.

A NEW tin lode has been discovered at Mount Croft, on the north-east side of Trencrom, Lelant, the results of the smelting of samples being highly satisfactory.

Queries and Replies.

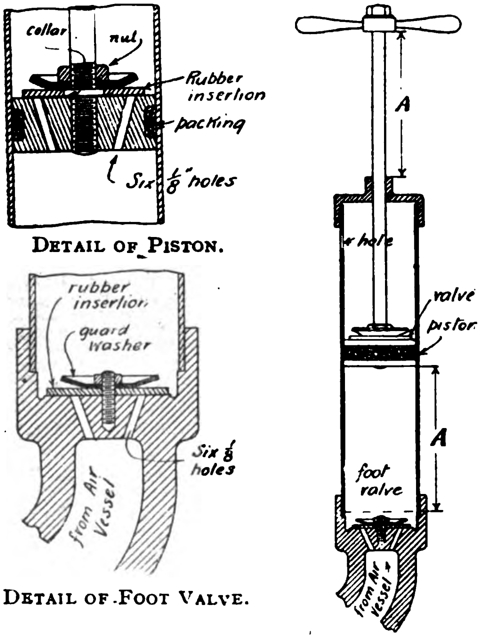
[*Attention is especially directed to the first condition given below and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-hand corner of the envelope "Query Department." No other matters but those relating to the Queries should be enclosed in the same envelope.*

Queries on subjects within the scope of this journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied, wherever possible, with fully dimensioned sketches, and correspondents are recommended to keep a copy of their Queries for reference. (3) A stamped addressed envelope (not post-card) should invariably be enclosed, and also a "Queries and Replies Coupon" cut out from the advertisement pages of the current issue. (4) Queries will be answered as early as possible after receipt, but an interval of a few days must usually elapse before the Reply can be forwarded. (5) Correspondents who require an answer inserted in this column should understand that some weeks must elapse before the Reply can be published. The insertion of replies in this column cannot be guaranteed. (6) All Queries should be addressed to The Editor,* THE MODEL ENGINEER, *26–29, Poppin's Court, Fleet Street, London, E.C.*]

The following are selected from the Queries which have been replied to recently:—

[14,963] **Vacuum Pump.** J. B. (Appleby) writes: (1) Could you send me a rough drawing of an exhauster, and tell me how it works? I want to build a small one for exhausting air. (2) What is the pressure of air on a square inch with a perfect vacuum in the air vessel?

We are not at the moment sure of the exact construction of the most modern design of air pump for laboratory purposes, but



DETAIL OF PISTON.

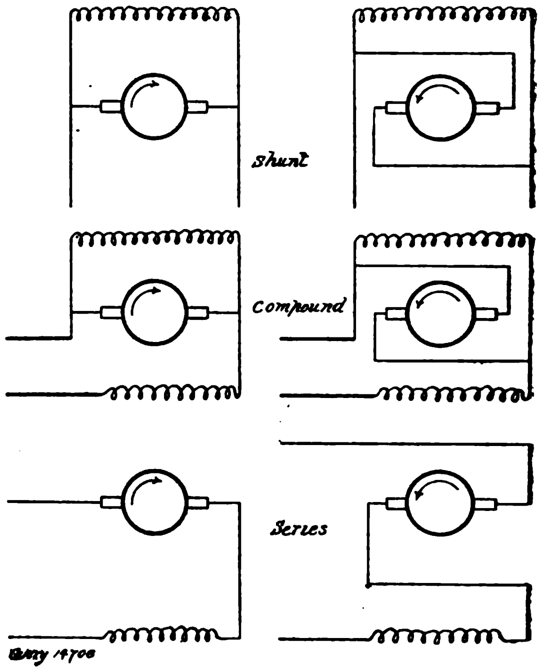
DETAIL OF FOOT VALVE.

DESIGN FOR A VACUUM PUMP.

should think an exhauster made on the lines of the enclosed sketch should suit your purposes. The construction is simple. The action is as follows: During the down stroke the rubber valve in the piston lifts and allows the air under the piston to pass away, the foot-valve preventing the air being driven back into the air vessel. On the up stroke the top (piston) valve closes, and as the foot-valve lifts, the air in the air vessel follows the moving piston. In making the piston-rod, please note that distance A A should be equal. The average pressure of the atmosphere is 14·7 lbs. per sq. in., so that if you could absolutely empty the air vessel of air every square inch of the outside would be subjected to this pressure. The air pressure varies with the barometer—or, really, the barometer shows the amount of atmospheric pressure existing at any time.

[14,706] **Reversing Series, Shunt and Compound Electro-Motors.** J. J. (London, W.C.) writes: Will you kindly let me know what alterations in the connections are necessary in order to reverse the direction of rotation of—(1) A shunt-wound electric motor? (2) A compound-wound electric motor? (3) A series-wound electric motor?

