THE

Model Engineer

AND

Amateur Electrician.

A Journal of Mechanics and Electricity for Amateurs and Students.

Volume VII.—1902.

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The asterisk (*) indicates that the subject is illustrated.

GENERAL INDEX.

THE

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A JOURNAL OF MECHANICS AND ELECTRICITY FOR AMATEURS AND STUDENTS.

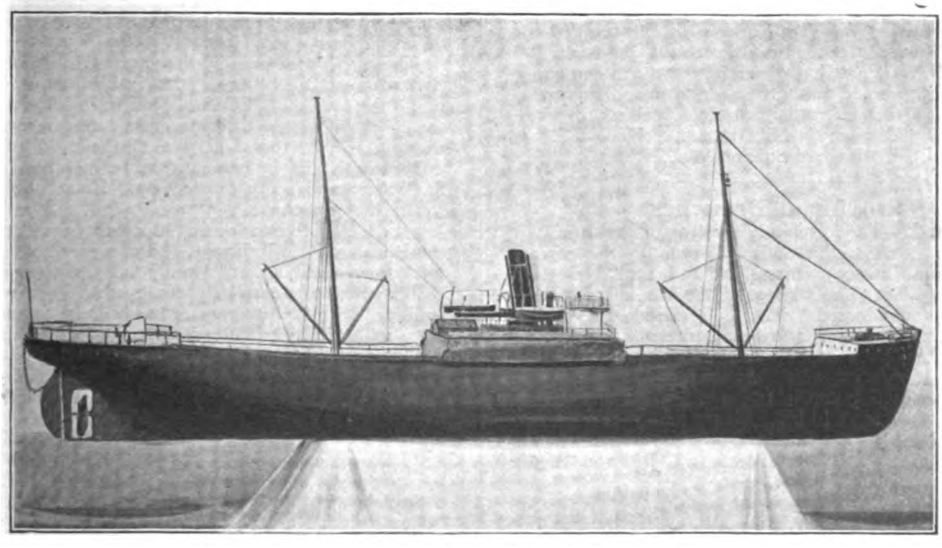
EDITED BY PERCIVAL MARSHALL, A.I.MECH.E.

VOL. VII. No. 76. JULY 1, 1902. PUBLISHED TWICE MONTHLY.

The Model Cargo Steamer, "Nyassa."

By D. W. HARRIS.

NOT long ago a friend of mine, Mr. A. H. Mares, finished building a ¼ in. scale model cargo steamer. I have taken the accompanying photographs of the vessel, which, together with this description, will be of interest to other readers of THE MODEL ENGINEER.



MODEL CARGO STEAMER, "NYASSA."

Not being the fortunate possessor of all the tools (namely forge, &c.) required for its construction, my friend formed the ribs and keel in the workshop of a friendly cycle-maker.

The hull is constructed of stout sheet tin, is 5 ft. 7 ins. long, 8½ ins. beam, and 7½ ins. deep. The ribs (five in number) and the keel are made of ⅛ in. by ½ in. iron, and the former are riveted on to the latter by steel rivets.

In putting on the tin shell, my friend had some difficulty in making same neat and even. Amidships the tin was put on in one piece, bent round the keel outside, and riveted at the top of ribs on each side; but the bow and stern were more difficult matters. The soldering iron was brought into use to make the hull sound and water-tight.

The main deck is of wood, ruled to form imitation planks, and is sunk into the hull tin, so that the tin sides form the bulwarks. Brass nails were nailed horizontally through the tin into the deck to support same.

The forecastle is 1½ ins. above the main deck, the poop 1 in., and the bridge 2 ins.; the first two being fixed in position by brass nails as before described for the main deck. The bridge is made of wood, supported by tin at sides, and is constructed so as to lift off when required.

There are stanchions round the forecastle, bridge, and poop, and four hatchways are provided. The boat is ballasted with lead placed inside the hull, and she draws 3½ ins. in the bow, and 4 ins. in the stern. A general idea of the fittings and the arrangement of same on the decks, and also the shape of the hull, may be gathered from the accompanying photograph.

The boiler is brass, and was constructed by Messrs. Lucas & Davies, the well-known model makers, and is of the "saddle" type. The dimensions are—9 ins. long, 5½ ins. wide, and 5 ins. deep. The cost was £1 15s. The lamp has three big burners, and burns for one and a-half hours at one filling, the fuel being methylated spirits.

The engine cost £1 10s., and was purchased second-hand at Messrs. Whitney's, City Road, E.C. It is a slide-valve, 1-in. bore, 1½-in. stroke, and is regulated through a hole in the boiler casing just behind the funnel. The exhaust steam from the cylinder goes up the funnel. The boiler and engine are placed practically amidships.

The shaft is of ⅛-in. steel, and the screw is 3 ins. diameter.

Should any reader of this magazine desire it, Mr. Mares will be pleased to furnish him with any further details he might require if he wrote to him through the Editor of THE MODEL ENGINEER.

The boat is, on the whole, very satisfactory in every way.

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 fortnight before its actual date of publication.*]

London.

FUTURE MEETINGS.

Saturday, July 12th.—Visit to Mr. D. C. Glen's residence and workshop at Watford. 2 57 p.m. from Euston. Fare 2s.

SUMMER EXCURSION.

Thursday, July 17th.—Visit to works of Messrs. Willans and Robinson, and the locomotive sheds of the L. & N.W.R., at Rugby. Members who intend going to Rugby should notify the Secretary, so that special terms as to fares, etc., may be obtained from the Railway Company.—H. GREENLY, Hon. Sec., 4, Bond Street, Holford Square, W.C.

Provincial Branches.

Bradford.—The fortnightly meeting of the Bradford branch was held at the Coffee Tavern, Tyrrell Street, Bradford, on Monday evening, June 2nd, 1902, Mr. A. P. Drake presiding. The minutes of the last meeting were read over and adopted. Mr. Pell exhibited a Corliss engine, and Mr. Wilson a lathe mandrel for 4-in. centre lathe. An enjoyable evening terminated at 10 p.m. It was the last meeting of the season. The next season will commence September 1st, 1902, when anyone interested in the work will be made welcome, and we shall also be pleased to see any intending members.—J. H. LAMB, Hon. Sec., Holly Bank, 109, Rushton Road, Thornbury, Bradford, Yorks.

Liverpool.—A meeting of the members of this branch took place on Wednesday, June 4th, at the Balfour Institute, when Mr. Reeves gave an interesting paper on the subject of "Break-downs and Failures at Sea and the Method of Repairing Them." He also described the working of a surface condenser, and owing to the time being limited, promised to continue his paper at the next meeting. Mr. Durrance proposed a hearty vote of thanks to Mr. Reeves, which was carried unanimously.

It was then decided to cancel the meeting for July, and the next meeting will therefore take place on Wednesday, August 13th, at the Balfour Institute, at 7.45 p.m., when Mr. Reeves will conclude his paper and Mr. Kirby will read a paper on "Electric Bells."—F. T. STEWART, Hon. Sec., 33, Cowper Road, Old Swan, Liverpool.

Tyneside.—The first ordinary meeting of this branch was held at Pillar's Café, Pink Lane, Newcastle, on Saturday, June 7th, at 7. The President, Mr. R. Bamford, took the chair at 7.15. Thirteen members were present and six new members were enrolled. Owing to an accident to the boiler, Mr. Bamford was unable to show the marine engine working as promised, but exhibited a beautiful set of castings, partly finished, of one of Thomassin's ⅝ in. bore 2-cylinder marine engine, which was greatly admired by all the members. Mr. E. Campbell then showed a small dynamo, which caused a good deal of discussion as to winding, brushes, and general construction. Mr. Addleshaw then described Mr. Wm. Munro's patent boiler, showing specification and tracings of same.

A committee meeting was arranged for Friday, June 13th, at 8, to discuss member's cards, rules, &c. The meeting closed at 10 p.m.

The next meeting, first Saturday in July.—GEO. F. ADDLESHAW, 2, Gladstone Street, Newcastle.

Superheated Steam for Locomotives.

AN interesting paper on the economies and advantages to be obtained by the use of highly superheated steam on locomotives by Herr Garbe, one of the board of managing directors of the Prussian State Railways, was recently read before the Berlin centre of the Association of German Engineers. By title the paper is a report on the locomotives exhibited at Paris, but Herr Garbe found the locomotives with the Schmidt superheater so interesting that the greater part of his report is devoted to locomotives of this class.

The superheater fitted to the engines in question consists of about 63 tubes 1·3 in. inside diameter, fitted round the inside of the smokebox wall. The steam to the cylinders passes through these tubes, while the furnace gases pass round outside of them. The steam is delivered to the cylinders at a temperature of about 825° F., that is, superheated 450° F. at 170 lbs. per sq. in. boiler pressure.

Four locomotives with this superheater are in use on the Prussian State Railways, and as a result of the economies they have shown twenty-five new engines now building are to be similarly equipped. The first engine equipped with the superheater has been in service for two years without any trouble developing in the superheater or in the cylinders. Herr Garbe reports that in October, 1901, this engine, which is of the American four-coupled type, was tested against two compound locomotives with the following favourable result:—

Locomotive.		Consumption Per Train Mile. Water.	Coal.
Superheated, No. 74	...	206 lbs.	34·0 lbs.
Compound, No. 73	...	278 ,,	37·7 ,,
Compound, No. 49	...	278 ,,	38·2 ,,

These results are the averages from a trial of nine days, running express trains of an average total weight of 360 gross tons. The engine from which these figures were taken has cylinders 19⅜ ins. by 23⅝ ins., and driving wheels 6 ft. 6 ins. diameter. Herr Garbe's paper is profusely illustrated with indicator diagrams, and he calls attention to the cards taken with partially closed regulator and short cut-off. It is in the ability of the locomotive with the superheater to run economically under such conditions that Herr Garbe finds one great advantage of the superheater. The range of power which is economically available with superheated steam, is so great that Herr Garbe proposes to build his locomotives with large cylinders, and to run them under ordinary conditions throttled down and with a short cut-off; the reserve cylinder power available will then be sufficient to render unnecessary the present practice of double-heading trains on heavy divisions.

According to Herr Garbe's estimates, the entire work on the Prussian State Railways can be handled with four classes of locomotives if these are fitted with superheaters. He has taken up the question with representatives of the four most prominent German locomotive builders, and in connection with them has determined the proportions of these four standard types. Drawings of these engines are given with the original paper.

The engines proposed are the following:—

Eight-wheeled American type for express service and ordinary passenger service, with cylinders 20½ ins. by 23⅝ ins., and driving wheels 6 ft. 6 ins. diam.

Mogul type for heavy passenger and light freight service, with cylinders 20½ ins. by 23⅝ ins., and driving wheels 5 ft. 1 in. diam.

Eight-wheeled, all coupled, heavy freight locomotive, with cylinders 21⅝ ins. by 23⅝ ins., and driving wheels 4 ft. 5⅛ ins. diam.

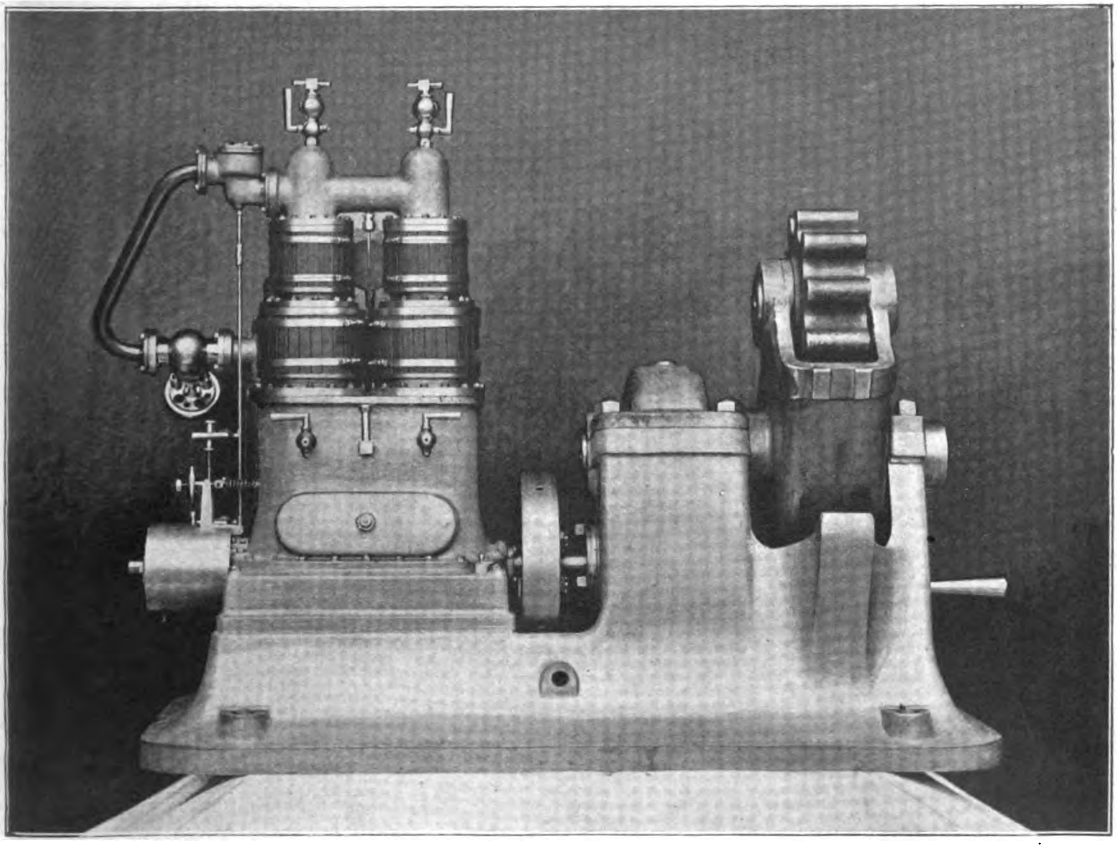
Mogul type tank engine for suburban service and short passenger runs, with cylinders 20½ ins. by 23⅝ ins., and driving wheels 4 ft. 11 ins. diam.

A Model "Willans" Central Valve Engine.

By Gerald Robinson.

THE readers of THE MODEL ENGINEER will, no doubt, find the following description of a small model Willans central valve engine, which has recently been completed, interesting and useful.

The famous central valve engine, invented by the late Peter Willans, is well known to most of us as one of, if not the most important of all high-speed engines now used so extensively for electric lighting and tramway undertakings.



A Model "Willans" Central Valve Engine.

The model represents the Willans standard G/s size compound engine of 100 h.-p., and is built to ¼ scale.

There are two high- and two low-pressure cylinders, 2⅛ ins. and 3⅛ ins. in diameter, respectively, arranged tandemwise in pairs over each of the two cranks, thus forming a complete engine over each crank. The cylinders are lagged with asbestos, and covered with polished teak, tied with brass bands. The stroke of the engine is 1½ ins.

The high- and low-pressure piston-rods, or hollow trunks, as they are termed by Willans, which contain the steam and exhaust ports, are made in one piece in the model, instead of being separated below the high-pressure piston, as is the usual method; this is done to avoid the joint, which] would have to be very small, and would probably cause trouble in the engine while running.

The lines of central valves, which run inside the hollow trunks, are turned from steel bars, having the high- and low-pressure valves in one piece; these are driven from eccentrics placed in the centre of the crank pins.

The crankshaft, which is in one piece, was turned from a bar of mild steel, the journals and crank-pins being 1 in. in diameter. The eccentrics are 24 degs. in advance of the cranks, giving the valves a lead of 1-16th in. The cranks run in a bath of oil contained in the bedplate, and the working parts of the engine are lubricated by splash. A steam separator and stop-valve are also supplied.

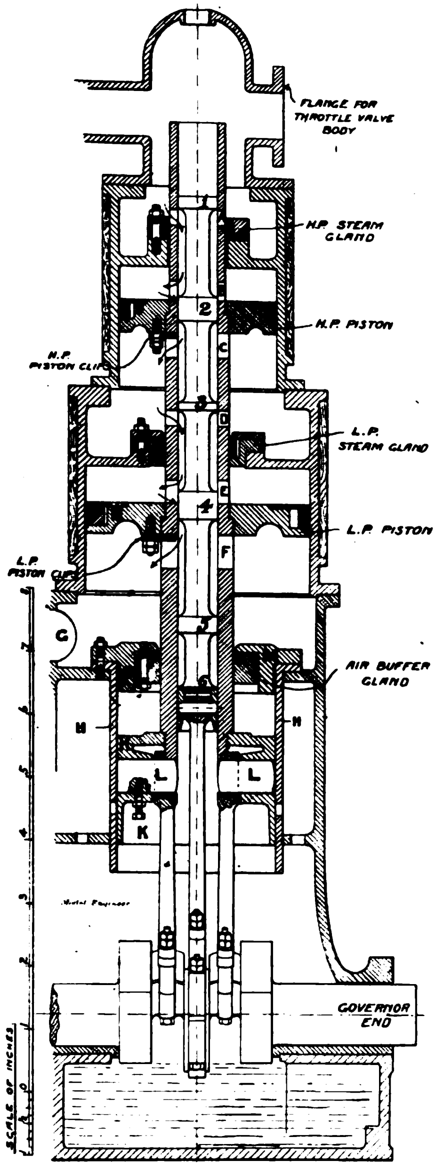


FIG. 1.—SECTION THROUGH ONE LINE OF MODEL "WILLANS" ENGINE.

The flywheel is 8 ins. diameter, and has a rim 2 ins. wide, the total weight being 18 lbs. The face of the flywheel is arranged as a half-coupling, which can be coupled to that of a dynamo or any other machine.

The huge crowd of nuts required for the model formed too big and too long a job for home manufacture, and were therefore obtained from 117, City Road. Mr. Whitney also supplied the small gunmetal fittings.

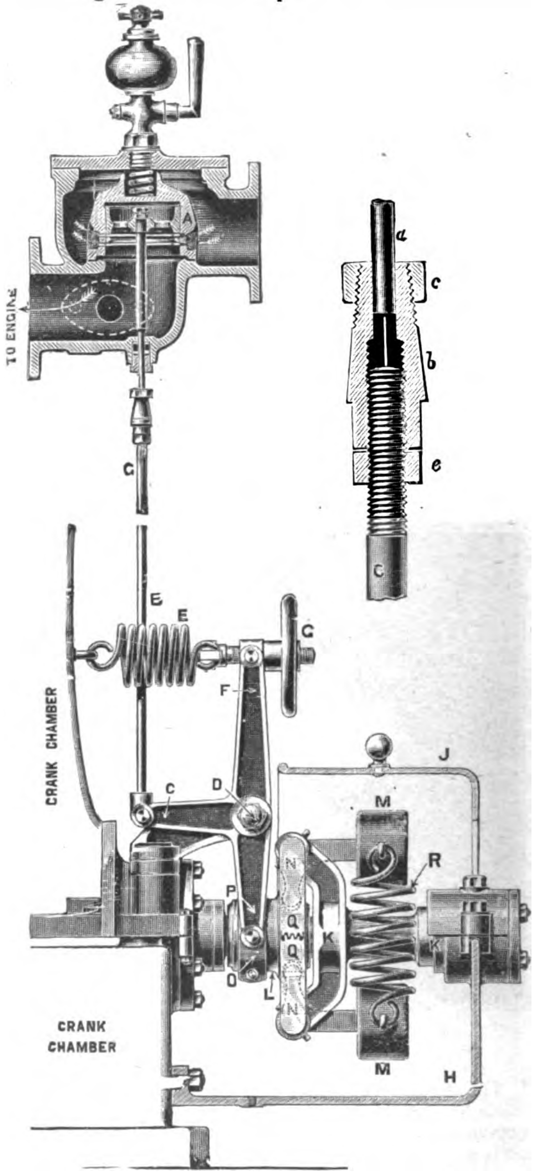


FIG. 2.—CENTRIFUGAL GOVERNOR OF "WILLANS" ENGINE.

Fig. 1 shows one line of the engine in section—the governor end line.

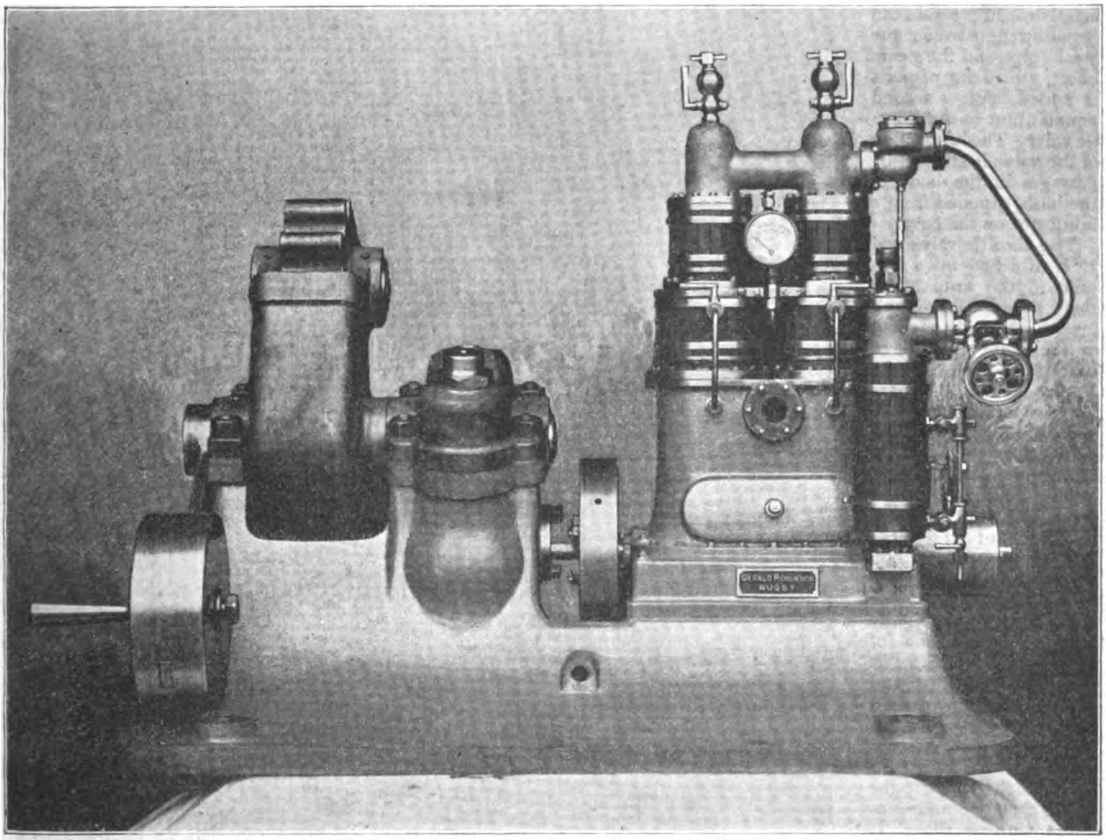
The live steam enters the steam chest through the throttle valve. The valve 1 separates steam from the H.-P. cylinder when A is cut off, and keeps a constant thrust on the line of valves by means of the steam-pressure above it.

When the piston is at the top of its stroke, steam is admitted through A, which is open to the steam-chest, it passes down the hollow trunk, and enters the H.-P. cylinder through ports B, and continues to do so until A is cut off by the H.-P. steam gland. At the bottom of the stroke, by the lead of the eccentric, valve 2 is above port B, the steam exhausting through B down the trunk into the L.-P. receiver through port C. Valve 3 being above port D, which is now open to the L.-P. receiver, steam passes down the trunk and is admitted to the L.-P. cylinder through port E, and continues to do so until port D is cut off by the L.-P. steam gland. At the bottom of the stroke, valve 4, by lead of the eccentric, is above port E; steam, therefore, exhausts at E, passes down the trunk and out at F into the exhaust chamber, and passes out through G. The cut-off in the H.-P. cylinder can be made earlier by putting in rings or distance-pieces under the steam gland so as to raise the gland ring.

The engine being a single-acting one, an air buffer is fitted to keep the lines of moving parts down on the bearings on the up stroke. This is formed by a guide piston K fixed on the bottom end of the trunk, which runs in a guide or air buffer cylinder H. On the top of the stroke air is compressed against the air buffer cover M, which contains a gland to prevent leakage to the exhaust chamber.

The crosshead pins L, to which the connecting-rods are coupled, are driven into the guide piston and fixed by means of set screws, the eccentric rod passing up between them to the valve guide O, containing the eccentric rod pin.

The H.-P. and L.-P. pistons are of cast-iron, and are fitted with cast-iron rings and springs of the usual Willans pattern. These are slipped over the trunks and pushed down on the shoulders shown in Fig. 1, bringing the under surface of the pistons level with the top edge of the exhaust ports C and F, which are exactly square; clips are then fixed on the pistons and clamped against the ports, drawing the pistons down tight on the shoulders, thus fixing them firmly in position.



MODEL "WILLANS" ENGINE. (Front View.)

The steam and air buffer glands are also fitted with cast-iron rings and springs.

Fig. 2 shows the centrifugal governor connected to the throttle valve, which is of the piston type, without rings, and works up and down inside a cylindrical bush A. The bush, which has a closed top, is held down by a stiff-coiled spring, and by the steam pressure, and its lower end, which is faced, makes a steam-tight joint against a face on the casing, as shown (the object of this arrangement is to give freedom for expansion in the bush). The boiler steam is admitted from the outside of the bush, in which there are usually two rings of ports, the amount of opening through the lowering ring being regulated by the position of the lower edge of the throttle valve.

Corresponding with the upper ring of ports is an annular port in the throttle valve; the distance of this from the lower edge of the throttle valve is such that the upper port commences to open slightly earlier than the lower one. Occasionally only one ring of ports is used, while in cases where, owing to lowness of pressure, or other causes, only a very small drop in pressure can be allowed between the steam pipe and the steam chest, a third ring of ports is added, with a second annular port in the throttle valve. The lubrication of the valve is effected by passages in the body of the bush, supplied from a lubricator on the cover.

The throttle valve rod B is attached by a pin joint to the arms C of two similar bell-crank levers, which are pivoted at the point D upon a bracket bolted to the crank-chamber. There are two springs (E) attached at one end to the crank chamber, and at the other to the arms (F) of the levers through a screw and hand wheel G, by means of which the pull of the springs upon the upper end of the lever F can be varied. The governor spindle is rigidly attached to the end of the crankshaft, and forms a continuation of it, and its outer end is carried by a bearing in the "governor guard" H, which consists of a cast iron trough bolted to the crank chamber and provided with a cover J, opening on a hinge, so that the revolving parts are perfectly accessible.

The revolving parts consist of a sleeve and pair of brackets (KK) in one casting, and of a short sleeve or collar L, both mounted upon the spindle. KK is free to slide lengthways upon the spindle, but is compelled to turn with it by means of a feather. The brackets KK carry the governor balls MM, which are mounted upon bent levers, whose short ends NN fit into a circular groove in the collar L. L is compelled to turn with the arms NN by short pins placed across the groove.

O is a second collar loose upon the collar L, but not able to move longitudinally upon L, because it lies partly inside a deep circular groove in it, while it is also prevented from revolving with it by the arms P of the two levers mentioned above, to which it is pivoted. The levers QQ are rigidly attached to the arms which carry the balls, and their free ends are geared together as shown; by this means the governor is balanced against the action of gravity. The levers QQ form, in effect, segments of two ordinary gear wheels.

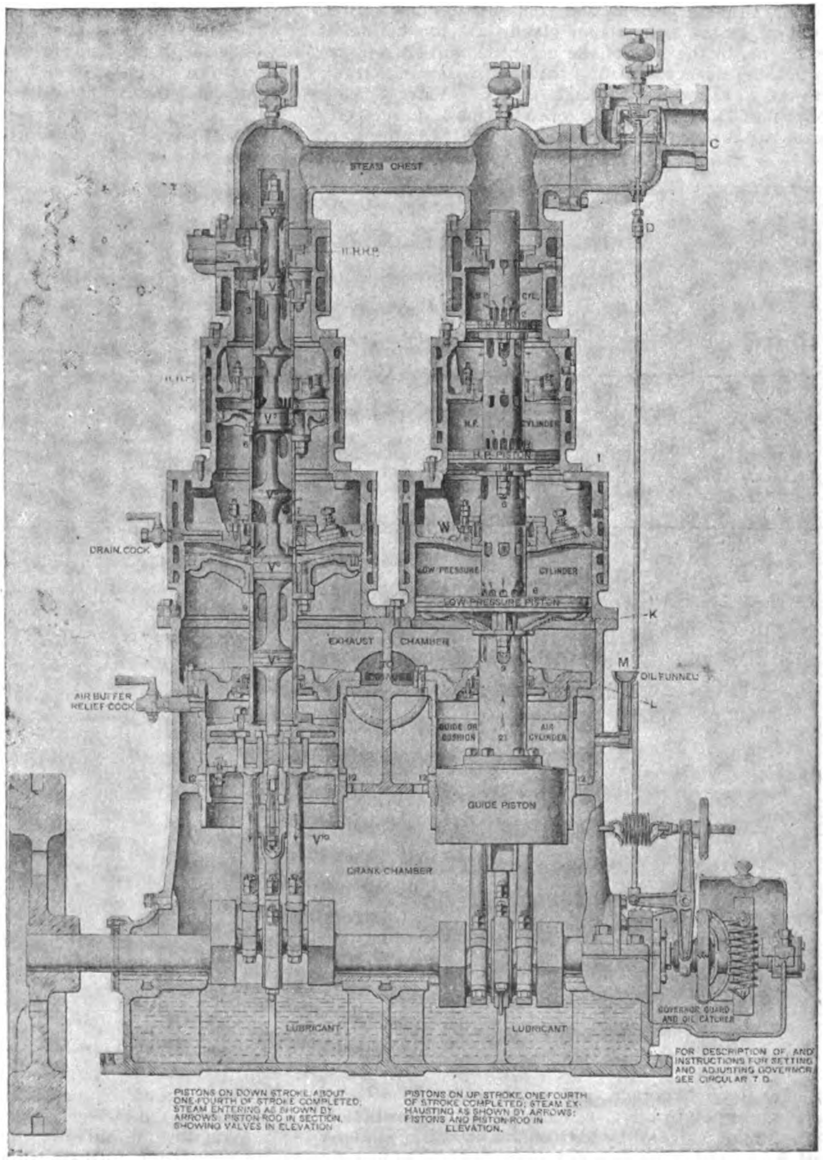


FIG. 3.—SECTION THROUGH A "WILLANS" CENTRAL VALVE TRIPLE EXPANSION STEAM ENGINE.

The action is as follows: The springs E acting through the levers FP and the collar O, keep the collar L constantly pressed against the arms NN, and consequently the bracket and sleeve KK constantly pressed against the end of the bearing in the governor guard, which is faced to work against a collar upon the end of KK. The revolving parts of the governor are, therefore, kept steadily in one position, endways, unaffected by end play in the spindle or crankshaft.

The springs E also, by their pressure upon the arms NN, supplement the centrifugal force of the governor balls, and assist them to move outwards against the resistance of the springs R. As the arms NN move outwards, the collar and cam follow them up, and permit the spring E to draw down and close the throttle valve more or less completely by means of the arm C. The relation between the centrifugal force of the balls, assisted by the tension of the springs E and the tension of the springs R, is such that at the intended speed, the balls assume the position which gives the proper opening to the throttle value for controlling the engine. If the speed, for any reason, such as reduction of load or increase of boiler pressure, begins to exceed that intended, the balls move farther apart, and the throttle valve is partially closed until the speed falls again. If, on the other hand, the speed diminishes, the balls are drawn together by the springs R, the springs E are overpowered, and the valve is opened.

If more tension be put on E by means of the handwheel G, the engine will run slower; if less, faster.

On its trial run the model developed 1 b.h.p. when running at a speed of 1000 revs. per minute, and non-condensing.

The model was originally coupled to some barring gear, and was afterwards fitted to a small Crompton dynamo, and was exhibited at the Glasgow Exhibition of last year. At the close of the Exhibition it was lent to the Board of Education, and now stands on view in the Engineering Section of the Victoria and Albert Museum at South Kensington.

The photographs show the model coupled to the barring gear mentioned above; being very close to the camera, the engine looks somewhat large, but its total height from the bottom of the engine bed to the top of the steam chest, is about 20 ins. The length of the engine bedplate is 12 ins.

Fig. 3 shows a Willans central valve triple expansion engine in section. From this can be seen all the details of the moving parts.

Two Simple Forms of Resistance.

THE *American Electrician*, quoting from the *Zeitschrift fur Elektrochemie*, describes two simple forms of adjustable resistance, one for dealing with fairly large currents, and another for small currents. The first is a metal resistance designed by Haber, and used by himself and Geipert in an experimental investigation relating to the electrolytic reduction of alumina. By its use the danger of overheating and of fire is said to be entirely avoided. Fig. 1 is a sketch of this apparatus. It consists of a large number of nickel tubes, placed parallel and joined at their ends to one another by U shaped couplings. The end tubes are joined by rubber tubing to some water supply and to the waste pipe. The gaps between the neighbouring tubes are provided with sliding bridge pieces of brass or nickel, which can be fastened by a thumb-screw in any desired position. When all the bridge pieces are at the top end of the resistance, the whole of the current passes direct to the apparatus through the heavy U-shaped couplings and the bridges, whereas when all the bridge pieces are at the bottom of the resistance, practically the entire length of the nickel tubing has to be traversed by the current. By adjusting the various bridge pieces the current can be regulated within

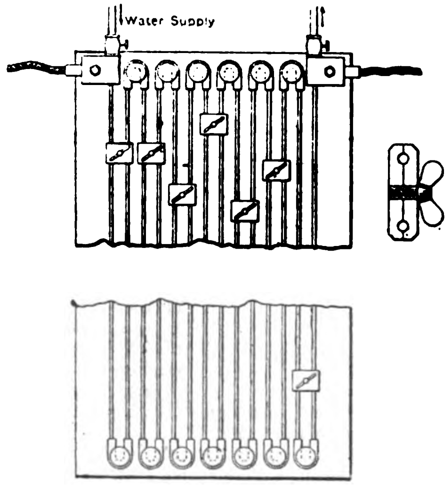


FIG. 1.

very close limits; and as the nickel tubes are kept cold by the constant flow of the water through them, the trouble caused by the variations due to heating in the ordinary forms of resistance is avoided. The second form of resistance is of the liquid type, as shown by Fig. 2. The U tube in which the resistance liquid is contained is formed with enlargements at its upper ends, and is provided with an elongation at the bottom of one leg and an escape cock at H. The mouth of one leg is covered with a flat cork disc at K, and through this the glass rod G slides easily. The electrodes are fused in the glass at E_1 and E_2. The variation in the resistance is effected by sliding the glass rod G up and down in the tube containing the electrode E_1. As shown in the diagram, the rod G nearly fills the narrower part of this tube, and only a very thin body of liquid is then present by which the current can travel from W_1 to W_2. By using a modified form of the apparatus with two additional legs containing sliding rods, and with electrodes connected in parallel, it is possible to regulate the current within very wide limits.

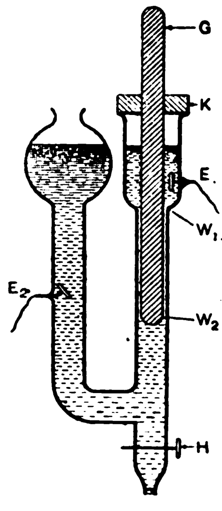


FIG. 2.

A CROSSED BELT increases the grip and consequently the transmitting power of the belt considerably. This is especially the case when one pulley is much smaller than the other, but, of course, there is more wear on the belt.

How to Become an Electrical Engineer.

By FREDERICK H. TAYLOR, A.M.I.E.E.

FREDERICK H. TAYLOR, A.M.I.E.E.

FREDERICK HENRY TAYLOR, Associate Member of the Institution of Electrical Engineers, is the younger son of the late Mr. William Thomas Taylor, of the London Stock Exchange. He was educated privately in London, and subsequently commenced his professional studies under Professor Silvanus P. Thompson, F.R.S., at the Finsbury Technical College of the City and Guilds of London Institute. After obtaining the college certificate, he was engaged upon various classes of installation work in and around London, and saw some of the earliest installations put down. He then became the private pupil of the late Mr. John Muirhead, M.I.C.E., of Westminster, whose firm, Messrs. Latimer Clark, Muirhead & Co., Ltd , were amongst the pioneers of the electric lighting industry in this country. On the expiration of his Articles, he was engaged upon the erection of the central generating station at Preston, which was one of the enterprises of his firm, and which is now supplying electric energy to the equivalent of upwards of 30,000 lamps, and ranks as one of the earliest stations in this country. After settling again in London, Mr. Taylor was engaged for some time on his own behalf in carrying out numerous electric lighting installations for public and private buildings. His taste, however, for a more purely professional life, induced him to join hands with an early contemporary of his—Mr. J. Hermann Field— and he then initiated his present practice as a consulting electrical engineer in Victoria Street, Westminster. He has since been retained as electrical adviser in various electric light and power installations, both private and for public bodies. As an expert witness, he has figured in many very interesting electrical "fights."

Mr. Taylor is the evening lecturer in the subjects of Electric Lighting and Transmission of Power, at both the Willesden and Tottenham Polytechnic Institutes of the Middlesex County Council.

THE best course to pursue in order to become what is popularly termed an "electrical engineer," is a question which is a good deal more far-reaching than is commonly supposed; and this is due to the ever-widening field occupied by the operations and uses of electricity. Scarcely a week of time passes by without one's being told that "electricity is still in its infancy." Hearing of this fourteen or fifteen years ago was not surprising; but to-day one is apt to wonder how it is that the non-electrical mind is so sadly misinformed. Probably, however, the reason for such a comment is to be found in the fact that, in these days of continual hurry, the majority of persons have neither time nor opportunity of really grasping the extent of electrical work in the present day.

In the light of above, a brief preliminary review of the scope of electrical engineering, and of the directions in which development is principally taking place, will probably assist the reader in his consideration of the subject.

Broadly speaking, one may divide up the electrical industry into the following departments :—

1. Electric lighting, which includes the lighting of towns from "central stations"; isolated lighting by private plants for factories and large public buildings; house wiring and fitting; ship fitting, etc.
2. Electric traction—including tramways, railways, and auto-cars.
3. Power transmission, and its distribution over large areas.
4. Telephony and telegraphy.
5. Electro-chemical work.

Electric lighting, both by "arc" and "incandescent" lamps, is now regarded as one of the common requirements of modern civilised life. From more or less unsuccessful attempts in what are known as the "early days" (1880 and 1882 or thereabouts), this section of the electrical industry has grown until the capital sunk in it is now represented by about thirty-seven million pounds sterling.

In Great Britain alone there are now over three hundred electric "stations" erected and working for the generation of electric energy for lighting and allied purposes in towns and cities; and of these no less than fifty-two are in London and the surrounding neighbourhood. From the price of 8d. per "unit," as commonly charged under the Electric Lighting Acts of 1882 and 1888, this being the maximum charge allowable, electric energy is now often retailed to the consumers as cheaply as 4d. per unit, and even less in districts which are favourably situated for its economical generation.

From being the luxury of the wealthy, electric lighting has in as short a period as ten years become the common every-day requirement of the middle and more numerous classes of society. In London, the electric light is now provided in some of our tenement dwellings through "penny-in the-slot" meters.

In view of such developments as these, we can with happy minds reflect upon the thoughtful complaint of our gas friend—that electricity is eight times as costly as its own fragrant compound, and still "in its infancy."

The various sections or departments of electric lighting work open up now a considerable field for employment for those who have taken up the profession for a livelihood.

Turning our attention to the world of "central lighting stations." Stepping down from the chief or resident engineer, who is in charge of the whole undertaking, several assistant engineers must needs be employed, the number depending upon the size of the particular station selected. Additionally also there are usually required those whose duty it is to take turn in charge of a "shift." Thus if three "shifts" are in vogue, each shift engineer would have to take charge of the station running for eight hours per day, the actual hours during which he would be on duty varying from week to week.

In addition to the foregoing staff, a moderate sized central station requires a distributing engineer, mains engineer or superintendent, and switchboard attendants.

The manufacturing and contracting side of electrical work provides an extensive field for employment, and offers probably a more varied experience than does the fixed and regular class of duty, inseparable from central station routine. Many large firms, originally established for mechanical engineering practice only, have, with the advent of electrical development, added a new department to their works for the manufacture of electrical apparatus and carrying out of electrical contracts, not only in connection with central lighting stations, but also for the numerous isolated installations which are required for the lighting and power equipment of factories, and large institutions and public buildings, which, either from their size or distance away from a central station, find it desirable to instal their own machinery for the generation of electrical energy.

A section of the electrical industry which has seen enormous growth during the last few years is that known as electric "wiring and fitting." Wherever a central station is started up in a given town or district, the houses and shops of the community open up a field for those who make a special business of "wiring."

In the early days of the industry this work essentially went to the firms in London or other large cities, already established for the purpose, but with the spread of technical education and consequent supply of properly-trained electrical engineers, it is now quite common to find a very respectable proportion of the work in the hands of the local tradesmen, such as builders, house furnishers, and gas fitters, who have met the needs of the case by opening an electrical department under the direct superintendence of a qualified electrical engineer.

Two classes of interior lighting work, which, from their nature, are special to themselves, are ship work and mine or colliery lighting.

The electric light on board ships is now regarded as a necessity by all the important steamship companies, owing to the advantages of safety and convenience, which cannot be obtained from other systems of lighting in this particular work.

Electric Traction, &c.—Since the passing of the Light Railways Act electrical engineers have been able to turn their attention to the hitherto sadly-neglected question of electric tramways.

In Great Britain there are now over eighty electric tramways in operation, and something over forty either projected or in course of construction. For the operation of underground, or "tube" railways, as they are now popularly known, electricity is so far without a rival; and for our ordinary surface railways also there is not the least doubt that it will, in the near future be employed. Just as power-generating "stations" are required for town lighting work, so also, of course, a station or stations are requisite for the operation of a tramway, "tube," or surface railway.

Each of these stations demands the employment of electrical engineers for its operation, and the staff is none the less important or numerous than that of a station devoted to light work only.

Many towns in the present day put down what are known as "combined" stations, or stations devoted to supplying electric energy both for tramways and lighting purposes, as this method of working presents certain advantages.

Probably at the present moment there is no branch of the electrical industry which is receiving such attention and advancing so rapidly as traction, although how long the present rate of progress is likely to be maintained, is, of course, a matter of some conjecture; but from the reader's point of view, this very progress is essentially an important factor.

Electric traction on common roads—that is, by motor-cars carrying their own source of power with them—is a subject which is slowly perhaps, but none the less surely, progressing, since the revision of the law relating to motor-cars in this country in November, 1896.

At the present time, the use of electric motor-cars is, practically speaking, restricted to large towns or cities, where accommodation is at hand for re-charging of the storage batteries carried; but in spite of their disadvantage for long-distance runs, their use is extending as improvements continue to be made.

Power Transmission.—The transmission of power from one place to another, is, from many points of view, one of the noblest engineering tasks ever allotted to man. Where distances are concerned, electricity appears to be the only method at present likely to be generally adopted, owing to the enormous advantages which it possesses.

Probably, the best known instance of electric power transmission is that of the Niagara Falls, where thousands of horse-power are every day being transmitted to Buffalo City, there to be used for all the various industrial purposes of which electricity is capable.

At the present time, however, various other large schemes for the transmission of power by electricity from places where its generation may be carried on at a low cost, to towns and cities where a demand for cheap power exists, are being either projected, or are in course of construction.

In Great Britain we have, for instance, such concerns as the Midland Electric Power Corporation (now laying down large works for the purpose of supplying electric energy in "bulk" to towns and districts for lighting or power purposes); the Derbyshire and Nottinghamshire Electric Power scheme; the County of Durham Electric Supply scheme; the Clyde Valley Electrical Power scheme; the Shannon Water Power scheme, &c. The British Dominions over the seas, being often more favourably situated than the Mother Country in possessing natural water-power, also have many large and successful power transmission schemes—South Africa, British North America, and New Zealand being amongst the number. As these early schemes develop, they will doubtless be followed by many others, and thus open up an additional field for the work of electrical engineers. The transmission of power to machine tools in mines and collieries and large factories is rapidly coming into favour, as its advantages become now clearly shown. As a proof of this, one has only to glance at an electrical trade directory and notice the wonderful increase in the number of firms or persons now specialising in electric motors, over that prevailing, say, three or four years ago.

Telegraphy and Telephony.—The oldest branch of the electrical industry may safely be looked upon as that of telegraphy. Our own Institution of Electrical Engineers was originally formed as the Society of Telegraph Engineers and Electricians, and for many years existed as such.

The field for employment in telegraph engineering is often looked upon as being much more limited than those of electric light, traction, etc. This may to some extent be so, but telegraphy should certainly be considered as one of the departments of the industry to which the student may look forward with hopes of remunerative employment.

The latest form of telegraphy, that in "wireless telegraphy," so called, will, it is believed, be subject to many great developments within the next few years. Although commercial men may look upon it as being at present largely experimental, no one can shut his eyes to the facts that telegraphic communication on this system is already in practical use on a good number of ships and on land stations.

Telephony, the sister industry to telegraphy, is at the present time the subject of very active development. Owing to the British Post Office now granting licences to municipal bodies to set up their own local exchanges, the use of the telephone is being very largely extended. Several "municipal" telephone systems are already laid down, such as Glasgow and Tunbridge Wells, whilst Brighton, Belfast, and Huddersfield have obtained licences, and many other towns will doubtless follow suit.

Electro-chemistry.—The use of the electric current for procuring chemical changes is a pretty old one, electro-plating and gilding having been practically used some sixty years ago. Amongst the electro-chemical industries now carried on may be included silver, gold, and nickel-plating, copper refining, galvanising (or zinc depositing), the electro depositing of iron, and the electrolytic production of alkalies and bleach, &c. For the student of a chemical bent, this branch of the industry offers a splendid field for work, as the applications of electricity to chemical production are capable of very considerable development. The Birmingham district particularly possesses many works engaged in electro-chemical processes such as those mentioned.

(To be continued.)

For the Book-shelf.

[*Any book reviewed under this heading can be obtained from* THE MODEL ENGINEER *Book Department, 6, Farringdon Avenue, London, E.C., by remitting the published price and cost of postage.*]

THE CONQUEST OF THE AIR. By John Alexander. London: S. W. Partridge & Co., 8 & 9, Paternoster Row, E.C. Price 1s. 6d. Postage 3d. extra.

"To sum up: the ordinary balloon will only be partially directable when the air currents have been charted; the *ballon dirigible* of the Zeppelin and Santos-Dumont type will never be controllable in strong head winds; to the 'heavier-than-air' machine, using aero-planes on the Maxim principle, or some other invention, we must look for the final solution of the problem of aerial navigation." These, the closing words of the author, express in simple language the conclusion reached by the most scientific aeronauts of the present day, and indicate what a long road has yet to be travelled in order to accomplish the end. Only a marvellous degree of pluck, nerve, and hopefulness will avail the inventor who himself would achieve the "conquest of the air," but fortunately it is just that combination which appears to belong to the majority of those who have already tried. It is exciting reading—this story of man's endeavour to reduce the regions of the air beneath his sway; and the tale is very well told in Mr. Alexander's book. It is historical, descriptive, and to a large extent explanatory. Sir Hiram S. Maxim has prefaced it with a few remarks to the effect that he has received a vast amount of correspondence from would-be inventors of navigable airships, and finds the present volume a handy one to recommend to these enthusiasts, most of whom lack knowledge of what has already been performed. Its price also justifies us in suggesting that all our readers would find the book a very happy investment.

THE LENS. By Thomas Bolas, F.C.S., F.I.C., and George E. Brown, F.I.C. London: Dawbarn and Ward, Ltd., 6, Farringdon Avenue, E.C. Price 2s. 6d. nett. Postage 3d. extra.

To the photographer who wishes to gain some special knowledge of the uses and properties of lenses as used in his ordinary work, this book should appeal, since it does not demand any mathematical knowledge outside what may be regarded as one's ordinary equipment in that respect. While this indicates to some extent the nature of the book, it must not be supposed that its scope is so limited, and, in fact, the information conveyed in its pages would be specially valuable in the selection and proper use of a lens; indeed, this is, perhaps, the more important intention of the work. The authors have made free use of technical works on the subject, and a clever Continental writer is laid under contribution for at any rate part of the methods adopted in the present volume. We have no doubt whatever that practical photographers who wish to understand the *modus operanai* of the lens will find this a very handy manual.

THE MOTOR BICYCLE. By R. J. MECREDY. Dublin: R. J. Mecredy & Co., Ltd., 2, Dame Court, Dame Street. Price 1s. Postage 1d. extra.

This is a handy booklet in stiff paper covers, containing general information for the motor-bicyclist. It is, consequently, written as simply as possible, although the effort to write simply on what are really deeply technical matters does not always succeed. This is particularly the case with the electrical section—generally a *pons asinorum* for authors of motor car books! In the present instance the paragraph devoted to the induction coil, for example, had much better have been omitted; it states only half-truths, and that not clearly. On the whole the book will, however, serve its purpose well enough. It is portable, well printed, and the diagrams are clear.

ELEMENTARY TREATISE ON PHYSICS. Ganot. Sixteenth Edition, edited by A. W. Reinold, M.A., F.R.S. London: Longmans, Green & Co., 39, Paternoster Row. Price 15s. Postage 6d. extra.

A new edition of Ganot's standard work on physics would seem to be necessary at a time when several important discoveries and many considerable developments have taken place. In spite of the fact that the volume is primarily intended to be an elementary treatise, dealing with fundamental and general laws rather than with the every-day applications of physical science, it would be impossible to regard as satisfactory a work which did not include, for example, a description of wireless telegraphy and Röntgen rays (in its electrical section), or of modern researches in the liquefaction of gases. These, and other recent developments in scientific matters, have received due consideration at the expense of descriptions of obsolete machines, and the volume can therefore be described as "up-to-date," if that is not too irreverent a way to speak of a book that is anything but ephemeral in character. On one point we are at variance with the editor of the volume. It may be that some students prefer the indexing of paragraphs rather than of pages; but for our part, we regard it as a much less practical method, and one that tends to waste of time.

CYCLOPÆDIA OF MECHANICS. Edited by Paul N. Hasluck. Second series. London: Cassell and Company, Ltd. Price (cloth) 7s. 6d. Postage 6d. extra.

This, like the previous volume, is a large, closely printed book of 350 pages of recipes, processes, and memoranda. It is intended for workshop use, especially where a considerable diversity of work is carried on, and its contents have been extracted from the pages of *Work* and the *Building World*. The book would be of the greatest utility to those in out-of-the-way districts, in the colonies, or in any place where a handy and intelligent man is called upon to carry out work of a character unusual to him. A good feature is a very copious and carefully compiled index—an absolute necessity in a volume of this kind. It should be in every public library, and in the hands of all those who come within the foregoing category.

How to Make a Lever Switch.

By J. A. B.

CUT out pieces like A, B, C, D, Fig. 1, from thin cardboard. A suitable size to make A is 1⅝ ins. from centre to centre of holes; B, ⅜ in. between centres, and 1¼ ins. long; C, 9·32nds in. between centres; D, ⅝ in. between centres of holes in base, and all—except C—⅜ in. wide. Now arrange all the patterns on a piece of 3·64ths in. hard sheet brass to make as little waste as possible; mark round each with a sharp point, then cut them out with a fret-saw, keeping well outside the lines. File up carefully to the lines (but do not "paint the pieces pea-green" !!).

If the surface of the brass is good, clean up with a toothbrush charged with rotten-stone mixed with oil, which may afterwards be washed off in benzoline, using the same brush, but be careful where it is done, as the benzoline is highly inflammable. If the surface is rough, the best way to get it up is to tack a sheet of fine emery cloth on a flat piece of wood and rub the pieces on the same.

Now make the handle E from a piece of 3-16ths in. rod; turn the pin to fit a ⅛-in. hole in one end of the lever A; rivet in with a nice round head, and file down the edge of the lever near the rivet, so that it will mount the piece B easily by the bevelled edge, and the rivet will then form a good rubbing contact on the same. Obtain a terminal like F, take off the top nut, apply soldering fluid and a small piece of soft solder to the largest side of the other nut, and then screw. Hold in the flame of a spirit lamp until the solder soaks through, then wash well in water, dry, and turn down the nut as H, making the height of the shoulder 1-32nd in. *less* than the thickness of *three* pieces of the sheet brass you are using; turn down the screw as at K, and rivet it in the centre hole in the base of D.

Next make two washers like M, the hole an easy fit to the pin H. Then make the piece C, the large hole in this being also an easy fit to the pin H. Place C on the pin H, also the two washers M, put on the nut and screw on tight; then run a small drill through both C and D at N, unscrew, take off C, and fit and rivet a small pin in D at C; then open the hole N so that it passes easily over the pin. Drill the large hole in A so that it is an easy but close fit to the pin H.

All parts should now be rubbed up with a duster and some whiting, and then be coated with pale gold celluloid lacquer, and, when dry, mounted on a board, with round-head brass ⅛-in. screws, as shown at Fig. 2.

When fixing the connecting wires, twist round, as shown at the top of switch, hammer flat, place under, and screw down tight. Make a paste of powdered blacklead and sperm oil, and rub a small quantity round the hole on both sides of the lever A, put the lever on the pin H, then put on C, and then one of the washers M, and the nut, and screw up until the switch works nicely. Also drive two brass pins in the board, as shown, to act as stops for the lever.

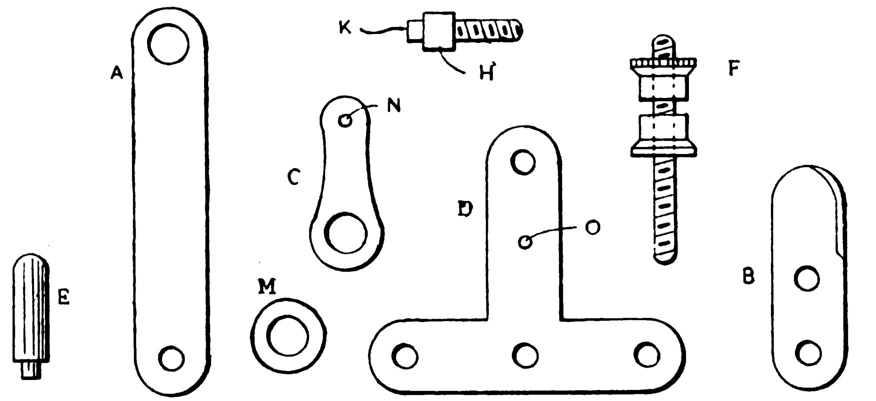


FIG. 1.—PARTS FOR MAKING SWITCH.

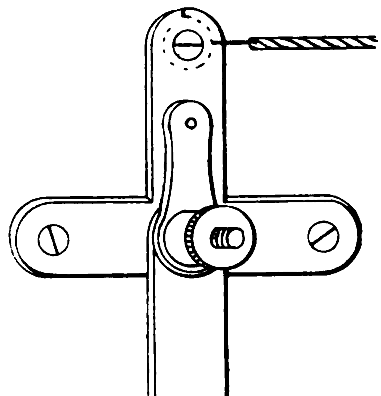


FIG. 2.—COMPLETE SWITCH.

The Motor Bicycle: Its Design, Construction and Use.

By T. H. Hawley.

II.—On the Various Positions in which the Motor can be Attached to the Bicycle Frame, etc.

A MUCH disputed point at the present moment is the position of the engine on the bicycle frame—not only regarding its effect on the stability of the machine, but with respect to the working of the engine; another factor, having considerable bearing on the subject, being the method of transmission.

The possible number of variations in engine position, too, are naturally limited in cases where the bicycle is of the ordinary accepted standard design; but where the bicycle takes a special form to accommodate a special motor, then the variations may be very numerous, and a great many designs are now on the market, whilst new combinations continue to appear at very short intervals, so that the intending purchaser or constructor of the complete machine might well be bewildered by the number of contradictory designs and the obvious similarity and close resemblance of others.

With regard to this latter class, which is by far the largest, it is clear that many of the recent designs show a new position for the engine for no other reason than being different to others; and indeed it would appear that every conceivable position round about the bottom bracket, short of actually turning the engine upside down, has been adopted by one maker and another.

Out of all this chaos, however, it is clear that there must be, within small limits, a best position, which will be evolved and determined by the combined effects of the conditions named.

For instance, it may be that some new form of transmission will definitely fix the motor to the rear of the crank bracket and seat post; meanwhile, experience may have taught us whether the vertical, the horizontal, or some intermediate position of the cylinder is best for durability and efficiency of the valves and piston.

At present the vertical position, or a diagonal nearly approaching it, is decidedly in favour; but it is more than likely that ease of adaptation to existing cycle frame design had a great deal more to do with the matter than considerations of engine efficiency, and many clever engineers are in favour of the horizontal position, their views finding some backing by the almost universal horizontal position of the cylinder in the stationary gas engine.

Students of purely steam engineering practice are apt to get considerably adrift in their arguments through not thoroughly grasping the different conditions under which the gas motor works, particularly when that motor is of the small high-speed air-cooled variety, the subject of greatest moment being efficient lubrication of the cylinder at excessive high temperatures, so that this point must not be lost sight of when deciding on the position of the engine on the frame, for it is obvious that a cylinder placed vertically right in front would be better positioned for keeping cool than if fixed in the rear, and more or less sheltered by machine and rider, and also that with the present pattern of radiating webs the vertical is more effective than the horizontal position.

A great deal of conflicting evidence is to hand as to the effect of placing the engine high or low, with relation to the centre of gravity, and although the balance of the argument is in favour of keeping the weight low down, it should be remembered that the rider himself is placed high, and weighs considerably more than the motor mechanism; but there is this difference, that, whereas the weight of the motor is a fixture, in relation to the machine, the rider is a moving weight, and his position determines the centre of gravity.

Personally, I am inclined to the opinion that placing the engine high or low does not affect side-slipping propensities to anything near the same effect as the consideration of which wheel is the driving wheel, and the length of wheel base; and in this connection, the balance of expert opinion is decidedly in favour of the rear drive and a long wheel base.

As to the rear drive, manufacturers would appear also to pretty well agree, as I am aware only of two makes in which the front wheel is the driver, the motor in each case being placed over the front wheel, and in front of the steering socket, turning, of course, with the turning of the wheel in steering.

That this type of front driving machine is more liable to side slip than the rear driver is generally admitted; but I think the mistake is commonly made of attributing this to the weight of the motor being placed high up in front; whereas, in my opinion, it has little, if anything, to do with the matter, the side slip being solely due to the fact of the steering wheel being also the driving wheel. And I am supported in this theory by the experience I had many years ago with one of the basket chair child carriers, which was fixed in exactly the same position over the front wheel, and with which I made long and frequent trips over all kinds of surfaces, carrying children of from four to six stone weight, yet without any mishap or suspicion of side slip.

A longer wheel base is undoubtedly desirable as a preventive to side slip, and also affords steadier steering when once a degree of speed is attained; my present machine is some 3 ins. or 4 ins. longer in wheel base than the ordinary cycle, and if I should build another frame I would add at least 2 ins. more, for other advantages would then be gained, such as increased knee space, greater latitude in position of handles and shape of bars, together with room for a petrol tank of 150-mile capacity and a spare accumulator.

Another factor which I believe has much to do with the stability and easy steering qualities of the machine is the amount of curve given to the ends of the front forks, in combination with the angle at which the steering socket is placed in relation to the road surface.

In the majority of existing machines the front fork curve brings the front wheel centre some 1½ to 2¼ ins. forward of the centre line of the steering post. What the exact distance should be for best all-round results is not accurately determined; but in relation to the motor bicycle, especially, the effect of increasing the curve, and thus the distance beyond say 2¼ ins., would appear to be to rather tend in the direction of increasing liability to side slip, and also making the machine unsteady for mounting and starting. But at high speeds and on dry surfaces a further increase of curve on front forks in combination with lengthened wheel base, would result in easier and more delicate steering by reason of the increased leverage over the road surface, and consequent quicker change of centre of gravity.

I think it necessary to place these matters before readers, so that they may think for themselves, and so be able to depart somewhat from the exact lines of the drawings I intend submitting, in case it should suit their convenience so to do, and this will particularly apply to such as may desire to attach a motor to an existing bicycle, which from some feature in its construction or design will admit of easy adaptation by fixing the engine in one position only, or that a choice of positions may greatly facilitate the work or reduce the cost.

The points, therefore, which would appear to chiefly affect the engine position are (1) the most efficient position for getting the greatest cooling effect from the air in combination with proper lubrication and uniform wear on valves, piston rings, and cylinders; (2) a position which shall give the minimum tendency to side slip; and (3) a position which shall allow of some efficient mode of transmission and control.

From the scores of designs on the market, I have prepared diagrams of a dozen selected systems for purposes of comparison on these all important points.

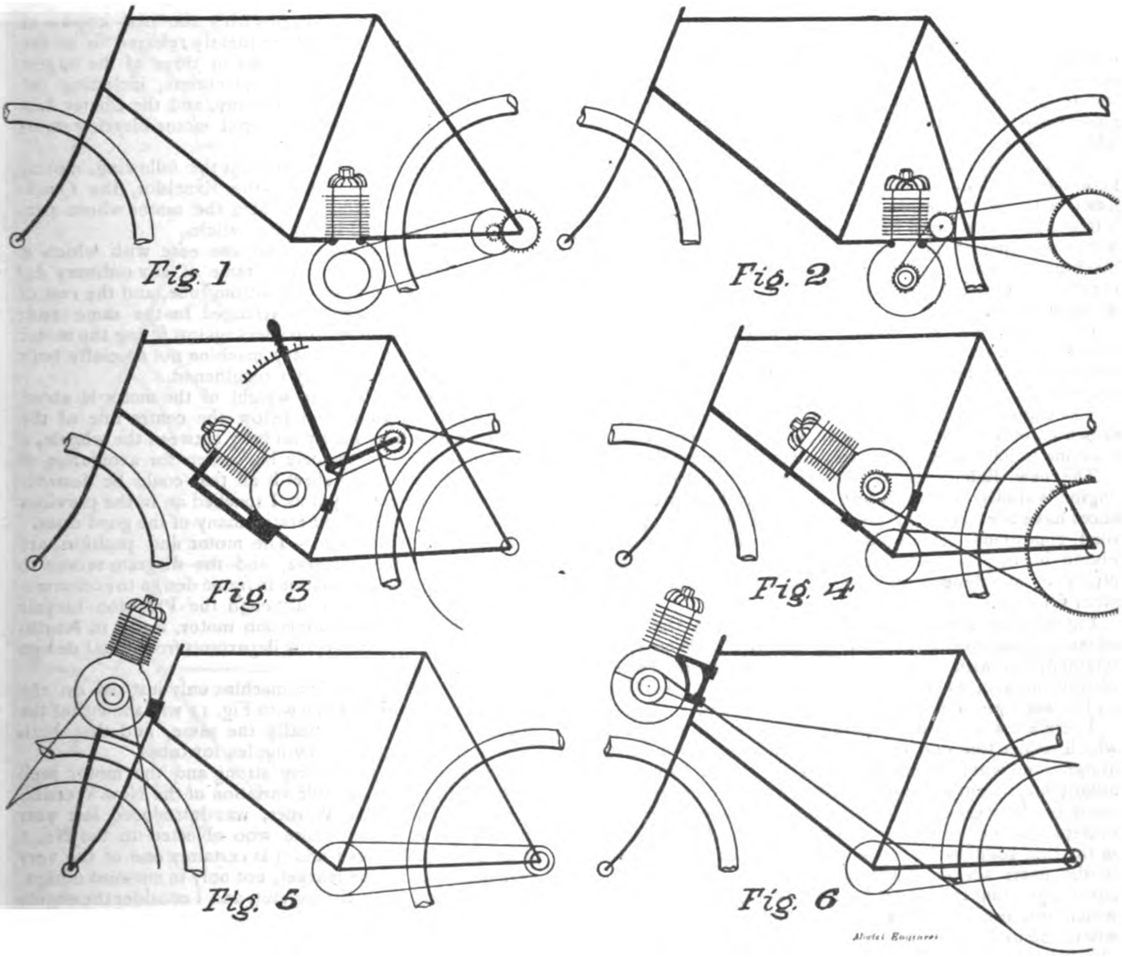
Fig. 1 represents the De Dion machine, which although not generally known and not "pushed" by the makers, presents certain features of interest, which, in part, accord with my own views.

The back frame is longer than usual, to accommodate the motor behind the seat pillar; the frame front is of normal length, thus the total wheel base is longer than usual; the drive is by belt to an expanding pulley, with rubber face, connecting to driving wheel by toothed reduction gear; pedals and cranks are fitted, but they are fixed, and act merely as foot-rests.

The good points about this design are—the large diameter of engine pulley as compared with most of the others, and consequent freedom from belt slip; adjustment of belt by expanding pulley, thus permitting the use of an endless or permanently joined belt; low position of engine and rigidity of support; frame front entirely clear for fitting large size tank, etc.

Messrs. De Dion Bouton, however, are now busy preparing an entirely new design, and which will be on the market shortly, though, as yet, few particulars are available; but it may be mentioned that the motor is characteristic and of entirely novel design, the contact-breaker mechanism, and the exhaust valve and cams, &c., being removed from the side of the engine and placed fore and aft, thus affording increased space for extension of engine crankshaft bearings, and greater all-round durability of parts.

Fig. 2, the Shaw, by Messrs. Shaw & Son, Crawley, closely resembles the De Dion in some respects, as the engine is placed in the same position; but in the original machine, as illustrated, the drive was by chains, first from motor to a chain wheel just clear of driving wheel, and thence to a large chain wheel attached to hub, no pedals being fitted, though in a later design I believe the chain drive has been abandoned, owing to frequent breakages,



FIGS. 1 TO 6.—ALTERNATIVE POSITIONS OF THE ENGINE.

and a belt drive substituted, with pedals and chain for starting the machine. The good points in this machine are—position of motor in combination with the additional stay tubes from saddle pillar to back stays.

Fig. 3, the Derby.—This machine was first constructed with the lever and quadrant, as shown, but with the short arm fitted with a grooved pulley, which could be brought into contact with the tyre, and so transmit power by friction, the pulley itself being mounted on the lever arm and chain driven from the motor pulley.

In the later pattern illustrated the mechanism remains the same so far as the small pulley; but a belt drive is substituted, and the lever serves to regulate the tension of the belt.

The motor is placed somewhat at a disadvantage for cooling purposes, but is most rigidly fixed to frame, and really assists in strengthening it. The good features of the design are facility for tightening belt whilst riding—a most important matter on long runs over hilly country, and the rigid fixing of motor.

Fig. 4, the Princeps.—The engine position and method of fixing to frame is almost the same as in the last described; but the transmission is by a single chain, and a free engine is secured by a gradual engagement clutch, which prevents chain breakage at starting, and allows machine to run freely down hill, at same time cooling engine, the clutch and combined positive drive being the strong features.

Fig. 5, the No. 1 Werner.—This was about the first motor bicycle to become popular, and is conspicuous by reason of its being the chief representative of the front-driver class.

The engine is mounted on a kind of platform, or fork crown extension, supported by duplex front forks. The machine is started by pedals and chain in the usual way.

The new Raleigh is another machine in which the engine is similarly placed, and some excellent performances have been done on this type of machine under good road conditions. Advantages of this design: Motor placed in very best position for cooling purposes, simplicity of attachment, and frame middle left clear for other fitments.

Fig. 6, the Royal Enfield.—Here we see that the advantageous cooling position of the No. 1 Werner is retained; but with the important deviation in the matter of transmission, which is by a long crossed belt working on the usual grooved pulley on the rear wheel.

There are a good many points in the entire machine, which render this one of the most successful of modern designs, the whole frame and also the motor being unusually massive in appearance, yet not unduly heavy; but many of these excellent features do not come under the present heading, so I shall simply state that the motor is in the best position for cooling, and is most rigidly fixed to the outer socket of the bicycle head. A very great advantage being the longer bearings to engine crankshaft, which this design allows of, but which is impracticable where the motor has to be fitted inside the ordinary width of crank tread. The long belt, too, is an advantage over a short one, and the crossing of the belt increases the gripping surface on the small engine pulley.

Riders who have used these machines state that the weight of the engine in front in no way affects steering, and does not induce side slips.

Fig. 7, the Holley.—This is quite a recent American importation, and, as the diagram discloses, is of novel arrangement in the matter of engine position, and the manner of securing the motor in the frame, but there are other good points differing from general practice.

A large malleable casting is bored out to form the ring of the crank-chamber, and this is brazed up into the frame proper; a flat belt is used and drives on a special wood pulley of extra large diameter, the belt pulley and tyre rim, indeed, being one formation of laminated wood, something similar to the Fairbanks wood rim; the extended lip or groove forming the belt pulley being just sufficiently smaller in diameter to well clear the ground and ordinary obstacles; the belt is adjusted by a jockey pulley, as shown, which is mounted on an adjustable frame attached to the back forks.

The good points in the design are—absence of fitting belt pulley to wheel in combination with the improved gripping surface of wood, and allowing of a larger pulley on the engine shaft; also great strength of frame, and fairly good cooling.

Fig. 8, the Minerva, is probably the best known of any modern motor, and is frequently referred to as the standard design of the day, two or three of the largest firms of cycle component manufacturers, including the Birmingham Small Arms Company, and the Chater Lea Company, having designed special motor bicycle sets to suit this motor.

The motor itself is also fitted on the following, among other well-known machines—the Excelsior, the Quadrant, the Phœnix, &c.; it is also the motor whose performance I described in my last article.

It is especially noticeable for the ease with which it may be attached to a bicycle frame of any ordinary design by its single clip on the bottom tube, and the rest of the equipment is similarly arranged to the same end; though I must again warn readers against fitting the motor in this fashion to an ordinary machine not specially built for motor work or specially strengthened.

It will be seen that the weight of the motor is about equally divided above and below the centre line of the wheels, and is also nearly midway between the wheels, a position which can scarcely be beaten for avoidance of side slip; the cooling effect is all that could be desired. Some of the defective points I touched on in the previous article, when I also enumerated many of the good ones.

Fig. 9, the Precision.—The motor and position are identical with the Minerva, and the diagram serves to show one method of variation in frame design to accommodate the Minerva motor, although the Precision bicycle itself is fitted with the Precision motor, made in Northampton, and in which many departures from usual design are to be found.

Fig. 10, the Aurora, is a machine only just put on the market, and a comparison with Fig. 11 will show that the engine position is practically the same, and that both frames are strengthened by duplex top tubes.

The Aurora frame is very strong and the motor well placed, but it is a palpable variation of the New Werner.

Fig. 11, the New Werner, was introduced last year to meet the wishes of those who objected to the No. 1 front-driving Werner; and it is certainly one of the very best machines on the market, not only in outward design, but in general merit throughout, and I consider the engine position to be about the best of the whole lot. The drawback to this design—from an amateur constructor's point of view—however, is that the engine is built into, and forms part of, the frame; so that a special design of both frame and motor is required. The drive is by belt, and the starting by pedals and chain.

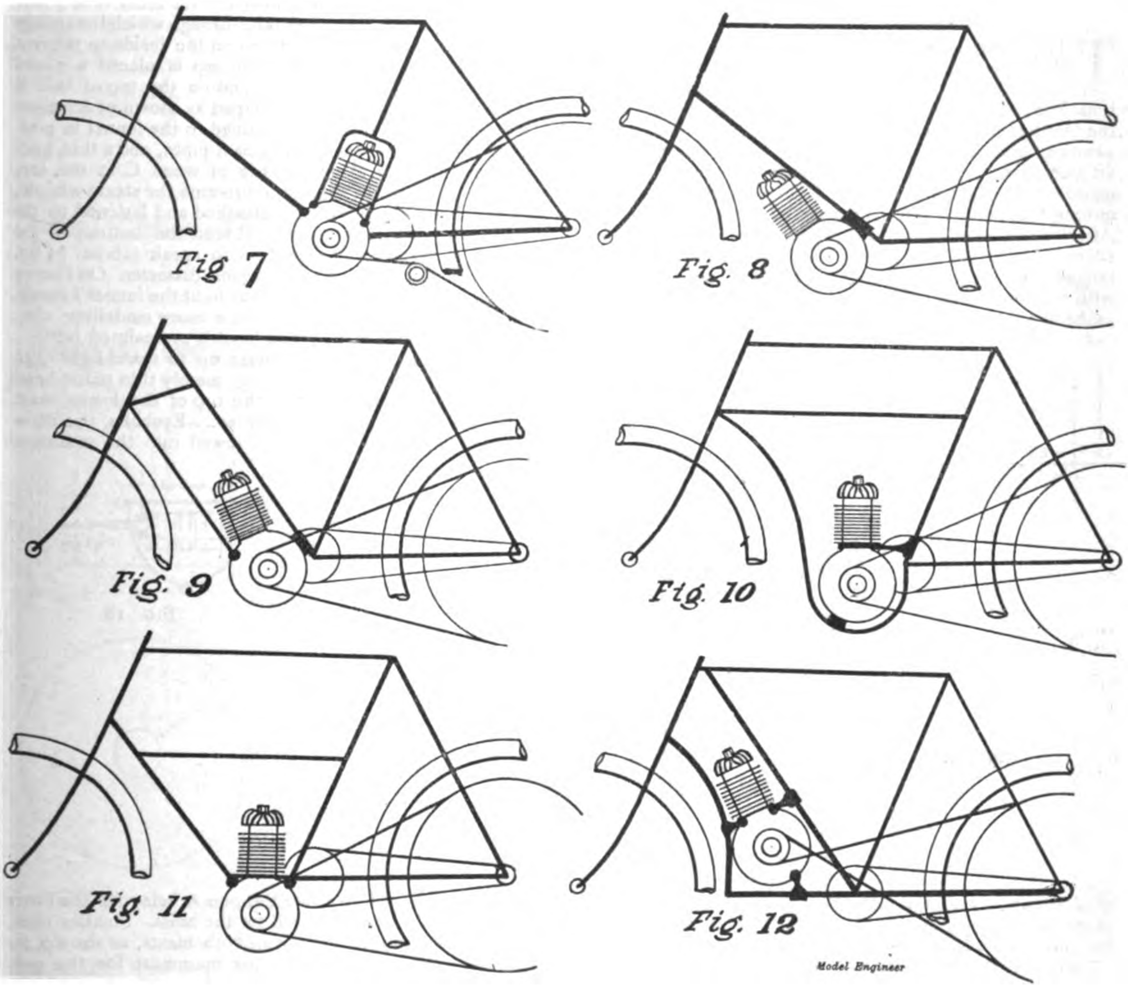
Fig. 12, the Chatfield, built by Mr. Chatfield, of Tunbridge Wells, is a rather attractive design, which has only just appeared. The motor is carried far enough forward to clear the crank throw, so that wider bearings and wider pulleys are used with great gain to durability and transmission. The drive is by a flat, crossed belt, 1¼ ins. wide, thus affording a good grip without undue tension. The belt rim is attached direct to the driving rim, and not to the spokes, as is usually the case. It will be seen that the points enumerated render this a good design where it

is required to fit a large power engine for trailer work, and the ordinary genuine De Dion motor of 2¾ or higher horse-power could be incorporated by the method of attachment shown.

I have endeavoured to bring out, both in the drawings and the descriptive matter, the best points of the various systems discussed; but it is obviously impossible to incorporate them all in any one machine.

on the general construction of Fig. 12, though not entirely approving of the crossed belt in this case, as the engine rotation is then, of course, in the opposite direction to the travel of the machine.

However, here is sufficient food for reflection for the present, and ample scope for readers to exercise their ingenuity in the direction of designing a special frame for an existing motor, or special motor for existing frame, a



Figs. 7 to 12.—Alternative Positions for the Engine.

In the matter of stability and freedom from side slip I certainly prefer the group in which the motor is placed about mid-way between the wheels, and on a line with wheel centres as in the New Werner, Minerva, Precision, etc., and in the matter of cooling I think there is little to choose between this position and the forward one, *always providing the motor itself is properly designed and made*, this being vital to any design.

In the matter of transmission I am not absolutely satisfied with any one type, but have a leaning toward a compound belt and gear drive, as suggested in the De Dion diagram; though were it not for the necessity of building a special frame I should be inclined to try a flat belt drive, using a two-ply belt of special construction,

subject on which I shall have something to say in my next.

(*To be continued.*)

The Northern of France Railway makes use of a system of audible signals to indicate when the distant signal is at caution. Between the rails is placed an insulated brass plank about 6 ft. 6 ins. long. This is so arranged that when the distant is at caution a wire brush fitted to the engine passes in contact with the plank, and operates a whistle in the cab. This requires the fitting of each distant signal with the necessary batteries as well as the engines themselves.—*The Engineer.*

Models Made Without a Lathe.

II.—A Model First-class Battleship, and How to Make It.

By Eric E. Temple.

(Continued from page 270, Vol. VI.)

THE casemates (four on each side) for the 6-in. quick-firing guns are made out of thin card cut to the shape shown in Fig. 17. A round hole is then made in position shown, for the gun to pass through, remembering that the two foremost casemates on each side have their guns pointing forward, whilst the rest have their guns pointing aft (see plan, etc.); thus four requiring the holes to be made on the right hand, as at A (Fig. 17), and four requiring them on the left, as shown by dotted lines at B. After the hole is made the card is painted with black enamel, and when this is dry, the lines representing the hinges, etc., for the openings of the gun are drawn in with Chinese white. The card is then fixed to the hull by bending it round and fixing it in position by means of lace of some sort, but at no place could I get the exact pattern, so I stuck each piece of cotton separately with seccotine, as shown in Fig. 24. The top and bottom pieces of card are painted black, the pins and railing silver. The whole is seccotined to the hull.

The funnels are made out of different-size card rolls, the inner tube being 1¼ ins. diameter, the outer one 1½ ins., the space between the two being filled up with layers of writing paper wound round the inner tube; four holes are made in the outer tube through which the strings D are passed, a knot being tied on the inside to prevent them from coming out. On the top is placed a round disc of card 1½ ins. diameter, and on the top of this is placed some modelling clay, shaped as shown at A. Steel knitting needles are then seccotined to the funnel in positions shown to represent the steam pipes, and a thin knitting-needle with a small piece of wood C at the top, shaped as shown in Fig. 27, represents the steam whistle, to which a piece of cotton is attached and fastened to the railings of the fore-bridge. Round the bottom of the funnel is placed a "slice," so to speak (about ⅜ in. wide), of another card roll of 1⅝ ins. diameter. On the top of this is fixed a ring of card, cut to fit the funnel exactly, and on the top of this ring is some more modelling clay, shaped as shown at B. The funnels are painted buff.

The masts are ⅜ in. diameter up to searchlight platform, the rest of the mast being merely thin paint brush sticks. A hole is drilled at the top of the lower mast, into which the upper part is fitted. Eyebolts, the diameters of which are ⅛ in., are screwed into the mainmast

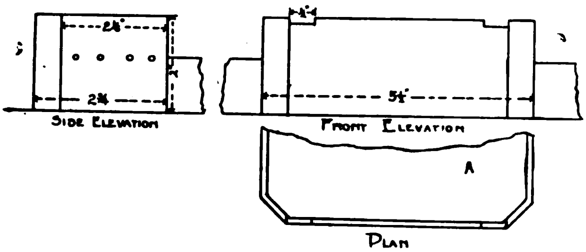


Fig. 15,

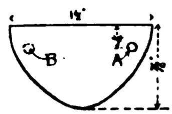


Fig. 17.

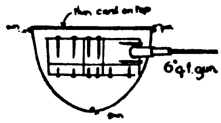
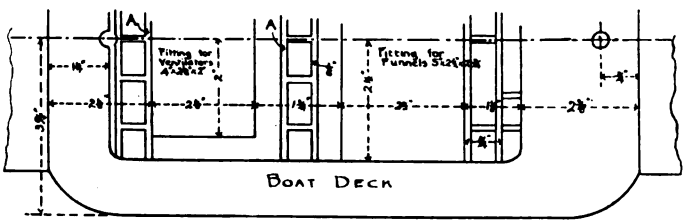


Fig. 18.

Fig. 16.



pins, shown in Fig. 18. Another piece of card cut to the shape shown in Fig. 20, also painted black, is stuck on the top of the casemate with seccotine.

Pieces A, B, and C are cut out of stout card to the shape shown in Fig. 21 for the 12-pounder recesses. The piece A is cut (about half through the thickness of the card) at *a*, *b*, and bent round at right angles, a hole made at *x* for the gun, and pieces B and C being placed at top and bottom of A, as shown in Fig. 22. The whole is then placed in the opening cut out for it in the hull (Fig. 5), and seccotined to it.

The propeller blades are made out of thin card cut to the shape shown in Fig. 23, and then twisted, as in Fig. 10. The part A is cut out of wood with a penknife, four small cuts being made for the blades to fit in. It is fixed by means of the pin shown in Fig. 10, and the whole propeller is painted gold.

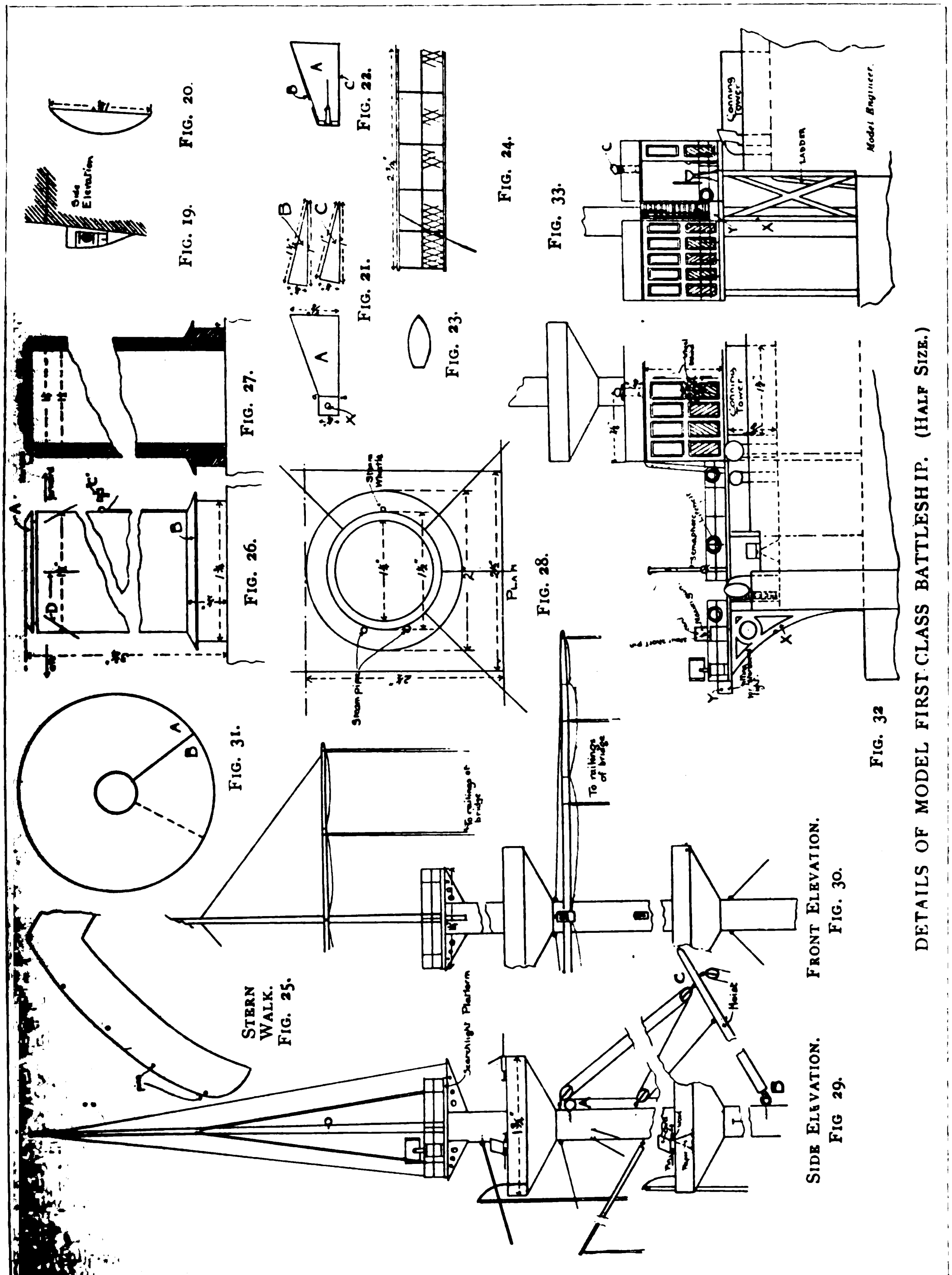
The stern walk is made out of two pieces of stout card cut to the shape shown in Fig. 25, placed ⅝ in. apart, and fixed with pins running from one to the other, every ¼ in. For the railing round this I intended to get some in the positions shown, the top one A being for the lower yard, and the bottom one B for the hoist. Smaller ones, 1-16th in. diameter, are put in both masts, as shown, for the ropes, and one is put in the mainmast for the gaff. The masts are then fixed in the holes cut for them in the deck. Figs. 29 and 30 show the mainmast, the foremast being made in a similar manner, but without hoist and gaff. They are painted light burnt sienna.

The upper yards are cut out of wood tapering slightly at each end, and fixed by means of a pin to the topmast. The lower ones are steel knitting-needles, fixed to the mast by means of eyebolts.

The hoist for steam pinnaces is cut out of wood, and tapers slightly towards the end. A small hook (a stout pin bent round) is fixed at the thicker end to fasten on to the eyebolt B. At the thinner end are fixed two blocks in the positions shown at C (Fig. 29).

The gaff is the stick of a very fine paint brush with a hook fixed at the end (a small pin bent round).

The conical part of fighting tops is made as follows: A circular disc is cut out of stout paper (Fig. 31), and the



DETAILS OF MODEL FIRST-CLASS BATTLESHIP. (HALF SIZE.)

round piece in the centre is cut out of this. By cutting a straight cut from the circumference to the centre, and pulling the end A over the end B until the required angle is obtained (about 60 degs.) the cone is arrived at, which is kept fixed by seccotining A to B. A circular piece of stout card forms the platform, a hole being cut for the mast to go through. The sides are made of strips (¼ in. wide) of thin card, and stuck round the edge of the platform.

The searchlight platforms are circular pieces of stout card, railings made of pins and cotton, ¼ in. high, being put all round. The supports for these are also of stout card, with three holes pierced in them, as shown in Figs. 29 and 30.

Figs. 32 and 33 show the fore bridge, which is made of wood 1-16th in. thick, the supports X being cut out of the same material with a fretsaw, whilst the rest are steel

Twelve 6-in. quick-firing guns are made out of small pieces of wood cut with a penknife to the shape shown in Fig. 18, a very stout pin being stuck in same, with the head cut off. The whole gun is painted silver.

There are sixteen 12-pounder quick firing guns made in a similar way to the 6-in. quick-firing guns, but smaller and with a thinner pin. These are also painted silver.

One of twelve 3 pounder quick-firing guns is shown in the fighting top, Fig. 29, which will I think explain itself, the conical stand being made on the same principle as the fighting tops, but of course very much smaller, and the whole gun is painted black.

Of the eight Maxim guns one is shown in Fig. 32, which will also explain itself, the stand being made of rolled up paper, and the whole gun painted black. Two of these Maxims are generally used as field guns for landing parties, and are not therefore shown.

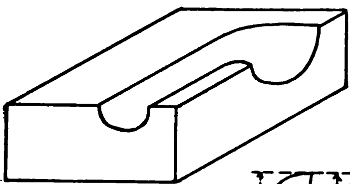


Fig. 34.

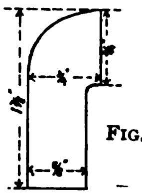


Fig. 35.

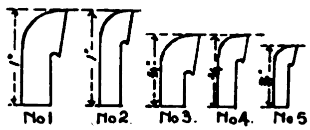


Fig. 36.

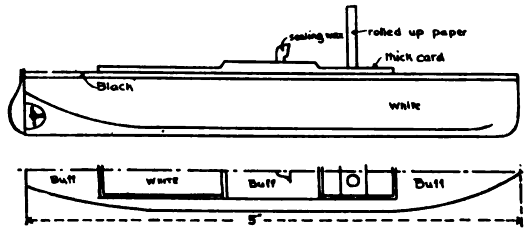


Fig. 37.

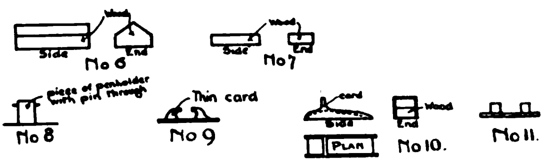


Fig. 38.

Fig. 39.

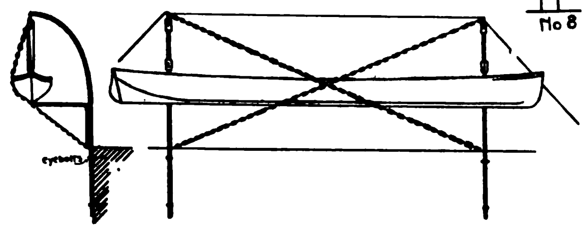


Fig. 40.

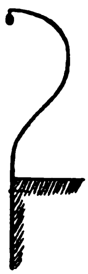


Fig. 41.

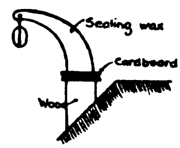


Fig. 42.

knitting-needles. The aft bridge is made in a similar manner to the fore bridge, but the arrangement is as shown in Fig. 1.

The conning towers are made out of pill boxes of 1⅛ in. diameter and ⅝ in. high.

The large ventilators are run with plaster-of-Paris in a mould cut out of wood, half of which is shown in Fig. 34. The face of the ventilator is hollowed out and painted red; the rest is coloured buff. Fig. 35 shows the dimensions of the large ventilators. The two aft ventilators have a bend in them. This lower part is cut out of wood. The two foremost ones are placed on the lids of two pill boxes, the latter being painted black. The smaller ones (Nos. 1, 2, 3, 4, 5, Fig. 36) are made out of sealing-wax. By cutting out a round disc of card, melting one end of the wax till it covers the card, and then when still warm bending it round at a little more than right-angles, makes a very good one. Fig 36 shows the dimensions of the smaller ventilators. The whole ventilator is painted silver, excepting the round disc of card, which is painted red. (The idea of sealing-wax ventilators I got from a back number of The Model Engineer.)

The four 12-in. guns (46-tonners) are made out of pen-holders. Painted silver.

The shape of the shields, etc., for 12-in. guns is shown in Figs. 1 and 2, the shield being made of modelling clay, painted silver, and the stand of wood cut out with the fretsaw and painted black.

Fig. 37 shows the elevation and half plan of one of the larger steam pinnaces, of which there are two. The other two are similar, but slightly smaller, and with only one funnel. They are cut out of very soft wood, and the funnels are rolled up paper painted silver. The rudders and screws are cut out of thin card, the former being painted white and the latter gold. The stands for these are cut out of thin card, as shown in Fig. 1, and painted silver.

The fore and aft wheel houses are cut out of Bristol board of medium thickness, a strip of gelatine being placed behind the openings for the windows, to represent the glass. The lines showing the panels are drawn in Indian ink with very fine lines. It is left white with black lines (Figs. 1, 2, 32 and 33).

The ladder steps are made out of a number of pieces of card (medium thickness) of equal width and length, and stuck with seccotine between two other strips of equal length. There are eight of these, great care being taken to get each step parallel with the one above, both longitudinally and transversely (Figs. 32, 33). The ladders L at the sides of the hull are made in a similar manner as regards the steps, but with one or two additions as shown, such as railings, etc. All the ladders are painted brown.

Fittings Nos. 6, 7, 8, 9, 10, and 11 are shown in Fig. 38, which hardly need explaining. They are all painted white, excepting Nos. 9 and 11, which are silver.

The capstans are made of three circular discs of stout card of different size, seccotined together, as shown in Fig. 39, and painted silver.

Fitting No. 11 is made out of a small rectangular piece of card, pierced with two holes ⅛ in. diameter, in which are fixed two equal pieces of incandescent light rods. Painted silver.

The fittings for port and starboard lights are made out of card, as shown at Y, Figs. 32, 33. The port fitting is, of course, painted red, the starboard green.

The searchlights are made of rolled up paper, two thin slips and a circular disc of card, and a round piece of gelatine, the latter representing the glass and painted black, with narrow strips of silver paper.

The semaphores are made out of thin card, which are painted black, excepting the stripes across the arms, which are left white (see Figs. 32 and 33).

The steering-wheel is placed inside the fore wheel house, the wheel being cut out of thin card and the stand made of wood cut to shape (Fig. 33) with a penknife. The stand is painted black, and the wheel silver.

The compasses are made out of rolled-up paper, a lead bullet filed, as shown at C, Fig. 33, and two smaller bullets. Painted black, with silver mountings.

The stanchions are needles stuck in until ¼ in. shows above the deck, and the rails (three rows) are made out of cotton twisted round each needle excepting the top rail, which goes through the eye. The whole railing is painted silver.

Small rings, ⅛ in. diameter, fastened to the railings of the fore and aft bridges and painted white, serve as lifebelts.

The davits are made out of hairpins bent to the required shape—eight being required as shown in Fig. 40, and eight as shown in Fig. 41. All painted white. The small ones on the sides of the four fighting tops are made in a similar way, but to the shape shown in Fig. 29, and left black.

The anchor davits are made of sealing-wax, which, after being made into a round tapering stick, are bent round as shown in Fig. 42. The base is wood and cardboard. The davit is silver and the base black.

The anchors are made of several pieces of stout card, cut out and fitted together as in Fig. 6. They are painted silver.

The cables are bought and painted silver.

Boats are cut out of wood to the shape shown in Fig. 40, and painted white, with a black strip, as in Fig. 1. A piece of thin card is cut out to show the seating, and stuck on the top of the boat. Two small eyebolts are required for the two blocks to be fitted on.