The rule for reversing the direction of rotation of the armature



REVERSING DIAGRAMS FOR SERIES, SHUNT AND COMPOUND ELECTRO-MOTORS.

of a continuous-current electric motor is this: the current must be reversed in either the field-magnet coils or in the armature coils, but not in both. The plan usually adopted is that of reversing the direction of the current in the armature. The diagrams above will explain.

[15,074] **Locomotive Boiler.** V. B. F. (Swansea) writes: I am building a vertical engine cylinder, 2 ins. bore by 1½ ins. stroke, for driving a 60-watt dynamo for charging motor accumulators occasionally. Pressure of steam, 50 lbs.; revolutions per minute, 500 (maximum), and intend building a locomotive type boiler with Belpaire firebox, and shall provide 1,000 sq. ins. of heating surface. Will this be sufficient for driving engine under full load, and also supplying steam to small steam donkey pump for feed water; cylinder of pump, ¾ in. by ¾ in. about? I wish to use oil fuel. Will a paraffin spray burner of some sort give enough heat? Also, where can I get such a burner? I can arrange to give more heating surface, if necessary, and want to be on safe side as regards this. I take it there is no objection to a locomotive type boiler as against a vertical boiler of equal capacity?

(1) A 60-watt dynamo will require about

$$\frac{60}{750} \times 2 \text{ b.h.-p., or } \frac{60}{750} \times 3 \text{ i.h.-p.}$$

$$= \frac{180}{750} = \text{about } \tfrac{1}{4} \text{ i.h.-p.}$$

A 2-in. by 1½-in. stroke engine, at a boiler pressure of 50 lbs. will develop, at 500 revs. per min., about ¾ i.h.-p., so you will have a good margin of power. The steam consumption would be from 9 to 11 cubic ins. per min., and a boiler with 1,000 sq. ins. of heating surface will be about the right thing for an average of ¼ i.h.-p.

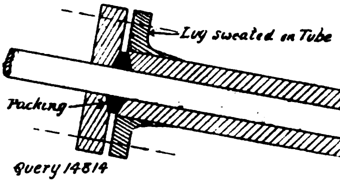
There should be plenty of steam available for a donkey pump in addition to the main engine. Do not increase the H.S. at the expense of the water-range. With regard to the firing: a spray burner, unless fitted with some special automatic device, will need almost as much, if not more, attention than a coal or briquette fire, and if you can provide the boiler with a firebox of ample dimensions, we would recommend solid fuel, to the exclusion of almost any arrangement of oil fuel. If you provide the firebox with water tubes, we would suggest a cluster of Primus burners. These however, will not stand very rough or very constant usage without deterioration. A locomotive type boiler requires a better draught than a vertical boiler, and, therefore, should always be used in conjunction with a blast-pipe employing the exhaust steam from the engine.

[14,910] **Magneto Electric Machine; Small Dynamo for Lighting.** B. P. W. (Watford) writes: I shall be very much obliged if you will kindly answer the following queries. I wish to construct a magneto electric machine for giving shocks, and shall be glad if you will tell me:—(1) What gauge wire should bobbins be wound with? (2) How many lamps, and what candle-power and voltage would a shunt-wound 10-volt 3 amps. dynamo light? (3) What is most suitable gauge wire to use from dynamo to lamps? (4) Are fuses necessary? (5) I am thinking of making an accumulator like one that was described in the *M.E.* a short time ago; that is, by filling the holes in lead plates (both positive and negative) with paste made of red lead. Would this act all right, and how many cells should I require so as to be able to charge from above dynamo?

(1) A good description is to be found in Bottone's "Electrical Instrument Making," post free 3s. 3d. (2) *Re* dynamo. About three or four 2 c.-p. 10-volt lamps. (3) Any convenient gauge, if close at hand. About No. 20. (4) Not essential. (5) Yes. A 10-volt 3-amp. dynamo would charge an 8-volt cell very comfortably.

[14,814] **Spark Coil Failure; Tail Shaft for Model Steamer.** C. E. G. (Muswell Hill) writes: (1) My 4-in. spark coil is faulty. How can I test for a short from the secondary coils? I have taken out condenser, which is made of paper and tinfoil alternate layers. How can I test this? The platinum contacts on contact-breaker are all right. What voltage would be the most suitable for working this coil? I have always used 2 volts hitherto, but find it not sufficient, and with 4 volts there is a big flaming spark at contact-breaker. (2) Can you recommend any good and cheap primary batteries to give 2 volts per cell, to be constant and inexpensive, and suitable for charging small accumulators up to 8 amps.' size? The cost must not be more than 1s. to 1s. 6d. per cell, and the voltage of three in series not less than 5 volts. (3) What is the pitch of a propeller? (4) Can you give me a good idea for a bearing to be used in a screw electric launch? When the motor is coupled up the shaft projects 2 ins. to 3 ins. into water and only ½ in. long tube is used, but water comes in too fast, and tallow will not stop it. (5) How can I roughly estimate current taken by motor for above boat in amps. without using an amperemeter?