The blocks for the hoists and anchor davits are ¼ in. long; those for the boat davits are ⅛ in. long; those for the fighting top davits 1-16th in.; whilst those for the yards and gaff are 1-32nd in. I made all the blocks (excepting the smallest) of wood, which hardly need explaining; and I found it a considerable relief to work with a watchmaker's magnifying glass. The very small ones (1-32nd in.) are eyes of needles cut as close as possible without breaking. Two cottons are passed through the eye, one being to fix it to the yard.

The small chains are made of cotton crocheted into a chain stitch.

The torpedo net poles and launch booms are merely leads out of pencils cut to the required lengths with a small cut made at each end for fastening cottons to. The lower cottons are fastened to small eyebolts placed in the hull by the water-line.

Figs. 1, 29 and 30 show the rigging. It should be remembered that some ropes are much thicker than others, and care has to be taken not to put a thick one where a thin one ought to be. For the ropes marked T, Fig. 1, I used ordinary ship string, and for all the others I used fine cotton.

On all the decks I placed smooth writing paper ruled in Indian ink, with lines about 1-16th in. apart. This gives a neat and finished appearance to the boat.

In concluding, I need hardly say that the expenses of building such a model are not at all heavy, as will be seen by the foregoing description. The exact cost I do not know; but of course the model took a long time to make.

The Institution of Junior Engineers.

A LARGE party of the members of this Institution recently paid a visit to the Great Eastern Railway Works at Stratford, by the courtesy of the Locomotive Superintendent, Mr. James Holden, M. Inst. C. E. They were shown over the various departments, the special features of interest being indicated to them. In the locomotive machine shop, automatic bolt machines and general machinery for dealing with locomotive work. Large planing machines, etc., were in operation in the erecting shop, where locomotives, both new and repaired, were in various stages of construction; in this shop, also, pneumatic tools were seen tapping and drilling. Pneumatic tools were also at work in the boiler shop, and hydraulic rivetters and flanging machines, together with general machinery appertaining to boiler work. The brass foundry contains a pneumatic moulding machine, and in the brass finishing shop above it are special lathes for manufacturing brass details and firebox stays, etc. The party also visited the locomotive department, the Westinghouse brake shop, smith shop, wheel shop, and iron foundry. In the carriage department, new main line composite carriages and suburban carriages were seen in the process of widening, so as to carry two extra passengers per compartment. The saw mills, which contain a variety of wood working machines, were also visited. A visit was also made to the running sheds, liquid fuel storage, engine paint shop, and oil gas works. At the conclusion, Mr. Kenneth Gray, Vice-Chairman of the Institution, conveyed the thanks of the members for the extremely interesting morning which had been afforded to them.

A YACHT, built by Yarrow & Co., to the order of Colonel McCalmont, was launched recently at Poplar. The vessel is of special design, being built on the lines customary with vessels of the torpedo boat class, and provided with turbine engines, fitted with three shafts and three propellers on each shaft, the boilers being of the Yarrow type.

The Editor's Page.

WE commence in this issue our long-promised articles on the subject of "How to Become an Electrical Engineer," and we would commend the information given therein to all aspirants for success in this important profession. In this, as in all other occupations, there is no royal road to fame and fortune, no system by which prosperity can be guaranteed to each and all alike. A man's success depends partly upon his natural fitness for the work, and partly upon the energy with which he prepares himself for promotion when the opportunity occurs. The old saying that there is always room at the top, applies to electrical engineering as much as to any other business, and so rapidly is the electrical industry developing that the prospects for really good men are thoroughly healthy.

* * *

But—and this is a very decided *but*—the lower ranks of the electrical world are sadly crowded, and even overcrowded with men whose abilities are merely ordinary, and whose remuneration is of a corresponding character. The rapid spread of electrical industry has caused many people to fancy that it opens a sure and easy road to fortune, and that they or their sons have only to become electrical engineers to have an assured future before them. This idea is a totally mistaken one, and it cannot be pointed out too strongly that electrical engineering is a profession requiring a most thorough and exact training, and that only those of good natural ability, whose whole heart is in the work, can hope to rise above the common level. In the articles we are now commencing, the author can do little more than indicate the the directions in which the efforts of the would-be electrical engineer should be directed; the rest must be left to the reader himself. From one who has been through the mill with success, however, such hints are of much value, particularly to those who bave no engineering friends to whom they can turn for advice. So many requests for information of this kind reach us from our younger readers or from their parents, that we feel sure these articles will be widely appreciated; and we trust they will serve the purpose for which they are intended. Some men will become engineers in spite of every obstacle or ill-fortune they may have to face; and if these articles enable them to steer a clearer, and perhaps shorter, course than they otherwise would have done our object will have been attained.

* * *

A well-known firm of cigarette manufacturers present each purchaser of a packet of a certain brand of cigarettes with a portrait of one or other of the former Kings of England, and on the back of each portrait is a brief summary of the most important events occurring in the reign of that particular monarch. The idea is good, but we trust that the information in general is more accurately stated than the following item, which we find on one of these cards:—"1765. Watt's discovery of steam." We do not think that even the most enthusiastic admirer of James Watt's genius ever claimed so much as this for him, and we trust that in justice to Watt himself his claim to the gratitude of engineering posterity may be more correctly stated in future editions of this "cigarette history of England."

* * *

"Up-to-Date" (Liscard) writes: "I am pleased to notice by your article in the Editor's Page, in issue of May 15th, that we may hope to get some authentic records as to speeds of model steamers belonging to clubs other than the Wirral M.Y.C. I have noticed that the steamers belonging to that club are of a very superior class as to design of model, also including engines and boiler, and mode of firing, which is benzoline, in burners of a very novel and practical kind, invented and manufactured by some of their members. Some of the steamers do wonderful speeds. I personally have seen the distance of their lake, 150 yards (actual measurement), done in 57 seconds time, taken on a stop watch. I would suggest that if this is the only club you are aware of having a steamer section, that you approach their energetic secretary to supply you with a list of their steamers' performances, as such would be of mnch interest and value to readers interested in this line of model engineering."

* * *

The foregoing letter gives us an opportunity of repeating our previous invitation to model yachting clubs having a steamer section to send us particulars of their boats in this class. In order to provide some incentive to model steamer builders to send us particulars of what their boats can do, we offer three prizes—value, one pound, fifteen shillings, and ten shillings—to the owners of the three boats doing the fastest authenticated performances. The following special conditions will apply:—The boat must make three successive trips over a course of not less than one hundred yards in length. The exact length of the course must be measured and the exact time to a second recorded for each trip. These particulars must be written down and certified by the signatures of two members of the executive of either any branch of the Society of Model Engineers, or any recognised Model Yacht Club, who must have been present at the trials. We shall calculate the speed of the boats on the average of the three trips. The results of the trials must be sent in to us not later than July 31st, and the winning competitors will be required to furnish photographs and short descriptions of the boats. The competition is limited to boats not exceeding six feet in length, and the starting time to be taken at the moment of turning on steam.

Answers to Correspondents.

"W. I." (Burnley?).—You omit your address. See our handbooks, "Electric Batteries" and "Small Dynamos and Motors," for the information required.

W. H. Webb.—We cannot have received the article in question.

"Engineer" (Alloa).—No name and no address! The conditions under which queries are answered in The Model Engineer are stated plainly at the head of the Query columns; unless they are adhered to, we cannot deal with the questions.

"J. D. P." (Kensington).—The reason that so little information on alternating current motors is to be found in text-books and elsewhere, is, that owing to certain difficulties in design and construction, very few really successful alternating motors have been made. We published a good design for an alternating current machine in our issue for January 1st, 1901, and other articles on alternating current apparatus appeared in the issues for September and October 1st, 1900. We shall probably take this subject up again before long.

Prize Competitions.

Competition No. 19.—Two prizes, value £2 2s. and £1 1s., are offered jointly by the Editors of the *Photogram* and of THE MODEL ENGINEER for the best and second-best technically good photographs showing a locomotive (with or without train) in motion. Particulars of train, stop, shutter, &c., to be given. Each print, etc., must be marked with a motto, pen-name, or symbol, and must *not* have the name or address of the sender. It must be accompanied by a closed envelope, bearing the motto, &c., and containing name and address of the competitor. Each competitor may enter as many prints as he wishes. The proprietors of the *Photogram* and the proprietors of THE MODEL ENGINEER shall have the right of publishing the winning and certificated competitions. The competition will be judged jointly by the Editors of the above two papers, and the last day for receiving entries is July 1st, 1902. The results will be announced in the *Photogram* for August, 1902, and THE MODEL ENGINEER for August 1st, 1902.

Competition No. 22.—Two prizes, value £2 2s. and £1 1s. respectively, are offered for the best and second-best designs (to include full description and working drawings) for a working model flying machine. The size, type, and propelling power of the model are left entirely to the choice of the competitor, the main stipulation being that it shall be capable of successful working. The model must have been actually made, and the prize-winners will be required to send in their models for inspection and trial by the judges before the actual awarding of the prizes takes place. The last day for receiving entries is June 30th, and the usual general conditions apply in this Competition.

Competition No. 23.—Full particulars as to this Competition are given on the Editor's page, preceding.

GENERAL CONDITIONS FOR ABOVE COMPETITIONS.

1. All articles should be written in ink on one side of the paper only.
2. Any drawings which may be necessary should be in good black ink on white Bristol board. No coloured lines or washes should be used. The drawings should be about one-third larger than they are intended to appear if published.
3. The copyright of the prize articles to be the property of the proprietor of THE MODEL ENGINEER, and the decision of the Editor to be accepted as final.
4. The Editor reserves the right to print the whole or any portion of an unsuccessful article which he may think worthy of publication, unless the competitor distinctly expresses a wish to the contrary.
5. All competitions should be addressed to The Editor, THE MODEL ENGINEER, 37 & 38, Temple House, Tallis Street, London, E.C., and should be marked outside with the number of the competition for which they are intended. A stamped addressed envelope should accompany all competitions for their return in the event of being unsuccessful. All MSS. and drawings should bear the sender's full name and address on the back.

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 Two-Throw Crank Axle.

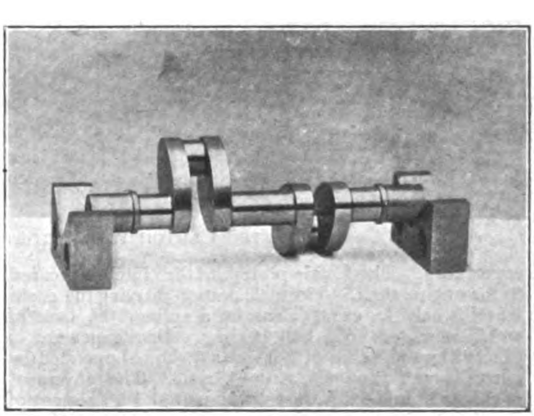
TO THE EDITOR OF *The Model Engineer*.

DEAR SIR,—The accompanying photograph shows a "Dunalastair" locomotive crank axle, which was made from a piece of steel boiler plate 1 in. thick and about 1⅝ ins. wide picked up from a scrap heap.

A piece 4¾ ins. long was cut off, after which the superfluous metal round the webs was drilled and sawn out, and the shaft rough-turned at the middle and ends.

The shaft was next heated red hot, one end held in the vice, and the other twisted through an angle of 90 degs. with a spanner. A ¼-in. hole was then drilled in each crank web, and a thin slice sawn out of each web to enable the crank-pin to be turned. Quadrant plates were keyed on each end of the shaft, and the centres (nine in number) were marked off on each end with the aid of a surface gauge and V blocks.

The two crank-pins were then turned, after which the sides and ends of the webs were done, and the plates



LOCOMOTIVE CRANK AXLE.

taken off to allow the body of shaft to be finished to size.

All that now remained was to file off the slight corners left on the webs to bring them to an elliptical shape.

I think that this way of making a crank axle is preferable to building up, as it is much stronger, neater, and more true to scale, and can be done as quickly as the latter method. The steel V blocks shown in the latter photograph were faced up in the lathe on every side except the V, the blocks being temporarily riveted together and the V filed out.

The lathe may often be used in this way to face up rectangular work, and saves a lot of filing, besides making a quicker and better job.

To return to the subject of the "Dunalastair" locomotive, I should strongly advise your readers to make their own patterns, if possible, as the saving in cost is considerable. I was asked 2s. 6d. from one of your advertisers for a motion-plate casting; but by making my own pattern I got an excellent casting made locally for 4d. Comment is unnecessary!—Yours truly,

Middlesbrough. S. C.

Power Transmission in Motor Bicycles.

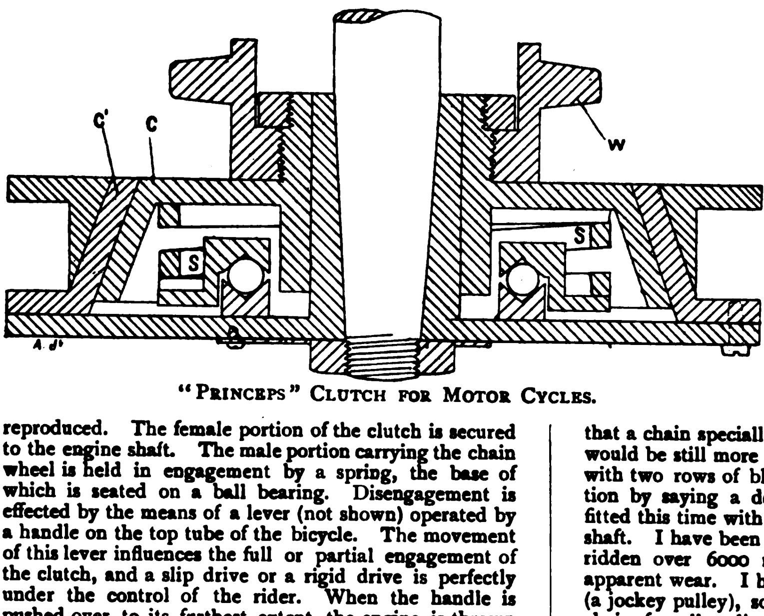
TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—In the early part of Mr. Hawley's interesting article on "The Motor Bicycle," in your June 1st issue, he refers "to the great strain put on the chain or gearing at the instant when the engine commences to drive," causing chains to break, &c. Mr. Hawley cannot have had any experience of our Princeps clutch for chain drive, which completely takes up this jerky strain and enables the machine to be started with the same smoothness as when belt-driven. We have never had a case of chain breaking on a Princeps motor bicycle. In addition to this feature, our clutch provides a free engine, one slight movement of a lever throwing the engine out of gear with the back wheel. Mr. Hawley is quite right in emphasising the great advantage of the chain drive as compared with the belt, when the former is provided with such an intermediary between the engine and the back wheel as our Princeps clutch. The principle of this clutch will be readily seen from the illustration here reproduced. The female portion of the clutch is secured to the engine shaft. The male portion carrying the chain wheel is held in engagement by a spring, the base of which is seated on a ball bearing. Disengagement is effected by the means of a lever (not shown) operated by a handle on the top tube of the bicycle. The movement of this lever influences the full or partial engagement of the clutch, and a slip drive or a rigid drive is perfectly under the control of the rider. When the handle is pushed over to its furthest extent, the engine is thrown out of gear and runs free.—Yours truly,

PRINCEPS AUTOCAR COMPANY.

46, Abington Street, Northampton.

[NOTE.—It will be seen, on reference to the second part of Mr. Hawley's article—pages 12 to 15 in this issue—that the principle involved in the above-mentioned clutch is dealt with. Mr. Hawley's article was, of course, written before the receipt of this letter.—ED. *M.E. & A.E.*]



"PRINCEPS" CLUTCH FOR MOTOR CYCLES.

TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—The article by Mr. T. H. Hawley on "The Motor Bicycle," in your issue of THE MODEL ENGINEER, dated June 1st, gives a lucid description of the various faults which are still to be experienced by those who indulge in this form of recreation. More especially do we notice how many of these faults would have been eradicated had the gentleman named been in possession of a reliable transmitter. It is to this particular question that we have for some time given careful attention. A series of experiments, with severe working tests, have resulted in what we can now affirm to be a solution of the difficulty of transmission of motor cycles by belts.

The registered motor cycle belt, "Lincona," has played a quiet but important part in recent contests; all belt-driven bicycles which have gained honours at important meetings during the year have been fitted with this belt, while such expert testimony as that of Messrs. Martin, Tessier, Stones and Wright, can leave no doubt as to its extraordinary capabilities.—Yours truly,

JAMES DAWSON & SON, LTD.
GEORGE DAWSON, Managing Director.

Boultham Leather Works, Lincoln.

TO THE EDITOR OF *The Model Engineer.*

SIR,—Noticing in your valuable issue of June 1st an article by Mr. T. H. Hawley on "The Motor Bicycle: Its Design, Construction, and Use." He deals, amongst his experiences, with the chain and belt drive for transmitting the power. He mentions the difficulty has not yet been solved for a satisfactory transmission of the power from the motor to the driving wheel, and I quite agree with his remarks *re* the trouble with belts and chains. I may, however, state that I have overcome this difficulty by a most simple and efficient method, which is as follows, and which I patented some time ago, and have been using with splendid results. My machine, a 2¾ h.-p. motor bicycle, and was originally driven with a 1¼ in. flat belt which gave me the usual trouble mentioned by Mr. Hawley, and after several experiments I finally fitted a chain wheel upon the motor shaft and covered the driving pulley with a band of leather, and used a chain as a belt. This proved a great success, and being satisfied that a chain specially made for this mode of transmission would be still more successful, I had a block chain made with two rows of blocks, or I may simplify my description by saying a double block chain, 1 in. pitch, and fitted this time with a double chain wheel upon the motor shaft. I have been using this for four months, and have ridden over 6000 miles without the slightest hitch or apparent wear. I have just added an important auxiliary (a jockey pulley), so that I may run with a very slack chain for all ordinary riding, and on mounting a steep gradient adjusting the jockey until the gradient is mounted, then throwing the jockey out of use and again running with a slack chain and *vice versa*. The above is an ideal drive, giving the necessary slip upon starting, and I have not the slightest doubt, when it becomes generally known, that this mode of transmission will be largely used in future.—Yours truly, CHAS. FRANKLIN.

Wesley Place, Horsefair, Bristol.

Sparks from Leather Belts.

TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—Doubtless many of the readers of THE MODEL ENGINEER are unaware that an electric spark can be obtained off an ordinary leather machine belt, which is running fairly fast and has been in use for some considerable time.

I was ignorant of the fact until a short time ago, when standing near an air-blower which was being driven by a crossed leather belt, I happened to hold a spanner near the point where the belting crossed, when to my

surprise I received a small shock. I then discovered I could get a spark off the belting on to the spanner almost an inch long, accompanied by a loud crack. I have since found out that nearly all other leather belts that are crossed will give off sparks of various lengths, providing they run fast enough and are perfectly dry.—Yours truly, B. C. H.
London, N.W.

Mr. Greenly's Design of Locomotive.

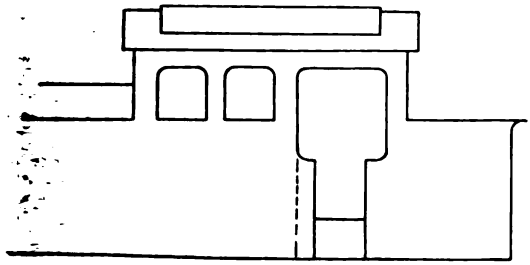
To the Editor of *The Model Engineer.*

Dear Sir,—I am sure we must all admire the handsome and cleverly designed locomotive, the details of which have been published in the last two numbers of The Model Engineer.

Most of Mr. Greenly's productions bear the stamp of originality, and this especially applies to his latest design. Having a good deal to do with steam, air, and water jets in connection with ejectors, injectors, and the like, I was very interested in his description of the blast experiments. But for fear of making this letter too long, I would have sent on some results of experiments bearing on the distances between steam nozzle and discharge tube, which is important in ejectors, and, of course, the chimney and exhaust nozzle is, after all, a special form of ejector.

Would it be asking too much of Mr. Greenly and yourselves to let us have a plan of the framing and trucks?

The mounting of the loco on friction rollers suggests the question whether Mr. Greenly has made any experiments as to balancing. The failure of many model



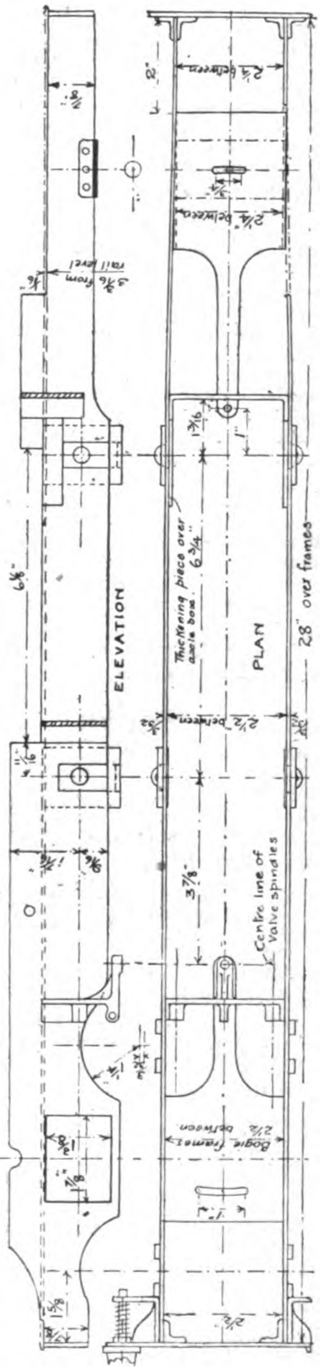
engines, especially those of the "toy" variety, to successfully negotiate points and crossings is, no doubt, largely due to want of balance, and the study of this matter is not only interesting but important. In many cases, the difference between bad and good running is only a question of judiciously chosen crank angles. As you ask for criticisms, I enclose a sketch of what I think is a slightly better looking cab.

Speaking of locos generally, I am rather surprised that none of your readers seem to have tried the simple Hackworth gear. I have not tried it myself, but it seems to me to be admirably suited to model loco work. The "Klug" gear, described in your paper some time back, is simply a Hackworth gear, with a return crank in place of the eccentric. I shall be pleased to send on a sketch of this gear, applied to a model loco.—Yours truly,

H. H. H.

[Yes, we shall be glad to have the sketch referred to.—Ed., *M E. & A.E.*]

Dear Sir,—I thank "H. H. H." for his appreciation of the published design, and, as he requests, I herewith enclose a drawing of the framing of the engine. I shall be pleased to have any particulars of the experiments with ejectors, and think that the results of the experiments with, say, ejectors of dimensions common to the chimney and exhaust nozzle of the average model locomotive would be welcomed by your readers.



Framing of ¼-in. Scale Ten-Wheeled Tank Locomotive.
Scale: ¼ Full Size.

With regard to the balancing of model locomotives, personally, the method adopted is to balance the moving parts approximately by reducing to scale from a similar type of real locomotive. If done thoroughly, I believe this method is sufficiently accurate for the purpose, and is correct in theory, but I have not yet properly worked out an example to check this statement. I will, however, take the opportunity of doing so, when a design of, say, an inside cylinder model locomotive presents itself for my attention. Although I always provide against any unsteadiness in the running of a locomotive by the addition of counterweights to the wheels, I do not think that very great harm would result by not balancing the reciprocating and revolving parts of a *small* model at all, simply because of the low rotative speeds and the small masses involved.

The question of cab is solely one of taste, and would not, I think, make much difference either way. The arrangement employed lessens the length of the cab, and therefore the over-all dimensions of the locomotive—that is, for a given position of the front weatherboard. The length of an engine and the rigidity of its wheel base limits to a very great extent the diameter of the curve around which it will safely pass. The curves usually desirable for a model railway are generally of much smaller radius than the scale size of the sharpest curve on a real railway—for instance, the scale size of an eight chain curve for ⅝-in. scale model is 28 ft. radius, and the difficulty of getting a model to travel freely around a curve of, say, 6 ft. radius, may easily be imagined. The wheel-base of a model locomotive must be made very flexible indeed to accomplish the above, and the super-elevation of the outer rail will also have to be considerable; further, the gauge of the railway may, with advantage, be increased some 3-32nds in. to ⅛ in. at the curves.—Yours faithfully,

London, W.C. H. G.

Amateur's Supplies.

[*The Editor will be pleased to receive for review under this heading, samples and particulars of new tools, apparatus, and materials for amateur use.*

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

Brass Electrical Fittings.

An illustrated sheet to hand from Messrs. Davis & Timmins, Limited, York Road, King's Cross, London, N., gives prices and details of numerous types of cable connectors, screwed nipples, reducing pieces, and other electrical cable fittings. The list will be useful to our trade readers in this line.

Electric Desk Fans.

Doubtless the summer *is* coming, though at the time of writing the midsummer weeks have not brought midsummer weather. When the warm days arrive, attention may well be turned to Messrs. Johnson & Phillips' electric desk fans, which, it is stated, have been designed with a view to efficiency, durability, and artistic appearance. They require about as much current as a 16 c.-p. lamp to drive a 12-in. fan and are made to run on circuits from 100 to 125 and 200 to 250 volts, direct current. Prices can be had from the makers, as above, their address being Victoria Works, Old Charlton, Kent. THE MODEL ENGINEER should be mentioned.

A New Petrol Motor.

A new class of petrol motor has been brought out by Messrs. W. Macmillan & Co., Mar Street, Alloa., N.B. This is of 3½ h.-p. size, and is supplied in parts for motor car and launch work. Reference to our advertisement pages will show the style of the engine, and readers should mention THE MODEL ENGINEER when corresponding with the firm.

* A New Drawing Scale.

A new drawing scale, which has some features of interest, has been submitted for our inspection by the designer, Mr. Geo. Huntley, of 10, Falmouth Road, Heaton, Newcastle-on-Tyne, who is preparing to supply similar scales to readers. The new scale is the outcome of Mr. Huntley's own personal wants as a teacher in technical schools, and it is designed to avoid altogether the division into twelfths and tenths which is a common and somewhat confusing system adopted in most ordinary scales for class work. Another very real advantage is that the new scale is only 9 ins. long—a very convenient size—and it is made in bevelled polished boxwood with scales starting from each end on each edge, making eight scales in all. Our only criticism is that we consider the scales of 4½ ins. and 9 ins. to the foot, should give place to those of ⅜ in. and 1 in. to the foot—which are more generally useful. The retail price of the scale has been fixed at 1s. 6d. net, the postage being a penny extra. Enquiries from readers should bear the name of this journal.

Catalogues Received.

A. W. Roy, 151, Shields Road, Heaton, Newcastle-on-Tyne.—Mr. Roy makes a speciality of the supply of dynamo and motor castings and parts for amateurs, and his illustrated list to hand shows these to be good in appearance and design. We note that where full sets are specified at given prices, everything is included, even to sufficient mica, vulcanite, or other insulating material, bolts and nuts, stampings, etc.; and this is doubtless a feature amateurs will welcome. A special line is quoted for field-magnet stampings, both for bipolar and multipolar machines. Armature stampings are also in evidence, plain ring or drum, cogged and tunnel types being all listed. Mr. Roy also issues a sixty-four page list of "Bronks" cycle accessories, which will interest readers dwelling in the district. A copy of either of the above lists will be sent to readers of THE MODEL ENGINEER on receipt of a penny stamp to defray postage, and to foreign and colonial readers the electrical catalogue will be sent free.

Fredk. Braby & Co., Ltd., Petershill Road, Glasgow.—A new illustrated list to hand gives one an idea of the extent of Messrs. Braby's manufactures, their work including apparently everything in wire and sheet metal wares, such as galvanised corrugated roofing sheets, tanks, boilers, cisterns, fencing, and, indeed, all that may come within, and a great deal that is ordinary outside the scope of, sheet metal working and general constructional engineering. The "barffing" process of protecting iron and steel goods is a speciality of the firm, for which they have put down extensive plant, enabling them to deal with this work at the most moderate rates. The list to which we refer is a handy one—described as the "Glasgow" catalogue—and should be obtained by all trade readers who see by our brief notice it would be of interest to them.

A. G. Thornton, 68, St. Mary's Street, Manchester.—The "Nerite" adjustable drawing board and square, introduced by this firm, is described and illustrated in a circular to hand. This apparatus can be fixed in any convenient position for the draughtsman, who can thus avoid the cramping due to the one position usually available. The system appears to be a thoroughly good one, well worked out, and is worth further investigation by those interested. Draughtsmen and amateurs should bear in mind that full and well-illustrated price lists of all kinds of drawing office requisites are to be had for the asking from Messrs. Thornton, this paper being mentioned when writing.

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 6s. 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," 37 & 38, Temple House, Tallis Street, London, E.C.

All correspondence relating to advertisements to be addressed to THE ADVERTISEMENT MANAGER, "The Model Engineer," 37 & 38, Temple House, Tallis Street, London, E.C.

All subscriptions and correspondence relating to sales of the paper to be addressed to the Publishers, Dawbarn & Ward, Limited, 6, Farringdon Avenue, London, E.C.

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THE

Model Engineer

AND

Amateur Electrician.

A JOURNAL OF MECHANICS AND ELECTRICITY FOR AMATEURS AND STUDENTS.

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

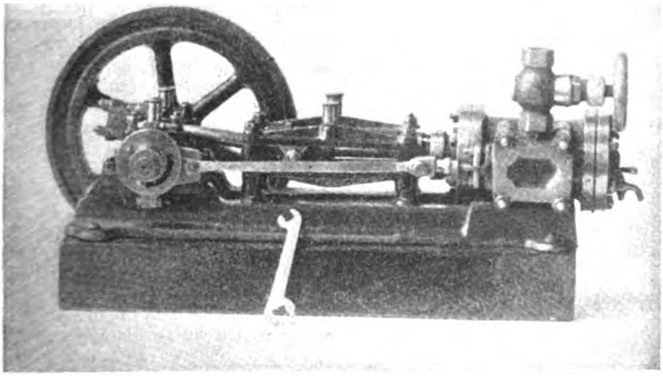
VOL. VII. No. 77. JULY 15, 1902. PUBLISHED TWICE MONTHLY.

Two Model Steam Engines.

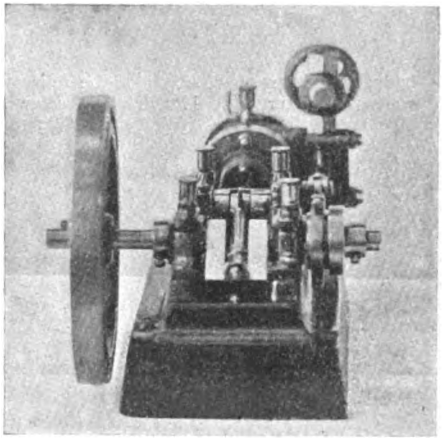
By A. O. GRIFFITHS.

THE accompanying photographs represent two models which I have made in my spare time. There is nothing novel about them, but they are models of ordinary types of engines. The horizontal engine is 1⅛-in. bore and 2-in. stroke, and needs little description. The castings are in iron, excepting the pedestal brasses, without load, and with steam at 25 lbs. pressure, which is supplied to it from a "flash" boiler through ⅛ in. iron pipe.

The vertical engine is ⅞ in. bore and 1-in. stroke, and is mostly of brass, the piston, crosshead, eccentric sheaves, and flywheel being of cast iron. The original crankshaft was made in sections, riveted and pinned together; but, in time, with the high speed (1,800 revs. per minute), and occasional rushes of water into the cylinder, it began to get loose, so, although not a turner, I decided to make



Side View.



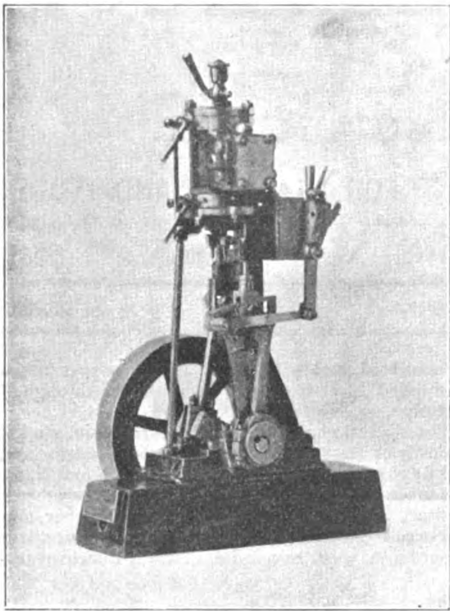
Front View.

MODEL HORIZONTAL ENGINE.

glands, slide blocks, and eccentric straps, which are of brass. The connecting-rod brasses at both ends are adjustable, at the crank end by bolts, and at the end next crosshead by a cotter. The crankshaft for this model was bought, but I have, since making this engine, always made this part of the engine myself. The eccentric, as will be seen by the photograph, is loose on the shaft, but is kept in proper position for forward or backward motion by a stud with nut projecting from a catchplate at the side of the eccentric, which can be moved along the slot shown to reverse the engine. This, of course, can only be done when standing, and with a spanner. The flywheel is 6 ins. diameter, and is secured by a gib-headed key. This engine runs about 800 revolutions per minute

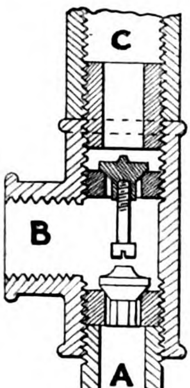
a new one, which I did by forging an oblong bar of steel, 4 ins. long, ⅞ in. wide, and 7-16ths in. thick, and drilling out to shape, leaving pieces on the ends, as described by "S. C." in your January number, and then turning up. This I found a very good method, making a strong and handsome crank. The reversing link, die block, suspension link, and connecting-rod are all of mild steel. The eccentric sheaves are secured to the shaft by grub screws through the thick parts. Every bearing is adjustable, including the crosshead pin, and thus knocks in them can easily be eliminated. It can hardly be heard when at full speed, except for a steady hum.

I have made a pump to feed my boiler, of which the clack box containing both the valves is made from an ordinary ⅜-in. brass T. The accompanying sketch (see below), which is actual size, shows the method of construction. A is the inlet, B the connection to pump



MODEL VERTICAL ENGINE.

body, and C part of the union on the delivery pipe. The seatings were turned to ⅜ in. diameter, screwed with ⅜ in. pipe thread, and then drilled through 3·16ths in., the



SECTION OF VALVE BOX FOR FEED PUMP.

(*Full Size.*)

holes being slightly countersunk and the valves fitted. Slots were sawn in the bottoms of the seats to enable them to be screwed into place with a screwdriver. The suction valve was put in through B, the top valve through C. The top valve has a setscrew screwed into it upon the underside to act as a stop to the suction valve. The nipple shown acts as stop to the top valve. This pump lifts 4 ft., and forces unfailingly against 50 lbs. boiler pressure at speeds from 100 to 600 or 700 per minute. The ram is ⅜ in. diameter.

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 fortnight before its actual date of publication.*]

London.

NOTICE.

The Hon. Secretary should in future be addressed
H. GREENLY,
2, Upper Chadwell Street,
Myddleton Square, E.C.

SUMMER EXCURSION.

Thursday, July 17th.—Visit to works of Messrs. Willans and Robinson, and the locomotive sheds of the G.C.R., at Rugby. Members who intend going to Rugby should notify the Secretary, so that special arrangements may be made.

FUTURE MEETINGS.

Saturday, July 26th.—Visit to Mr. D. C. Glen's residence and workshop at Watford. 2.57 p.m. from Euston. Fare 2s. (It should be noted that the date of this visit has been altered from July 12th, as previously announced.)

On Saturday, June 21st, about twenty members journeyed to Ashford, Middlesex, to visit Mr. H. A. Bennett's residence, model railway, and workshop. The day was fine, and upon arriving the members were conducted to the workshop, which is situated at the end of the long garden at the back of the house. The workshop proved of great interest to the members, as it is especially well equipped, containing, in addition to numerous smaller tools, two lathes, a shaping machine worked by a 1½ h.-p. gas engine. The shop is lighted by electric light, supplied by a dynamo driven by the above engine.

In the engine-house adjoining the workshop, Mr. Bennett's 1¼ in. scale G.E.R. type model locomotive formed the chief source of interest to the majority of the visitors. Steam was raised, and the engine, which burns charcoal and coal, showed its powers by taking the members, two or three at a time, up and down the long track laid in the garden. The engine was timed, and performed the journey, starting and stopping, at the average rate of 7½ miles per hour.

Tea was served by Mrs. Bennett and some lady friends, and at its conclusion the Chairman (Mr. Percival Marshall) moved a very hearty vote of thanks to Mr. Bennett for his great kindness in receiving so many members at his house, coupling with his name that of Mrs. Bennett, whose share in providing for the comfort and amusement of the visitors was no less important. The vote was enthusiastically carried with acclamation. After a further visit to the workshop, and an hour's running of the model locomotive, the members returned to town by the 8.15 p.m. train.—HENRY GREENLY, Hon. Sec., 2, Upper Chadwell Street, Myddleton Sq., E.C.

Provincial Branches.

Bolton.—The monthly meeting of the Bolton branch was held on Tuesday, June 17th, at the Oxford Café, there being eighteen members present. Mr. Hays occupied the chair. The meeting proved of exceptional interest on account of the models shown. These were three in number: (1) A very highly-finished model Bramah press, with pump attached, was exhibited by the maker, Mr. A. Mitchell (member). The press is capable of bending a 1-in. bar of wrought iron cold, and is calculated to give a pressure of 4 tons per sq. in. The design is of the regular standard pattern. The novelty of this exhibit is in the fact that all the parts are made out of materials from the scrap heap. (2) A ⅝-in. scale model G.N.R.

locomotive made and exhibited by Mr. Wood (member). The boiler is at present fed with charcoal and gives very satisfactory results. Mr. Wood has the satisfaction of being able to say that the model is entirely his own work, as he has made both his own castings as well as patterns. The work was done on a lathe which the owner describes as "not being worth threepence." The model is a highly creditable piece of work. (3) A model compound marine type inverted vertical engine, owned by the president, Capt. Slater. This model is fitted with link reversing gear and is provided with a four-groove fly pulley at one end of the crankshaft. The model is strongly made, but is in very good proportion. The models, together with the discussions they raised, formed the means for a very satisfactory meeting. The meeting closed at 10 o'clock.—ERNEST MALLETT, Hon. Sec., 83, Manchester Road, Bolton.

Edinburgh.—The June meeting of the Edinburgh Branch of the Society of Model Engineers was held on 18th inst. at the Society's Rooms, 13, South Charlotte Street. Mr. Curle presided over a large attendance of members. The minutes of the previous meeting having been read and approved, six new members were admitted to the branch. On the motion of the Chairman, a hearty vote of thanks was awarded to Messrs. Dunbar, Anderson, Runciman, Forbes, and Morrison for their valuable assistance in the installation of the new lathe. On Mr. Kirkwood's motion it was agreed that all members joining after June 1st in each year should be liable for only half the annual subscription for that year. A plan for raising a sum of money to purchase additional tools for the workshop was submitted, and was approved of by the meeting. This being all the business, Mr. Robert Kerr proceeded to show under steam a model of a beam engine, Mr. Miller exhibited a planing machine, and Mr. Hunter a drill chuck. The meeting terminated with a vote of thanks to the exhibitors.—W. B. KIRKWOOD, Hon. Secretary, 5, North Charlotte Street.

Norwich.—The last monthly meeting of the Session of the Norwich Society of the Model Engineers was held at the Technical Institute, St. George's, on Friday evening June 6th, under the presidency of Mr. R. Wright. The main purpose of the Society is to foster an interest in the construction of model engines, electrical apparatus, etc. The chief object of the gathering was to consider a scheme for initiating a workshop for the use of the members. A number of models, &c., were on view. Previous to the principal business of the meeting a paper was read by J. C. Walker on "The Educational and other Advantages of Model Engineering." He said there was a gap somewhere in teaching lads their trades, and this Society helped to fill that up. In these days of the subdivision of labour, when some were not properly taught, it behoved them to learn their trade elsewhere. The Chairman said he believed a workshop for the use of members would considerably help the Society and increase the interest in the work. Similar Societies in other towns were working on these lines, and he thought by a little energy on the part of the members they might follow their example. He had made enquiries with the view to ascertaining the cost of premises and the amount of incidental expenses, and he thought an inital outlay of £15 would enable them to start. Many members could not afford the expenditure for securing the required tools for carrying on work, and the specimens before them were illustrations of what could be done with a few machine tools. In order to keep pace with similar Societies it was absolutely necessary to attempt a scheme of this kind, and he suggested that subscriptions be invited to meet the expenditure. He would be willing to help in any he could. A general discussion followed, in which the opinions expressed met with the members' approval, but in view of the summer season it was decided to allow the matter to remain in abeyance till the opening meeting of the next Session in September, and in the meantime that efforts be made to obtain subscriptions towards meeting the expenditure. Most of the members intimated their willingness to support the scheme, and it was decided to canvass others with the same object. Mr. G. N. C. MANN, Hon. Secretary, Redwell Street, would be glad to communicate with any interested in the movememt.

Leeds.—On Tuesday evening, June 10th, a meeting of the Leeds Branch of the Society of Model Engineers was held in St. Andrew's Church Schools, there being a poor attendance. One of the members showed one of the cheap sets of castings for bicycle motor, which are being sold by the Madisons Casting Co. Afterwards a visit to Liverpool was discussed; also that the meeting should close for the summer, that is until September, the meeting terminating at 9.30 p.m.—W. H. BROUGHTON, Hon. Secretary, 262, Carlton Terrace, York Road, Leeds.

Nottingham.—The meeting of this branch was held at the Gordon Café, Derby Road, on June 6th. The chair was taken by Mr. A. H. Doughty (vice chairman) at 8.15. After a discussion upon workshop matters, an exhibition of working models, to be held on Friday and Saturday, June 27th and 28th, was decided upon. Three new members were elected, the branch now having a total of 30 members; and after a vote of thanks was accorded to the Chairman, the members adjourned to Mr. Wilson's workshop to inspect a newly finished vertical boiler under steam. The test was very satisfactory, and the boiler drove a ¼ h.-p. engine under full load.—R. P. READER, Hon. Sec., 4, Wellington Square, Park Side, Nottingham.

Oldham.—The monthly meeting of this branch was held at the Oriental Restaurant, Church Terrace, on Tuesday, June 17th, when Mr. Watson occupied the chair. After the formal business, the question of a competition was discussed, but was left over for the Committee to deal with. Mr. G. Dellow had on view a model dynamo which was run with splendid results. Mr. Kay had on view an accumulator, which was very neatly made. It was decided to draw up a programme for the coming winter session. The total number present, including members and friends, was twenty-two, and the meeting closed at 10 o'clock with a vote of thanks to the Chairman.—R. L. COLLINGE, Hon. Sec., 15, Weddop Street, Westwood, Oldham.

The Aeronautical Institute and Club.

AT the General Meeting of the Aeronautical Institute and Club, held at St. Bride's Institute, Fleet Street, E.C., June 6th, Dr. F. A. Barton being in the chair, a paper by Mr. Frederick Walker was read, on "The Screw Propeller and Aerocurve in Theory and Practice." Mr. Walker's paper was followed by a discussion, in which many members took part. Mr. J. F. Carter, the representative of the Aeronautical Institute and Club at the recent Congress of Aeronauts, held in Berlin, then read an interesting paper on the work of the Congress. Mr. P. L. Senecal afterwards made some experiments with several working models, the machines flying about the hall, the purpose of Mr. Senecal's experiments being to prove that a flying machine after this description could be steered by means of a movable weight. Mr. Senecal was very successful in showing this, and was closely watched by an interested audience. The meeting concluded with a hearty vote of thanks to the Chairman, Dr. F. A. Barton.—O. C. FIELD, Hon. Secretary, 20, Adelaide Road, Brockley, London, S.E.

Model Electric Railways on the "Third Rail" System.

By F. J. Burnham.

AMONGST the many readers of this journal who possess a steam locomotive, and a track of suitable length upon which to run their models, few appear to have turned their attention to electric traction. Surely, with the rapid growth of electric traction in this and other countries, it must have occurred to the model engineer that it is quite possible for him to adapt his system for the running of an electric locomotive, especially as, in my opinion, the latter has numerous advantages over the steam locomotive. I feel pretty sure that if readers were as much acquainted with the science of the one as of the other, they would not hesitate in giving their preference to the new power as some of our railway companies themselves are now doing.

The advantages of the electric locomotive over the steam locomotive are numerous: no matter how much it may be used, it does not require any attention in the way of cleaning up, and is always ready for work so long as a suitable supply of current is available; the regulation of speed can be done outside the locomotive altogether, by means of a resistance coil in the main circuit; a switch can also be placed in the circuit, which would enable the operator to start or stop the model if out of reach; an electric (solenoid) brake can be fitted to the locomotive or any other vehicle it may be drawing, and this can also be worked from the main circuit through the resistance coil. In my opinion this is the only type of brake that can be satisfactorily worked on models, and the results leave nothing to be desired. The power can be graduated to a nicety, or it can be applied suddenly if the model is in danger. The power for a brake need not be taken off the central rail, since to make it possible to operate the brake from a distance, it will be advisable to have outside conductors in suitable places which could be connected to the resistance coil and be controlled by a two-way switch, thus preventing the current from being in the side conductors while it is in the central rail, or *vice versa*, bringing into use the same power which drives the locomotive to stop it, and at the same time making it impossible to apply the brake while the current is in the motor, the connection to the brake solenoid on the locomotive being made by a collector mounted on the side of the framework; this collector would take the positive current just as the central rail does: the negative returning through the running rails in the same manner as the main current for the motor. A too sudden application of the brake when the locomotive is travelling at a high speed, will, of course, "lock" the wheels, thereby causing skidding; should this happen, the current could be switched right off and afterwards re-switched on, the sudden or gradual application of the brakes depending on the speed the switch handle is moved across the contacts of the resistance coil.

The centre rail need not be arranged so that the current is in the whole length the whole time; it can be conveniently arranged so that any particular portion of the central rail can be cut out of the main circuit, especially at the ends where the locomotive could travel the last few feet with its stored energy, thereby avoiding a violent collision with the buffer stops. The switching in and out of various sections of the third rail may be performed by ordinary electric light switches placed under or near the track at any convenient position.

To those who are thinking of converting their railway systems, I should like to emphasise the fact that it is only a simple operation, incurring but a small expense, and it may be said also that an electric locomotive, as complete in its design as a steam locomotive, is far simpler to make; it costs less, is not so liable to get out of order, and the results are superior.

In equipping an ordinary railway track for electric traction, the first thing is to get some ordinary electric light wire, about 7-22nds. This will be found very suitable for the purpose on account of the thick insulation, which will be found advantageous if the track is laid down in a garden. This wire should be laid the whole length of the line, either underneath or between the rails; whether the track consists of single, double, or treble lines or sidings, one wire will suffice for any number. This wire will be connected to the resistance or main controlling switch, and will take the + current which is used on the central rail. The object of this wire is to provide current to each section of the central rail, so that in the event of any particular section being cut out, the remainder will still be supplied from the wire.

Referring to Fig. 1, *a* shows the third or central rail, which has beside it the main cable *b*. The third rail is shown divided in two places, making three independent sections, each section having its own switch *c* connected to the cable *b*. This system of switching in and out of circuit different sections is not absolutely necessary on a short track, so that when the locomotive is nearing the end of its journey it can be travelling over a dead section. For a complicated track, consisting of loops, crossings, sidings, or any form of junction where shunting would be carried on, this is very important, and in any case it will be found extremely convenient.

It is remarkable that many amateurs think that great difficulties have to be contended with in the third rail system on an ordinary crossing or turn-out, or whereever there are points. As a matter of fact, no difficulty exists whatever. Referring to Fig. 2, which shows a single turn-out, it is obviously necessary to break the third rail where the ordinary running rail crosses it, and this break must be sufficiently long to prevent a short circuit between the third rail and the ordinary running rails (which carry the return or − current) when a wheel is passing that point. Allowance, of course, must be made for the flange and for the amount which projects over the rail. This break in the third rail is considerable, but in order that the slipper or collector on the locomotive shall still have a surface to slide on, strips of hard wood *f* should be fitted, as shown, and as the top of the third rail is elevated above the running rails, these strips *f* should be bevelled down to the level of the outer rails. The break in the third rail—viz., the parts between the extremities *d* and d^1 being compensated for by electrically connecting the ends by the short piece of insulated wire *e* placed under and clear of the rails. It may here be mentioned that although the third rail is elevated above the surface of the running rail, it is also necessary that the slippers or collectors on the locomotive should not, even when in their lowest positions, touch the surface of a running rail when crossing it. Should this occur, a short circuit will take place, blowing the fuse in the main circuit, or, if there is no fuse, damaging the accumulator.

There is no need, when a locomotive is passing over a break of the description shown in Fig. 2, for the current to be temporarily cut off from the locomotive; although it would retain sufficient energy to carry it over the break. Two current collectors should be provided (one at each end of the locomotive) and their distance apart should exceed the length of the break, so that while one slipper may be resting on a dead point the other will be on a live point. Fig. 3 illustrates this, one of the collectors passing over one of the running rails; and the collectors, although mounted on springs, should be so adjusted that it would be impossible for them to drop and make contact with the running rail when passing over the gap *g*.

The running rails which take the return or negative current should offer as little resistance as possible; therefore, it is absolutely necessary that every joint in the rails should be electrically, as well as rigidly, connected. An ordinary fishplate may suffice for a good electrical connection, although it cannot be relied upon on account of scale or rust. One way of doing the work properly would be to tin that part of the fishplate and the surfaces of the rails upon which the fishplate bears; but not using spirits of salts as a flux on account of its corrosive action. Another method where fish plates are not used is shown in Fig. 4, where a bond consisting of a piece of thin copper strip can be secured across the joint by screws by this method. Tinning the surfaces is not essential if cheese-headed screws are used and the holes in the rails are carefully tapped.

Fig. 5 shows another form of bonding, which can be adopted on a track where the rails are already laid down, and where it may not be possible to drill and tap the rails without first taking them up. The bond consists of a plain piece of thin copper strip soldered direct to the rail ends; but it should be made longer than the former bond and should be bent in the middle, as shown, to allow for any contraction or expansion of the rails if these are in long lengths; otherwise, the joint will soon give way when the rail contracts.

The third rail, which must now receive consideration, should be made of brass strip about 5-16ths in. by 1-16th in., or, better still, 3-16ths in. by 5-16ths in. channel brass. The latter will keep straight when laid down, and although it is more expensive than ordinary strip, it will be found worth the extra expense, as there is less loss of current in transmission to the locomotive through a level central rail than through a strip which might easily be bent between its points of support. Channel or strip brass cannot be purchased in such long lengths as ordinary bar iron, which might be used for the running rails, and where a long length of third rail is required in one section it is not necessary to connect the ends rigidly together to ensure a good electrical connection; in fact, it would be better if the ends were left about 1-16th in. apart, and electrically connected underneath by a short piece of copper wire soldered thereto. In the case of the third rails of two different sections, as previously described and illustrated in Fig. 1, their ends of course must not touch, and should be at least ½ in. apart.

The method of supporting the third rail presents no special difficulties. If brass strip is used it will need supporting at about every 6 ins. on pieces of hard wood or vulcanised fibre secured to the sleepers as shown in Fig. 6, but where channel brass is used it need only be supported at about 12-in. intervals, and this could be done by having the supports cast in brass, and soldered to the channel brass, and held down to the sleepers as

Fig. 1.

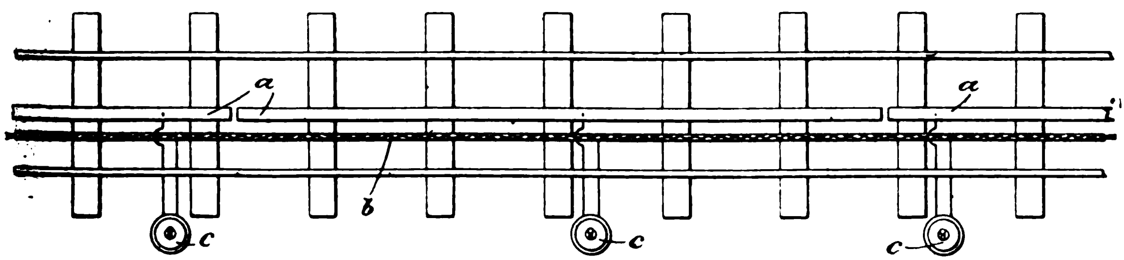
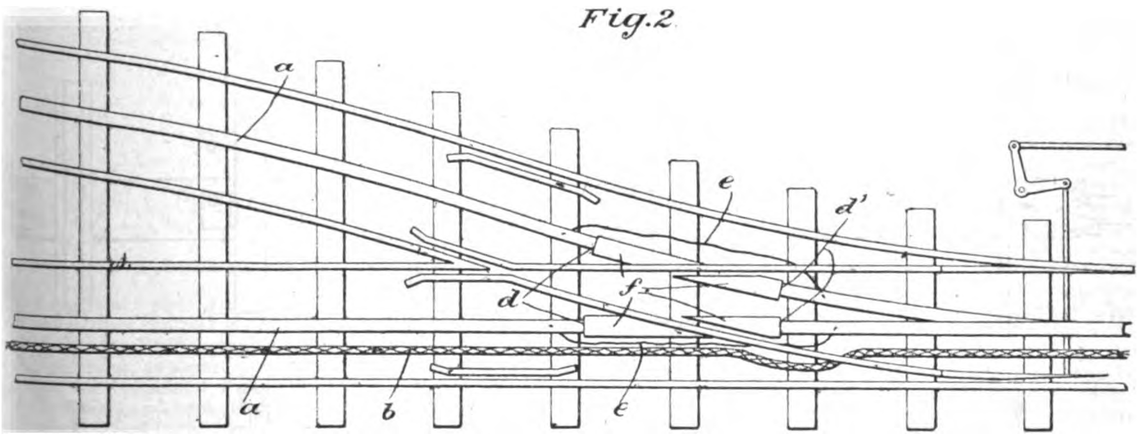


Fig. 2.



PLANS OF ELECTRIC RAILWAY AND CONDUCTORS.

shown in Fig. 7. This method is by far the best to adopt, the rail not being secured by screws leaves the surface perfectly smooth, thereby minimising sparking; furthermore, it involves less labour in erecting, and is more substantial.

This I think will conclude the description necessary to guide those who are about to convert their present system, and I will now proceed to describe the method of controlling, and the power required.

In the foregoing description it was stated that a cable strengthening the current admitted to the rails, and on moving it on to contact *o* the resistance coil will be completely cut out, thereby allowing the full current on the third rail or brake conductor. In the diagram eleven contacts are shown, which indicate about eleven speeds.

It is quite possible for the regulation of speed to be performed on the locomotive itself by having the resistance coil mounted within the cab; but the special advantage of the electric over the steam locomotive would then be lost, it being almost impossible to regulate the speed whilst the

Fig. 3.

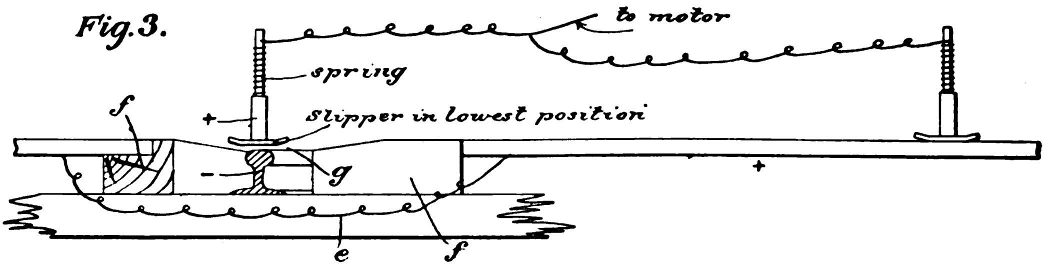


Fig. 4.

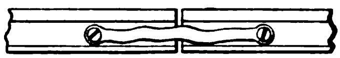


Fig. 5.

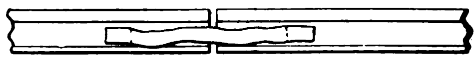


Fig. 6.

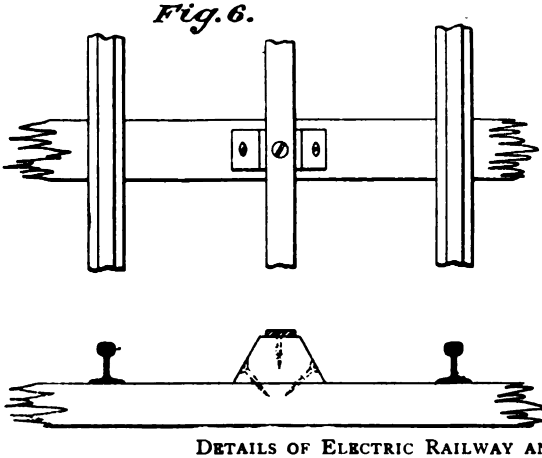
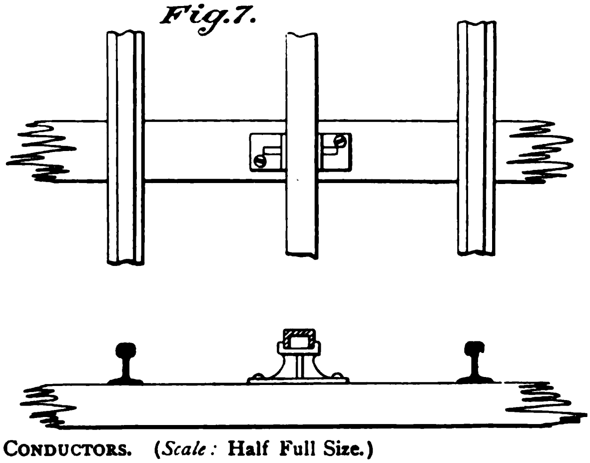


Fig. 7.



Details of Electric Railway and Conductors. (*Scale:* Half Full Size.)

should be laid down the whole length of the track; the current should, as nearly as possible, be delivered to the middle of this cable, not to the ends. Fig. 8 is a diagrammatic view, showing the connections from the battery or generator to the resistance coil or controller, and from there to the rails. The positive current from the battery is conveyed to the resistance coil *k* through the contact lever *l* and contacts *m*, each contact being joined to one convolution of the coil so that when the lever *l* is on the contact *n* the current will have to travel through the whole of the convolutions of the coil *k*, giving the maximum resistance. On moving the lever to the left, over the contacts, the resistance coil is shortened, thereby engine is in motion. Another method which might be adopted for varying the speed is to adopt an ordinary series parallel controller on the locomotive itself, by which three speeds can be obtained:—(1) By switching into circuit one coil of the field-magnets; (2) a faster speed by switching into circuit the two coils in series; (3) and the fastest speed by switching into circuit the two coils in parallel. This system can also be adopted for a locomotive with two motors; but as the regulation of speed on the locomotive involves a complication of wiring and connections to the controller, I will not enter into its description any further—especially as it possesses no advantages over the method previously described. For a large locomotive, where the operator could travel on the engine, it would be the proper system to adopt; but for a model, outside controlling is advisable.

Fig. 9 (see next issue) shows a controller for a model electric locomotive, on which the current is dealt with before entering the motor. The connections between the third rail and controller, and from there to the motor and the return circuit, are shown diagrammatically. The controller *p*

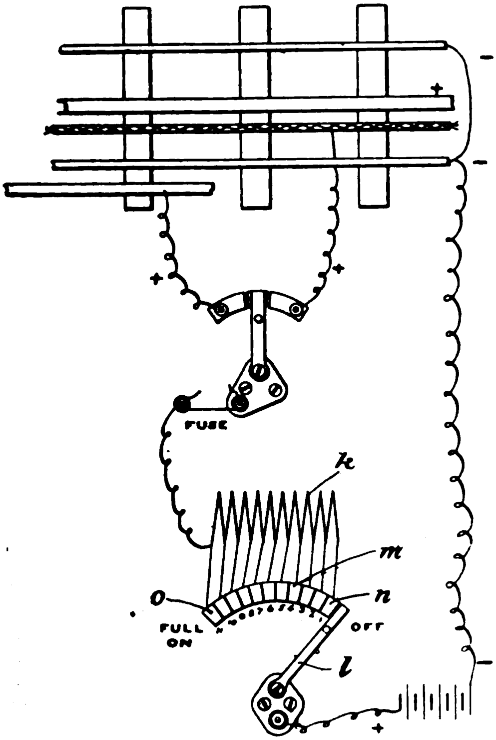


Fig. 8.—Diagram of Connections.

consists of a plain, upright piece of hard wood *q*, to which the various contacts are attached, and it can be arranged so that the "Off" position is when the handle *u* is perpendicular, as shown: and by shifting the handle to the left to the point *r* the locomotive would move in that direction; and by moving it to the point *s* the locomotive would travel in the opposite direction, this being all that is necessary for starting, stopping, and reversing.

(*To be continued.*)

Red lead may be regarded as an insulator, at any rate after a certain lapse of time, observes the *Farben Zeitung*. On pulling down the Bremen telegraph office in 1894, an iron joist that had been coated with red lead for eighteen years proved to be perfectly insulated; and a sensitive galvanometer, traversed by a current of 150 volts, showed no leakage. This circumstance led to experimental investigations; and it was found that a substance made of low-quality fibre surrounded by red lead is a good insulator, while also withstanding attack from the atmosphere. Red lead mixed with linseed oil has, indeed, no great insulating effect while it remains liquid; but after oxidation in the air it forms a substance that has considerable resistance to the electric current.

How to Become an Electrical Engineer.

By Frederic H. Taylor, A.M.I.E.E.

(*Continued from page 10.*)

Having now considered the scope of the profession which the student has contemplated entering, let us now turn attention to the education which is necessary, in order that he may occupy a position creditable, alike to his profession and himself.

I start with the student as he leaves school, probably at the age of, say, 15 or 16 years. By some such an age may be considered as far too young for a serious setting out along the pathway to a definite calling; but there is much to be done, and certainly no good and much harm is brought about by a rest after the school studies are finished, and whilst the parent or guardian looks about to see what offers itself.

The school training should in itself have been thorough, and have comprised geometry, algebra, trigonometry, and other subjects such as usually go to form the curriculum of a good middle-class school.

Whatever branch of the industry an electrical engineer may eventually settle down into, or "specialise" in, a good sound preliminary all-round training is essential. Such training may, broadly speaking, be divided up under two heads—(*a*) theoretical, and (*b*) practical, neither of which can safely be dispensed with if the end in view is maximum efficiency.

Assuming that the student is about the age mentioned, and therefore has half-a-dozen years at his disposal, he should now take up a course of day study at one of the well-known technical institutions or colleges, most of which are possessed of well-equipped departments specially devoted to electrical work.

The training afforded by such a college usually extends over two or three years, and the courses will comprise the following: Mathematics, geometry, machine drawing, physics, mechanics, electro technology, chemistry and workshop practice. In physics, mechanics, electro technology and chemistry, both lecture classes and laboratory work will be given, and in the workshops some practical instruction in the use and handling of tools, etc. All these subjects are essential to a proper training, although the connection between some of them and electrical engineering may not at first sight be apparent.

Such a course of work will form a very good basis for the more purely theoretical side of the student's education. Some of the technical institutions grant a certificate to those students who pass their final examinations. This, in itself, forms a record of efficiency commendable to prospective employers, which should be earnestly worked up for.

Every electrical engineer, if he be rightly so termed, possesses some training and experience *as an engineer*. That is to say, he must be well acquainted with the "practical mechanics of things," understanding methods of manufacture and construction, and the use of tools, etc. As illustrating the advantage of such training, it might be here mentioned that some of our best electrical engineers of to-day are men who were originally trained as mechanical engineers, and afterwards added electrical training to their existing knowledge.

To ensure such a training, apprenticeship or pupilage forms the best method of procedure. Most of our electrical engineering firms of importance take into their works either apprentices or pupils, or both. In this connection, the question will at once be asked, what is the difference between the apprentice and the pupil? Practice, in this respect, unfortunately, varies in different firms; but, generally speaking, the apprentice does not pay as high a premium for his teaching as the pupil, and, therefore, does not usually share his advantages. As an instance coming within the writer's experience, the apprentices in a certain large firm paid £50 premium, and were only allowed to work in the fitters' and instrument makers' shops of the works. Their more happily blessed friends, the pupils, paid £315 premium for the same term of employment, but were allowed to work in each and every department of the establishment, and thus their experience was much wider and more comprehensive.

The student should never look askance at the truly commercial side of his profession, and if the opportunity can anyhow be obtained, he should make a point of getting experience in it. During his pupilage, therefore, or say, at the end of it, he might well spend some time in the offices and estimating departments of the works. Such work as this may perhaps appear tedious, but the experience gained will prove of the greatest value in after life, certainly, if a business on one's own account is the future goal.

As to the cost of such an education as just indicated:— The fees charged by the different technical colleges vary considerably, and, in fact, may be anything from £100 per annum for a two or three years' course, down to £15 or £10 for the same period. From the writers' experience it does not follow that the institutions charging the highest fees necessarily afford the best education; in fact, it is quite possible to obtain a thoroughly sound course of training for the fee of about £15 per annum.

A large number of our colleges and institutes have "evening courses" in electrical engineering and allied subjects, arranged for the convenience of those who, for various reasons, are unable to devote the daytime to study. In these courses the student is frequently allowed to pick whatever subject or subjects he wishes, that is to say, he might enter for electrical engineering lecture and laboratory courses only, or he might add to these, mathematics, physics, &c., or any other subject appertaining to his profession, although the principals and lecturers are invariably ready to advise an intending student as to the best course to pursue, in order to meet his own particular set of circumstances.

The fees charged for evening work are usually quite small, and vary according to the number of subjects taken. In electrical work 7s. 6d. to £1 1s. per session is an ordinary range, although there are some institutes where the fee is as low as 2s. 6d. per session per subject.

The fees or premiums charged by different manufacturing or contracting firms for pupils or apprentices vary very considerably, the premium in most cases being largely governed by the firm's estimate of its own good self and its virtues. Large firms with wide connections, a big name and extensive factories, naturally charge larger sums than their smaller brethren, particularly so as many people who would pupil their sons to them are apt to form the opinion that the larger the firm the better the experience and training obtainable.

Articled pupils usually are required to pay a premium of from 100 to 300 guineas, according to the firm chosen, and it is customary not to take pupils for less than three years. A few firms might be found who would accept pupils for two years; but three is none too long a period to spend in this part of one's education.

Apprentices, on the other hand, usually pay from thirty to sixty guineas per annum for about three years. As previously mentioned, for the reduced premium they usually do not enjoy such wide limits of training as the pupil—certainly so in works where both are taken.

Additionally to their premiums, both pupils and apprentices provide their own board and residence; the old days when the apprentice lived under his master's roof and was invariably articled at the age of 14 for not less than seven years being now passed away, and likewise also the kind of treatment he frequently used then to receive.

It might, however, be urged that to study for two or three years at a technical college in the day classes, and then to serve articles of pupilage or apprenticeship for a similar period, is too expensive in view of the means at one's disposal.

If this be the case, the following alternative courses present themselves:—

(i) To take up an apprenticeship and contemporarily with it to study at evening courses at a suitable, and, if possible, neighbouring technical institute or college.

(ii) Having studied at a day technical college and obtained whatever certificate or award may be possible, to then offer oneself as an "improver" or junior assistant in an electrical firm, and gradually gain one's practical knowledge in that way.

(iii) Or to obtain employment in a works, and follow evening courses at a technical institute contemporarily.

To place the various courses of electrical engineering training in their order of merit, they should be arranged as follows:—

1. Technical college day study, with subsequent pupilage.
2. Technical college day study, with subsequent apprenticeship.
3. Apprenticeship, with contemporary evening courses.
4. Technical college day study, with subsequent improvership, etc.
5. Any good practical engineering employment in a works, with contemporary evening courses.

In order that the student may, without long and tedious enquiry, have some idea as to where he had best place himself for the more theoretical side of his profession, a list of some of the chief Colleges and Institutes possessing an electrical department is given hereunder, together with the name of the Secretary or Principal, to whom enquiries might be addressed:—

The Finsbury Technical College of the City and Guilds of London Institute, Leonard Street, Finsbury, E.C.—Principal, Prof. Silvanus P. Thompson, F.R.S; Registrar, K. Dove, Esq.

King's College, London.—Principal, The Rev. Archibald Robertson, D.D.; Secretary, Walter Smith, Esq., A.M.Inst.C.E.

University College, Gower Street, London, W.C.—President, The Right Hon. Lord Reay, G.C.S.I., LL.D.; Secretary, J. M. Horsburgh, Esq., M.A.

The City of London College, White Street, Moorfields, E.C.—Principal, Sydney Humphries, Esq., B.A., LL.B.; Registrar, D. Savage, Esq.

The Electrical Standardising, Testing and Training Institution, Faraday House, Charing Cross Road, W.C.—Principal, Hugh Erat Harrison, B.Sc.; Secretary, Howard Foulds, F.I.S.

The Northampton Institute, Clerkenwell, E.C.—Principal, R. Mullineux Walmsley, D.Sc., F.R.S.E.; Clerk to the Governors, Sydney Axford, Esq.

The Northern Polytechnic Institute, Holloway Road, N.—Principal, J. T. Dunn, Esq., D.Sc.; Secretary, W. M. Macbeth, Esq.

The Polytechnic Institute, Regent Street, W.—Secretary, C. J. Peer, Esq.

The Birkbeck Literary and Scientific Institute, Bream's Buildings, Chancery Lane, E.C.—Secretary, W. H. Congreve, Esq.

The Goldsmiths' Company's Technical and Recreative Institute, New Cross, S.E.—Secretary, John S. Redmayne, Esq., B.A.
The South-Western Polytechnic, Manresa Road, Chelsea, S.W.—Principal, Prof. Herbert Tomlinson, B.A., F.R.S.
The Willesden Polytechnic (Middlesex County Council), Priory Park Road, Kilburn, N.W.—Principal and Secretary, Wm. Houston, Esq., B.A.
The Tottenham Polytechnic (Middlesex County Council), High Road, South Tottenham.—Secretary, J. W. Tomlinson, Esq.
The Acton and Chiswick Polytechnic, Bedford Park, W.—Secretary, W. H. Barker, Esq., B.Sc.
The Battersea Polytechnic Institute, Battersea Park Road, S.W. — Principal, Sydney H. Wells, Wh.Sc.; Secretary, Joseph Harwood, Esq.
The People's Palace, Mile End Road, E.—Director of Studies, J. L. S. Hatton, Esq., M.A.
The West Ham Municipal Technical Institute, Romford Road. E. — Principal, A. E. Briscoe, A.R.C.Sc.(London).

Although London and its suburbs are well provided with technical institutions, the Provinces are by no means lacking in their educational efforts, and the following large towns are amongst those possessing colleges or institutes for technical training in electrical and allied subjects:—Manchester, Salford, Birmingham, Bristol, Liverpool, Nottingham, Sheffield, Leeds, Durham, Edinburgh, Bradford, Brighton, Croydon, Derby, Glasgow, Leicester, Belfast, Cork, and Galway.

The "session" or educational year for evening courses may be taken as usually commencing the last week in September or first week in October, and concluding at the end of April or beginning of May.

The sessions for day courses begin usually at about the same time as those for the evening work, but frequently extend into June or July.

The hours of study are generally from about 9.30 a.m. to 5 p.m. in the day, and from about 7 p.m. to 10 p.m. in the evening classes.

Some few of the day colleges, such, for instance, as the City and Guilds, require the student to pass an entrance or "matriculation" examination before he be admitted, and such examination usually comprises Algebra, Trigonometry, Euclid, English composition, etc.

Day and evening classes alike usually prepare students for the public examinations of the City and Guilds of London Institute and the Board of Education, the evening classes frequently arranging their syllabus of lectures with this object in view.

Where an apprentice or improver is about to take up evening work it is most essential that he should make a point of attending the very first lecture of the course, and before joining seek the advice of the Principal of the Institute, or the chief of the electrical department as to what courses are best suited to the needs of his particular case. Often I have had students come to me bemoaning the fact that the work they are doing during the daytime as improvers, apprentices, or assistants, is not in any way assisted by their evening studies as it should be, enquiry showing that they have entered for classes quite ill suited to them for lack of proper advice.

Turning to the question of pupilage and apprenticeship, the selection of a firm must necessarily be somewhat guided by the funds at the student's disposal. It is not every firm which makes a practice of taking either apprentices or pupils; but the writer has gone to some trouble in collecting together the names of many important firms and companies situated in various parts of London and Provinces, who adopt this custom:—

Drake and Gorham, Ltd., 66, Victoria Street, S.W.
Strode & Co., 48, Osnaburgh Street, Regent's Park, N.W.
J. E. Spagnoletti & Co., Goldhawk Road, W.
Barlow Bros. & Co., 237, Shaftesbury Avenue, W.C.
The Newton Electrical Works, Ltd., Taunton, Somersetshire.
Lord and Shand, Plymouth.
Crompton & Co., Ltd., Chelmsford.
Johnson and Phillips, Old Charlton, Kent.
The General Electric Company, Ltd., Victoria Bridge, Manchester; and 56, Barwick Street, Birmingham.
Gent & Co., Leicester.
Lea and Warren, Kettering, Northamptonshire.
The Electric Construction Company, Ltd., Wolverhampton.
Robert Dawson & Co., Ltd., Stalybridge, Cheshire.
J. H. Holmes & Co., Portland Road, Newcastle-on-Tyne.
Ferranti, Ltd., Hollinwood, Lancashire.
P. R. Jackson & Co., Ltd., Salford Rolling Mills, Manchester.
Mavor & Coulson, Ltd, 47, King Street, Mile End, Glasgow.

In making the choice of a firm the student will probably find it advantageous to note the following points:—

1. Do not choose a firm where the number of pupils or apprentices taken is large in proportion to the number of workpeople employed. Such works are usually termed, in vulgar language, "pupil shops," and the best class of workmen, who are always able to reckon on constant employment, will avoid them as never being satisfactory. Where so many learners exist in proportion to the skilled hands, it becomes quite impossible for the latter to give the former any individual attention worth having. To obviate this sort of thing, most of our best firms limit the number of pupils or apprentices in each department of the works.

2. Whether the firm be large or small, or the premium paid little or much, by all means insist upon having proper "Indentures" or "Articles," which will form the precise lines of agreement between the pupil and his employer; and if the former be under age, the parent or guardian will also be included in the agreement. The Stamp Duty on indentures is now only half-a-crown, and the value of having them is twofold:—Firstly, if properly drawn up they protect the interests of the apprentice by binding down the employer to cause him to be properly taught his business, trade or profession; and secondly, at the expiry of the term it is customary for the employer to endorse the indentures to the effect that the apprentice has well and faithfully served him during the period therein named, assuming that to be so.

3. If intending to ultimately specialise in a particular branch, such for instance as traction, select a firm which you find to be really and actively engaged in pushing this particular class of work. It is customary with some firms to pay a salary to their apprentices or pupils. In most cases, this is purely nominal, and of the order of, say, 2s. 6d. per week the first year, 5s. per week the second, and 7s. 6d. or 10s. weekly the third year. Improvers, too, often receive a small salary, according to their ability and usefulness.

A few words of advice to the intending apprentice, pupil or improver during his term of service may perhaps be of interest and use as assisting towards success.

On entering the works for the first time, do not expect to find the British workman a cultured gentleman who is waiting there expressly for your benefit. Like other men he has his faults and peculiarities, so for your own good make the best of them, and without necessarily associating with him, get him to look upon you as his mate.

"Paying your footing," as it is called, is one of the customs which the new recruit is not allowed to forget, and which it will pay him to remember. In other words, the shop will be expect to be "treated." Beer is the supposed solution to the question; but a box of cigars is just as efficacious, and obviates the repugnant idea of a trip to the village inn.

Keep good hours, whether your employers are strict with you in this point or not. Never consider that dirty odd jobs are beneath you; but when they have to be done, do them with a hearty good will as part of your work and duty.

Generally speaking make yourself agreeable, and those you have to work amongst will make themselves agreeable to you, and be willing to help you to learn.

Should you, as a pupil or otherwise, have a right to go through the various departments of the works, see that you *do* do this. Often when a fellow has been in a given shop some months he becomes useful at his work, and the foreman of that shop may, for his own interest, want to keep him there, which is of course disadvantageous to the pupil. To take the case of a good-sized electrical works the pupil might well map out his course somewhat as follows:—

The works drawing office, pattern shop, foundry, smiths' shop, engineers' shop (that is, general fitters' and machine work), erecting shop, testing department, estimating department, and, if possible, some time on outdoor contracting work.

Drawing office work is particularly important, and six or eight months is none too long a time to devote to it, even if the pupil has previously had some practice in machine drawing in a technical college.

The student will do well always to take careful notes during his work, in such matters as the results obtained on tests at which he is present, general principles of design as used in the work he comes in contact with, rough-and-ready rules used by workmen in their work, etc., and when left to himself, such observations will always be of great service to him.

One sometimes sees nowadays advertisements for pupils in central lighting stations. Such experience is well enough so far as it goes; but it is more suited to one who has already had shop training, or one who having trained himself generally, is intending to specialise in that class of work, than for anyone else.

The remark has sometimes been made that "pupils are no use"; but the writer has never once heard the observation from the lips of anyone who has himself received proper systematic training in his profession such as pupilage provides; but rather it has always been said by one who has been lucky enough to get to some sort of position *in spite* of his lack of proper training, and not *because* of it.

Where an instance does occur of a pupil who at the end of his time is little else than a "waster," the fault is most certainly the individual's, and not that of the system, and the cause is not often far to seek. Usually, it is a case of a young man possessed of wealthy parents who considers that he might as well take an easy time, and not trouble himself to work or think, as whatever happens, he will always have plenty to live upon. Failures from this very reason occur in every walk of life.

In the allied branches of engineering, pupilage is the recognised method of training, and many of the greatest names known to engineers are those of men who "served their time" as pupils.

General Course of Study.—Modifications to the suggested system of education must necessarily often arise to meet the particular circumstances of a particular person, and much, of course, must depend upon the personal efforts at study and at work of the student himself.

To meet the needs of a general training as an electrical engineer the student might with advantage map out his work as follows:—

If attending a day college, let him take up the programme usually arranged for first-year students, and if able to pass well in the examinations which are set, to follow up the second year course. Sometimes a third-year course is provided, and, if so, it is desirable that this also should be followed.

The text books which it will be desirable to use contemporarily with the day work during the first year, will be as under, and for the assistance of the student, the publisher's name is added in each instance:—

"Elementary Lessons in Electricity and Magnetism," by Silvanus P. Thompson (Macmillan & Co.).

"Electric Light and Power Distribution," Vols. I and II, by Perren Maycock (Whittaker & Co.).

"Practical Electricity," by W. E. Ayrton (Cassell and Co.).

"Electric Wiring, Fitting, Switches, and Lamps," by Perren Maycock (Whittaker & Co.).

In a second-year course, the following books might be added together with those relating to special subjects, which are referred to later:—

"Dynamo Electric Machinery," by Silvanus P. Thompson (E. & F. N. Spon).

"The Alternating Current Circuit," by Perren Maycock (Whittaker & Co.).

In evening classes of technical institutes the syllabus is usually arranged so as to cover the work embraced in the examinations of the City and Guilds of London Institute, and thus frequently extends over three years.

In the first year the "Preliminary" grade is taken, in the second the "Ordinary," and in the third the "Honours" grade. The instructors generally recommend students' books wherewith to accompany their work, and the foregoing are usually amongst those chosen.

In order to gain a maximum of advantage from any given book, the student should not set himself to begin reading at the first page and continue on, chapter by chapter, to the end. By such a course he will give himself many a bad headache and a lot of fruitless labour. On the other hand, let him in his spare time for study carefully look up a given part or subject just after he has heard a lecture on it or been engaged in practical work relating to it. Then carefully compare his own notes with what he finds in the text-book, and endeavour to amplify them from the same. By this method he will not only add to his knowledge, but what he learns he will not forget.

A word might here be said on the subject of taking notes at lectures and elsewhere. Some people imagine that to take notes at lectures you must be able to write shorthand. Such is not the case.

The student merely needs to attend carefully to what is said and done, and to make *abbreviated* notes of the principal facts that are given, and a little experience and thought in this direction will soon enable him to judge correctly of what he had best note in writing and what he can safely reckon on committing to memory through his ears only.

The rough notes of lectures, etc., as taken at the time, should not be looked upon as permanent, but should be carefully written out at home, with the assistance of the text-book as above mentioned.

At most of our colleges and institutes in both day and evening courses, a certain amount of work is usually set, to be done by the student himself at home. Too much stress cannot be laid upon the importance of regularly and carefully working this out, even if a little anticipated recreation has to be foregone in consequence. In evening or other classes, where a feature is made of preparation for the City and Guilds Examinations, the instructors obviously have but little means of judging of a student's fitness for the same if he does not regularly submit home work for inspection.

At this period of his training the student might certainly begin to take in, and study some of the weekly periodicals, say, for example, the *Electrician*, the *Electrical Review*, or the *Electrical Engineer*. By so doing he will not only be posted up in the latest developments of the electrical industry, but will find much that is directly instructive in its character. Each of the three papers mentioned is published on Fridays, the first-named at sixpence, the second at fourpence, and the third at threepence.

Specialisation.—At the present time, when competition is daily becoming keener and keener, it is not surprising to find men "specialising," as they say—that is, following up some one particular branch of an industry, and perfecting themselves in all its details as they go along.

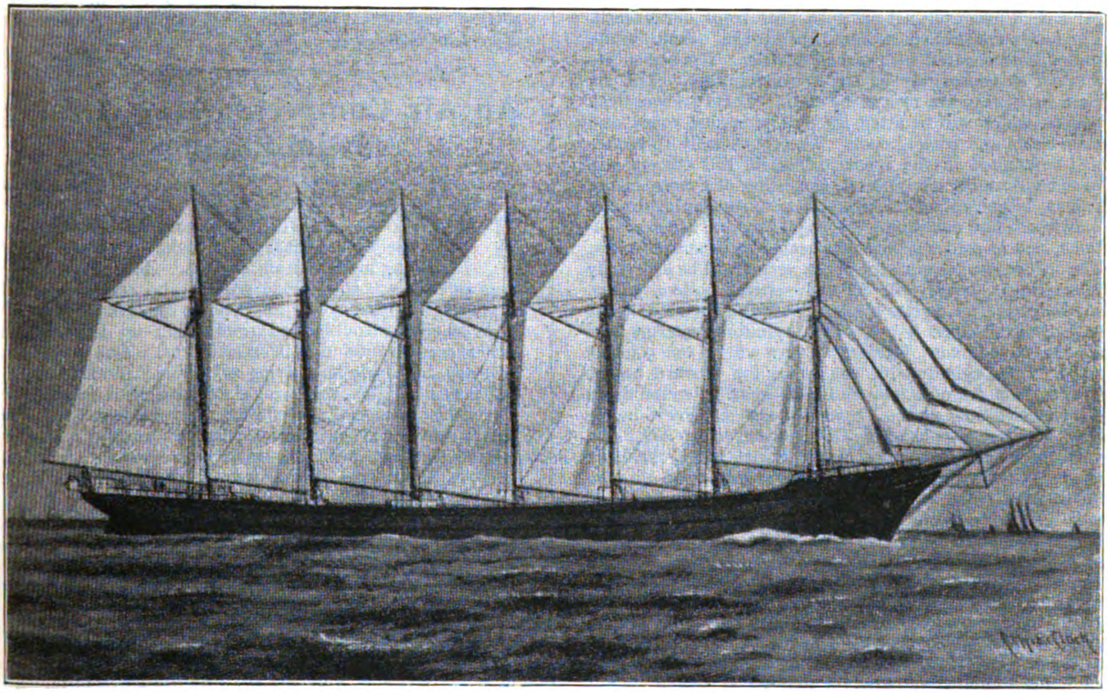
The training which the student (or the electrical engineer as we may probably now call him), has received should fit him to specialise in any of the branches of the industry for which he may possess a particular fancy.

(To be continued.)

THE largest impulse water wheels ever constructed, measured by the power developed, are to be made by a San Francisco firm for the Bay Counties Power Company, of California. Two wheels are to be built to develop 3,700 h.-p. each, using water under a head of 1,600 ft. These wheels, says the *Engineer*, are to be direct-connected to 2000-kilowatt alternators, and both machines will be mounted on shafts of nickel steel.

The First American Steel Schooner.

THE chief shipbuilding novelty of the year is the great seven-masted schooner *Thomas W. Lawson*, which is now nearing completion at the yard of the Fore River Ship and Engine Company, Quincy, Mass. The seven-masted schooner, besides being the first to carry more than six masts, will, when launched a few weeks hence, be the largest sailing vessel in the world—a fact made possible by the use of steel instead of wood in her construction. The big six-masted schooners *Eleanor A. Percy* and *George W. Wells* are both built of wood. The frames of the new schooner are all in place, and already show the typical schooner lines fore and aft, and since the plating is also nearly finished it is easy to appreciate the great bulk of the hull, which is nearly one-third longer than that of the U.S. cruiser *Des Moines*, now about ready for launching, in the same yard. On the same beach, too, the Fore River Company is building two of the new 15,000-ton battleships, probably the most powerful in the world, and yet even these are but little longer than the seven-masted schooner. Her length over all is 403·4 ft. Her other principal dimensions include a length of 368 ft. at the water-line; moulded beam, 50 ft.; moulded depth, 34 ft. 5 ins.; load draft, 26 ft. 6 ins.; and full load displacement of about 11,000 tons. On account of her great size the new schooner is being built as strongly as the ordinary steel ship. She receives additional stiffness from a cellular double bottom, which extends as far fore and aft as the lines of the hull will admit. Between the two bottoms there is a space of 4 ft.,



AN AMERICAN SEVEN-MASTED STEEL SCHOONER.

which will be used for carrying water ballast when shifting ports for a cargo. The capacity of the double bottom is about 1,200 tons of water, so that the idea obviously means a great economy of time and labour. The schooner is planned to carry a cargo of about 7,5co tons, and her cost will be in the neighbourhood of $250,000, finished and ready for sea. About 2000 tons of open hearth steel has been used in her hull, which is plated on the "in and out joggle" system. All plates, except those of the sheer strake and garboard, are lap-butted. The sheer strakes are double strapped and triple riveted. All longitudinal seams are double riveted, and the sheer strakes are doubled for one-half the length amidships. Three tiers of deck beams are fitted throughout the vessel, and all beam knees are three times the depth of the beam. In addition to the two steel decks, the upper, forecastle, and poop decks are covered with wood, the planks being secured to the steel decks with galvanized iron bolts set up with nuts from underneath. The heads are sunken as usual, bedded in oakum, white leaded, and covered with turned dowels. The seams are caulked as thoroughly as for a wooden ship. The six main hatchways are 17·4 ft. by 16 ft. There are four deck houses, which will be fitted for galley, engine room, and main cabin and wheel house. The crew—only 16 men—will be bunked in the forecastle, while the officers will have comfortable quarters aft, consisting of a main cabin, pantry, large captain's cabin, and state rooms, finished in hardwood, and containing the usual modern accommodations, and in cold weather to be heated by steam radiators. The mechanical equipment of the vessel will be especially interesting. There will be two vertical boilers, 56 ins. in diameter, by 90 ins. high, one in the forward house and one in the after house, with inspirators, injectors, and all the concomitant fittings. There will be one 9 in. by 10-in. double cylinder ship engine for the forward house, with friction drum and winch heads on an extended drum shaft on the outer end. There will also be five 8-in. by 8-in. hoisting engines with link motion, to go on deck, with galvanized iron winch heads on each end of the drum shaft. Two coil condensers will be employed to condense the exhaust steam for the hoisting engines, and each will feed a fresh water tank of 300 gallons capacity. There will be two direct acting steam pumps for main ship purposes, with steam and water cylinders, each 12 ins. in diameter, by 12 ins. stroke. There will also be one 6-in. by 4-in. by 6-in. duplex donkey pump of the packed piston type, to be located near the after boiler; and one 7½-in. by 5-in. by 7-in. pump of similar type located near forward boiler, both to be piped for use as circulating pumps, and also for washing decks and for fire purposes. Two hand pumps of the deep chamber type will also be provided for emergencies. The windlass will be of the Hyde pump brake type, with double geared messenger attachment and iron bitts. Wildcats will be fitted on a 2¾ in. chain, and a capstan and winch-head will also be connected with the windlass. Steam steering gear will also be provided, although it is expected that, except in narrow channels, the great schooner may easily be steered by hand. The seven-master will have the typical schooner rig, and the total sail area will be about 43,000 square feet. The lower masts and spike bowsprit will be of steel, and the topmasts, booms, and gaffs will be of Oregon pine. The height from the deck to the topmast truck will be 155 feet, and the diameter of the steel lower masts, which are now being built at the Fore River yard from original designs, will be 31 inches. The spike bowsprit is 85 feet over all. The standing rigging, and in special cases the running rigging of the lower sails, will be of wire rope, and the sails will be trimmed as well as hoisted by steam. The *Thomas W. Lawson* was designed by B. B. Crowninshield, of Boston. She will be under the management of Captain John G. Crowley, of Taunton, Mass., who is an experienced handler of the modern big schooner. Incidentally, Captain Crowley has the distinction of adding a new word to the English language—the term "pusher" for the seventh mast. The first six had previously been named in order—fore, main, mizzen, spanker, jigger, and driver. All in all, she should prove the most interesting commercial sailing craft launched this year. And when one remembers the fact that she represents a typical American development from the original, archaic two-master which took the water at Gloucester—not thirty miles from the new Fore River yard—nearly two hundred years ago, it may be added that her launching will have no small historical significance in the annals of American shipbuilding. The vessel will bear the name of the great Boston millionaire, who is also the owner of the steam yacht *Dreamer*, and one of the most enterprising yachtsmen and business men in America.—*American Shipbuilder.*

An Air Compressor for Driving Model Engines.

By W. E. S.

THE pump here described was designed expressly for the use of amateurs who make a speciality of building model steam engines. The main object kept in view was to provide a quick and ready means of supplying compressed air for driving models upon occasions when the trouble and time taken up in getting a boiler ready would not be convenient. The apparatus will also be of use for driving a "show" model, which, as fixed in its glass case, would be spoiled if handled or driven by steam in the regulation way. It would also be handy during the construction of a cylinder and piston for a model engine, when it would prove advantageous to know whether the piston was a perfect fit without escape of air.

I take it that nearly every model engineer possesses a lathe of some sort, and this air compressor is constructed so as to work off the faceplate of lathe.

Briefly, the pump consists of two cylinders and pistons worked from a crank pin on faceplate of lathe.

A reservoir is also provided, and is coupled to the ends of cylinders by means of two elbows for maintaining a constant pressure. The whole is fixed on to a base which is placed at right angles to bed of lathe, and is securely held to the bed by means of a bolt and nut.

The drawings (Fig. 1) show the arrangement clearly enough, but perhaps a description of a few of the important details will not be amiss.

It should be borne in mind that the proportions here shown are for a lathe of 3 in. centres, and the cylinders are 1⅛ ins. diameter, and of necessary length to permit of a 1½ in. stroke; therefore, anyone contemplating making a pump must make the wooden base and other details to suit his own particular lathe.

The cylinders are of cast brass of about ⅛ in. thickness, with a flange at one end and a stiffening rib at the other end. A bottom flange is provided, through which four holding-down studs pass, and are screwed into the wrought iron plate, which forms part of the base of the whole. The cylinders should be accurately bored, and smoothly finished, and the flange at end should be faced up from a surface plate, so as to bolt up tightly without the necessity of packing.

Next to the end flange is the valve plate of 1-16th in. thickness brass. This should be quite flat, so as to pre-

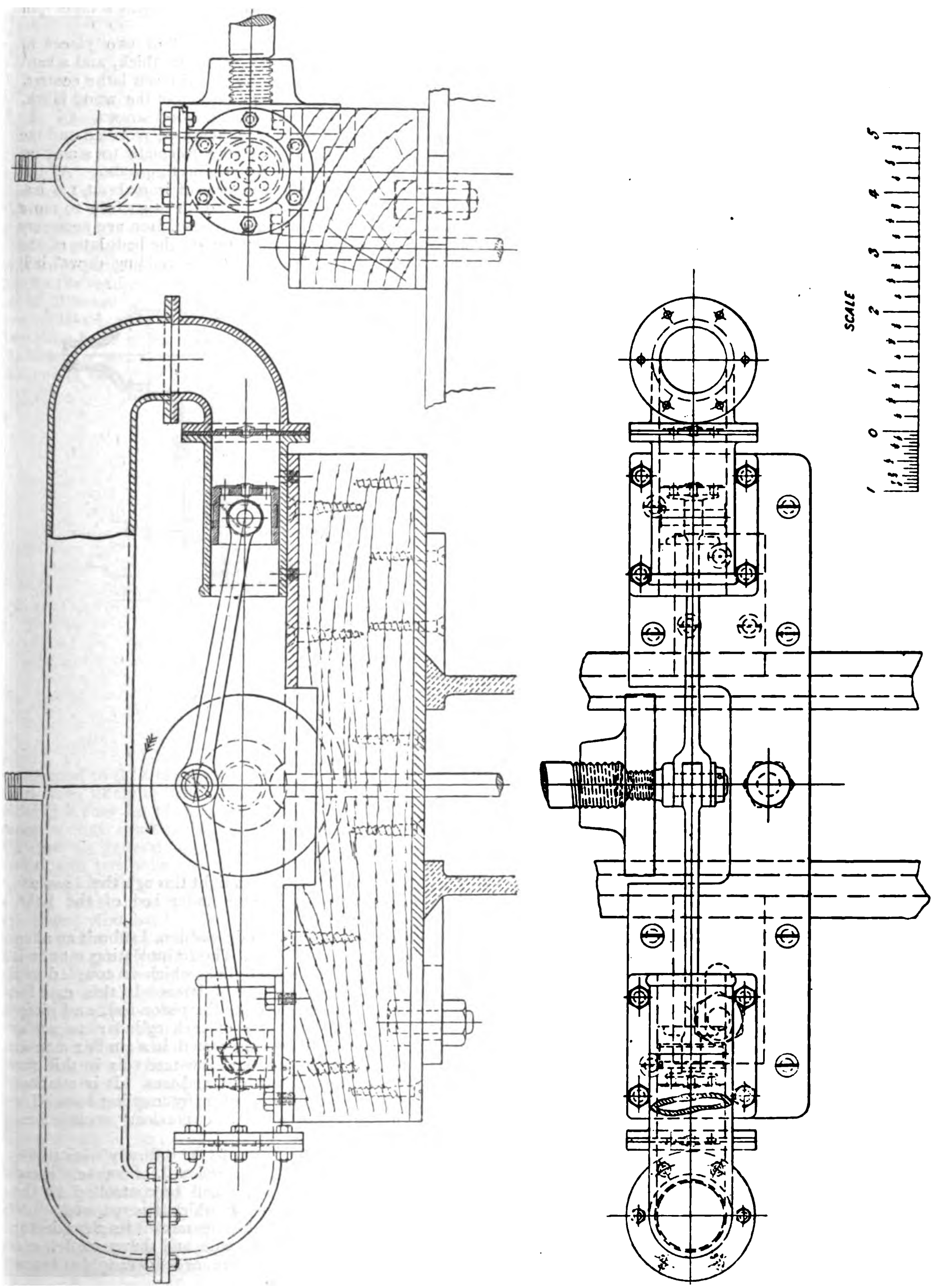


FIG. 1.—GENERAL ARRANGEMENT OF AIR COMPRESSOR.
(For description see page 36.)

sent a smooth surface to the sheet-rubber valve, which is fastened to it by means of a copper rivet and washer.