(1) Connect a sensitive galvanometer to one end of secondary; couple up a few cells in series with galvanometer and secondary, and earth one end of battery, leaving the loose end of secondary presumably insulated. If there is a big leak you will get a deflection of galvanometer when current is switched on. Very slight leakage cannot always be detected except when coil is working at high tension. If you are certain there is a leakage, unwind secondary until you come to faulty place; then rewind or try section by section, if built in sections, and see that each portion gives its proper spark. About 4 volts should be used. (2) Bichromates are about the best for heavy current work. (See lists of any of our advertisers for prices, etc.) (3) The distance the screw would travel in one revolution if rotated in a solid. (4) A small well-fitted gland is what you require. Try some cotton rope, dressed with tallow,

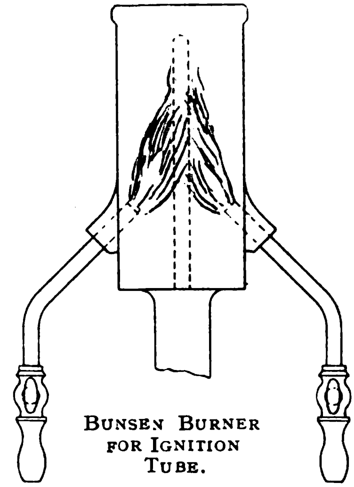


BEARING FOR MODEL PROPELLER SHAFT.

and inserted and held in position by a washer clamped up to end of tubing. The inside edge of washer to be bevelled, as shown in sketch. (5) Approximate by its size and windings. (See "Small Dynamos and Motors," 7d., post free.)

[13,883] **Small Gas Engine Ignition Trouble.** F. B. (Portsmouth) writes: I have a gas engine made by me from castings, and as I have it totally different to the drawings, I should like your opinion of the proportion of valves, etc. The engine was meant to be worked on the Lenoir system. The ignition was a light burning under a hole half-way along the cylinder, the hole being uncovered by the passage of piston. The smaller pressure and escape through this hole determined me to alter it to Otto principle. On the out-stroke the gas and air valves open, the quantity of gas being regulated by hand valve, and not by lift of valve. This also regulates the air, as gas is under small pressure. The compression on the engine is very good, bringing one up with a jerk on every fourth stroke, if wheel is turned round by a handle. My only trouble is that I cannot get an explosion, but the exhaust lights up with a "poof," making me think I have at least an explosive mixture. The tube I can only get an ordinary red heat, and if I turn the Bunsen burner suddenly off and on, it won't light up with the heat of tube. Is this necessary, or does the compression help ignition? Should the lagged outer tube have vent-holes top and bottom? If so, what size and number? When I put too much gas through Bunsen burner, it does not light inside, but lights at top, and when just right amount to light inside it does not seem enough to heat the tube, for tube only gets red-hot. Is outside tube big enough, for when mine is lagged, diameter inside is only ¾ in.? Also what horse-power could I expect, and speed, for I made all valves large, so as to get high speed?

Your trouble may be due to one or two causes, viz., the ignition tube, incorrect mixture. From what you say *re* the charge firing in



BUNSEN BURNER FOR IGNITION TUBE.

the exhaust, we should say you are flooding the engine with gas. The tube, of course, must be made quite hot—not a dull red, but a bright. If you find that one Bunsen, when burning properly, is not large enough, we advise you to fit another burner as shown in our sketch. You will find this will effectually keep the tube hot. If you read our new handbook, "Gas and Oil Engines," 7d. post free, you will find a full and detailed description of such burners, which will help you considerably.

The News of the Trade.

[*The Editor will be pleased to receive for review under this heading samples and particulars of new tools, apparatus and materials for amateur use. It must be understood that these reviews are free expressions of Editorial opinion, no payment of any kind being required or accepted. The Editor reserves the right to criticise or commend according to the merits of the goods submitted, or to abstain from inserting a review in any case where the goods are not of sufficient interest to his readers.*]

An Evening Workshop.

We are asked by Mr. Sam Middleton, of Faraday House, 179, Camden Grove North, Peckham, S.E., to state, for the benefit of model engineers who are handicapped in not having means or place for a lathe, etc., that he is prepared to let (for evenings only) one of his workrooms, with lathes and tools, for a small fee. Readers who may be interested should apply to the address given above.

Mr. Middleton will also send upon application his list of new and second-hand instruments, comprising telegraph apparatus, telephones, coils, Wheatstone bridges, and miscellaneous electrical articles.

New Catalogues and Lists.