Eight holes are drilled, as shown in the end view for the passage of air, and six holes to take the bolts which couple up this valve plate to the flange of cylinder and also the elbow leading to reservoir.

The elbow is a brass casting ⅛ in. thick, with flanges the same diameter as the flange on cylinder, and drilled to suit.

The reservoir, to which this elbow is attached, is made of copper tube 1⅜ in. diameter outside, and about 5-32nds in. thick. It should be well annealed and then filled with melted resin, so as to obtain a bend without a kink. When the correct length of tube is obtained, a flange the same diameter as the one in elbow must be brazed on the ends with bolt holes in it to correspond.

take up any side play of piston-rods, and at the front end it has a washer fitted tightly on to it with a taper pin passing through each.

The base of all this is composed of two pieces of wrought-iron plate, about 3-16ths in. thick, and a hard wood block of such a depth as will suit lathe centres. The plates are at the top and bottom of the wood block, and are fixed to it by countersunk wood screws.

A portion of the wood block must be recessed and the top plate cut away to allow the faceplate to stand in, also to give clearance for connecting-rods. At the bottom of this base are two pieces of iron about 1¼ ins. wide, one being fixed to base and the other free to move by means of a slot. These pieces of iron are necessary to prevent any play of the pump on the bedplate of the lathe, and in addition to these a holding down bolt

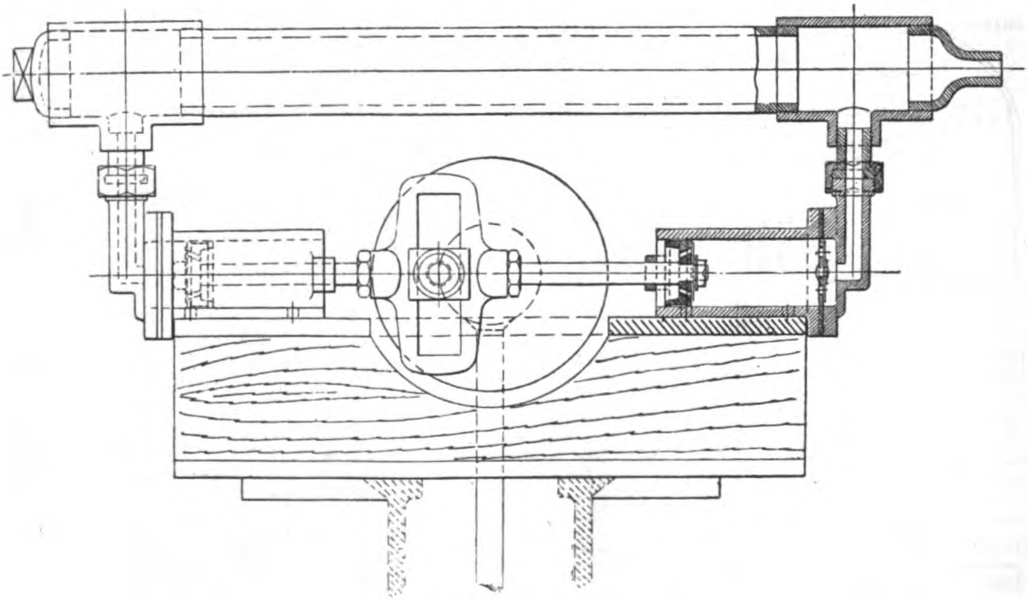


FIG. 2.—ALTERNATIVE DESIGN OF AIR COMPRESSOR.

A short piece of tube should be brazed in the centre on top of reservoir to take a flexible strong india-rubber tube to the model.

The pistons are provided with bosses on the inside, and are drilled to take steel pins for the piston-rods to oscillate freely upon. The pin should be a good fit so as to be quite tight and immovable in the boss. A groove should be cut on the outside of piston to receive a well-greased leather to keep it tight. The back of the piston is drilled with eight holes in a similar manner to the valve plate for the air inlet, and a circular disc of rubber is attached to it in the centre by a rivet and washer.

The connecting-rods are of steel, and one of them has a fork end as shown in plan, while the other is furnished with a solid end of such a size as to fit nicely in the fork end.

The small ends of rods in the pistons must fit between the inside bosses of pistons without side play, and are drilled to fit pin so that it shall work smoothly without any knock.

The crank pin is of steel carefully turned and is screwed in tightly to faceplate. It is provided with a collar to

⅜ in. diameter, which passes right through the base and is fastened to a washer plate under bed of the lathe, should be provided.

For those who prefer a straight action, I submit an alternative arrangement (Fig. 2). The reciprocating motion is obtained through a slotted link which is coupled to a crank pin on the faceplate of lathe. In this case the pistons are tightly screwed on the piston-rod, and pieces are fixed at the front end of each cylinder to act as guides. The valves are constructed in a similar manner to the one just described, and the reservoir in this case is made of ordinary gas barrel and tees. It is attached to the back of the cylinder covers by coupling nuts. The description of base for the previous arrangement applies also to this one.

The lathe should be driven in the ordinary direction—that is, towards you. The speed will, of course, depend upon the output of air, and will be controlled by the size of the model, the speed at which it is run, etc.

The great advantage of the apparatus is its cleanliness; often when one has a well-made and showy model, one is not tempted, except on rare occasions, to put steam into it.

How to Set a Simple Slide-Valve.

By John Alexander.

ONE of the ever-recurring problems that confront the steam engineer is that of setting the valve of his engine. While the problem is by no means a difficult one for an experienced engineer, at least as far as a simple slide-valve engine is concerned, it is at the same time one over which the beginner is likely to worry considerably. In order to aid the beginner, we will here give explicit directions for setting the valve of a simple slide-valve engine, proceeding step by step in the same order in which the engineer would proceed. In this connection the reader is reminded that there are often a number of different ways in which a certain object may be accomplished, and that consequently a difference in the directions here given and those proposed and perhaps practised by somebody else, does not necessarily imply that one of the set of directions is wrong. A man who is accustomed to do a certain job just in one particular manner is often likely to look askance upon any different way of doing it that he hears proposed; partly, perhaps, by reason of that conservatism which is opposed to any innovation on general principles and without any other reason, and partly by reason of a disinclination to investigate and carefully analyse some method of doing work different from his own. This is mentioned in order that the reader, who may be but a beginner in steam engineering, may not lose confidence in the correctness of the directions here given if he happens to read a different set of directions somewhere else, or is told by somebody imbued with ultra-conservatism that this particular method of setting a slide-valve is all wrong.

No claim to originality is made for the method of setting here explained, which is successfully used by many engineers. Since an understanding of the directions involves a knowledge of certain technical terms which are either used in a different sense in widely separated localities, or are unknown, an explanation of them is here given.

The term "cut-off" in this article will always be taken to mean the point at which the valve closes the steam port; in practice, the location of this point is almost always given by naming the fractional part of the stroke at which it occurs. Thus, if the valve closes the steam port when the piston has completed ⅝ of the forward stroke, the valve is said to give a ⅝ cut-off on the forward stroke.

The term "lead," when used in connection with a valve employed for distributing the steam in a steam engine, is commonly considered to mean the amount the steam port is opened for the admisssion of steam when the crank is on a dead centre. The crank is on a dead centre when the centre of the crankpin is on the straight line drawn through the centre of the cylinder and the centre of the crankshaft. When the valve is so set, that the edges past which steam is admitted are just about to uncover when the crank is on either dead centre, the valve is said to be set "line and line," and evidently has then no lead. When the valve does not uncover the steam ports until *after* the piston has commenced its stroke, the valve is said to be set with "negative lead."

In an ordinary slide-valve engine the valve is pulled and pushed to and fro by an eccentric, whose eccentricity determines the valve travel. The travel of the valve is exactly equal to twice the eccentricity of the eccentric (this is often called the "throw" of the eccentric) when the valve stem is connected directly to the eccentric rod; when a rocker arm is used it may be more. The travel of the valve determines simply the amount that the steam ports are opened, but need not be taken into consideration as far as the setting of the valve is concerned.

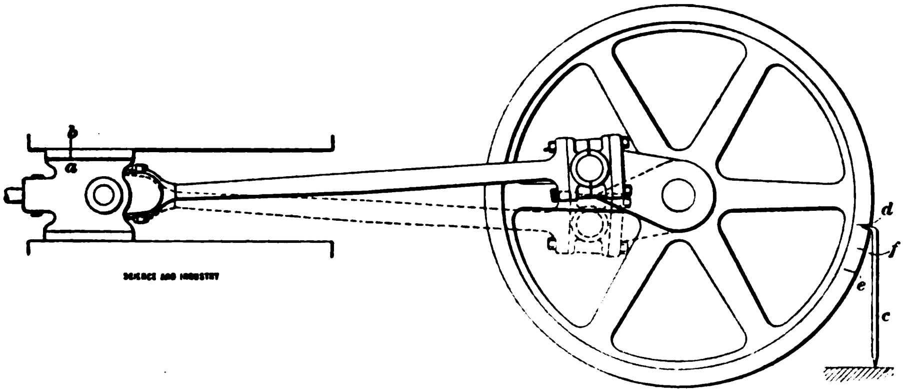


Fig. 1.—Method of Placing Crank upon Dead Centres.

The purpose and object of valve setting is to make all the events, which are the opening and closing of the steam ports and exhaust port, take place at the proper time and also at the same time on the forward and return stroke of the piston. This object can only be imperfectly accomplished with an ordinary slide-valve by reason of circumstances beyond the control of the engineer. Thus, with an ordinary slide-valve it is not possible to set it so that when the valve shows an equal lead on both ends of the cylinder, the cut-off will take place at the same fraction of the stroke. Conversely, if the valve is set so that the cut-off will be equal on both strokes, the lead will be unequal. These defects are inherent to a valve motion that is operated upon from the crankshaft, and hence depends for the timing of the different events upon the crank position. With the ordinary direct connection between the valve and eccentric they can be partially cured by a special construction of the valve, but not by a change in the setting of the valve—at least, not satisfactorily.

The first step to be taken when about to set an ordinary slide-valve, is to open the steam-chest so that the valve can be seen. Now place the crank on one of the dead centres. There are several methods by which this may be done, such as observing the motion of the cross-head while slowly turning the engine by hand, watching for it to come to a stop, and, considering that the crank is then on a dead centre. This is one of the most inaccurate methods that can be conceived, and in its inaccuracy is only rivalled by the method in which in a horizontal engine a spirit level is placed upon the top of the connecting-rod. Conditions are conceivable in which the use of a level thus applied may give the dead-centre positions of the crank; these conditions are rarely extant, however, in the common form of engine. A third method is aptly called the "squinting method," and consists in standing in front of the engine and judging by squinting along the connecting-rod, crank, and piston-rod, if they are in a straight line. This method is beautiful in its simplicity, and while it will give surprisingly accurate results when performed by a man gifted with extraordinary squinting ability, is not to be recommended lightly for every-day use, by reason of the fact that relatively few people are capable of judging with any degree of accuracy when the piston-rod, connecting-rod, and crank are in the same straight line. The only condition under which the writer would be inclined to employ it, would be in case of an emergency where the eccentric has slipped, and it is more imperative to get the engine running again quickly than to get a nice job of valve setting, which can be left until a more propitious time.

Many engineers believe that the best method of setting the crank on a dead centre is to set it by tramming. The operation, while familiar enough to experts, is usually difficult to beginners, and is consequently here explained. Turn the crank in the direction in which it is to run until it almost reaches one of the dead centres, and make a mark, as *a*, in Fig. 1, on the cross-head, and make a mark *b* on the guide in line with *a*. Now take a tram *c*, having pointed ends, and setting one end into a centre punch mark made in some convenient stationary object, make a mark *d* on the flywheel. Now turn the crank past the dead centre until the mark *a* is considerably past the mark *b*. Then slowly turn the crank back, that is, in a direction *opposite* to that in which it was turned in passing the dead centre, until the marks *a* and *b* coincide again. The crank and connecting-rods will now be in the positions shown in dotted lines. With the same tram used for making the mark *d* on the flywheel, make a mark *e* now; then make a mark *f* midway between *d* and *e*, and turn the flywheel until the marking point of the tram comes to the mark *f*. The crank is then on a dead centre. Repeat the operation to find the other dead centre position of the crank.

Particular attention is called to the fact that the movement of the crank by which the marks *a* and *b* are made to coincide for the second time, should be *opposite* in direction to that in which the crank was turned in passing the dead centre. If this precaution is neglected, a quite serious error is introduced through the change in length of the connecting-rod caused by the necessary looseness of the crankpin brasses and wristpin brasses on their respective pins.

The crank having been placed on one of the dead centres, roll the eccentric around on the shaft until the proper steam port is just slightly opened. If the crank is on the crank-end dead centre, the steam port nearest to the crank end of the cylinder is the proper one to be opened; likewise, if the crank is on the head-end dead centre, the steam port on the head end should be opened. The position of the eccentric in regard to the crank should be as follows for a direct valve (a valve admitting steam past its outside edges and exhausting through the cavity in the middle):—When the valve is direct connected to eccentric, or through a rocker-arm that does not cause the valve to move in a direction opposite to that of the eccentric rod, the eccentric should be at least 90 degs. *ahead* of the crank. When a rocker is employed that changes the direction of the motion of the valve in respect to that of the eccentric rod, the eccentric should be slightly less than 90 degs. *behind* the crank.

Fasten the eccentric temporarily in this position and turn the crank to its other dead centre. Now observe if the proper steam port is opened, and, if so, how much. If it is opened more than in the first dead-centre position, it is an indication that the valve stem is too long, and must be *shortened* by one-half the difference in the amount If the lead is less than in the first crank position, or if the steam port is not uncovered at all, it shows that the valve stem is too short and requires to be lengthened by one-half the difference in the leads at the two ends in case the port is opened, or by one-half of the amount that the valve falls short of opening the steam port in case the latter is not opened. In the latter case it will often occur that when the valve stem has been lengthened the correct amount, the valve will not show any lead. This need not worry the engineer, however, as the proper lead is given by the next adjustment.

The proper length of the valve stem having been found as directed, place the crank on one dead centre again, if it has been moved since the last time it was placed there. Now shift the eccentric *ahead* of the crank when the valve is direct connected or a direct rocker is used, if no lead shows with the crank on the dead centre, until the required lead is obtained. If too much lead is shown, shift the eccentric *towards* the crank until the lead has been reduced sufficiently. When a reversing rocker is used, and no lead shows, shift the eccentric *towards* the crank, and if the lead is too much, shift it away from the crank. Fasten the eccentric.

To make sure of the adjustment it is well to place the crank on the opposite dead centre, and observe if the lead is the same. If this is not the case, it shows that the length of the valve stem was not correctly adjusted, and hence the operation must be repeated until the lead is equal on both ends.

It is to be observed that the method of setting here given applies only to a direct valve, and holds good for a direct piston-valve as well as for a slide-valve.

In setting the valve, the crank must obviously be turned by hand. The precaution of always turning the crank in the direction in which it is to run must never be neglected, since a non-observance of this precaution will result in a badly set valve.

As far as the cut-off is concerned, it is beyond the power of the engineer to equalise it when no provision for an equal cut-off has been made in the design of the engine; for this reason it is customary to set the valve simply for equal lead, except in case of vertical engines, where the lead should be slightly larger at the bottom end of the cylinder.—[The above instructive article is taken, by permission, from our esteemed contemporary, *Science and Industry*.]

THERE is projected at Washington, U.S.A., a specimen of "geographic sculpture," as it is called, which will certainly lick creation. It is to be a model of the United States on the scale of about 2½ ins. to every linear mile of territory. It will include a representation of every highway, railway track, and bridge in the country, as wel as forests, water-courses, swamps, and mountains. It will be so made that at any time pieces of a standard size may be taken out and changed, so as to conform to new conditions. Sectional duplicates will be struck off in large numbers at a low cost for use in schools, libraries, and railway offices. It is estimated that it will be possible to place a model of this size in a low but well-lighted building about 800 ft. long and half as wide.

The Editor's Page.

SOME little while back we referred to the freedom of model boilers from explosion, pointing out that although disasters did occasionally occur, they were fortunately few and far between. In this connection an interesting letter has just reached us from "A. H. G.," of Sydney, N.S.W., who writes as follows:—"I enclose a newspaper cutting taken from the *Sydney Morning Herald*, of April 28th inst., which shows the danger of using oil drums for boilers. About two years ago a lad of 14 years of age determined, against my advice, to use an oil drum for a boiler, and put four longitudinal stays in it; but before generating steam therein I suggested he should test it with a bicycle pump, which he did, with the result that the ends between the stays bulged in such a way as to convince him that an oil drum would not, even with stays, be a success as a boiler. A very little calculation shows that an oil drum, 11 ins. in diameter, has an end surface of 95 sq. ins., so that 5 lbs. of steam would exert a pressure of more than 4 cwt. on each end, a strain and heat even at that low pressure which oil drums are not made to stand."

* * *

The following is the cutting which our correspondent encloses:—"An accident happened on Friday afternoon at the residence of Mr. J. T. Burcher, J.P., of Yorks Estate, about a mile from town. Three lads, William Burcher (16), Philip Merz (16), and Kernahan (12), were experimenting with a model engine made by young Burcher. The boiler was made from a 5-gal. oil drum, and all fittings were of brass. Merz was acting as fireman, and was sitting in front of the engine attending to the fire. The end of the boiler nearest Merz blew out, and he received the full force of the scalding water and steam, the result being that he was scalded severely. The empty boiler was driven a distance of about 8 yards with sufficient force to shatter the palings of the fence. Some earthenware pipes used for a flue were shattered into fragments. Burcher was only slightly scalded, and Kernahan is uninjured."

* * *

The foregoing cases serve to emphasise the fact that a boiler must be specially designed and built to do the work of a boiler, and must not be merely something of a suitable size and shape converted to a purpose for which it was never intended. The lesson which is taught by the above should appeal with especial force to those model makers who pride themselves on their ability to make a working model from "odds and ends," and to those who, through necessity or otherwise, desire to exercise extreme economy. To paraphrase an old proverb, "Economies are dangerous," particularly when applied to boiler making.

* * *

"H. A. S. U." (Co. Westmeath) writes:—"In reply to the query of 'F. B. K.' (Bowral) in THE MODEL ENGINEER of June 1st, I remember seeing the model loco (an improved 'Rocket') to which he refers somewhere about the year 1884. It was then in want of repairs, and I think could have been bought for a small sum. I have often wished I had bought it."

* * *

We should like to say a word or two on the subject of working drawings to those firms who supply sets of castings. Most amateurs who purchase sets of castings have a somewhat limited knowledge of the details of the type of engine they intend to build, and are quite at a loss to set about the work unless they have a proper set of drawings to guide them. It too often happens, however, that the so-called working drawings supplied with the castings are nearly or quite useless, while in some cases no drawings at all are supplied. Sometimes they are incomplete, sometimes they are incorrect, and sometimes they are neither to any scale nor properly dimensioned. Indeed, we have seen sets of drawings which are merely freehand sketches of the parts, and very poor at that. No engineering firm starts to build an engine or machine without a proper scale drawing being supplied to the workmen employed; and if this is necessary when trained mechanics are engaged to do the work, how much more essential must it be in the case of an amateur building an engine perhaps for the first time in his life? Several of our advertisers we know supply really first-class drawings with their castings, and we are sure this policy on their part is fully appreciated by their customers. No excuse can well be made on the score of expense, for we believe that every amateur who is at all keen on doing his work in proper style, would willingly pay the slight extra cost which the drawings would entail. From the amateur's point of view, the cost of the drawings would undoubtedly be money well spent, for he would in most cases not only save himself unnecessary thought and trouble, but would spoil a good deal less of his work, and would be saved the expense of purchasing extra castings or material to replace it. We are quite sure that those firms who make a point of supplying really good working drawings with their castings will find the policy amply repay them.

* * *

We willingly give space to the following letter from "W. O." (Hodnet), in the hope that it may meet the eye of someone able to assist an enthusiastic amateur in the way desired. We shall be pleased to forward any replies to our correspondent. "I have been a regular subscriber to your paper since its commencement, and am greatly interested in everything relating to mechanics and electricity. I have a fair theoretical knowledge of these subjects, but living in a small country village, and not knowing anyone having the same tastes, I have never been able to acquire any practical experience in model making and metal work generally. My object in writing to you is to ask if you would be good enough to make it known in THE MODEL ENGINEER that I would like very much to hear of anyone, either amateur or professional, within easy cycling distance of Hodnet, Shropshire, who would be willing to give me help and instruction in model making in their own shops. If such a person exists, I should be very pleased to make his acquaintance, and we could, no doubt, easily come to terms as regards payment, etc. I leave business early during the summer, allowing plenty of time for the work during the long evenings."

Answers to Correspondents.

"E. G. E." (Bath).—Thank you for the photo of your model yacht. Although this has not sufficient of special interest in it to warrant our reproducing the photo, we think you have turned out a very creditable piece of work.

"E. L."—You do not send your address or enclose a stamped envelope. We believe the same lathe may be obtained from Mr. Stiffin, 4, Station Buildings, Acton Street, Hackney, London, N.E.

"W. G." (Newton).—We do our best to help you in your difficulty. We cannot too strongly advise purchasers of castings, &c., to find out if drawings are supplied with the goods before ordering them, and if so, stipulate for proper working drawings to be sent. It is hardly fair to us for our advertisers to expect the Query Department to do work which should be done by draughtsmen in their employ. We have, of late, made several working drawings for queriists from rough sketches of the castings supplied to them without any such necessary aids, but we cannot be expected to do this as a regular thing.

Prize Competition.

Competition No. 23.—Three prizes, value £1, 15s., and 10s., respectively, are offered to the owners of the three model steamboats doing the fastest authenticated performances. The following special conditions will apply:—The boat must make three successive trips over a course not less than one hundred yards in length. The exact length of the course must be measured and the exact time to a second recorded for each trip. These particulars must be written down and certified by the signatures of two members of the executive of either any branch of the Society of Model Engineers, or any recognised Model Yacht Club, who must have been present at the trials. We shall calculate the speed of the boats on the average of the three trips. The results of the trials must be sent in to us not later than July 31st, and the winning competitors will be required to furnish photographs and short descriptions of the boats, in accordance with the usual General Conditions printed below. The competition is limited to boats not exceeding six feet in length, and the starting time is to be taken at the moment of turning on steam.

General Conditions for above Competition.

1. All articles should be written in ink on one side of the paper only.

2. Any drawings which may be necessary should be in good black ink on white Bristol board. No coloured lines or washes should be used. The drawings should be about one-third larger than they are intended to appear if published.

3. The copyright of the prize articles to be the property of the proprietor of The Model Engineer, and the decision of the Editor to be accepted as final.

4. The Editor reserves the right to print the whole or any portion of an unsuccessful article which he may think worthy of publication, unless the competitor distinctly expresses a wish to the contrary.

5. All competitions should be addressed to The Editor, The Model Engineer, 37 & 38, Temple House, Tallis Street, London, E.C., and should be marked outside with the number of the competition for which they are intended. A stamped addressed envelope should accompany all competitions for their return in the event of being unsuccessful. All MSS. and drawings should bear the sender's full name and address on the back.

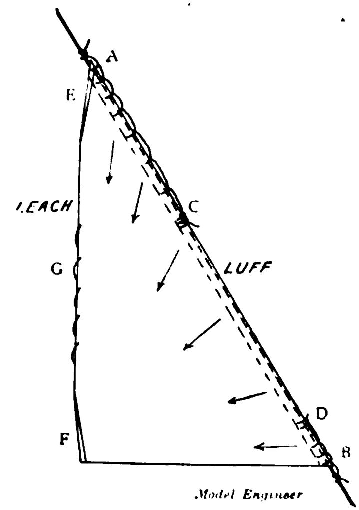
Model Yachting Correspondence.

[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 should invariably be attached, though not necessarily intended for publication. Communications should be written on one side of the paper only.]*

Sails of Model Yachts.

To the Editor of *The Model Engineer.*

Dear Sir,—I am glad that the articles by Mr. W. H. Wilson Theobald have given rise to some correspondence. I notice that he advocates *taping* the edges of sails. This is certainly the strongest method, but it is difficult, if not impossible, to get the tape exactly right first time, and difficult to alter it when once fixed. Consider an untaped headsail with a cord through the luff and fastened to the sail at the points A and B. The tension in the sailcloth is more or less in the direction of the arrows. The portions AC and BD will tend to stretch, since C will be pulled down, and D up along the cord. As a result, the portion CD will wrinkle. This may be prevented by distributing the strain along AC. A piece of cotton is sewn through the sail so as to form a number of half hitches. These must be sewn so that they grip the inside



cord tightly, but the needle must not go *through* the cord. The ends may be finished off simply by two half hitches. This is *perfectly* adjustable. If permanence is required, the ends may be sewn into the sailcloth and cord after the sail has been used a few times.

Another thing that requires adjustment after trial is the leach. It is usually too tight or too loose, according to the cut of the sail, and, to some extent, the nature of the cloth, when the selvage is used as leach. A tight leach can be eased by folding over, and sewing the ends, as at E and F. A loose one may be tightened by sewing the extreme edge with very fine cotton, taking stitches about ¼ in. long and two threads deep (G); this is also adjustable, and is unaffected by changes in the dampness of the sail.

Many men cling to the loose-footed mainsail. It is certainly more difficult to make a laced sail sit well; but, once fixed, the better distribution of strain enables the sail to keep its shape longer, and admits of the use of lighter cloth and a lighter boom. Mr. Wilson Theobald states that the foot of a laced sail should be cut concave.

Is this a slip? I always do the opposite. I believe in using the lightest cloth that will stand the ordinary strain, because it absorbs so much less water in damp weather, and I risk the possibility of an occasional tear in a collision.

Unlike the model engineer or "large" yachtsman, the model yachtsman runs no serious risk in cutting down the safety factor to the lowest limit. It is only by doing so and replacing those parts which prove too weak, that he can really find out the strengths required in the various parts.—Yours truly, N. S.

Troedyrhin.

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.]*

Power Transmission in Motor Bicycles.

To the Editor of *The Model Engineer*.

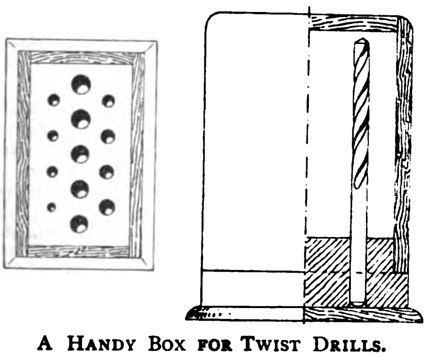
Dear Sir,—Having read the exceedingly able and interesting article by Mr. T. H. Hawley in your June 1st issue, I should like to draw his attention to a new specially constructed V-shaped riveted hide belt, invented, I believe, by Mr. H. W. Stones, of Stones & Higgs, cycle agents, Lincoln. With the special pulleys it seems (after some severe testing by that clever motor cycle rider, H. W. Stones), the only successful belt on the market.—Yours truly, H. Waygood.

Ellersie, Storeton Road,
Birkenhead.

A Handy Box for Twist Drills.

To the Editor of *The Model Engineer*.

Dear Sir,—I enclose a drawing of a very handy box I have made for twist drills. Mine holds thirteen drills



A Handy Box for Twist Drills.

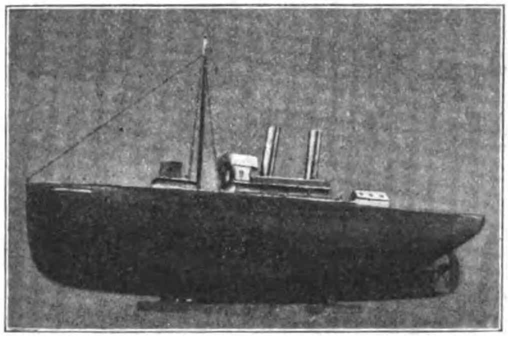
from 1-16th in. to ¼ in., and the drawing—which is one-third full size—shows this size. I made it of whitewood, and stained it mahogany colour and varnished it. The base is cut from a solid piece, rabbeted all round the side to a depth of about ¼ in., and the holes for the drill shanks are bored right through it (I arranged them in three rows), the right drill being used for each hole, and run through it till the shank fits in loosely. The ornamental bottom is afterwards glued on. The lid has its four sides mitred together and the top let in. The top horizontal edges are rounded off, and the lid made to fit nicely on to the rabbeted base. If desired, two hooks may be put on the base to hold it down; but for a tight-fitting lid this is unnecessary. Of course, for more drills or larger sizes the dimensions can be altered.—Yours truly, G. H. M.

London.

A Fast Model Steamer.

To the Editor of *The Model Engineer*.

Dear Sir,—The accompanying photograph shows a model steamer which I have made, and which is capable of travelling over a measured distance at the rate of five miles an hour. The hull is 34 ins. long, by 6 ins. broad, by 6 ins. deep, and is made of red pine. The deck is tin, made in three sections for lifting off; unnecessary fittings are dispensed with, as speed is the main point. The funnels, forehatch, and bridge are made to slide off. The mast shown in the photograph is always taken down when the boat is under steam. The boiler I am using was



Mr. Andrews' Model Steamer.

made from a design given by Mr. Halpin in the April 1st issue, 1901, of The Model Engineer, and I had to make it much smaller to get it into my boat. I have tried several types of boilers, but none of them could keep up steam for any length of time. The above boiler works at 30 lbs., but fails to keep up this pressure when full steam is turned on to engine, but it can keep up 20 lbs. with the valve half open. I use methylated spirits for firing, the burner being 3½ ins. long. The chief dimensions of boiler are:—Length, 6¾ ins.; diameter, 3¾ ins.; firebox, 2½ ins. high by 2½ ins. wide. The boiler fittings are—Steam gauge, two gauge taps, steam tap, and filling screw. The engine is partly designed from the one described by Mr. Morriss for his torpedo boat, with the exception of ball-bearings and return crank for working the slide-valve. I have used an eccentric, and engine-shaft runs in ordinary bearings. The cylinder is ½ in. bore by ¾-in. stroke, the ports are 1-16th in. by 3-16ths in. long, and the exhaust is 3-16ths in. long by ⅛th in. wide. The engine runs at a very high speed, and drives a four-bladed propeller 1¾ ins. diameter. I have tried four different propellers, 2½ ins., 3 ins., and two 1¾ ins. diameter, all except one having three blades each. The results with the above propellers are as follows:—

	Diameter.	Speed of boat.
Propeller, 3 blades ...	2½ ins. ...	3 miles per hour.
,, ,, ...	3 ins. ...	2½ ,,
,, ,, ...	1¾ ins. ...	4¼ ,,
,, 4 ,, ...	1¾ ins. ...	5 ,,

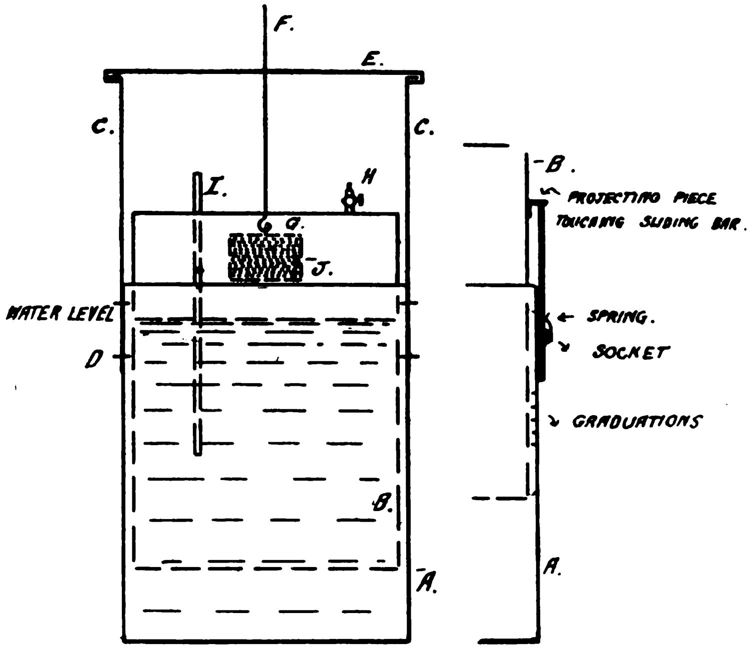
This appears to prove that a small propeller running at a high speed is a great deal better than a large one running at a lower speed. It took 15 lbs. of steam to move my 3-in. propeller, and it only takes about 2 lbs. to drive the 1¾-in. propeller. Although the boat is not highly finished, being made more for experimenting with, she is capable of travelling at a good speed, which I hope to increase. The total weight of boat, boiler, engine, and a lead keel is about 12½ lbs. Any reader making a steamer hull should make the counter long and with a gradual sweep similar to a racing yacht's stern, and the engine should not be too large or it will require a boiler which the boat cannot hold. Steam ports should be made large, and exhaust twice the width of steam ports. The exhaust pipe should also be as large as possible, except where draught is required for steam raising.—Yours truly,

Tweedmouth. H. ANDREWS.

An Automatic Acetylene Generator.

TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—I notice that there has been some correspondence in THE MODEL ENGINEER with regard to various forms of acetylene gas generators. I see that some readers do not approve of the system of the carbide descending into the water, and then when gas is formed being drawn off again. Having made one of this type, I must say it has worked well, and I think it a success, seeing that it has never failed to generate, and has always worked with great regularity. Regarding its economy, by the design you will see that it must necessarily saturate all the carbide thoroughly with water, hence no particle of gas can be lost. Owing to the large surface of water being presented continually to the gas, it prevents it from getting hot, as it would otherwise do. I will now endeavour to describe the construction.



AUTOMATIC ACETYLENE GENERATOR.

A is the outer cylinder for containing water; B, gas holder; CC, iron uprights, bent in hooked shape at the upper ends, the other ends being riveted to outer cylinder at D; E, a guiding bar (for gas-holder rod), bent over to fit tops of upright standards, CC; G, hook for carbide holder, which is a continuation of the guide rod F, soldered round in the top; H, gas tap outlet to purifier; I, the safety valve, which may be either used or not, and consists of a piece of ½ in. gas piping; J, the carbide holder, consisting of a box made of perforated zinc, with a door opening at the side, the interior fitted with zinc shelves, the distance between them being regulated by the size of the gas-holder to be made—one shelf having to accommodate just so much carbide as will generate enough gas to raise the gas-holder to the required height without allowing the safety valve to come into operation.

The action is as follows:—When the carbide holder is filled and put on the hook prepared for it, put gas holder into outer tank, and fill same with water till within 2 ins. of the top. Open the tap of the gas container, and allow the gas to be excluded. When this has proceeded far enough gas will generate off the bottom shelf, and will keep all the rest of the carbide dry on the other shelves till required.

The purifier, which is put in "series" with the generator and the gas jet, may consist of a small tin canister (of course, a brass one will be more substantial) filled with cotton wool, and in layers with the wool sprinkle some bleaching-powder.

A "tell tale" for showing one how much gas can yet be generated can be made by putting on the outside of the gas holder a piece of iron to project, and on the outside of the outer cylinder put a socket and spring, which presses upon a piece of round iron, sliding in the socket as in the right-hand sketch. This is so regulated that each time the gas holder sinks to generate once again, the projecting iron touches the rod, and as only the carbide in one shelf of the carrier is acted upon at each descent, it follows that each time the gas holder descends it will push the sliding rod downwards by the depth of one shelf. The way to graduate so as to show the amount of carbide left in the carrier is as follows:—Start the generator, and when doing so pull the registering rod right up. The first generation of gas will push the rod to the correct height, and from the bottom of the sliding rod divisions can be marked of to the same number as the shelves in carrier, and to the same distance apart.

Hoping that this will be of use to the readers of THE MODEL ENGINEER.—I remain, yours truly,

Ardingly. C. N. TURNER.

MR. WM. DEAN, chief superintendent of the locomotive, carriage, and waggon and signal department of the Great Western Railway has retired, and Mr. G. J. Churchward has been appointed to succeed him. Mr. Dean has been with the Great Western Railway Company nearly fifty years, and has reached the "retiring age." He was appointed to the responsible position he has now vacated at a very early age, but his tenure of the office has been most successful. Mr. Chuchward served his pupilage at Swindon, and subsequently successively held the positions of manager of the carriage works, manager of the locomotive works, and assistant superintendent of the whole department.—*Railway Engineer.*

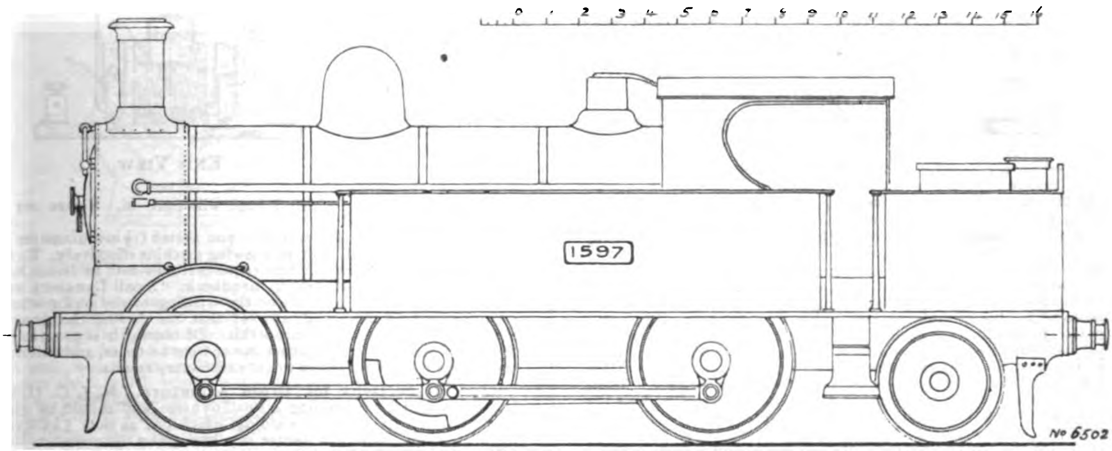
Queries and Replies.

[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, *37 & 38, Temple House, Tallis Street, London, E.C.]*

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

[6502] **L.N.W.R. Goods Tank Locomotive.** F. G. (Birmingham) writes: Could you oblige me with a drawing of the six-coupled radial tank engines on the L. & N.W. Railway for a ¼-in. scale model, giving particulars as per enclosed query sheet? As it is the first model of a locomotive I have attempted, and have had very little experience in drawing, would you kindly favour me with everything that will guide me? (1) Length over buffers; (2) Distance between axles, centres; (3) Height of centre of boiler from rails; (4) Diameter of boiler over laggings; (5) Would Joy's valve-gear be workable on ¼-in. scale? (6) Size of steam and exhaust ports; (7) Diameter of steam pipe from dome; (8) What would be the best working pressure?



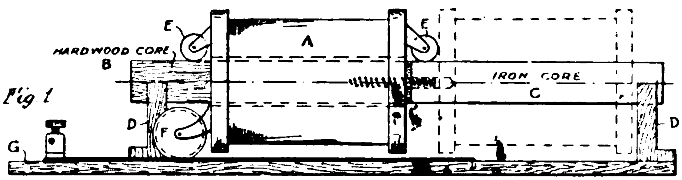
SIX-COUPLED RADIAL TANK ENGINE, L. & N.-W. RLY.

We have no working drawings of any of the L. & N.W.R. Co.'s tank engines, but from the photograph you send and our knowledge of L. & N.W.R. locomotive practice, we are able to make you a very nearly correct scale sketch of the six-coupled radial tank engines, No. 1597 class. The boiler is shown for ¼-in. scale model as 2¾ ins. outside diameter, and with centre 3 11-16ths above rail level. The wheel bases, reading from either end, are 3½ ins., 4¼ ins., and 3½ ins., total, 11¼ ins.; cylinders, ¼ in. by 1 in.; steam ports, 1-16th in. by ¼ in.; exhaust, ⅛ by ¼ in.; internal diameter of steam pipe, ⅛ in.; working pressure, about 25 lbs.; heating surface, 65 to 75 sq. ins.; tubes, 5-16ths or ⅜ diameter. To make Joy's gear would require considerable skill, and as you are a beginner, we can only advise you to use the slip eccentric. The valves will have to be on top of or below the cylinders. Gauge of railway, 2⅝ ins. We will criticise your working drawings if you will send them on to us when complete. The details of construction given on drawing in reply to your Query 5731, April 1st issue, should be used in the present case. If two cylinders are used, the best method is to put the centres as nearly together as possible, and arrange the eccentrics outside the cranks. The most convenient position of the valve chest is below the cylinders.

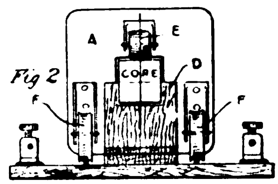
[6551] **Electrical Difficulties.** "COLONIAL" (Sydney, N.S.W.) writes: (1) In your issue of January 1st, you publish an article by "Nemo" on the making of two simple galvanometers. You will see that the wire in the shape of the figure 8 is at the bottom of the hole in the wood. Then it would appear that you place the compass down on top of this. Now, I suppose, there must be contact of some sort to make the needle move, and seeing that the compass has glass on both sides of it, and, moreover, the wire is insulated, I would like to know how and what makes the needle move. (2) Electric lamps are generally sold according to voltage, but heir value seems to me to be in their candle-power. How do you tell their candle-power? and what voltage should I ask for when I want a lamp strong enough to read by? (3) Would a lathe, such as is ordinarily advertised for retwork, etc., do for small model engineering work? and could you recommend a book on home-made lathes, the price, and where procurable? (4) Could you give me a sketch of a simpler headstock for the home-made lathe illustrated in your November 15th, 1901, issue, as I cannot get a rotary sewing machine to make it from? (5) I have some thick sheet lead which I intend to make into accumulator grids. I am going to bore holes in them instead of casting. About what size holes should they be? (6) Would ordinary No. 20 or 22 bell wire do for electric light wires? The current would not be above 20 volts.

(1) The electrical action of the coil of wire on the needle takes place through the air or any other medium that happens to be in the way. The fact that the wire is insulated, and that there is glass between the needle and the wire, does not in the least affect the action. Really, it is obvious that you should look up a text-book on electricity, because—although we are quite willing to answer difficulties you may meet with—we cannot possibly deal with the *principles* of electrical action, such as can be readily learned from any text-book. (2) If you want an electric lamp for any purpose, it is presumed that you know the circuit on which the lamp is to be run. It is also presumed that you know the voltage of that circuit, so that all you have to do is to order a lamp of the right candle-power to suit you, and the right voltage to suit the circuit. As to the particular amount of light necessary to read by it depends entirely upon the position of the lamp, etc. If high up in the room you would find 32 c.-p. only just sufficient, whereas 8 c.-p. would be ample if the lamp is near your shoulder. (3) We know of no book on the subject of home-made lathes, but one or two articles have appeared in THE MODEL ENGINEER. You could hardly do practical model engineering on a fretwork lathe. (4) The ordinary type of headstocks as used on simple lathes would be simpler than that illustrated in this article. You do not, however, give us any idea as to the tools and material at your disposal, so that it is quite hopeless for us to attempt to answer the questions in more detail. (5) The holes might be ¼-in. diameter, countersunk both sides, so as to hold the paste. There should be about ⅛ in. between the edges of the holes. (6) The gauge of wire for electric light work depends not only upon the voltage, but upon the ampères and upon the length of the cable. No. 22 would only safely carry about ½ to 1 ampère a few yards, and No. 20 should not be expected to carry more than 2 ampères at 20 volts for a greater length than ten yards, or there will be a considerable drop in voltage. We are very pleased you appreciate THE MODEL ENGINEER so highly, but regret that your omission to weigh your letter before sending it resulted in our having to pay an excess postage of 5d. this end!

6384] **Sliding Solenoid.** W. A. (Manchester) writes: I beg to ask you for a little information respecting the working of a solenoid I have had put together. I desire in the model to reverse the practice mentioned in text-books, in which the solenoid is always fixed to a base and the core or armature is "sucked" in. I wish to make the solenoid to travel, about its own length, along a core or armature suitably and stationarily supported on brackets. To do this, of course, the solenoid must be fed with current through a trailing pulley, as is the case in the overhead tram trolley system. The black line on the baseboard in the drawing represents two stout copper wires laid parallel and insulated from the baseboard. On these wires, which have a battery binding screw each at the end, the pulleys F run—one leading current into the solenoid, and the other carrying it out to the other copper rail and back to the battery. The core or armature C rests at one end on support D; the other end of core is screwed into a similarly dimensioned piece of hard wood B, which is in its turn supported on the other brackets D. To reduce the friction of the solenoid in sliding from the wooden part to and along the iron core, it (the solenoid) is provided with two small friction pulleys marked E. The core or armature is 1 in. square, and the solenoid A is a slack fit upon it—about 1-16th in. clearance all round. The solenoid bobbin centre is formed of a tin tube, over which are cemented the square wood ends and on this bobbin the winding is built up, the ends of the wire being brought out to the left and screwed contact made with the bearing arms of the pulleys F. Now according to theory, if a suitable current is fed in by the pulley F, the solenoid ought to be so energised as to set up a field of magnetic lines in the adjacent core or armature C, and the attraction between these two should draw it (the solenoid) along from the wood supporting extension piece to and along the iron core to the position shown in dotted section, when the magnetic forces should be in equilibrium. Now the solenoid is 4 ins. long, and is wound with



SIDE VIEW OF SLIDING SOLENOID.



END VIEW.