The Universal Motor Co., St. James' Road, Derby.—The section of this firm's catalogue, which we have just received, relates to the small-power gas and oil engines, 1-, 2-, 3- and 4-cylinder petrol motors for marine work, and cycle motors. Prices for the foregoing are given as well as for complete sets of castings; the universal 2 b.h.p. motor cycle, and complete motor attachments for ordinary roadsters are also listed.

Another section of this catalogue deals with all kinds of car motors from 5 to 30 b.h.p., manufactured by the Universal Motor Co. The complete list will be sent post free to any readers upon receipt of three penny stamps.

Hardy & Padmore, Worcester Foundry, Worcester, have sent us their new price sheet, giving particulars of their "Ideal" gas and oil engines for small-power; also the "Lowne" patent vacuum engines.

The Editor's Page.

WE give with this issue, in accordance with our usual custom, an index to the contents of the volume, which is now completed. The index, apart from the ordinary uses of such a compilation, has one characteristic which we commend to the attention of those readers who occasionally take us to task, in all good faith be it understood, for not devoting sufficient space to their pet subject in one or other of our weekly issues. A glance through the items in the present index, or indeed through the index of any one of the thirteen volumes of the *M.E.* we have now published, shows not only the faithful way in which we have adhered to subjects legitimately within the scope of our title, but also the immense variety of information we have given on such subjects. Whatever mechanical or electrical subject a reader may be specially interested in, he can hardly look through an *M.E.* index without feeling that, taking the volume as a whole, he has been very liberally catered for. Binding cases for the volume are now ready, price 1s., or post free 1s. 3d.; while complete bound copies will be ready within a few days, price 6s. 6d., or post free 6s. 11d.

* * *

Our next issue, to be published on January 4th, will commence a new volume, and, as is customary at this period of the year, we shall mark the event by the presentation of a plate of coloured working drawings. The subject of this year's plate is one which we know will be welcome in many quarters. It is a ½ h.-p. gas engine, but for the benefit of those who have not a supply of town gas available, we shall, later on, show how this engine can be run as an oil engine, or from a small suction producer gas plant. We have previously promised a design of this kind; but, for some reason or other, the selected contributor has not been able to carry out his intention, and the matter has been unavoidably postponed. In order to avoid further delays, we put the matter into the hands of Mr. W. C. Runciman (a member of our regular staff, and the author of an excellent little handbook on Gas and Oil Engines in our MODEL ENGINEER series). We think that when the design appears next week it will be generally admitted that he has exactly met the requirements of the reader who wishes to build a really practical and serviceable engine capable of running a moderate sized amateur workshop or a useful electric light plant. In order that readers may make sure of securing this issue, we suggest that it should be ordered at once, through a news agent or bookstall.

Answers to Correspondents.

T. J. B (Greenwich).—We have not received any previous communication from you.

J. B. (Leeds).—Articles have appeared on this subject in back numbers. Please look the matter up in index. See Vols. V and VI. Also kindly comply with our rules in future.

H. W. P. (Forest Gate).—The hot-air engine is not at all suitable or powerful enough for this purpose. Besides this, they are extremely bulky for their power. Kindly comply with Rules in future.

F. G. A. (Harringay).—We will endeavour to publish drawings at an early date—as soon as we can get sufficient particulars. Yes, it would be possible to use *M.E.* loco. motors in this connection.

J. B. (Middle Hutton).—You cannot charge primary batteries in the same way as accumulators or secondary cells. See our handbook—"Electric Batteries," 7d., post free. Also recent query replies *re* charging accumulators. Kindly comply with our Rules in future.

G. L. (Canada).—The scheme is quite feasible, but we would advise (for a sea-water boat especially) the use of a gasoline (petrol) engine. Further, a considerable experience is necessary to make a successful engine of the type you mention.

Notices.

The Editor invites correspondence and original contributions on all amateur mechanical and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected or not, and all MSS. should be accompanied by a stamped addressed envelope for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

This journal will be sent post free to any address for 13s. per annum, payable in advance. Remittances should be made by Postal Order.

Advertisement rates may be had on application to the Advertisement Manager.

HOW TO ADDRESS LETTERS.

All correspondence relating to the literary portion of the paper, and all new apparatus and price lists, &c., for review, to be addressed to THE EDITOR, "The Model Engineer," 26—29, Poppin's Court, Fleet Street, London, E.C.

All correspondence relating to advertisements and deposits to be addressed to THE ADVERTISEMENT MANAGER, "The Model Engineer, 26—29, Poppin's Court, Fleet Street, London, E.C.

All subscriptions and correspondence relating to sales of the paper and books to be addressed to Percival Marshall & Co., 26—29, Poppin's Court, Fleet Street, London, E.C.

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Contents.

[*The asterisk* (*) *denotes that the subject is illustrated.*]