1¼ lbs. No. 22 S.C. copper wire, making about 1000 turns. The air-gap is a little too large for my way of thinking, but whether this is a very serious defect I do not know. The iron is 6 ins. long and 1 in. square. When a battery of four dry cells is connected to the binding screws there is not the slightest energy shown. The cells are said to give 1½ volts each, and the four coupled in series should give 6 volts. The discharging power of each cell is said to be 10 amps., but as the wire used is No 22 only about 2 amps. can pass. Even when the solenoid is pushed along over the iron core (by hand) the iron seems to be very feebly magnetised. Am I right in assuming that a higher voltage will be required to get the current into the solenoid through the rolling contact of the pulley F? What battery power would you suggest as being capable of making the apparatus work as shown? I am aware that a trough filled with mercury, in which the pulley F could slip or roll along, would give better contact than a loose-running pulley; but such a trough would not fit in with the other arrangements about the model. I may further add that when solenoid has run its length along the iron core it is intended then to cut off the battery power and bring the coil back to its original position by, say, a weight or spring, and this process has to be repeated *ad. lib.*

You have not calculated from "Ohm's Law" the current you are able to get. If, as you say, the total voltage of the cells is 6, and the resistance of No. 22 wire is 5·6 ohms per lb., or 7 ohms for the 1¼ lbs., it is obvious that even without counting the internal resistance of the battery the maximum current would be 6-7ths of an ohm. This is utterly insufficient to produce the desired effect. There is no doubt the clearance is rather too great, and a possible cause of loss of energy is the tin centre, which, if continuous, allows a large current to be induced in it on each make and break of current which draws on the strength of the supply current just at the moment when the greatest energy should be found in the solenoid coil. When metal centres are used for such a purpose they should be split longitudinally, so as to prevent the current circulating in them. To get a current of 2 amps. in the solenoid bobbin, the voltage would have to be not less than 14, and even then the battery used would have to have a small resistance. Better than this would be to employ eight small bichromate cells of, say, 1-pint capacity connected in series, and giving a total of 16 volts. This would produce a current approaching 2 amps. in the solenoid, and would give a fairly powerful result.

[6544] **Electric Engraving Machine.** S. H. D. (Blackburn) writes: Could you, through the medium of your interesting journal, give me the following particulars of an electric engraving tool. (1) Details of construction. (2) Probable cost. (3) Name of manufacturers who would make one; and cost, if I should buy one from a regular dealer in such things. (4) Current and voltage required.

(1) The electric engraving tool is practically an electro-magnet of the ordinary bell pattern, with contact-breaker, but having an arm attached at right angles to the hammer shaft, and a hard steel point on the end of this arm. When working, the magnet pulls a soft iron armature, and thus hits the surface to be engraved with the sharp point. We hope to be able to describe such an instrument in detail in due course—it is too long a matter for the Query Department. (2 and 3) The General Electric Company, Ltd., Queen Victoria Street, London, E.C., supply the correct machine, with support and battery complete. The price of engraver alone is 45s., and that of the complete outfit 88s. 6d. (4) The voltage should be about 6, and cells capable of about 2 ampères discharge should be used.

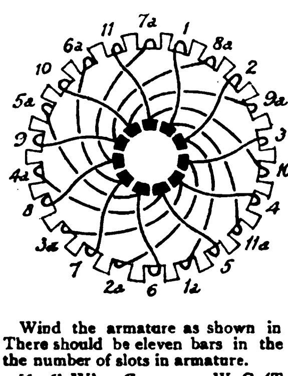
[6328] **"Dupont" Two-speed Gear.** J. B. N. (Roath) writes: With reference to the "Dupont" two-speed gear described in THE MODEL ENGINEER for April 15th, 1902, could you tell me what the male clutch is lined with, marked "C"?

The male clutch of the "Dupont" two-speed gear of latest pattern is lined with a fabric, the composition of which we are unable to state, but it is similar in appearance to Dick's patent fabric and gutta-percha belting, and is no doubt somewhat similar. In the earlier clutches we believe raw-hide was used, but was discarded for the present fabric.

[6405] **Motor to Run a Sewing Machine.** R. E. P. (Bradford) writes: I shall be very much pleased if you can give me some idea of drawings and dimensions of a small motor to run a sewing machine (say, about 20 lbs. to drive) something after the style of a tramcar motor, and also the number and quantity of wire to wind on the magnets and armature. I should prefer to make this motor myself, and trust you will help me in the above way. I have a shaft, stampings, etc., which I hope will come in. Please say if they are of any use.

A motor made with the armature you sketch (1½ ins. diameter × 1½ ins. long) is too small to drive a sewing machine effectively. To do this, an ordinary sewing machine requires from 1-20th to 1-12th h.p. nominally. You would find our handbook, "Small Dynamos and Motors," of use, both to describe the winding of the motor whose armature you sketch, and also of that for driving the sewing machine, if you decide to make this. Of course, it is practically out of the question to run such a motor from batteries, and an electric supply main is necessary to get satisfactory results.

[6515] **Connections for Drum Armature.** N. J. C. (Edgbaston) writes: I am building a small dynamo, and should be glad of your advice *re* method of winding, which has 22 slots ½ in. deep by ¼ in. wide. Will you please say how many commutator bars there should be, and how I should connect ends of armature winding?



CONNECTIONS FOR DRUM ARMATURE WITH 22 SLOTS.

Wind the armature as shown in the accompanying diagram. There should be eleven bars in the commutator—half as many as the number of slots in armature.

[6416] **Wire Gauges.** W. C. (Technekum, Schweiz) writes: I have had your Magazine for the whole of 1899, and would like to build the dynamo shown in No. 20 (August). I should like to know if you could give me any details, or if you could tell me where I could get any details about it. Could you kindly tell me how thick the copper wires are for the following numbers, namely, Nos. 14, 20, 21, 22 and 24, mentioned in the above article.

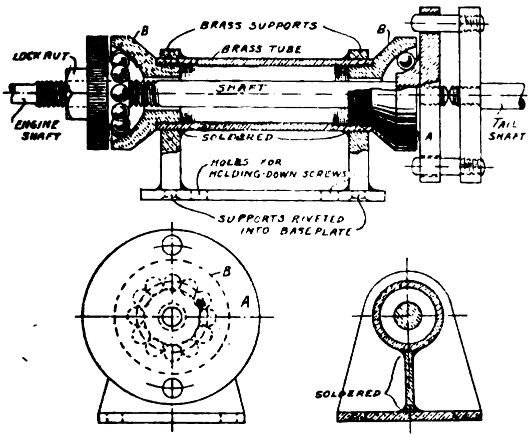
This refers to the design by Mr. E. L. Pearce, for a 100-watt "Simplex" dynamo. The wire gauge implied by the author of the article is the English standard (which is the most "official" of the hundreds of gauges in existence in this country). The following shows the actual diameters of the particular numbers you quote:

Gauge No.	Diam. in inches.	Diam. millimetres.
14	·080	2·032
20	·036	·9140
21	·032	·8124
22	·028	·7109
24	·022	·5585

You do not make it quite clear what extra details you require, the article in question being complete in itself, although, of course, it does not enter deeply into the matter of construction.

[6519] **Thrust Bearing for Propeller Shaft.** C. S. (Uxbridge) writes: Could you give me a sketch, with dimensions (approximately), of ball-bearing thrust suitable for a model steamer? What size balls should be used?

A sketch is here given suggesting a method of making a ball thrust bearing for the propeller shaft. It consists of a brass tube, tapped at ends, to take the hard steel cups B B, and held to a base-

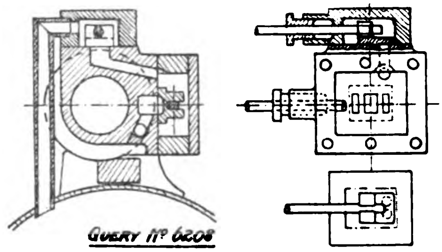


THRUST BEARING FOR PROPELLER SHAFT.

plate by two brass brackets, soldered, and having the bottom edges riveted, as shown. The catch-plate A—also of steel—is screwed tight on the shaft, and carries the tail shaft by means of the two pins in its catch-plate. The shafts are both turned off nice and round at the ends, which meet, so that the thrust of the screw is taken by the engine shaft, which transmits it to the bearing at right-hand end. The adjustment is at the other end, the outer cone of that bearing having a milled edge, and being provided with a lock nut, as shown. Steel bicycle balls, not larger than ⅛ in., should be used, and the bearing surfaces of cones and cups should be hard. If they are made of iron these bearings should be case-hardened. The circle of balls should allow a little play, but not enough to leave room for another ball.

[6208] **Cylinder for Model Traction Engine.** W. R. (Keith) writes: I am obliged for your previous reply, and in accordance therewith, I am sending you herewith the castings (saddle, two steam boxes, cylinder, and two valves). I quite understand your sketch (not reproduced) of the usual arrangement of a traction engine cylinder; but I do not think the saddle here is intended to cover in; however, you may understand it better than I do. I should be obliged if you could show the position and number of steamways in the face of the upper chest and where connected to, and where the opening on the valve chest occurs from the top chest bringing in the steam.

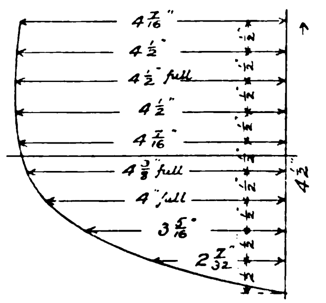
In reply to your further query, we have examined the castings and we enclose a tracing of the best possible way (in our opinion) to get over the difficulty. We do not know what was the intended method of machining and fitting the castings, and in any case they cannot be finished in the orthodox manner. The saddle should be affixed to the boiler and the cylinder to it. The steam (regulator) box must be connected to the boiler by a separate pipe, there being no connection with the boiler cast in the cylinder and saddle, as is usual in traction engine practice. In the steam box, a slide-valve regulator should be fitted; this is, we think, quite clearly indicated in the sketch. The ports may be two 5-64ths in. holes running into a 3-32nds in. inclined hole drilled from the main valve-face. A nick will have to be filed in the steam chest to form a clear passage for the steam. The regulator-valve must be specially made, and, as the main valve you send is useless for its purpose, the casting for the regulator-valve may be used in its place. The casting for the regulator-valve is incorrectly designed—it requires no cavity, and therefore, having such, can easily be made to supply the need of a new valve in the main valve-chest. The exhaust port is another point which has received no attention in the casting. We indicate one way of arranging it. Drill from the front end of the casting an ⅛-in. hole half way through, and connect it to the ⅛ by 3-16ths-in. exhaust port (previously sunk in the valve face) by an ⅛-in hole drilled from below. The entry of this hole must afterwards be plugged. Of course, a part of this cover must be cut away to allow the exhaust pipe to be fixed. The



CYLINDER FOR MODEL TRACTION ENGINE.

exhaust can be connected by a pipe to the chimney very easily with a piece of 3-16ths-in. pipe. Inside the funnel, the exhaust pipe should be slightly contracted, and the end upturned exactly concentric with it. The steam port 1-16th by 3-16ths in. should be sunk and connected to the ends by two 5-64ths or 3-32nds in. holes placed side by side and at the covers the cylinder may be chipped away to form a passage for the steam to the piston. The castings provide little metal for making satisfactory stuffing boxes and glands, and we think that the use of the ordinary gland with two studs or screws should be made in preference to the model makers' type of screwed gland.

[6413] **5-Rater Model Yacht.** J. R. G. (St. Leonards) writes: Please can you inform me whether the following dimensions of hull would be any good for a 5-rater, $\frac{\text{L.W.L.} \times \text{S.A.}}{6000}$ rule? I am fairly expert at designing the shapes of hulls for a given displacement, but have no experience of designing a hull to carry a given area of sail. L.W.L. 31 ins., beam 9 ins., draught of hull 1¾ ins., extreme draught 14 ins., displacement about 8½ lbs., L.O.A. 41 ins.; midship section rather flat, lines of an average fulness. Roughly



MIDSHIP SECTION—5-RATER MODEL YACHT.

speaking, do you think such a hull would be sufficiently canvassed with its 960 sq. ins.? The prevailing fashion at Hastings leans towards preposterous width of beam and shallowness of hull. Is it the general experience of model yacht experts that finkeelers of excessive flatness of hull (say, 12 ins. beam × 1½ ins. draught), are faster and better to windward than those of more moderate proportions (say, 8 ins. beam × 2 ins. draught)?

We find on looking in to the suggested figures, that you will be unable to get 8½ lbs. displacement out of the given length and beam, unless the curve of areas were exceptionally heavy; 8½ lbs. displacement equals 235 cubic inches of water displaced. The coefficient of fineness of yachts is usually just half of the solid formed by multiplying the L.W.L. by the area of the midship section. As you propose 31 ins. L.W.L. the fraction for obtaining the area of the MS. would be $-\frac{31 \times \text{MS.}}{2} = 235$ where we find MS. = about 15 sq. ins. draught (the draught at the MS. is always less than the extreme draught of hull), it would be necessary to have an absolutely square MS. to make it large enough. We should recommend that the draught be increased to 2½ ins., leaving the L.W.L. 31 ins. and the beam 9 ins. We enclose a MS. which may be of use to yourself. Now, as regards extreme draught of boat, including fin, which you suggest as 14 ins., this is absolutely outrageous. What would you think if *Shamrock* were to draw 40 ft.? This is the same proportion. Your boat should not draw more than 8 ins. We know, and regret, that models are built with preposterous draught, but with a good beam—and 9 ins. is ample for a 31-in. L.W.L.—and nice easy lines fore and aft, it should not be necessary to have a draught of more than quarter of the L.W.L.

[6539A] **Testing Resistance of Electric Light Installation.** G. J. J. (Newport) writes: I have fitted our house with eight electric lights of 16 c.-p. each, and am thinking of getting the Electric Light Company to connect them to their mains; but I now find that the resistance of the insulation must amount to so many ohms before they will connect. Now, I am not sure if my work will come up to their standard, but through the kindness of a friend I have the use of a testing instrument (ohmmeter)?, exactly as used by the company for testing, and I should like to know the result of a test myself before I call them in to pass the work. Will you kindly tell me how to use the machine? Here is a description of the instrument. It is a case about 12 ins. × 6 ins. × 6 ins., containing 24 dry cells, and in the top part of the case is a galvanometer with a graduated scale reading from 0 to 80°. On one side of the case (outside) is one terminal marked A; on the opposite side are two terminals marked, respectively, B and C. Just underneath the glass, which covers the top of case, are two tables, one marked AB and one AC, which give a list of degrees and their equivalent resistance in ohms. I have tried to make a test, but could get no deflection of the needle, although it was "balanced" to stand at zero. I proceeded thus: Connected A to my leads and C to earth (gas-pipe), but there was no deflection whatever. By standing on the wet floor and placing my finger on terminal A, I got a deflection of 20°, and on taking my finger away, the needle returned to zero. Does that show good or bad insulation resistance? I should be very glad to know.

We can hardly give you information how to test your installation, without a sketch of the instrument you are using. The information you give is rather vague, and might apply to three or four instruments for testing installations, *i.e.*, resistance to earth. Try joining a wire on to the terminal where your lead comes to, and putting the other end on to the gas pipe where your earth wire is connected. If you get a big deflection, and no deflection when the lead is connected up again to the instrument, we should be inclined to think that your installation is good; but we cannot say for certain, not knowing the instrument you use.

Amateur's Supplies.

[*The Editor will be pleased to receive for review under this heading, samples and particulars of new tools, apparatus, and materials for amateur use.*

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

Bicycle Motor Parts.

Parts for the construction of motors for bicycles, and also carburettors, coils, accumulators, switches, pulleys, &c., can be had from W. Bravery, 175, Upper Grosvenor Road, Tunbridge Wells. Castings and forgings, finished, partly machined, or rough, can be had for all parts, and complete motor bicycles and the conversion of ordinary bicycles are amongst the matters Mr. Bravery undertakes. Mention should be made of THE MODEL ENGINEER in correspondence.

Lathes on Easy Terms.

Messrs. S. Holmes & Co., Albion Works, Bradford, have informed us that they have decided to allow amateurs to purchase their lathes on a system of monthly payments. Of course, this can only be done at a little extra expense, and for the 17s. 6d. lathe for example, will be charged four monthly instalments of 5s each, the lathe being forwarded on receipt of the first payment. These terms apply only to the above and to the 22s. 6d. lathe by this firm.

*For Model Boiler Makers.

The advantages of solid drawn (*i.e.*, seamless) tubing for boilers need not be reiterated here, and the only drawback which presents itself to the amateur boiler maker in the use of this material is the occasional difficulty of obtaining it readily. This has been met by Messrs. Bassett-Lowke & Co., of 20, Kingswell Street, Northampton, and we have received from them a sample of 3-in. diameter tubing 1-16th of an inch in thickness, which in every respect is admirably suited to its purpose. Messrs. Bassett-Lowke stock this quality of tubing in all regular sizes from ⅜-in. to 5-in. outside diameter. Stout seamless brass or copper tube, thick enough to take a full thread, is to be obtained from 3-32nds in. to ½ in. outside diameter, and light brass tube from ⅛th in. to 3-16ths in. outside diameter. Messrs. Bassett-Lowke state that they will now be able to supply light brass tubes, suitable for flue tubes and which will come cheaper than that previously obtainable from them. Their list (price 4d.) gives full particulars of the sizes and cost per foot run of all tubing at present kept in stock.

*A Cheap Boring Bar.

Mr. H. Hine, of 101, Winchester Road, Lower Edmonton, London, N., has designed a new pattern boring bar, which has the merit of being low in cost without any attendant drawbacks. The boring bar is suitable for many purposes, and, where holes of 1¼ ins. and over are to be bored, provides a very rigid holder for the tool; smaller holes can also be bored by a second arrangement, and tools (two) for each, and a key for securing them in the bar, are sent with it. The price is 5s., and the shank of the bar is ¾ in. square. Mention THE MODEL ENGINEER when writing.

Blow-Lamps for Model Boilers.

Suitable blow-lamps for model boilers, intended for operation by means of benzoline, are sold by Mr. A. Cusack, 15, Holywell Row, Finsbury, London, E.C. These lamps, it is stated, can be used in any position; they have, of course, no wicks and do not need pumping. The flame can be regulated to any degree, and as lamps in various sizes and with one or two nozzles can be had, readers should have no difficulty in securing the right one for their own individual needs. They should mention THE MODEL ENGINEER when corresponding on this subject.

Change of Addresses.

THE UNIVERSAL ELECTRIC SUPPLY COMPANY have written asking us to announce that they have removed to 60, Brook Street, Chorlton-on-Medlock, Manchester, where they will have a show-room, and keep a large assorted stock of everything electrical, including all the latest novelties.

BUTLER BROS.—We have been requested to notify readers of THE MODEL ENGINEER that this firm have changed their place of business, and, in future, all correspondence should be addressed to Henry Butler (the new style of the firm), Whiston Street Works, Derby.

Catalogues Received.

Sanders & Crowhurst, 71, Shaftesbury Avenue, London, W.—A neat list of photographic goods, apparatus and accessories is to hand from this firm. Readers interested can obtain a copy on application, THE MODEL ENGINEER being quoted.

Frank F. Wellington, Ltd., The Towers, 36, St. George's Square, Regent's Park Road, London, N.W.—Wellington's monthly *Motor Car Register and Advertiser* is a publication of interest to a large class of our readers. Its scope is fairly obvious, and we find in the April issue, for example, second-hand and other motor bicycles and tricycles in large numbers, whilst a considerable space is devoted to voiturettes, small cars, motor vans, etc., for sale or exchange. The price of the *Register* is a penny per issue; but those interested will do well to remit 1s. 6d. to the publisher, and have it forwarded regularly for a twelvemonth.

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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HOW TO ADDRESS LETTERS.

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THE
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A JOURNAL OF MECHANICS AND ELECTRICITY FOR AMATEURS AND STUDENTS.

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

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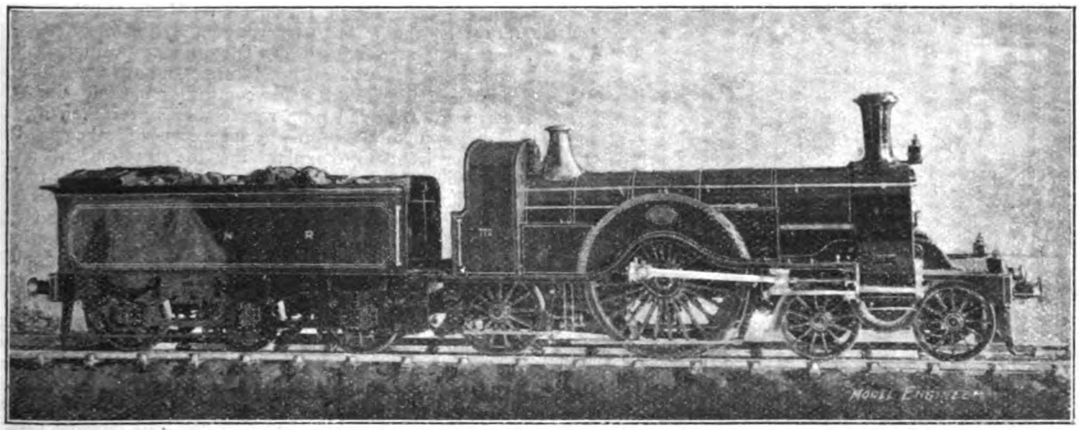
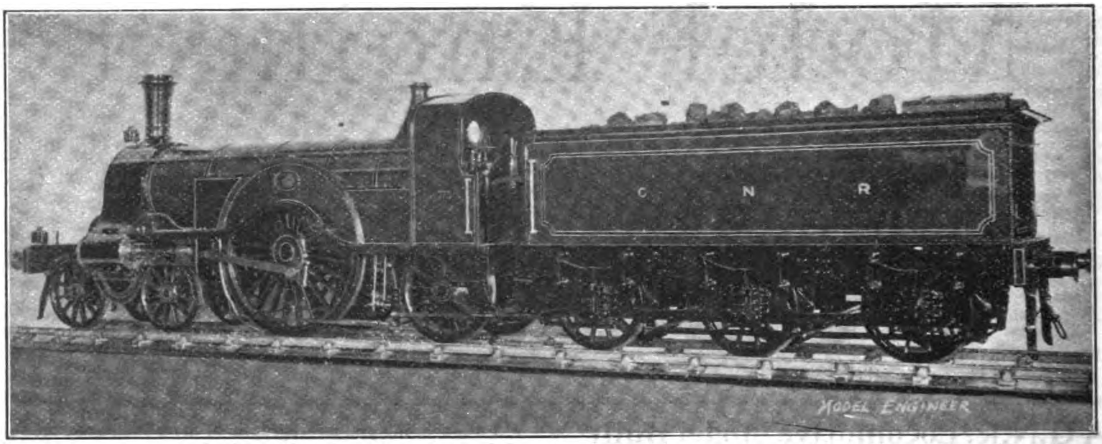
A G.N.R. Locomotive Model Built in America.

FEW locomotives can compare in popularity with the famous "single-wheelers" designed by Mr. Patrick Stirling for the express passenger traffic of the Great Northern Railway, on which line they still make exceptionally good runs, and do exceedingly good performances with the special class of work for which they were intended. In spite of the large number of counter-attractions in the locomotive world nowadays, these beautifully designed engines still take high rank in the regard of model-maker and professional alike. They may be regarded as typically English, if so comprehensive a term can fairly be applied to a class of machine so divergent in details as locomotives generally are. Their fame, however, is not confined to this country, though we rarely hear of the construction of a model anywhere but at home. The fact gives additional interest to the photographs and particulars of a very fine model of No. 779 in this class, built by Mr. Charles L. Palmer, of Albany, N.Y., whose name is well known to old readers of this journal. This latest specimen of his art certainly appears to equal in finish the American locomotive model, and the model cruiser, *Tigress*, both of which have appeared in these pages. With regard to the present model, Mr. Palmer writes:—

"I am sending you photographs of my 1-inch scale model G.N.R. locomotive, just finished. I have never seen one of the engines, but built it from photographs, and a scale drawing published by an English engineering paper. I had to make all the patterns, including those for the English double-headed rail and chairs. Many of these fine engines have been built in England, but I thought this may have a certain interest from being built in America from plans only. The boiler has no water legs, which, I have found, are little or no use with oil fuel. The furnace is lined with fire-clay, mineral wool, and air spaces, and I have no trouble from paint burning. The boiler is a plain cylinder with twenty-five ½-in. flues. It is a rapid steamer. The feed is by a donkey pump under footplate, out of sight. The engine weighs about 60 lbs. and tender 35 lbs. charged. This is about $\frac{1}{1728}$ of weight of original, and about as it should be. The pressure is 120 lbs. on the square inch. The oil is sprayed into the furnace by a steam jet, and gives perfect combustion, as described in my article published in THE MODEL ENGINEER a couple of years ago. I am surprised it is not used more with you for models, in place of the clumsy and disfiguring "Primus" burners. I carry oil in a well-tank in the tender, out of sight, from which the atomizer raises it, so there is no danger of overflow. I will gladly give particulars of the arrangement to anyone who wishes to give it a trial; it is smokeless and odourless. I have to thank you for in-



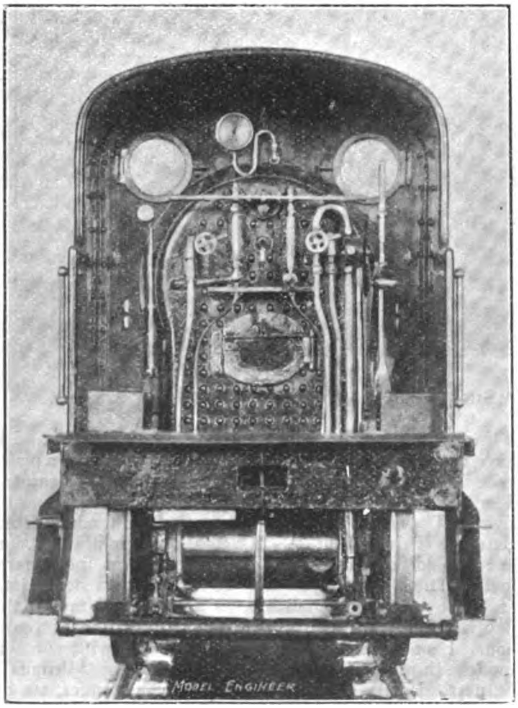
A 1-IN. SCALE MODEL G.N.R. "SINGLE" LOCOMOTIVE.



MR. PALMER'S INCH SCALE MODEL GREAT NORTHERN LOCOMOTIVE.

formation, to which much of the success of the model is due."

We reproduce three views of the engine, all of them showing its careful and finished workmanship, though hardly doing justice to it. We heartily congratulate Mr. Palmer, and are sure other readers will join with us in wishing success to any further work he may undertake in the same direction.



THE CAB OF MR. PALMER'S G.N.R. LOCOMOTIVE.

The Electrolysis of Gas Mains.

On Wednesday, June 11th, Mr. Swinburne (President of the Institution of Electrical Engineers) delivered a lecture before the Incorporated Gas Institute on the electrolysis of gas and water mains by the stray currents from electrical tramways. He traced the history of the legislation as to tramways and the telephone and gas and water industries. The present position is that tramways may use earthed returns, and are not liable for damages to gas and water companies if their pipes are corroded, provided proper precautions are taken by the tramway undertakers to prevent excessive leakage. The lecturer went on to explain how the stray currents arise, and how they enter and leave the pipes. Electrolytic corrosion only occurs where the electricity leaves the metal and goes into the damp earth. The methods of minimising leakage are using rails of large cross section; efficient bonding, or electric welding, or cast-iron jointing; return feedings, return feeders with negative "boosters" or "suckers," and "helpers." The methods of minimising the effects of stray currents are connecting the pipes by wires to the power house, or to parts of the rails that are negative to them. One of the chief safeguards is that the tramways must themselves be the chief sufferers by electrolysis, as they have not only their own rails to consider, but they also use lead covered cables which are very easily attacked; and destruction of these cables would be a very serious matter. The natural earth currents must have effects comparable with those of tramway leakage. Lead and iron service pipes in metallic contact with cast-iron mains are apt to be corroded without any extraneous currents. Finally, the lecturer held that the tramways do damage pipes, but he did not know how far the damage is really serious. Time alone will show whether the pipes will be seriously attacked, but if they are really injured the companies should approach Parliament again later on. Electrolysis is a matter of degree and a matter of time.

AN American contemporary, *Science and Industry*, sends us a neat "supplement," consisting of a tabulated list of standard keyways, to a taper of 1/8 in. to the ft. Correct sizes of keyways are given for shafts of diameters from 1 in. to 16 7/8 ins., rising by 1/8 in. in diameter. The list might be very useful in machine shops or drawing offices.

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 fortnight before its actual date of publication.]*

London.

On Saturday, July 25th, a visit to Mr. D. C. Glen's residence takes place, members travelling to Watford by the 2.57 train *ex* Euston.

The first indoor meeting after the summer will take place on Tuesday, September 23rd, at 7 p.m. Further particulars of the meeting will be announced in due course.

Provincial Branches.

Cardiff.—At the last meeting it was decided, in consequence of the recent small attendances, not to hold any further meetings during the summer. The next session will open on October 7th.—R. T. HANCOCK, Hon. Secretary, 168, Newport Road, Cardiff.

Dublin.—The members of the Dublin Branch, and some of their friends, numbering in all about thirty, were recently invited by the directors of the Great Northern Railway Company to visit the newly-constructed electric tramway on the Hill of Howth. The members and their guests assembled at Amiens Street Station at 2.52 p.m., where they were received by the president of the association, Mr. J. G. Purser, C.E., and Mr. Whieldon, engineer of the electric line, and conveyed by rail to Howth, where an electric car was in waiting to carry the party up to the summit of the hill overlooking the Bailey Lighthouse. Having inspected the accumulator house at the summit of the line, the party next visited the Bailey Lighthouse, thrown open for their inspection by kind permission of the Trinity Board. Here the lantern is of the latest pattern, having been lately constructed by the famous firm, Messrs. Chance Bros., Ltd., of Birmingham. On the return journey experiments were tried with the electric brake, which was found to work without a hitch, and brought the electric car to a standstill on the steepest gradients. At Sutton the car entered the large car shed, when the mechanism of the motors was fully explained by Messrs. Whieldon and Goulding and other gentlemen connected with the line. From thence the party proceeded to the power house, where the electricity is generated by powerful dynamos of the most modern construction, and, having inspected the boilers, the party adjourned for dinner to the Golfers' Hotel, at Sutton, where an excellent repast awaited them. Votes of thanks to Messrs. Whieldon, Goulding, and the other officials of the Electric Tramway, and to the directors of G.N.R. Company were passed unanimously, after which the members and friends were conveyed to Dublin, having spent a most instructive and pleasant day. To Mr. J. G. Purser, the genial president of the association, the thanks of all are due for the excellent arrangements made for the trip, which were most successfully carried out.—T. E. WINCKWORTH, Hon. Secretary, 149, South Circular Road, Dolphin's Barn, Dublin.

MEMBERS OF THE DUBLIN BRANCH OF THE SOCIETY OF MODEL ENGINEERS.

Leeds.—A meeting of the Leeds Branch was held in St. Andrew's Church School on Tuesday evening, June 24th, there being a very small attendance. One of the members showed a very neat scribing block and an angle and twist drill gauge. Afterwards it was arranged that we should pay a visit to Liverpool on Saturday, July 12th, and see through the engine rooms of some of the Atlantic liners if the Secretary could obtain permission. It was also proposed by Mr. Broughton, seconded by Mr. Siddle, that we should suspend the meetings for the summer, the next meeting to be held the second Tuesday in September. This was passed by all the members present.—W. H. BROUGHTON, Hon. Secretary, 262, Carlton Terrace, York Road, Leeds.

Tyneside.—At the meeeting of this branch held on July 5th, in the absence of Mr. R. Bamford, Mr. Boyd, the Treasurer, took the chair at 7.30. After the minutes of the previous meeting had been read and adopted, Mr. Turnbull showed the members his engine and boiler under steam; the former is a horizontal engine 1⅛ bore by 3-in. stroke, the boiler pressure being 30 lbs. on the sq. in. It was greatly admired by all, and was the more creditable in that Mr. Turnbull is an amateur, and the engine is so well designed and finished. A hearty vote of thanks was accorded to Mr. Turnbull for his kindness. There were thirteen members present, and two new members were enrolled. The next meeting will be held on the first Saturday in the month of August (the 2nd), at 7 p.m.—GEO. F. ADDLESHAW, Hon. Secretary, 2 Gladstone Street, Shieldfield, Newcastle-on-Tyne.

The Oldest Steam Engine now at Work.

LAST summer, much to one's surprise, while at the Glasgow Congress of Engineering, and directed by the excellent handbook prepared for the guidance of members of the Congress, a real live Newcomen engine was discovered at a colliery at Rutherglen, near Glasgow. It is almost certainly the oldest engine now at work, and is really a quite remarkable case of the survival of the unfittest.

A few years ago an engine of James Watt's manufacture, with sun and planet wheel complete, was taken down at a London brewery. It had been continuously working for 102 years, and was not at all decrepit when dismounted. It now forms an archæological exhibit in the museum of Sydney University. But this engine, though interesting and of about the same age as the Glasgow Newcomen, was of a comparatively modern type. It did not represent an extinct race.

The Newcomen engine at Farme Colliery, Rutherglen, was built in 1809, and has worked continuously to the present time. As it was constructed long after Watt's invention of the separate condenser, it may, perhaps, be inferred that one object in its design was to escape payment of royalty. Curiously enough, unlike all other Newcomen engines of which there is record, it is a winding, not a pumping, engine. The cylinder is of pure Newcomen type, but there is a modified Watt parallel motion with the radius bar above the beam, and a crank and flywheel of comparatively modern type.

The cylinder is 3½ ft. in diameter, and the stroke 6 ft. It takes about 35 seconds to raise coal from the bottom of the pit to the ground level. The cylinder was never bored, but it now has a beautiful internal surface, having worn out probably a thousand packings. The piston is packed with hemp gasket, and carries a layer of water on top, which makes it quite steam-tight. There is no automatic valve gear. A single handle, worked by a man, opens alternately the steam and injection valves. There is no air pump. Gravity and the pressure of the incoming steam drive out the condensed steam and injection water through a flap foot-valve. It is stated that except brasses and one or two spur wheels, broken by accident, no important part of the engine has been renewed since it was built.

The beam is about 17 ft. long, and the flywheel is 15 ft. in diameter. There is a feed pump worked from the beam. The latter is carried on a masonry pier. The engine works quite smoothly and well, and, strange as it may seem, it is probably, for the intermittent work it is doing, not so extravagantly wasteful as might be supposed. —W. C. UNWIN, in *Cassier's Magazine*.

TWO 80-ton guns, forming the armament of the pier turret at Dover, are to be removed as obsolete, and will probably be destroyed locally, owing to the heavy cost of transport.—*Engineer*.

How to Become an Electrical Engineer.

By FREDERIC H. TAYLOR, A.M.I.E.E.

(*Concluded from page 35.*)

ASSUMING that he is now about to take up some definite employment, he will do well to seek it with a firm who are themselves actively engaged in his own speciality, even if he may have to accept a little less remuneration than he could obtain in another quarter. He should also endeavour to attend any special courses of lectures or instruction on his special subject, which may happen to be going. Several of the more important technical colleges and institutes have, in the winter months, "special courses," which are usually well advertised in the electrical weekly papers and elsewhere.

Most of the important branches of electrical work are now well treated of by up-to-date books, and these will well repay careful study. The names of a few are given below in each subject, although, of course, new works are frequently coming out, which, as they appear, should be looked into for their value to be ascertained :—

Central Station Work.

"Central Station Electricity Supply," by Gay and Yeaman (Whittaker & Co.).

"Central Electrical Stations," by C. H. Wordingham (Whittaker & Co.).

"Polyphase Electric Currents," by S. P. Thompson (Whittaker & Co.).

Electric Traction, etc.

"Electric Traction," by J. H. Rider (Whittaker and Co.).

"Electric Railways and Tramways," by Philip Dawson (*Engineering*).

Telephony and Telegraphy.

"A Manual of Telephony," by Preece and Stubbs (Whittaker & Co.).

"The Telephone System of the British Post Office," by T. E. Herbert (Whittaker & Co.).

"Practical Information for Telephonists," by T. D. Lockwood (*Electrician*).

"The Telephone Systems of the Continent of Europe," by A. R. Bennett (*Electrician*).

"Electricity in its Application to Telegraphy," by T. E. Herbert (Whittaker & Co.).

"The Application of Electricity to Railway Working," by W. E. Langdon (*Electrician*).

"The Telegraphist's Guide to the New Examinations in Technical Telegraphy," by James Bell (*Electrician*).

"Submarine Cable Laying and Repairing," by W. Preece (*Electrician*).

"Signalling Across Space without Wires," by Dr. O. J. Lodge (*Electrician*).

"Wireless Telegraphy and Hertzian Waves," by S. R. Bottone (Whittaker & Co.).

Electro-Chemistry and Electro-Metallurgy.

"Electro-Chemistry," Dr. G. Gore (*Electrician*).

"The Art of Electrolytic Separation of Metals," by Dr. G. Gore (Whittaker & Co.).

"Electro-Metallurgy," by W. G. McMillan (Griffin and Co.).

Electric Light Fitting and Wiring.

"Electric Wiring, Fittings, Switches, and Lamps," by P. Maycock (Whittaker & Co.).

"Electric Light Fitting," by J. W. Urquhart (Crosby Lockwood).

"Electric Ship Lighting," by J. W. Urquhart (Crosby Lockwood).

"Electric Lighting for Marine Engineers," S. F. Walker (Whittaker & Co.).

"Colliery Lighting by Electricity," by Sidney F. Walker (Whittaker & Co.).

Several very good periodicals are published which are devoted to the more important special branches of the electrical industry, and the student will do well to make a study of them in order to enlarge his knowledge and keep it up to date. Of these the following may be mentioned:—

On Electric Traction and Power Transmission.

The Tramway and Railway World (published monthly; annual subscription, 10s.).

The Light Railway and Tramway Journal (published monthly; annual subscription, 10s.).

The Street Railway Journal (a New York weekly; annual subscription, 25s.).

Traction and Transmission (monthly supplement to *Engineering*, 2s.).

On Electro Chemical Work.

The Electro Chemical Review and Electro-Colourist.

The Chemical News (published weekly; price 4d.).

The Electro-Chemist and Metallurgist (annual subscription, 6s.).

On Telegrahpy and Telephony.

The Electrical Review (weekly, 4d.).

The American Telephone Journal (published weekly; annual subscription, 1 dollar).

In order to study the various periodicals and works mentioned, the student is by no means obliged to buy them. In London and most of our large provincial towns free public libraries and reading rooms exist, to which reference can always be made. Sometimes a student has informed me that he cannot see what he wants at such a place. In this case he can always repair to the Patent Office Library, at Southampton Buildings, Chancery Lane, W.C., where an excellent collection of technical books and newspapers—English, American, and foreign—are at his service, at any hour of the day from 10 a.m. to 10 p.m., including Saturdays.

Papers are frequently being read before the various scientific and learned societies, such as the Institution of Electrical Engineers, the Institution of Civil Engineers, the Society of Arts, the Society of Chemical Industry, etc. Each of the societies publish *Proceedings* which give the papers that are read and the discussions which follow on same. The latter are particularly valuable, as showing the various shades of opinion which exist upon the debateable subjects. In the absence of the actual *Proceedings*, the student will usually find the more important papers either reproduced or abstracted in the current weekly electrical trade newspapers.

Employment and Remuneration.—His training and education being advanced to a stage of usefulness, the electrical engineer has now to beset himself to find occupation and remuneration for his services.

Some firms make a point of giving employment to their pupils or apprentices upon the expiry of their articles of indentures, assuming, of course, that these have been well and faithfully served. Morally speaking, this, of course, is the right and proper thing to do, and in many cases it is a great advantage to a young engineer to get a start in the works of the firm to which he was articled. Also, one may assume that firms would not take apprentices or pupils unless it paid them to do so, and therefore they should feel it incumbent upon themselves to do what they can for those who have served them well and truly. The practice, however, has its disadvantages, which may be said to be as follows:—

1. When an apprentice or pupil is given an appointment upon the staff of his firm, he is in the eyes of all the existing staff (who knew him in his previous capacity), nothing more than "a mere old apprentice," and in such a case perhaps, "familiarity has bred contempt."

2. The principals of the firm, from their very familiarity with him *as their apprentice*, are not so likely to place the same esteem upon him, or to consider his services as worth so much as they would those of one who, whilst only equally efficient, was not so well known or familiar to them.

The practice, however, of giving pupils or apprentices the chance of staff appointments is not altogether a bad one, *as a start*, though, in the writer's opinion, such appointment should be looked upon *merely as a start*, and not as a permanent job.

It is often said that "A rolling stone gathers no moss," but "moss" may rightly be looked upon as a sign that everything is still, and consequently no progress is being made. Any young engineer, staying many years in the same firm, is apt to find himself becoming "crystallised," as it were. This is very undesirable, and the engineer should, whilst steadfast in his work, take progress as his watchword, and whenever an opportunity of new and valuable experience presents itself, take it, and follow it out exhaustively.

The method by which the young engineer should proceed to obtain employment for himself must very largely depend upon the particular circumstances in which he is situated. Needless to add, at whatever period of life he be, influence, as in all other professions or businesses, is invaluable to him, particularly when beginning; but assuming he is without the blessing of influential friends, and has to rely upon his own efforts and merits entirely, the following suggestions will be of assistance to him:—

If known to any firms, through having come into contact with them previously, let him make his needs known to them, and offer himself as an assistant in one of the departments of work with which he is familiar. In getting the first start, the possession of certificates and articles of apprenticeship, &c., are usually of value as evidence of knowledge. Unfortunately, one sometimes meets with employers, who have a lordly disdain for certificates, diplomas, and all such things; so that the young engineer must not be chagrined at coming across such an one, but rather put his feelings in his pocket in case there should be nothing else to put there.

A careful perusal of the electrical trade papers, as they are published on Fridays, will frequently afford information of appointments which are vacant. In the absence of immediate results in this way, application may be made to suitable firms, which in the first instance, at least, should be by letter. In placing one's merits forward, it is always well to give due prominence to any *practical* experience that may have been had, as many firms would place far more value on, say, six months spent on outdoor erecting work amongst engines and dynamos than on a year or two spent in obtaining a certificate, although the latter may represent very real knowledge.

Once in employment, and with some further experience gained, the young engineer should keep his eyes wide open for (1) other and superior jobs which may crop up outside, and (2) for advancement where he is. In regard to the latter, the following advice might be added:—That if you are not getting all you want, and feel you deserve, ask for it, as it is usually assumed that those who don't ask, don't want, particularly as regards remuneration.

With a view to affording some practical notions as to the probable financial results which may be expected by the electrical engineer when he is engaged upon the staff of a firm, the following figures are given as being approximately the remuneration offered in the more common branches of the electrical industry. Some notes regarding the appointments are also added.

1. Electrical draughtsmen, salary from £65 to £100 per annum, according to experience, rising to £150 to £200 if assistant only. A chief draughtsman in a large electrical works often rises to £250 or £300 as annual salary, though in this case his experience must be of the very best, and his responsibility is equally great.

To be of much use as a draughtsman, actual workshop experience is essential. Although for the most part the pay is poor, the experience gained is good, as the work affords practice and information in the designing of the apparatus or plant manufactured.

2. Central station work:—(i) switchboard attendant, from £62 to £80 per annum, (ii) "shift" engineers, from £80 to £150 per annum, according to size of station and consequent responsibility involved; (iii) assistant engineer, from £78 per annum (junior assistant) to £200 (chief assistant engineer); (iv) chief engineer, from £200 per annum in moderate sized stations to £800 or over in very large stations. The position of shift engineer and those above it require some experience with engines and boilers, and with steam plant generally. Good training in the workshops is highly desirable. Stations taking up electric traction schemes afford ready opportunities for one who is wishing to eventually specialise in that branch of the industry.

3. Contracting and general installation work:—Supervision of house wiring work, &c., from about £100 per annum on small work, increasing up to about £250 per annum on large and responsible work, such as that attached to big institutions or public buildings, &c. A good knowledge of estimating is very desirable, and likewise the ability to economically arrange the work of the men employed and to efficiently control them.

4. Electrical engineers in charge of private installations of electric light and power are mostly employed as "working engineers"—that is to say, to take active charge of running machinery, &c., and carry out extensions or repairs. The rates paid vary from £80 to £150 per annum, depending upon the responsibility involved. Some very large manufacturing or other concerns employ a resident electrical engineer, whose duties are only to supervise the "working" engineers employed and to design any extensions or alterations required, the salary in such a case being of the nature of £250 to £350 per annum. A good, all-round knowledge of general engineering is usually needed, and practical experience in the running of gas or steam engines, etc.

5. Marine work may be divided up under two heads—viz., appointments on one of the large ocean liners, such as those of the P. & O. Steamship Company, and appointments in the Royal Navy.

The rate of pay on a steamship company's boat is about £8 per month, and includes, of course, board and quarters. The work usually comprises entire charge of all the electrical plant aboard, including the engines which drive the dynamos, and electric motors, searchlights and bells, &c., also any temporary lighting that may be needed for concerts or balls. A medical inspection is usually insisted upon before engagement. One of the chief advantages of a position like this is that it brings to light the real "grit" in a man and teaches him self-reliance; for in cases of difficulty or emergency he has no one to fall back upon and is held responsible to the chief engineer for every matter under his care.

For an appointment in the Royal Navy as electrician, the candidate is usually required to pass an examination in, both theory and practice. This must show a good general knowledge of the construction of electrical apparatus and instruments, testing, &c., and also practical ability to use a lathe, and do his own repairs to motors, or generators, &c. The pay starts at about £100 per annum, rising to about £118, with eligibility for advancement to chief electrician, after further examination. This latter position is, of course, much better paid, and carries with it a pension after a certain term of service.

This class of work is, in the writer's opinion, well worthy of consideration, as the part played by electricity in all classes of naval work is rapidly extending; in fact, the modern uses of it on board a large man-of-war well deserve a special central station for lighting and power.

6. Clerk-of-works:—Since the advent of large contracts in town lighting, power and traction schemes, there has grown up the position of clerk-of-works. The duties are, of course very similar to those of a clerk-of-works on a building contract—namely, to act as the engineer's representative, and to see the contract through. Owing to the variety of work which is carried out in connection with the putting down of a large central station, the position carries with it a very excellent all-round experience. Apart from this, when the scheme is completed, and a resident engineer is to be appointed, the clerk-of-works, if his services have been satisfactory, usually stands in a very good position for the obtaining of the appointment. The salary given is of the order of £150 to £250 per annum.

7. Teaching:—An appointment as instructor or lecturer in electrical engineering is sometimes rather looked down upon by electrical engineers engaged in the "trade" side of their calling, although why, is not clear. The pay in this class of work is not usually very good; but that may be said of all teaching work—anyway, so far as this country is concerned. A position as demonstrator at a technical college is usually worth from £80 to £200 per annum, the average being certainly nearer the former than the latter. The duties occupy the whole of the day, and frequently involve evening classes as well.

As a set-off against the rate of pay, the excellent experience gained should never be lost sight of, nor the fact that such positions bring one in daily contact with scientific men of high rank, whose personal influence cannot be lightly estimated where there is ability to be noticed and rewarded. Experience in *actual teaching* is very necessary to gain any but the more humble appointments. Knowledge is one thing, but ability to impart that knowledge to others is quite another, and a successful teacher must combine the two.

For information as to where electric lighting stations, or electric tramways, &c., are in operation, reference should be made to such work as the "*Electrician* Blue Book," or "Electrical Trades Directory," as it is more often called. This work is published annually, and gives a very complete list of all the electric lighting and tramway concerns in Great Britain, together with notes as to proposed schemes, &c. The publishers are the *Electrician* Printing and Publishing Company, Ltd., of Salisbury Court, Fleet Street, E.C., and being a well-known work, it may be seen at most of the important public free libraries in London, and the large provincial towns.

Another excellent publication of a directorial nature is "Garcke's Manual of Electrical Undertakings." This is published annually, and gives full particulars of all the important electric lighting, tramway and power stations in Great Britain and other parts, telegraph and telephone concerns, and the chief public manufacturing electrical companies. The price of this work is 12s. 6d., and it is published at Mowbray House, Norfolk Street, W.C.

Apart from the Mother Country, in which it is assumed that the young electrical engineer has received his early training and experience, openings exist in most of our Colonies and British possessions beyond the seas for suitable men; but those who go must see that they *are* suitable.

A great mistake has often been made by people supposing that what is not good enough for this country is good enough for others. That is not so, and as one of the highest in the land said at a great public gathering a short time ago, great opportunities exist for development in our Colonies, but we "must send them of our best." In other words, then, young engineers intending to emigrate to the Colonies or foreign lands, should first make themselves efficient—then, and not till then, think about emigrating.

Probably those who have the fallacious idea that England is worked out, are turning hopeful eyes to South Africa, and this not without good reason. In this country there is not the least doubt that there is good room for young, energetic, and well trained electrical engineers. Power transmission, tramways, and mining will be amongst the foremost openings for electrical work. Good knowledge of the most up-to-date practice, such as "polyphase" work, is highly desirable. The Colonial agencies in London (mostly situated in Westminster) should be applied to before one decides on emigrating, so that full particulars may be known as to climate, trade, cost of living, &c., in the part proposed to be visited.

Many a young engineer with high ambitions, and capital at his back, seems to feel it is his bounden duty to employ both of them in starting up in business on his own account. For this he needs a good commercial knowledge, as well as engineering experience. The latter, without the former, will never leave him financially successful. In other words, he needs a good knowledge of prices, of buying and selling, of management of men; of up-to-date business methods, and, above all, the ways and means of getting business at remunerative prices. Of course, such knowledge may all be provided for him in a partnership, where his place, whilst being purely technical, provides a certain amount of opportunity for seeing what is done by the purely *commercial* men of the firm, and this course of action is probably the safer, if business on one's own account is decided upon.

In electrical engineering, as in other businesses (and probably rather more so), one often hears of new firms which crop up, live for a year, then expire abruptly; and the explanation if sought would frequently be found to be want of business knowledge and experience. Thanks to the possession of a good "reserve fund" at home, a young beginner is frequently able to meet undesirable balance sheets at the ends of his first few years of business, and to hold out until such times as having gathered together the nucleus of a connection and some good commercial ability, he sets his course "full steam ahead," with but remote possibilities of reverse.

Whatever his position, and, however good from a financial point of view, the electrical engineer should never begin to consider his education complete. Of all the professions and businesses of life, there is probably hardly another which is advancing so rapidly as the electrical one. What was done five years ago is, in many instances, obsolete, so that every opportunity must be used to keep one's self up to-date.

Probably one of the most desirable ways of keeping pace with modern practice is by membership on the Institution of Electrical Engineers This Institution, originally founded in 1871 as the Society of Telegraph Engineers and Electricians, has advanced both in importance and usefulness, until at the present time, under its various classes, it numbers upwards of 4000 members. Considered, therefore, in the light of membership only, it may be regarded as truly representative of the whole electrical industry and profession.

The Institution consists of honorary members, foreign members, members, associate members, associates, and students. A few notes as to the last four of these will probably be of interest.

The student class is intended for those who are studying electrical science, and who are under 22 years of age. The annual subscription under this head is one guinea.

Associateship is intended for persons over 21 years of age who are connected with electrical science or engineering. The annual subscription is one and a half guineas.

The associate member must essentially be an electrical engineer or electrician, and at least 25 years of age, so that his status is naturally a higher one than that of the associate; similarly, also, is that of the members. The annual subscription in the former case is two guineas, and in the latter three guineas.

On election, or transfer from one class to another, an entrance-fee is usually payable in addition to the annual subscription.

The ordinary meetings of the Institution are held between the months of November and May, and usually about once a fortnight. At these meetings papers on electrical subjects, as contributed by members, are read and discussed, and afterwards published in the *Journal* of the Institution.

The advantages of belonging to the Institution, briefly speaking, may be summed up as follows :—

(a) Membership of such a body undoubtedly lends a certain status, as the Institution would certainly not admit persons who it could not consider as fit and suitable.

(b) The Council of the Institution may issue to any member or associate-member a Diploma showing the class to which he belongs.

(c) The various classes of members have the privilege of attending the ordinary meetings of the Institution, and hearing the papers and discussions which may take place.

(d) They also receive the published *Proceedings* of the Institution from time to time, and also the publication known as *Science Abstracts* which is issued monthly, conjointly by the Institution and the Physical Society of London.

(e) The Institution Library is available for the use of members and possesses a valuable collection of electrical works.

The life of the Institution is by no means confined to London or even Great Britain. Local sections of the Institution exist in several of the large provincial centres such as Manchester, Birmingham, and Newcastle, and in Glasgow and Dublin. Calcutta and Cape Town also are similarly blessed. The value of the local sections to electrical engineers resident in those parts is very great, as they have their meetings and discussions like the parent Institution.

In the United States, Australia, New Zealand, South Africa, and the more important parts of the Continent, there are the local Honorary Secretaries and Treasurers of the Institution.

Specially important matters connected with electrical profession often receive the direct attention of the Institution, as for instance the excellent "Institution Wiring Rules," now so well known to electric lighting contractors.

The student section is by no means insignificant. This class of members have meetings of their own for the reading and discussing of papers, and also visits to works are often arranged for, through the courtesy of large manufacturers and contractors.

In considering the choice of electrieal engineering, as his profession or livelihood (which it is hoped these articles will assist) the reader may well regard it as a great and honourable profession. By many, the present is often spoken of as the age of electricity. This however, is true only in part, for the work which electricity is destined to perform in the near future may safely be regarded as far greater and far more wonderful than anything which has yet been witnessed.

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 should invariably be attached, though not necessarily intended for publication. Communications should be written on one side of the paper only.]*

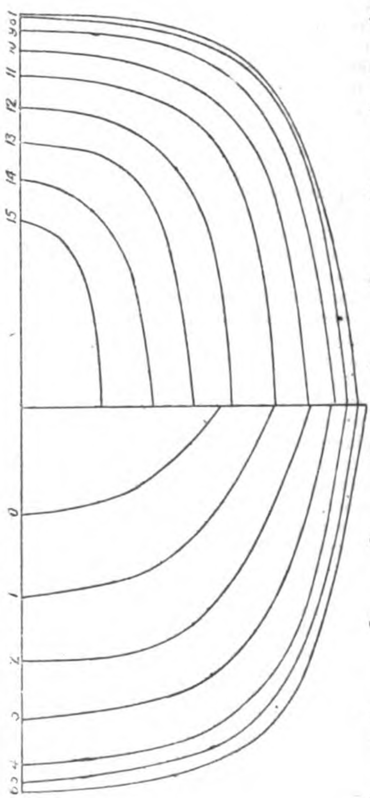
A Fast Model Yacht.

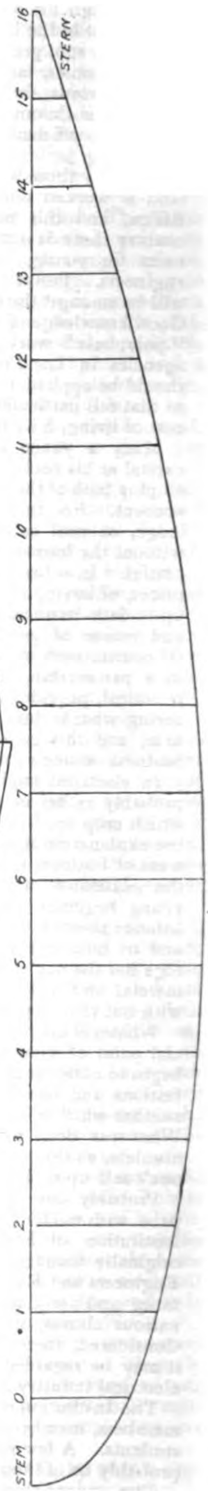
To the Editor of *The Model Engineer.*

Dear Sir,—I was pleased to read in No. 75 of your most interesting and useful journal, reply to E. McK. T., which I am sure will assist those like him and myself, who are interested in model yacht building. Through the medium of your journal I have been able to pick up much useful information. Thinking it might be some value to your correspondent, "E. McK.," I enclose the lines of a 30-in. model I made lately, and which has proved to be a very fast and steady sailer, having had the best of ten models in a cup race held here lately. I may say from experience that models built from reduced scale of large yacht racers are not a success, as they have much too fine lines. I have now built three "30 ins. overall" yachts, the first of which had a beam of 6¾ ins., with 3 ins. depth at the fifth section. The second yacht was 30 ins by 7½ ins. by 3½ ins., and it proved a steadier boat in every way. The third, which is the one I now sail, and of which I enclose sketch, is 30 ins. by 8 ins. by 3¼ ins., has proved beyond a doubt that these fuller lines are a decided success. Instead of having the widest beam at the eighth section I have placed it at the seventh, and greatest depth at between sects. 5 and 6, thus giving greater stability to the part of the boat where most is required. Sharp arrow-pointed bows in the scooped bow type are next to useless, as the buoyancy is most seriously affected by them. With a yacht of good wide beam you can in light weather carry more sail and make her get over the water with a truer course than can ever be got out of a narrow crank, which is only fit for sailing in a tank of water, with a cord tied to it. Should "E. McK." wish to try the building of a yacht from the lines enclosed, I will be pleased to furnish him with further particulars, and give paper patterns of main sail, gaff, top-sail and jib, as I found sail-making and trimming require as much attention and practical experience as hull-making does.—
Yours truly, A. Noble.

Fin-keel, 18 ins. starting 6 ins. from stem; 5¼ ins. deep at Sections 5 and 6, including lead keel.

Hull made from block of yellow pine with light mahogany deck. Weight (hull, fin, and deck) 2¼ lbs. Total weight with lead keel, 7½ lbs.





Design for 30-in. Fin-Keel Model Yacht.

By A. Noble.

(One-quarter Full Size.)

Soldering Irregular Pieces.

J. A. P. sends to *Railway Machinery* the following method which he has found very handy when it is necessary to solder together two irregular pieces of metal or the two parts of a broken piece. On a piece of tin put a small lump of putty. Take the two pieces to be soldered, and press them into the putty so that they will come in contact and occupy the position in which it is desired to unite them. Having thus formed the mould, remove the pieces and hold the mould over the gas-jet; or, if a flexible gas jet is at hand, apply the jet directly to the mould. This burns the oil out of the putty and leaves a firm seat for the pieces. After the mould has been hardened, replace the pieces, apply a little acid, put a small piece of solder at the joint, and turn the flame on to it. Let the solder come to a good melting heat, and then cool the pieces, which will be found to be soldered very satisfactorily. This, like other kinds, requires some practice; but, after a little experience, it will be a very simple matter to solder the most irregular pieces.

The Motor Bicycle: Its Design, Construction and Use.

By T. H. Hawley.

(*Continued from page 15.*)

III.—On Designing Special Frames for the Motor Bicycle, and the Design of a Special Motor for the Bicycle, etc.

THAT the present day type of motor bicycle is more or less of a compromise will be admitted by all who have closely watched its development from the very first. It was, naturally, the easiest way to approach the subject in an experimental sense to design a simple form of motor, and simply clip it on to the standard pattern bicycle frame; but this could not be done without

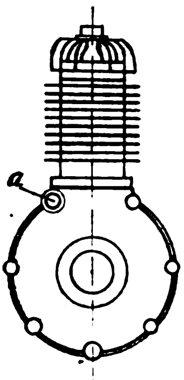


Fig. 13.

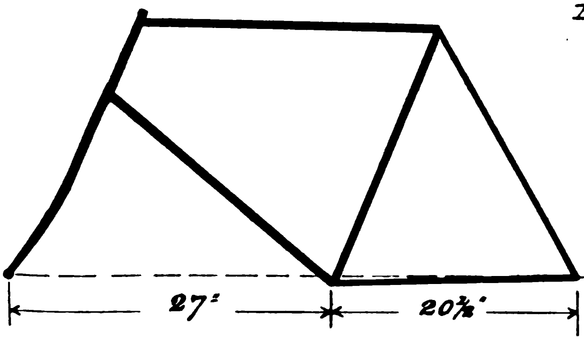


Fig. 14—Diagram of Ordinary Bicycle Frame.

sacrificing something in the constructional details of the motor, though it must be admitted that, so far, a considerable amount of satisfaction has been derived from machines of this class. We have, however, now arrived at a stage in the development of the motor bicycle when it seems probable that the orthodox bicycle frame will have to give way to a more or less special design, in which every detail has been considered with regard to carrying an efficient motor.

There are two chief reasons why the ordinary bicycle frame is unsuitable for the motor bicycle of the future, and why its entire re-modelling may be looked for at an early date:—The first is that in the earlier bicycles the engine was rarely of more than ¾ to 1 actual horse-power, and for these small engines an ordinary frame simply built up with stouter tubing did well enough. It was soon discovered, however, that if the machine was to be looked upon as a vehicle for transporting the rider over average country without having to use the pedals, a much more powerful engine would be needed, and we have now gone by gradual steps up to from 1½ to 2 h.-p., with a prospect of a call for still more power by reason of the great success of the trailer attachment.

In the second place, the fitting of these higher powered motors in the cramped space of the ordinary frame, has necessitated cutting down the engine bearings and the contact-breaker parts, to an extent not compatible with durability, whilst the frame itself cannot longer be considered safe for a further increase of engine power, as merely using heavier tubing will not ensure the stability of the machine, unless the strength of the connecting sockets is increased in proportion; indeed, I think the increase of strength in this direction is of more vital importance than the mere tubing, and it is ridiculous to suppose that fittings which have been pared down to the lightest possible point for safety in an ordinary bicycle should be safe to carry the added weight of a powerful engine and the stress of drive, with vastly increased vibration.

It is, therefore, a rather interesting speculation at the

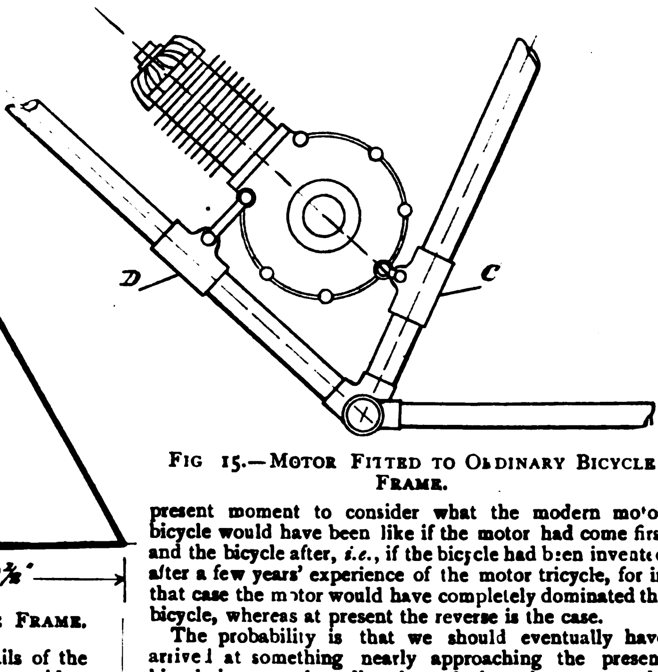


Fig 15.—Motor Fitted to Ordinary Bicycle Frame.

present moment to consider what the modern motor bicycle would have been like if the motor had come first and the bicycle after, *i.e.*, if the bicycle had been invented after a few years' experience of the motor tricycle, for in that case the motor would have completely dominated the bicycle, whereas at present the reverse is the case.

The probability is that we should eventually have arrived at something nearly approaching the present bicycle in general outline, but of altogether more substantial construction, as, of course, the weight of machine would be of less consequence, and incidentally I may mention that I do not side with those who advocate a cutting down of weight policy in connection with bicycle motors or motor bicycles, for the simple reason that in order to obtain the necessary power in the motor and the strength of frame to carry it, it is necessary to go beyond the limit at which a machine could be truly described as portable in the same sense as the ordinary bicycle.

Therefore, if we have a machine which, when the weight is cut down to the lowest point, is still too heavy to be carried upstairs, or conveniently lifted by one person, we might as well invest in a few extra pounds of metal to ensure safety and durability.

I am aware that a certain section of the trade view the matter in a different light, and seek custom by exploiting the light weight of the motor itself. In one case this has been reduced to 22 lbs. for 1¾ h.-p. But it should be remembered that such items as petrol and tank to contain it, together with the induction coil and other fittings, cannot be much reduced, so that the gain in the mere engine is not going to make so very much difference in the total weight of machine if the frame is to be reliable and safe, and more than anything else, the tyres.

I shall deal with tyres in a later article, but I would like, at this point, to advise all who contemplate motor cycling to invest in what, in their own opinion, is the very best tyre for the purpose, irrespective of cost; for, until one has experienced it, one does not realise the difference between repairing an ordinary cycle tyre and a motor tyre, for in addition to the difficulty due to the increased weight of the machine, there are usually more fittings to be disturbed in the removal of the driving wheel, so that here again we have increased weight; because it is impossible to secure a fair degree of immunity from puncture except by increasing the thickness of the walls of the outer cover; and as the thickness of the outer cover is increased so must the diameter of the tyre, if resiliency is to be preserved.

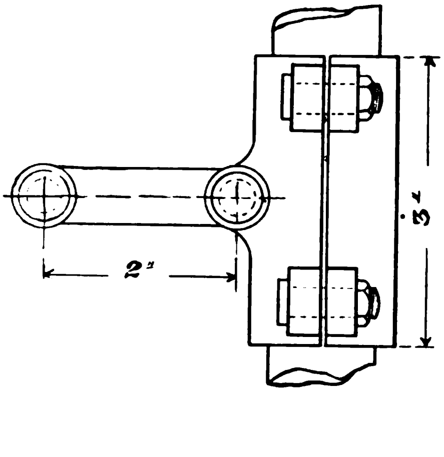
From the above argument it will be seen that I am of opinion that the motor bicycle of the future will tend to become heavier rather than lighter, and I fail to see the compensating advantages of the very light machine, providing the heavier machine can be made absolutely reliable under all ordinary conditions.

It is true that, so long as the starting of the machine is by pedalling, any increase of weight will handicap the rider in making a start up-hill; but here, again, I think experience on the part of the rider—which will come with time—will enable him to keep his machine up to such a state of efficiency as will ensure it starting at the first effort, and I may add that pulling a trailer with 10 stone in it, I have, personally, had no difficulty in starting up slight inclines.

If I am correct in my deductions, the position to-day would appear to be, that the maker of motors only, is afraid to launch out without having regard to the existing bicycle frame, for fear of crippling his output by reason of purchasers being unable to procure frame fittings with which to complete the machine. On the other hand, those firms who build up frames and purchase motors, will—other things being equal—naturally select a motor which falls within prescribed measurements, as employed on their ordinary cycle designs; though with a free hand, the manufacturer of motors knows full well that it would be possible to vastly increase the efficiency of his motors, if he did not have to consider dimensions and weight.

Now, supposing two points in present design—the position of the engine somewhere near the crank bracket, and the pedals for starting and assisting the engine, are to be retained—and I am pretty certain they will—then it is evident that if the present type of motor is also to be retained, the tread or distance between cranks must be increased to allow of better bearings and other fitments on the motor, and also permit of a more reliable method of transmission.

I cannot see the slightest disadvantage in this, for granted that a narrow tread is an advantage on the ordinary bicycle where constant pedalling must be done, a few inches increase would make no material difference on a motor bicycle where the pedals are only in use occasionally, and as the spreading out of the transmission gear would involve a widening of the space between back forks and stays, there would be room for a larger driving tyre, and this, I am of opinion, would be a distinct gain. The largest tyres in common use on motor cycles at present are 2 ins. diameter; but I am satisfied that 2¼ ins., or even 2½ ins., would be a distinct advantage.



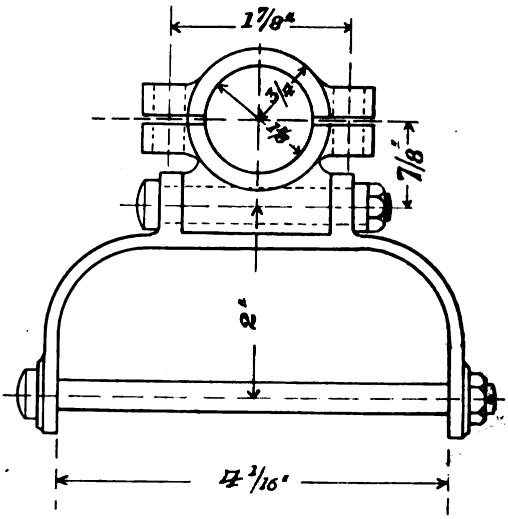


Fig. 16.—Side View and, Fig. 17, Top View of Clip for Bicycle Motor.

The great point, however, is the securing of reliability and efficiency in the motor itself; and the leading firm of small motor manufacturers—De Dion Bouton, of Paris—has just completed a motor on entirely novel lines, designed specially to go between the cranks of any ordinary roadster frame. This I will describe later on.

For the present, we may deal with the more ordinary patterns of motors and the best form of frame suitable.

Fig. 13 shows the outline of the ordinary De Dion motor of 2¼ and 2¾ h.-p., and as a goodly number of these are on the market at very moderate prices, it will come well within the scope of the present papers if I make suggestions as to the fitting of these motors into a suitable frame, for it will be noticed that there is no clip for attachment to the tubes of a bicycle frame. Then again, the majority of small motors not specially constructed for the bicycle are on the same lines, and a similar remark applies to the majority of the castings advertised for sale. So that whereas in some cases the amateur will buy his engine finished and be content with building the bicycle, there are others who will wish to do all the work; and, yet again, others, who having an

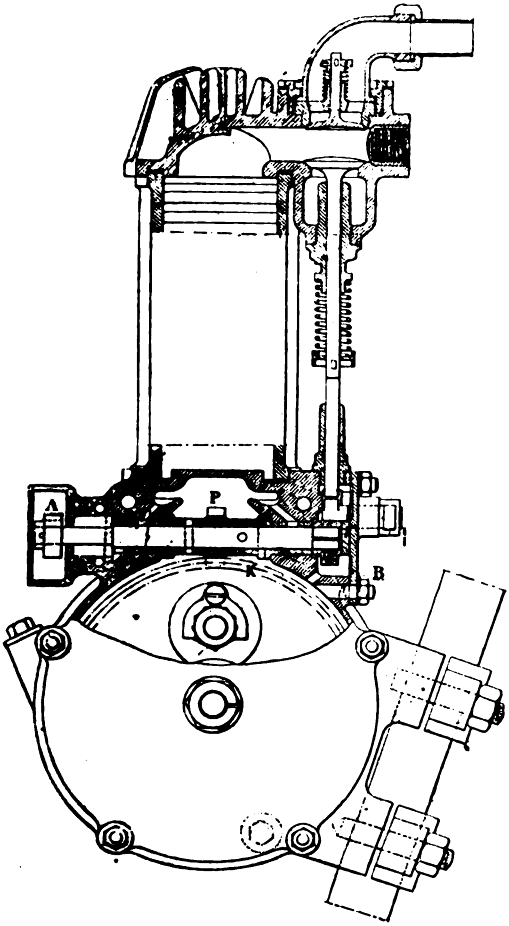


FIG. 18.—SECTION SHOWING VALVES AND HALF-SPEED SHAFT OF DE DION BICYCLE MOTOR.

ordinary bicycle, would like to convert it into a motor bicycle, purchasing the motor and making the necessary alterations themselves—a subject I shall deal with fully in the next article.

So with a view to meeting the requirements of each class of readers, I propose to take first the case of a man in possession of an ordinary De Dion motor who wishes to build a suitable frame for it.

The first point to be decided will be the position the motor shall occupy on the frame, and this in turn may be regulated by the fittings available, or the facilities for machining special fittings, another factor being that if the motor is too wide to go between the cranks of an ordinary roadster machine we are debarred from adopting the best position, unless the crank bracket is specially constructed.

Provided, however, that the crank clearance can be managed, I think, for a De Dion type of motor, there can be no better fixing or position than that shown in the last article as the No. 2 or "New Werner," in which the motor is vertically placed in front of the seat column and about midway between the two wheels.

The special frame construction and method of fixing the motor is, I believe, patented; but there are many other ways of securing the motor in this position, and there are other positions for the motor which are probably little, if anything, inferior, and which may be attained with less expenditure in the way of extra work.

The ordinary De Dion motor, the construction of which was fully described in the issue of October 1st, 1901, with full working drawings, has seven bolts connecting the two sides of the crank chamber; and it is obvious that by inserting longer bolts, or otherwise, any of these seven holes may be utilised for attaching the motor to the frame; but one of these marked A on the drawing, Fig. 13, is

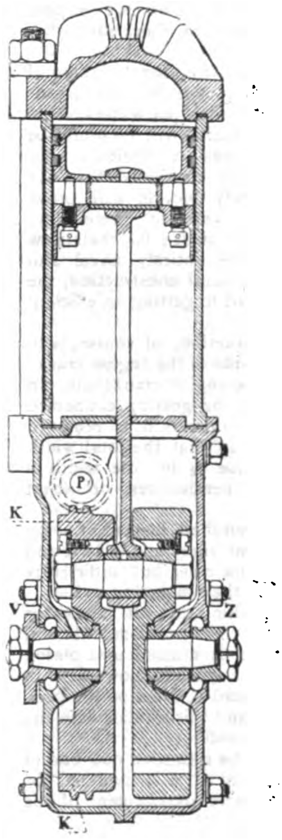


FIG. 19.

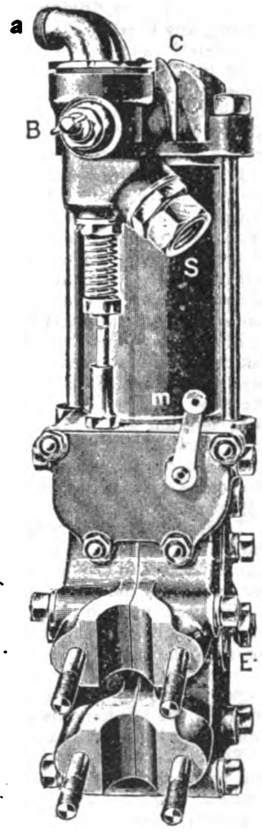


FIG. 20.

larger than the rest, being the one by which the tricycle motor is connected to the tricycle frame.

Fig. 14 is a proportionate diagram of an ordinary bicycle frame, as made up from standard B.S.A. fittings, and Fig. 15 illustrates the position of motor which most nearly complies with accepted theories, having regard to registered designs in combination with ease of fitting. It will be noticed, however, that the motor is not supplied with any means of attachment, so special clips will have to be devised. This need not be much of a stumbling block, for although I am not aware of any suitable clip on the market, it is a simple pattern making job to produce the clip shown in Figs. 16 and 17, and at D in Fig. 15, which may be best made in phosphor bronze, and the other clip shown at C in Fig. 15 is practically the same, varying only in dimensions; the drawings show a clip suitable to take the crank case of the Dion motor, described in the last series of papers, either the 2¼ or 2¾ h.-p. size. The motor may be connected to the frame by two clips of Fig. 16 pattern, by attaching one to the seat-post, as in Fig. 15, and the other to the bottom tube. With the aid of a couple of these clips it will be seen that quite a variety of positions may be secured for the motor, either on the standard frame or one specially constructed.

I have already outlined my ideas of a special frame for the motor bicycle, the chief features of which should be ample strength, plenty of clearance between tyre and forks, and between tyre and driving belt or chain, with a good big tyre to driving wheel; but I do not propose offering any fixed design at present, as there are other considerations to be dealt with.

On the second part of the subject—*i.e.*, the designing of a special motor to suit the existing type of frame, I cannot do better than present readers with particulars of the New "De Dion" bicycle motor, which will no doubt be on the market by the time these lines are in print.

The premier firm has evidently concluded that the ordinary dimensions of the safety bicycle will prove sufficient for motor requirements, and that there is no necessity to depart from accepted lines; for their new motor, although embodying some entirely novel and rather startling departures from general construction, the alterations made are solely directed to getting an efficient motor inside the ordinary tread.

The common method of construction, of course, is to put the distribution gear on one side of the engine crankcase and connected directly to the engine crankshaft. In the New De Dion the whole of the gearing connected with ignition and exhaust valve operation is removed from the side of the crank-case, so that the total width of the engine is decreased by some ¾ in., the width of the crank-case being only 14 centimetres, or about 5½ ins.

To accomplish this the half-speed shaft, instead of being parallel to the engine, is placed at right angles to it and immediately on top of the crank case, but sufficiently removed from the centre to clear the connecting-rod.

The exact method of accomplishing this will be clearly understood by reference to Figs. 18, 19 and 20. It will be seen that one of the flywheels is utilised as a pinion for actuating the half-speed shaft, which is shown at P in Figs. 18 and 19. A circular thread K is cut on the periphery of the left-hand flywheel, and this meshes with the worm wheel P on the half-speed shaft.

The exhaust valve is operated by a cam on one end of the shaft, and at the opposite end at A is mounted the ignition cam, this necessitating a re-arrangement of the combustion head.

It will also be observed that the cylinder proper is devoid of the usual radiating webs, and that the head is held down by two bolts only, in place of four. The admission pipe *a* in Fig. 20 is now connected by a simple screw fitting, in place of the rather clumsy device formerly used, and may be turned round to any angle to meet the delivery pipe. Fig. 20 gives a general outside view of the engine, in which *a* is the delivery to inlet valve, B the sparking plug, C the combustion chamber, S the exhaust, and *m* the advance spark lever. The motor is intended to be clipped to the seat-post of the machine in the forward position.

It would be injudicious to criticise the design minutely at present, but the position of the De Dion Company may be taken as a guarantee that the engine is a practical success.

Of the good points that strike me, I may mention the advantage of having a double bearing to the half-speed shaft, one each end, for this will ensure great steadiness and durability in both exhaust cam and ignition cam. The next point that strikes me as especially good is the method of securing a long engine-shaft bearing by deeply recessing the flywheels.

The abolition of the cooling webs to cylinder walls appears a doubtful policy, unless the cylinder tube is of steel and very thin, though it is well known that there is little advantage in cooling ribs at the lower end or outward end of the stroke; for by the time the piston reaches this point, the temperature has dropped enormously by expansion, the greatest heat, of course, being in the combustion chamber at the moment of ignition.

The one point about which I am inclined to be dubious is the durability of the thread K and the worm wheel P, supposing the flywheel carrying the thread K is of cast iron; if it is of steel, then this doubt is largely removed.

Provided, however, that efficient working and durability is assured, this motor is likely to play a considerable part in the problem of fixing a standard pattern of motor bicycle frame, as, of course, the whole thing is at once simplified by reason of retention of the usual bottom bracket.

This design is, of course, not open to the amateur constructor; but it serves to show the latest step taken to solve the problem.

In my next paper I shall deal with the subject of attaching the motor to an existing ordinary bicycle, and the method of strengthening the frame to meet the increased strain.

(To be continued.)

A Well-made Model Marine Engine.

By A. L.

THE engine shown in the accompanying illustration was built to drive a 10 or 12-ft. dinghy, and it is quite possible that, with a good steam pressure and a moderate-sized propeller to admit of a fair piston speed, it would accomplish this object. The reason why, in the first instance, a larger size was not chosen was, that the only tool available was a 3-in. centre slide-rest lathe, which, as it was, rendered the engine quite a formidable undertaking. However, by change of circumstances, the greater part of the engine was ultimately done on a 4½-in. Barnes lathe, which I consider an excellent tool, but could suggest one or two particulars in which it could be greatly improved. One is, that if broader bearing surfaces, along which the saddle slides, were provided it would overcome the tendency to undue wear near the head, where most of the work is done. The other is, that any pressure on the spindle, such as occurs in drilling or turning between centres, causes the same to bind slightly and run stiff, and a ball-bearing or other means of taking the thrust would be a great improvement. Neither of these two items, however, need prejudice the average amateur against this lathe, as, even in its present form, the bed would stand a huge amount of wear before giving any trouble, and the binding of the head does not affect the accuracy of the work done, which, after all, is the main consideration.

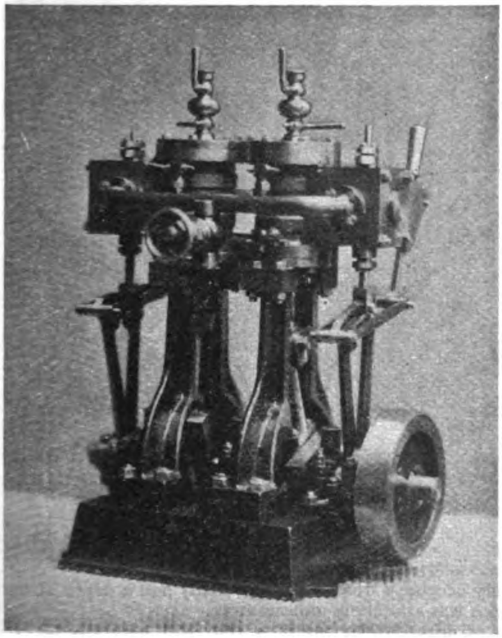
The engine stands about 15 ins. high, the cylinders are

1⅝ ins. bore, 2½ ins. stroke, and the travel of the valve is ⅜ in., and the castings, except the bedplate, balance wheel, &c., are in gunmetal by W. Martin & Co., and and I am glad of this opportunity to acknowledge my indebtedness to this firm for their unfailing courtesy.

The crankshaft is a malleable steel casting of excellent quality, machined in the usual manner, and being unbalanced I found that, when detached and spun loose between centres at any speed, it shook the whole room, so I filled in the balance wheel for one-half of its circumference on both sides with lead, which just balanced the cranks, and it now runs very sweetly.

The valve is adjusted by one square nut let into a slot in the valve, and between this nut and the valve is a small spiral spring which holds the valve to the face.

The steam-pipe, ports, &c., are somewhat larger than the size of the engine appears to warrant, but being intended for actual work I thought it best to be on the safe side.



A Well made Model Marine Engine.

The appearance of the engine in the photograph herewith reproduced is not enhanced by the fact that it requires a few finishing touches before it is really complete. The lagging of cylinder, drain pipes and other details, still require making and fitting.

A new magazine—to be issued twice yearly—has been produced by the engineering section of the University of Birmingham. It cannot be said to reach a high order of merit, either from the scientific or the literary side, but it will probably find appreciative readers who will forgive much for the sake of the local interest. The price has been fixed at 4d. and the *Engineering Magazine* can be obtained on application to the Editor, at the University.

Notes on the Wolverhampton Exhibition.

PROBABLY many model engineers in the Midlands will find their way this summer to the Art and Industrial Exhibition now open at Wolverhampton; and though there is but little to be seen in the way of models, the engineering exhibits generally are certainly well worth seeing. The exhibition, as a whole, falls a long way short of its predecessor at Glasgow; but this is the misfortune, rather than the fault, of Wolverhampton, whose local facilities are hardly so favourable to an enterprise of this kind as were those of the northern city.

The exhibition is located partly in the West Park and partly in some ground lent by Lord Barnard, the whole site occupying about 30 acres in extent. The main attraction to our readers will doubtless be the Machinery Hall, and while we have not the space to spare to refer to many of the exhibits, we may perhaps point out some of the items of special interest. In the way of models, there are two miniature steam hammers to be seen on the stand of Messrs. B. & S. Massey, of Openshaw, one of the single standard, and the other of the double standard pattern; while the Stirling Boiler Company, Ltd., also use models to illustrate their specialities. These include a 1 in. scale sectional model of a Stirling boiler, and also an experimental model, chiefly made of glass, which is used to give demonstrations of the principle on which the boiler works. Messrs. Heenan & Froude show a working model of a safety device for preventing pit cages from falling down the shaft should over-winding occur, and also a neat model of a coal-tipper. The working model loco "Diamond Jubilee," described some time ago in our pages, is shown by the L. & N.W.Ry. Company, who also have two model steamers on view. The Midland Railway is represented by a model of the Forth Bridge, and the Great Western Railway by two fine models of their cross Channel steamers. An interesting model, which is to to be found close to these exhibits, is a representation of the Southampton Docks to a scale of 1 in. to 50 ft. Even to this small scale the model takes up a large space, and shows in a most instructive fashion the accommodation and resources of this important southern port. A model of one of the big Southampton liners, the *Kinfauns Castle*, of the Union Castle line, is shown on the next stand, and gives an excellent idea of what a modern 10,000-ton passenger boat is like

Of the machinery in motion, we may select for special mention the automatic machine tools shown by Alfred Herbert, Ltd.; the electrical machinery shown by The Electric Construction Company, Ltd., Messrs. Bever, Dorling & Co., Ltd., Mavor & Coulson, Ltd., Bruce Peebles & Co., Dick Kerr & Co., Ltd , The Lancashire Dynamo Company, and Messrs. Ernest Scott and Mountain; the steam engines by Messrs. Belliss and Morcom, Ltd., Robey & Co., Ltd., Wm. Sisson & Co., Willans & Robinson, Ltd., and Browett, Lindley and Co.; the gas engines by Messrs. Crossley Bros., Ltd., and The National Gas Engine Company; and the several exhibits of printing and woodworking machinery by different firms. One electrical item which will probably be new to many of our readers is the "spiralette" device for increasing the illuminating power of incandescent electric lamps, this consisting of a closely-wound spiral of glass, which fits over the ordinary pear-shaped bulb of the lamp. It may be seen in use at the stand of the Hiram Maxim Lamp Company, Limited.

The Blickensderfer Electric Typewriter is a decided novelty, which should be inspected. In this clever contrivance the whole of the work of the typewriter is done electrically, the current being taken from an ordinary supply circuit. The keyboard, of course, requires manipulating in the usual way; but the operator merely touches the keys, no power being required beyond the very light tap required to make the necessary electrical contact.

Most exhibitions have their curiosities, and not the least interesting example of this kind at Wolverhampton is the collection of inventions and literature belonging to the Thorneycroft family, and shown on a special stand in the Industrial Hall. Here may be seen a model of a steam engine adapted for blowing domestic fires, and for ventilating rooms, and some models of coaches and carriages invented by Lieut.-Col. Thorneycroft. Some illustrated records of this gallant officer's aeronautical experiences are also on view, together with a number of other items which testify to his ingenuity and enterprise.

One thing which the engineering visitor to Wolverhampton will not fail to observe with interest is the new service of electrical tramcars now running from the railway station to the exhibition gates. This is installed on the Lorain system, in which no overhead wires or underground conduits are used, the current being collected from projecting studs between the rails, by means of a slipper contact bar underneath the car.

The Rating of Model Yachts.

By W. H. Wilson Theobald, M.A.

In the June 1st issue of The Model Engineer appeared a note to the effect that a new Model Yacht Club was being formed at Hastings; it was further stated that the Secretary was anxious to obtain particulars of the rules in force amongst the various model yachting clubs to enable him to frame rules for his own.

By "rules" it is assumed is meant "rating rules," and not "sailing rules": if the former is the case, that Secretary is to be pitied! Perhaps by this time he and his colleagues have come to some satisfactory solution of what will—more is the pity—always prove a vexed question amongst model yachtsmen; but if they have not done so, why not go the "whole hog," and sail under the new Y.R.A. Rule—namely,

$$\frac{L + B + \frac{3}{4} G + 4d + \frac{1}{2}\sqrt{S.A.}}{2\cdot 1} = L.R.$$

Admitted that the formula presents difficulties to the novice, after all a model is an easy thing to handle, and could well be measured in a bath or suitable tank.

The actual measuring of the boat, however, is probably not the real difficulty.

Many who follow the sport, design and build their own craft; some take the trouble to master the whole subject of lines and centres (may their number increase); others merely take a block of wood, and cut it down until it pleases the eye, afterwards weighting it with lead to bring it to the desired L.W.L. The latter folk are those who probably cause the trouble when any rating, other than L.O.A. or L.W.L., is proposed.

No doubt many an excellent boat results from this rough-and-ready method; but the chances are that, if required for a certain rule, she would be found too big or too small in some dimension.

The excuse of not being able to secure a design, or not being able to design, cannot be put in as evidence against a change, as the lines of many boats built under the new rule have, and do appear in the *Yachtsman* and *Field*, which could, with little modification, be used for models; and surely there is more pleasure in sailing a miniature of a real racing yacht than some "glorified washtub" produced by a "length only" rule, or a shallow dish of 5 ft. long, with preposterous draught under the late L. and S.A. Rule.

The mere fact that so many clubs make use of the L. and S.A. Rule seems to prove, at any rate, that model yachtsmen *do* follow the lead of those who have studied the question; and when these authorities frame something which they consider will foster a better form of boat, it seems a trifle surprising that those who appear to be thirsting for some satisfactory formula, should not jump at the opportunity afforded them.

The Model Engineer does not hold a "brief" for the new rule; but it would be a thousand pities if clubs, either in the embryo state, or those contemplating a change, threw away the chance of giving this rule a trial. The old L. and S.A. Rule had a long innings; but at the finish it was admitted by all to have run to seed. Models, of course, could never have been built on the lines of the most extreme craft, as these latter were practically kept on an even keel by the acrobatic performance of the crew, and for this very reason the model never

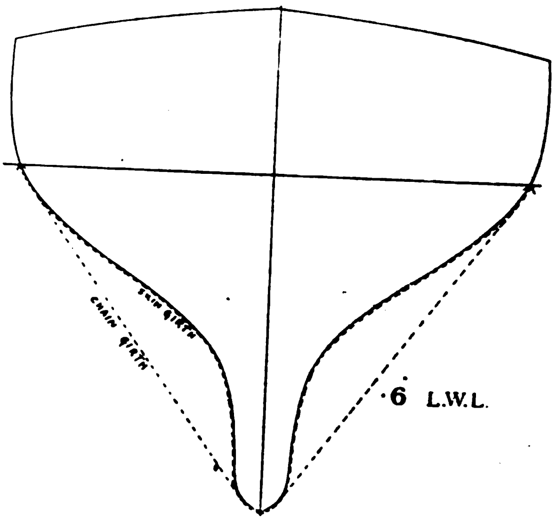


Fig. 1.

really became a freak, although many had a depth of fin which was absolutely unnecessary.

Any untaxed element in a rule will naturally be exaggerated until in time it becomes entirely out of proportion. What the new rule will have produced by the end of 1907 (the length of life it has been given by the authorities) remains to be seen; but there is no doubt that at the moment it is producing a most desirable type.

Before discussing the possibilities under the rule it may be well to explain what is meant by each element. The length (L) is the length on the L.W.L. B is the extreme beam. G is the chain girth taken at ·6 of the L.W.L. from its fore-end; *d* is the difference between the chain girth, and the skin girth at that section (as in Fig. 1). $\frac{1}{2}\sqrt{S.A.}$ explains itself. These elements are added together, and divided by 2·1, and the result is the linear rating of the boat.

The classes are divided into 18, 24, 30, 36, 52, 65, and over 65, and take the place of the old ½, 1, 2½, 5, 20, 40, and over 40 raters under the late L. and S.A. Rule.

The whole design rests upon the curve of the section where the *d* element is measured, and a few sections drawn at random will give the designer some idea of what an important question this *d* becomes. The skimming dish is, of course, absolutely wiped out, and the "theoretical" perfect section would be that without any hollows in which $d = o$. The question, therefore, is how much S can be given to the section to obtain the best result, without overdoing the *d*.

There is one weak point in the formula, which is producing an undesirable profile. The draught of the boat must not be greater forward than it is at ·6 of L.W.L. without the extra draught being added for the measurement; but nothing is said about *aft* of the section, excepting that there must be no *hollow*. The result is that, by drawing the profile in a straight line from the fore end of the water line, and carrying it well under the after end, a good useful amount of dead wood is obtained for lateral resistance, and the girth G (measured at ·6) can be kept small. Fig. 2 (A) shows the extreme profile possible. Such a boat would be very tricky to steer, besides being apt to damage herself badly in the event of bumping heavily on hard ground. A compromise is usual, either by a long easy sweep as in Fig. 2 (B), or by dropping the keel as in Fig. 2 (C). Both the latter outlines enable the lead, and conseqently the centre of gravity, to be placed lower, giving greater stability to the boat.

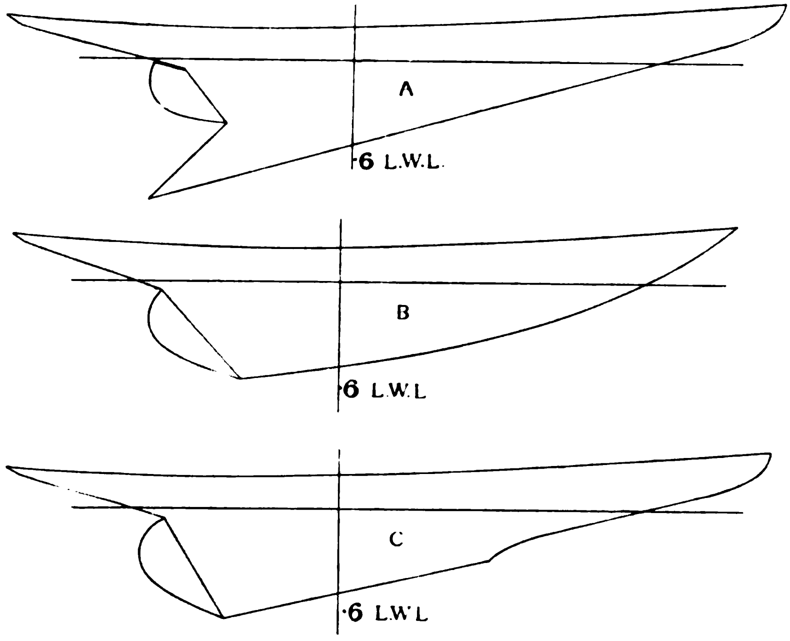


Fig. 2.

As a help to readers the accompanying design, Figs. 3 to 6, is given as an example of the type of craft produced by this rule and was drawn to represent a 36 L.R. She is 34 ins. on the L.W.L. and carries 1,500 sq. ins. of sail. The overhangs are, perhaps, a trifle exaggerated, but the value of these, in enabling the buttock lines to be drawn out, has been fully demonstrated by the old L.W.L. and S.A. Rule. The sharp angle on the section of the lead gives the least possible ½ girth on the given beam and draught. If the latter were decreased a trifle, the usual semi-circular finish could be given and the girth remain practically the same. The displacement of the boat is just under 13 lbs., showing her to be a lighter craft than the usual 10-rater.

The following are details of the model, the drawings of which are to a scale of 1½ ins. to a foot (one-eighth full size). Figs. 3, 4, and 5 show the sheer plan, body plan and half-breadths respectively. Fig. 6 indicates the area and displacement curves. The length over all is 53·3 ins.; L.W.L. = 34 ins.; beam (extreme) 9·28 ins.; draught (extreme) 7·1 ins. The rating may as well be shown as follows:

$$\text{L. }(34) + \text{B. }(9{\cdot}3) + \tfrac{3}{4}\text{ G. }(10{\cdot}7) + 4d.\ (2{\cdot}2) + \tfrac{1}{2}\sqrt{\text{S.A.}}\ (19{\cdot}4) = 75{\cdot}6,$$ which, divided by 2·1, = 36 L.R.

There is one point in model yacht design which should be most carefully considered by the designer, and that is the sail carrying capacity. Readers of The Model Engineer will have noticed how, when on the subject of locomotives, it has always been pointed out that a boiler made to a certain scale is not powerful enough to feed cylinders of the same scale. This can be said also of model yachts, if "hull" is substituted for "boiler," and "sail area" for "diameter of cylinders." Take, for instance, the *Valkyrie III*. She was 90 ft. on the L.W.L. and carried 14,000 sq. ft. of sail. An exact model of 3 ft. W.L. would have 2,240 sq. ins. of sail. (The sail area varies as *the square* of the scale in this case $\frac{1}{30}$, and, therefore, $(\frac{1}{30})^2 \times 14{,}000$ sq. ft. = 15·55 sq. ft. = 2,240 sq. ins.). Her displacement was about 145 tons, which would give the model a displacement of 12 lbs. (Displacement varies as *the cube* of the scale). A model 10 rater of 36 ins. W.L. could only carry 1,666 sq. ins., and even then, unless of average displacement, say 17/20 lbs., she would be none too stiff. It will be seen, therefore, that models of large racing yachts to scale, both as regards hull and sail area, would be most unsatisfactory.

Looking at this question from another point of view, it can be argued that a model is unsinkable, and also that it matters little whether she is keeled over flat during an extra heavy puff, as she will always right again. As a consequence, a model could carry a press of canvas in strong squally weather, which would be positively unsafe in a real yacht. But there is always a happy medium, and, as a general rule, a model that keeps on fairly even keel and steers a steady course will be found to win more races than another perhaps a trifle faster in medium breezes, but which will get her lee rail awash in the strong puffs and so distort the curve of immersion.

The present rule tends to decrease beam; but from the certificates of yachts built it would appear that the custom has not been to reduce the beam to less than one-quarter of the L.W.L., and stability lost on beam is more than compensated for by the liberal amount of displacement caused by the *d* element giving a full-bodied boat. As an example, under the old L. & S. A. Rule the ½-raters were boats of about 15 ft. water-line, 6 ft. beam, and 4 to 6 ins. depth of hull—mere saucers, with absolutely no ballast beyond the crew, and this limited to two people (say, 300 lbs.). The present 18 L.R. is a "ship" of

17 ft. water-line, 4 ft. 9 ins. to 5 ft. beam, displacing anything up to 22 cwt., with a wholesome body and half a ton of lead on her keel. There can be no two questions as to which is the better sea boat of the two. Probably the most consistently successful yacht ever built was *Britannia*, and, although she has never been measured for the new rule, and the exact 4*d* cannot be known, there seems little doubt that she would be a very suitable type; and, it must be remembered, she was designed for the L. & S.A. Rule. It would, of course, have been suicidal to have attempted to build a large boat on the lines of some of the small racing freaks, and there seems little doubt that the extreme proportions put into these smaller fry have been responsible for the drastic measures taken by the Yacht Racing Association to prevent the abuse of unlimited beam and light displacement.

Seeing that the new measurement fosters a larger and heavier boat, it would be advisable, perhaps, not to change from the 10-rater to the 42 linear raters (their equivalent), but to take the class lower—namely, the 36 L. Raters. The average dimension of the yachts built for this class are about 34 ft. L.W.L., with 9 ft. beam drawing about 5 ft. 9 ins. of water. They carry 1,500/1,600 sq. ft. of sail, and a model built 1 in. to the foot should give an excellent little boat for competitive purposes, besides which the model yachtsman would have the opportunity of testing the merits of the rule and finding out its weak points. It took "model engineers" many years before they were able to induce the various model supply firms to follow the outlines of the present day locomotives in making their stock castings; but by perseverance they are succeeding, and the model yachtsman, who only has himself to please as to form of boat he builds, should surely be as up-to-date as his mechanical brother.

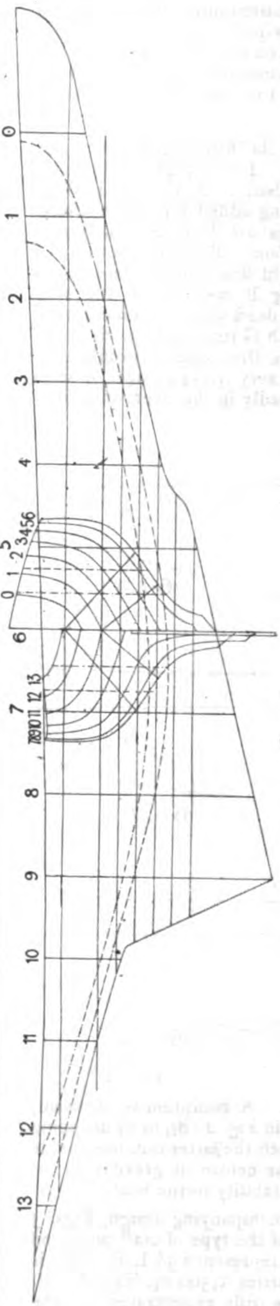
"Vested interest" has played—and always will play—a very prominent part when the question of out-classing certain successful boats is mooted by the introduction of a new rule; and, as a consequence, it is usual to give a year's grace before the alteration, or, at all events, to continue to give races for the old classes for a limited time.

It is a serious question, when many hundreds of pounds have been spent on a racing boat, to find in her second season that she is out-classed. This consideration does not hit the model yachtsman quite so hard, although to many lovers of the sport shillings are as important as pounds to the rich man; but it is surprising for what a little outlay a model can be built, leaving aside, of course, elaborate fittings.

During last year many letters on this subject of rating of models appeared in THE MODEL ENGINEER, containing suggestions which were excellent in their way, particularly those which hit at draught, but the formulas which included length, beam and draught would have required just as careful measurement as the Y.R.A. Rule itself; so why not choose the latter?

It would be most interesting to know how models, built under the various rules in vogue amongst model yacht clubs, would come out under this new rule, and perhaps owners who are interested in this question would measure their craft and send the results to the Editor. A comparison could then be made, and it would be found perhaps that many rules, appearing totally different on paper, produced similar results.

In conclusion, it cannot be too strongly urged on new clubs, and those contemplating a change, that if only they would set the ball rolling and "plump" for the Y.R.A. Rule others would very soon follow suit, and there would be in time one Y.R.A. and one Model Y.R.A. sailing their respective races under the same rule.



FIGS. 3 & 4.

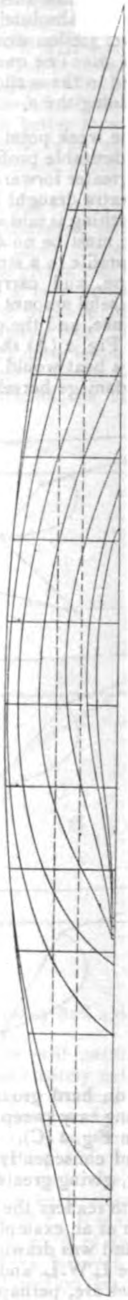


FIG. 5.

FIG. 6.

DESIGN FOR 36-RATER MODEL YACHT, Y.R.A. RULE.

Displacement	...	...	12·75 lbs.
L.O.A.	... 53·3 ins.	L.W.L.	.. 34 ins.
Beam, extreme, 9·28 ins.		Draught, extreme, 7·1 ins.	

A New Departure in Wimshurst Machines.

A WIMSHURST machine of novel construction has been invented by Mr. F. Tudsbury, the plates of which work in a vessel filled with air (or other gases) under pressure. It is well-known that under these conditions there is a very great increase of resistance to an electric discharge, as is seen in the ignition of the compressed gases of an oil or gas engine. The new Wimshurst machine appears to work very successfully, and the following description, kindly furnished by the inventor, will doubtless be read with interest by the large number of amateurs who study this section of electrical science. Mr. Tudsbury says:—

"The increased efficiency of this machine depends on the high insulating properties of the compressed air in which the plates work, which has the effect of preventing leakage in all directions to such an extent as to raise their tension or voltage to that of plates quite twice their diameter. The effect of gases other than atmospheric air have not as yet been tried. For some time I have seen the want of a portable and fairly unbreakable induction electric machine that will start without difficulty in any state of the weather, and at the same time be of sufficient power for medical and x-ray work.

"About eighteen months ago it occurred to me that if a machine was worked in compressed air it would increase its power. I tried an experiment with a pair of ebonite plates, and found that this was so. A pressure of 15 lbs. on the square inch quite doubled the power and length of spark given at atmospheric pressure. After considerable experimental work, I have completed a machine of special construction with ten ebonite plates, 8 ins. diameter, enclosed in a strong airtight metal case of cylindrical shape, 10 ins. diameter, 4½ ins. long, with slightly rounded ends. The results obtained with this are as follows, using Leyden jars, 2 ins. diameter, coated 2 ins. high:—

Pressure.	Spark Length.
0 lb.	2½ ins.
15 lbs.	5 ins.
30 lbs.	7 ins.
45 lbs.	8 ins.

This last being in length equal to the diameter of the plates used.

"As to frequency of discharge, at 45 lbs. pressure, the machine gives three 6-in. sparks per turn of the crank handle. Through a small glass window in the case, it is to be seen that the usual mass of not very bright sparks and brush discharge at the neutralising brushes disappear under pressure; only a stream of very vivid sparks are seen about ¼ in. long. The air in the case being chemically dried, the machine is independent of atmospheric conditions, so much so that it will actually work when completely immersed in water. Its starting qualities are perfect; in any state of the weather, sparks appear between the terminal balls the instant the handle is moved. The polarity never reverses, and the case is practically airtight; when once pumped up, the pressure on the gauge falls but little in several days, consequently a few strokes of the pump occasionally suffices to maintain the working pressure.

"Our firm are manufacturing a number of these machines, each having six plates 6 ins. diam. These will be of sufficient power to perform all ordinary experiments—wireless telegraphy and some x-ray work. For the last two purposes they are eminently suitable, owing to their certainty of action in any state of the weather. We also intend placing on the market a machine on this principle with ten plates 14 ins. diam., suitable for x-ray and therapeutic uses. This will be equal in power to an ordinary Wimshurst with eight 30 in. plates, and will be portable. This machine, power for power, will be considerably cheaper than an ordinary machine. My invention is protected by patent No. 22,731 of 1901.

Finishing Piston Rings.

A CORRESPONDENT of *Railway Machinery* writes: Seven years ago I worked in an engine shop in Denmark engaged in the building of gas engines, and send you their method of finishing piston rings. These piston rings were turned in the ordinary way, the sides being faced and the rings split, as shown in Fig. 1. Five or more rings were then laid together and drawn up by means of an iron band, as in Fig. 2, until the ends came close together. Next they were clamped to the faceplate, Fig. 2, with six clamps, the

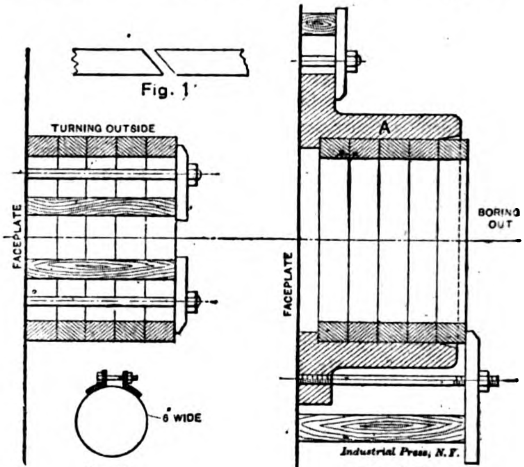


Fig. 2 Fig. 3

band was removed and the rings turned to the exact diameter of the cylinder. Finally the rings were put into a cast-iron cylinder, *A*, Fig. 3, of the same diameter as the engine cylinder, the rings were again clamped and then bored out to the proper dimensions. This method was found to be very quick and accurate.

FOR four years, says the *Cosmopolitan*, an efficient wave motor has been working at Santa Cruz, California. It stands at the edge of a rocky cliff fronted by deep water. Two well-holes, one 8 ft. and the other 5 ft. in diameter, were sunk in the rock, the foremost within 5 ft. of the edge of the cliff, and the other directly behind it. These wells extend from a level 30 ft. above high tide to a point below ebb tide, and at the bottom are connected by a horizontal tunnel with the ocean, so that the water stands at the same level as in the sea outside. In the well nearest the cliff edge is a counterbalanced float, rising and falling with the swells of the sea. The second well contains the plunger of a force pump, working in a long pump barrel, and it is actuated by being connected with the rising and falling float. In this way water is forced on every down stroke of the piston in the pump to a vertical height of 125 ft., where it enters a 5000 gal. tank carried on a derrick 60 ft. from the ground. From this tank the water runs off to smaller tanks, where it is used for sprinkling and other purposes.

The Editor's Page.

WE are pleased to be able to report that the joint competition promoted by the proprietors of *The Photogram* and ourselves has been highly successful, a large number of entries being received from readers of each paper. It will be remembered that two prizes were offered for the best and second best photographs of a locomotive in motion, with or without a train. With a subject of this kind it was only to be expected that there would be considerable variety in the character of the entries, not only by reason of the many different types of engine available for treatment, but because of the almost infinite range of scenery and surroundings through which the iron horse speeds when on its way. Some of the competitors contented themselves with snap-shots of a very ordinary character, as poor in the selection of a point of view as in the subsequent technical matters of development and printing, while one, at least, quite missed the mark by sending in a country view, in which a microscopic train could only be discovered after careful search. However, putting the obviously unsatisfactory entries on one side, the remaining prints received a very careful consideration of the judges, with the result that the prizes have been awarded as follows. First prize of £2 2s. to

Mr. TICE F. BUDDEN, M.D., B.C.
Crouch End, N.;

and the second prize of £1 1s. to

Mr. G. W. PILCHER,
Shrewsbury.

The work of the following competitors was selected for commendation:—Mr. Aubrey Brocklebank (Liverpool); "Up Diner" (Tweedmouth); "Express" (Birmingham); "Comet" (Southampton); "Loco" (Halifax); "Urgent" (Manchester); "Rangatira" (Christchurch, N.Z.); "Atlantic" (Canada).

* * *

With regard to our Competition No. 22 for model flying machines, which closed on June 30th, we do not appear to have allowed sufficient time for actual experiments on the part of our readers to be brought to a successful conclusion, as the only entries we have received relate either to projected ideas for models, which have not been put to the test, or to models which are in a more or less incomplete stage. We therefore think the best thing to do is to keep the competition open for a month or two longer, in order to give intending competitors ample time to carry out their trials. We will therefore accept entries for this competition up till October 31st next, and we trust that this will lead to some really satisfactory designs being received.

* * *

We are disappointed with the result of our Competition No. 21, for the best design for a $\frac{1}{10}$ h.-p. electro-motor. The entries were few in number, and none of them was really satisfactory. The best article—all things considered—is that by

CHARLES ERNEST SAVAGE,
133, Station Street,
Loughborough, Leicestershire,

to whom the prize (£2 2s.) has been awarded. This competitor describes a motor of ample capacity for the work—indeed, its general fault is that it is too large. Some of the details could be improved upon, as, for example, the bearings, which are plain and not sufficiently large. The article by W. S. Pyrah (Hull) is worthy of commendation, especially in regard to the drawings. The motor described by this competitor, however, is too small to do the work effectively, and his windings are not satisfactory.

Answers to Correspondents.

"W. C." (Dingwall).—The article in our May 1st issue this year on "Testing and Repairing Small Dynamos" is just suited to the needs of your case. Our handbook, "Small Dynamos and Motors," would also give you an idea of the proper way to make up the machine.

"READER."—Your name and address is not enclosed. Look up the back numbers of the *Engineer* for drawings of battleships, etc.

"S. C." (Edinburgh).—We are glad to hear that you are pleased with your lathe. You would do well to get "Practical Lessons in Metal Turning," by Percival Marshall, price 2s., or post free 2s. 3d. from our publishers. This is specially written to show amateurs how to use a metal turning lathe.

Prize Competition.

Competition No. 22.—Two prizes, value £2 2s. and £1 1s. respectively, are offered for the best and second-best designs (to include full description and working drawings) for a working model flying machine. The size, type, and propelling power of the model are left entirely to the choice of the competitor, the main stipulation being that it shall be capable of successful working. The model must have been actually made, and the prize winners will be required to send in their models for inspection and trial by the judges before the actual awarding of the prizes takes place. The last day for receiving entries is October 31st, and the usual general conditions apply in this Competition.

Competition No. 23.—Three prizes, value £1, 15s., and 10s., respectively, are offered to the owners of the three model steamboats doing the fastest authenticated performances. The following special conditions will apply:—The boat must make three successive trips over a course not less than one hundred yards in length. The exact length of the course must be measured and the exact time to a second recorded for each trip. These particulars must be written down and certified by the signatures of two members of the executive of either any branch of the Society of Model Engineers, or any recognised Model Yacht Club, who must have been present at the trials. We shall calculate the speed of the boats on the average of the three trips. The results of the trials must be sent in to us not later than July 31st, and the winning competitors will be required to furnish photographs and short descriptions of the boats, in accordance with the usual General Conditions printed overleaf. The competition is limited to boats not exceeding six feet in length, and the starting time is to be taken at the moment of turning on steam.

GENERAL CONDITIONS FOR ABOVE COMPETITION.

1. All articles should be written in ink on one side of the paper only.

2. Any drawings which may be necessary should be in good black ink on white Bristol board. No coloured lines or washes should be used. The drawings should be about one-third larger than they are intended to appear if published.

3. The copyright of the prize articles to be the property of the proprietor of THE MODEL ENGINEER, and the decision of the Editor to be accepted as final.

4. The Editor reserves the right to print the whole or any portion of an unsuccessful article which he may think worthy of publication, unless the competitor distinctly expresses a wish to the contrary.

5. All competitions should be addressed to The Editor, THE MODEL ENGINEER, 37 & 38, Temple House, Tallis Street, London, E.C., and should be marked outside with the number of the competition for which they are intended. A stamped addressed envelope should accompany all competitions for their return in the event of being unsuccessful. All MSS. and drawings should bear the sender's full name and address on the back.

For the Book-shelf.

[*Any book reviewed under this heading can be obtained from* THE MODEL ENGINEER *Book Department, 6, Farringdon Avenue, London, E.C., by remitting the published price and cost of postage.*]

VERBAL NOTES AND SKETCHES FOR MARINE ENGINEERS. By J. W. Sothern. Third Edition. Revised and enlarged. London: Whittaker & Co., Paternoster Square. Price 4s. 6d. nett. Postage 3d. extra.

As regards the major portion of this excellent book, we can hardly add anything to our remarks on the appearance of the previous edition. The present volume has, however, been specially enlarged to include a section—a very satisfactory one—on marine electric lighting. With this addition the book is the right thing for engineers competing for first and second class certificates under the Board of Trade new regulations for marine engineers.

RAILWAY CARRIAGE AND WAGGON REVIEW, NO. 2. Locomotive Publishing Company. London: 102A, Charing Cross Road, W.C. Price 6d. Postage 1d. extra.

This tastefully printed quarterly supplement of the *Locomotive Magazine*, entitled the *Railway Carringe and Waggon Review*, deals only with railway rolling stock, and besides describing and illustrating by scale drawings and photographs the general arrangements of these vehicles, enters minutely into the details and methods of construction of all kinds of carriages and waggons. A coloured plate of an East Coast Joint Line's twelve-wheeled sleeping carriage is given away with this issue (No. 2).

THE APPLICATION OF ELECTRIC MOTORS TO MACHINE DRIVING. By Andrew Stewart, A.I.E.E. Second Edition. London: S. Rentell & Co., Limited, 2, Exeter Street, Strand. Price 1s. Postage 1½d. extra.

Mr. Stewart has produced a handy little volume for those interested in putting forward the claims of electro-motors for power purposes. Besides enumerating many classes of work for which motors are particularly adapted, details of relative costs are quoted, and a list of the common steam and other losses involved in ordinary shafting-driven plant will help the electrical engineer when advising as to a change to electric power.

CITY AND GUILDS OF LONDON INSTITUTE. PROGRAMME OF REGULATIONS FOR EXAMINATIONS OF CANDIDATES. Session 1902-1903. London: Whittaker & Co., Paternoster Square. Price 9d. nett. Postage 3d. extra.

This is the annual guide issued by the City and Guilds Institute for "the registration, conduct, and inspection of classes and examination of candidates in technology and manual training," and as such should be in the hands of all those particularly interested. This includes both teachers and students, amongst whom a large number of our readers may be reckoned.

ELECTRICAL INSTALLATIONS. By Rankin Kennedy, C.E. Vol. I. London: The Caxton Publishing Company. Price (cloth) 9s. nett; leather, half-bound, 12s. 6d. nett per volume. Postage 4d. extra.

It is not altogether an easy matter to speak definitely of the merits of a book of this character, with only the first volume to guide one. The subsequent volumes (the book is to be in four of these) may quite alter the impression given by the first, although that impression is distinctly good. The contents, however, at first strike the reader as being somewhat discursive, a view which is explained, as it is realised that the volume is devoted rather to the principles of the subject—illustrated, however, at every turn by practical examples—than to the study of the modern applications, which will naturally form the matter of the later sections. We like the carefully written analogy between water power and electrical actions—an analogy followed out with considerably more skill and completeness than is usually the case; and Chapter 2, again, dealing with the study of current and resistance measurements, is practical, clear, and is made still more useful by the simple apparatus described and illustrated. This should prove a most satisfactory matter for the student. Since we have already indicated the character of the volume, there is no need to particularise its contents beyond stating that one excellent section is devoted to meters, and others to motors, dynamos, instruments, and the phenomena of electrical induction. One of the most interesting points raised by the author is the question of the future employment of unipolar or non-polar dynamos. He is convinced that such machines will eventually oust the huge and expensive multipolar dynamos of the present times.

CLOUDS AND WEATHER SIGNS. By Commander D. Wilson-Barker, R.N.R. London: Office of *Knowledge*, 326, High Holborn, W.C. Price 1s. nett. Postage 1d. extra.

Although not a large book, this is an excellent one in its way and should amply succeed in drawing attention to what is, after all, a very important—though much neglected—branch of study. "Nephology," or the study of cloud forms and characters, bears in it the nucleus of meteorological observation, and it offers the advantage of great facility and the needlessness of any instruments but the human eyes. The illustrations to the present book are most beautiful, and are not only a credit to the photographer but form a really valuable guide to the reader himself.

MOTOR CYCLES, AND HOW TO MANAGE THEM. By A. J. Wilson. Fifth Edition. London: Iliffe & Sons, Ltd., 3, St. Bride Street, E.C. Price 2s. 6d. nett. Postage 3d. extra.

As we stated in reviewing the fourth edition of this book, it is invaluable to those who wish to obtain a working knowledge of the petrol motor. In its present form—entirely re-written, and with various minor faults eliminated—the volume may be still more confidently recommended.

Practical Letters from Our Readers.

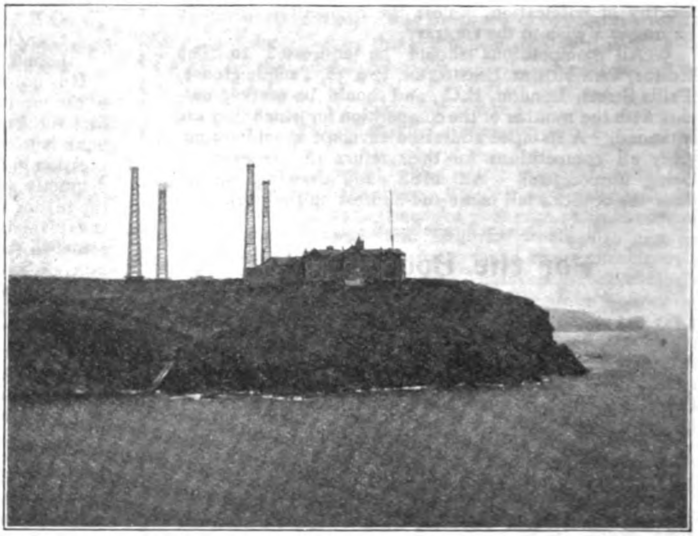
(The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a nom-de-plume *if desired, but the full name and address of the sender* MUST *invariably be attached, though not necessarily intended for publication.)*

A Marconi Wireless Telegraphy Station.

To the Editor of *The Model Engineer*.

Dear Sir,—The illustration below will, I think, interest some of your readers. It is a photograph of the Marconi Wireless Telegraph Station at Poldhu, Mullion, Cornwall. There are four towers, each 215 ft. high, with a 20-ft. square base and a 9-ft. square top, and they are the highest wooden structures in the world. They are arranged in the form of a square. Joining the tops of the towers there will be a wire, from which will descend to the power and instrument room (to be seen between the two inner towers). The power is supplied by a 25 h.-p. Hornsby oil engine and a multipolar Mather & Platt dynamo. When the coils are working, the "crack" of the spark can be heard a mile off. The thin pole on the right is the "receiver" for Ireland and shipping. The building in the foreground is the Poldhu Hotel (a noted health resort). When complete, there will be a 40-ft. flagstaff on each of the towers, which will bring the height up to 255 ft.—Yours truly.

Camborne. J. E. Davies.



"Marconi" Station at Poldhu, Cornwall.

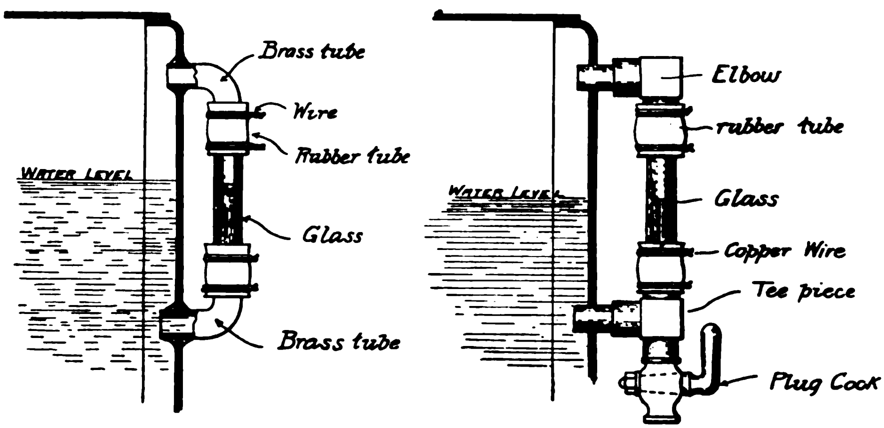


Fig. 1. A Simple Water Gauge for Model Boilers. Fig. 2.

A Simple Water Gauge for Model Boilers.

To the Editor of *The Model Engineer*.

Dear Sir,—I think the following description of a simple water gauge for model boilers may be of use to some of your readers. To make it, all that is required is two small pieces of ⅛-in. brass tubing, two pieces of thick rubber tubing (such as is used to connect a bicycle inflator with the valve on the tyre, which can be obtained at any bicycle shop, and will stand a great pressure), and a small piece of thick glass tube. Bend the brass tubes to a right angle as indicated on the accompanying drawing (Fig. 1), and solder it into boiler. Then push the pieces of rubber tube over the glass; hold it between the brass tube ends, and push back the rubber tubes until they are half over the brass tubes and half over the glass. Then put four small pieces of copper wire over the rubber as shown, and make secure, where the ends are twisted together, by a touch of ordinary solder. If a more elaborate gauge is required, the brass tubes may be replaced by an elbow for the top one, and a T-piece with a small cock screwed into it for the bottom one, as shown in alternative arrangement (Fig. 2). If the *bicycle pump rubber tube* is used, the glass will stand any pressure up to about 25 or 30 lbs. I have several of them in use, and they do equally well for locomotive, vertical, or marine boilers.—Yours truly,

J. M. W.

Peckham.

Stampings for Electro Motors.

To the Editor of *The Model Engineer*.

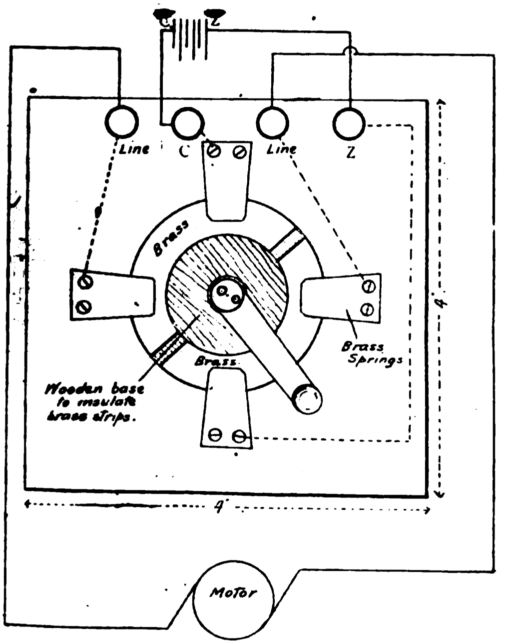
Dear Sir,—Since the publication of the article, "Models Made Without a Lathe," No. 1, I have found that others intending to make the model are experiencing difficulty in getting the laminations. May I be allowed to suggest the name of a firm, viz., Messrs. Hawkins, Electrical Engineers, 125 to 128, London Road, Southwark, London, S.E., who stock this and several other sizes, both of the drum and ring types? For the 2¼-in. (8 slots) their price is 5½d. per dozen, postage extra.—Yours truly,

West Hampstead. G. L. Griffiths.

Reversing Switch for Electro Motors.

To the Editor of *The Model Engineer*.

Dear Sir,—Having seen one or two sketches in The Model Engineer of motor reversing switches, I am sending you a sketch of one that I have had in use for some time. The board is made of a piece of wood four



Reversing Switch for Electro Motor.

inches square. There is a circular piece of wood in the middle of this board, upon which are fixed two thin brass strips of the shape shown in the sketch. This circular piece of wood is made to swivel on a small brass pin, so that the two brass strips make contact with the four springs on the base board. These springs are also made of brass, and are about ⅝ in. long and ¼ in. wide at the top, tapering to 3/16 in. at the bottom. The circular swivelling block is 2 ins. in diameter. I think the sketch will fairly well explain itself.—Yours truly,

Manchester. C. W. Wakelin.

New Design of Model Tank Locomotive.

To the Editor of *The Model Engineer*.

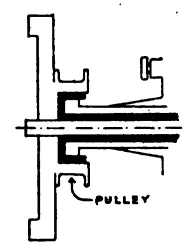
Dear Sir,—Referring to the design for a model tank locomotive in your issues of May 15th and June 1st, I wish to draw attention to the position of the superheater. The blast pipe is placed between the smokebox tube plate and the superheater. I maintain that as it is the velocity of the steam jet up the funnel which causes a fall of pressure on either side of it, and by this means causes the hot gases and air to be drawn up the funnel through the tubes from the furnace, so this same fall of pressure will cause the hot air around the superheater also to be drawn up the funnel, thereby causing a fall of temperature. Also the cold air playing on the front plate of the smokebox will cause a reduction in the temperature on that side. I consider a better position for the superheater would be between the tube plate and the blast pipe, about ¼ in. forward from the tube plate. In this position the hot air and gases would play round the superheater on their passage to the funnel. Referring to the cylinder, no drain cock is fitted as is usual on large engines. Is this intentional, or only an oversight?—Yours truly,

Forest Gate. F. J. K.

Power Transmission in Motor Bicycles.

To the Editor of *The Model Engineer*.

Sir,—Mr. Hawley has certainly studied the question of motor bicycles very fully, and although he favours some few types more than others, he does not seem to think that there is as yet any perfect machine. I hope you will allow me, for the benefit of your readers, to speak of a machine which, after many trials alongside of the best makes, I consider the best on the market. I refer to the motor bicycle built by Messrs. A. Jean & Cie., of Paris. I may state that a friend of mine has just completed a thousand-miles tour on one of them, and he never had a single stop nor a single repair to effect to his motor, the only trouble having been a few tyre punctures; but this, of course, is outside the question. I consider this performance extremely remarkable, as I do not know as yet



Flywheel Bearing in Messrs. A. Jean & Co.'s Motor Bicycle.

of any other bicycle capable of such good work. After such long work, the motor is just as fresh as before the start, not one part having slackened or moved.

The motor is in the best possible place for cooling—that is, in the forward part of the frame, and is vertical, constantly under the eyes of the rider, and being firmly attached to three tubes of the frame, is absolutely rigid.

One very interesting point about the motor is the patent device adapted to the inlet valve. A single handle on the cylinder head closes the admission of gases, and opens the cylinder to the outside air through a large hole. When going down hill this allows the cylinder to be very rapidly cooled by the air worked in and out by the piston. The same lever being half turned, a very smooth start of the engine is obtained, thus avoiding the sudden jerks when the motor catches on, as in the other machines.

Another very interesting feature of this motor is the bearings in mangano-phosphor bronze cast in the same time as the crank case of patent aluminium alloy, known as the "Partinum." The two metals being cast together, the bearings are absolutely fast and cannot move.

The motor has a very heavy outside flywheel, and very long bearing. Besides the inside bearings in which works the shaft, the flywheel has a crown extending over the projection of crank case, and acts as a second bearing, counterbalancing the pull of the belt.

The belt is of the flat type, of a patent composition, guaranteed not to stretch nor slip.

Should the oil leak out of crank case along the shaft, it cannot run on the pulley, being prevented by the overlapping of the pulley, and thus can never interfere with the grip of the belt.

I will be pleased to furnish any reader with any other particulars needed.—Yours truly,

34, Rue Truffant, Paris. R. GASPARD.

TO THE EDITOR OF *The Model Engineer*.

DEAR SIR,—I have given this matter a great deal of attention, and after a lot of experimenting and testing over veiy hilly districts, I think I may say that with my "Ideal Grippe" Belt Pulley, I have got as near perfection as it is possible to get—that is, with the belt drive. There is not the slightest doubt that the belt drive, when got to perfection, is the ideal drive, it being silent, neat, and easily repaired, and at the same time very light. I have no doubt that those who are in the habit of making tours with the motor bicycle, will uphold that the most simple drive is the best. One does not want "special" belts, clutches, etc., as it means you must either carry a duplicate of parts or spare belt, as the special line of goods are not always stocked by local repairers and stores. The fitting of my "Ideal Grippe Belt Pulley" involves nothing special in fittings or belts, the ordinary twisted hide belt being used; this pulley is simple and efficient, and does not scrape the belt away. It consists of a grooved pulley with rounded projections placed alternately right and left of the grooves, causing the belt to take a slightly sinuous course. With this arrangement I have found it impossible for the belt to slip when running, no matter how wet or greasy the belt may be; at the same time, it will allow just sufficient slip when the engine is first started to prevent breaking of belt. This pulley can be had in any size for any engine, and further particulars may be had from me.—Yours truly, WILLIAM BRAVERY.

Motor Manufacturer, Tunbridge Wells.

Queries and Replies.

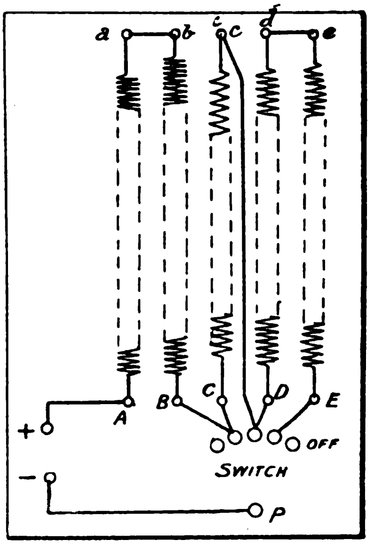
[Attention is especially directed to the first condition given below, and no notice will be taken of Queries not complying with the directions therein stated. Letters containing Queries must be marked on the top left-hand corner of the envelope "Query Department." No other matters but those relating 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, *37 & 38, Temple House, Tallis Street, London, E.C.]*

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

[6387] **Resistance Board for Charging Accumulators.** P. H. (Sittingbourne) writes: I wish to make a simple resistance board for charging accumulators from an 110-volt circuit, the same as described in the December 15th, 1901, issue of THE MODEL ENGINEER. I want to get 2, 4, and 6 ampères (separately) by using the plugs. Please state size and length of iron wire to go on the board, and also the time required to form plates 5 ins. × 4 ins. (five plates in a cell).

It would not be advisable to use iron wire for this particular case, as it would require much too great a length to be accommodated in a moderate space. It will be better to obtain platinoid resistance wires of the following gauges and amounts. Of No. 24 wire 14 yards will be needed; 4½ yards No. 26; and 10 yards No. 28. Of the first size, one ounce will be just sufficient; much less of the others will, of course, do. The diagram of resistance board herewith is to a scale of 3 ins. to a foot. The 14 yards of No. 24 wire (bare, of course) is divided into two equal parts, and wound closely on a ½ in. diameter rod. The ends are fixed to pegs A, *a*, and B, *b*. The coils should spread slightly, so that adjacent turns do not touch. *a* and *b* are joined by a piece of No. 16 or 14 copper wire. The 4½ yards of No. 26 wire is similarly wound and stretched from C to *c*. The remaining wire (10 yards No. 28) is treated like the first, and is attached to pegs D and *d*, E and *e*; *d* and *e* are joined by copper wire. There are five contact points in the switch, the central pivot of which (P) is joined to the terminal by a No. 14 copper wire. Two switch contacts (at the ends) are "off" positions. Next to the left hand one of these comes a contact which is joined to B and to C with stout copper wire. When the switch arm rests on this contact a current of 6 ampères would pass, A being joined to the + terminal. The next contact is joined (by



means of No. 16 copper wire) to D and to *c* direct; it forms the 4-ampère contact. The next point is connected to E, and is the 2-ampère position. The resistances are, of course, calculated for a very small resistance in the accumulator circuit, and the board must be fireproof, the wires supported well away from it and clear of inflammable objects, as the passage of the current will heat the resistances to redness. Charging the cells at 4 ampères (rather high for the size given) they should take about five hours, and twice as long at 2-ampères charging rate. To *form* the plates, charge at the lower rate for thirty or forty hours right off, continuing long after the cells have begun to boil.

[6598] **Primary Batteries.** J. O. N. (Hulme) writes: (1) Is a bichromate battery polarising? (2) If not, where can I get a polarising battery, and what price do they run? (3) What is the average power of a very small bichromate battery, say price about 2s?

(1) Alas, yes! (2) Polarisation is usually regarded as a *defect*—indeed, the most serious defect of batteries at all—except their expense. The article, "Home-made Dry Cells," in our March 1st issue this year explains the point, which you have doubtless misunderstood. For what purpose is the battery required? Why not read our handbook, "Electric Batteries," on the subject in general? (3) If you only knew what a complete answer to this query meant! It cannot be answered in brief, except by saying that the potential is about 2 volts with a high resistance in circuit, that the ampèrage depends on the amount of that resistance and the size of the cell, and that the quantity of power available is derived from the product of the above factors and the length of time the cell is in action. Rather an indefinite reply—but unfortunately the best under the circumstances. You must read up your text-books. You are, we imagine, only at the threshold of the subject so far, and must study it well to grasp the meaning even of the questions you put.

[6584] **Calcium Carbide.** A. L (Newcastle) writes: Could you oblige me with addresses as near here as possible of those who supply calcium of carbide for acetylene gas generator about ¼ in. size, broken, &c.? I have constructed a generator, which, by your valuable assistance, so far gives very good results.

The Dargue Acetylene Co., 57, Grey Street, Newcastle-on-Tyne, will supply you with the required material. Mention this journal when writing or calling.

[6409] **Charging Accumulator.** E. W. B. (Horfield) writes: I should be very much obliged if you could let me know in your queries whether it is possible to charge an accumulator from an electric light main; and if so, which is the best way to do it?

Yes, it is quite possible. You will find instructions on the above in our No. 1 handbook—"Small Accumulators, How Made and Used," which can be obtained post free 7d. from our publishers, Messrs. Dawbarn & Ward, Ltd.

[6463] **Electro Motor to Drive Lathe.** Van Rhl (Edinburgh) writes: Could you please state what size electric motor would be suitable for driving a turning lathe (small 2⅝ ins. centres) for light work, and about how much would it cost? Also, what is the best preparation for polishing amber and vulcanite? Are there any books on briar pipe-making?

A 1-6th h.-p. motor would be powerful enough for light turning on a 2½-in. lathe. The cost depends, of course, on the make; and the more you pay for it, generally speaking, the better will the machine be. You can get prices easily enough from the many advertisers in The Model Engineer who deal in these goods. We do not know of any book on the subject mentioned in the latter part of your letter, and must call your attention to the fact that you do not adhere to our rules, which state that different subjects should have separate sheets of paper devoted to them.

[6528] **Slow-speed Dynamo.** B. T. O. (Gateshead) writes: Will you kindly give me dimensions and wiring for a dynamo to give 5 volts 2 amp. at 1000 revs. per minute? This is a low speed, but is the utmost I can manage without gearing, which I wish to avoid. I want the dynamo for charging accumulators from house tap. I have taken a brake test of water motor, and reckon that 10 watts is all it is good for. Kindly give me the simplest possible wiring for armature, as, although I have carefully read No. 10 of your series, I am still very uncertain as to the winding and commutator connections of drum armatures. Something like the Gramme ring is more in my style. Also, can you tell me how I could calculate the dimensions and wiring for any output at any given speed?

If you wish to run your dynamo at such a low speed, the size of the armature will have to be about 8 ins. across, and, of course, this means a correspondingly big machine, which, we think would hardly pay you to make, as the output you require it for is so small. We would suggest putting a large pulley on your water motor, and a small pulley on your dynamo. For example, suppose your motor runs at 500 revs. per minute by putting an 8 in. pulley on your motor, and 1 in. on your dynamo, the speed of the latter would be 4000, which is about the speed required for armature of a 10 watt dynamo. A dynamo of this output is shown in The Model Engineer Series, No. 10, page 52. The winding of the wire on the armature and commutator connections are shown plainly in Fig. 42 of the same work, the end of one coil being connected to the beginning of the next. There is no hard and fast rule for calculating the output of any dynamo at any speed, as it depends on various circumstances what the output will be. Generally the speed is made to suit the size of armature required for a particular machine.

[6530] **Accumulators.** D. J. J. (Mold) writes: (1) I have a small accumulator which was emptied of acid accidentally. I cut the pitch all off the top to examine the plates, and can see nothing the matter with them as far as buckling, &c. is concerned. Do you think I could charge the cells again without changing the plates? (2) I want to charge the accumulator, which has three cells, on the principle stated in The Model Engineer for May 15th, 1901. Please state how many 3-pint size gravity batteries I should require, or would quart size be better? (3) I have a quantity of spelter. Will the same do, if I melt it, to make the zinc for the batteries? (4) Should the zinc be amalgamated? (5) What lamp should I use for night-light with this accumulator?

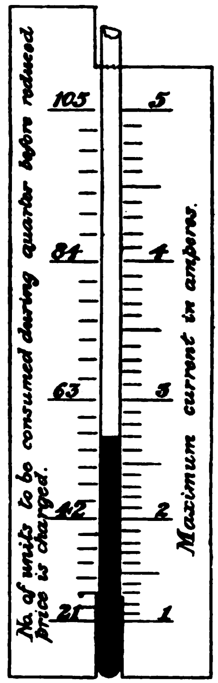
(1) Yes, if the plates are not buckled. Refill up the three cells with a mixture of 1 part of sulphuric acid to 5 parts of water. The acid must be added to the water very slowly and not the water to the acid. Repitch the top, leaving a hole in each cell, so as to let out the gases given off during charging and discharging. (2) The 3-pint size would be better than the quart, as they would hold more solution, and, therefore, last longer, but there would be no increase in voltage. The number of cells you would require would be nine, as your accumulator is a 6 volt one. (3) We would not recommend you to use spelter, as it is not pure zinc, and if the zinc is not pure, local action will take place and spoil the action of the battery. (4) It would be advisable to amalgamate the zincs, but it is not absolutely necessary. The amalgamation of the zincs preserves them from being acted upon by the acid when the battery is not in use. (5) You would require a 6-volt lamp as your accumulator is divided into three cells, and each cell gives 2 volts. By putting the three cells in parallel that is, joining all the positive plates together, and all the negatives together, you could use a 2-volt lamp.

[6536] **"Manchester" Dynamo (500-watt).** P. S. E. J. (Leatherhead) writes: Being an ardent reader of The Model Engineer and also of your handbooks, I am writing to ask your advice on the subject of a dynamo which I am about to build to light my house electrically. I can give it very little attention when made, and require an output of 500-watts. I thought that a "Manchester" type would be as good as any. Am I right? You might give me particulars of size of armature and a few directions as to winding of same, which are not given in "Dynamos and Electric Motors." If I use a water-motor, could you give me any idea how much the water-rate would be from the Lambeth Water Company? I intend to build one from directions given in December 15th number of The Model Engineer. I intend to use the dynamo sometimes for accumulator charging.

The "Manchester" type of dynamo is a fairly good form of dynamo, and is pretty easy to make. You would be able to get the castings and fittings from some of our advertisers. The size of armature, directions for winding, and full particulars for making a machine for the output you require, are all given very clearly in the book you mention. We expect the Water Company would charge you a special rate, but do not know what that rate would be. Your 500-watt dynamo will require a larger water motor than that you propose to make, as this is only intended to drive a 100-watt machine.

[6539B] **Rebate Indicator in Electric Light Installation.** G. J. J. (Newport) writes: Can you kindly explain the system of charging for electricity on what is termed the Rebate System, where 7d. per unit is charged for the first hour and 4d. for all hours after? How is it calculated?

The way the system of charging by the Rebate Indicator is calculated is as follows: The maximum current in ampères you use at one time + voltage of lamps + time + number of days between setting and re-setting the indicator ÷ by 1000 gives the number of units to be used before



Rebate Indicator.

the reduced price is charged. Suppose you use ten 16 c.-p. lamps all at one time, then the total number of ampères would be ·27 × 10, as one 16 c.-p. lamp takes about ·27 ampères at 240 volts, which is, we believe, the voltage of your lamps. The time in this case is one hour, and the number of days is either 91 or 182, according to whether the indicator is set quarterly or half-yearly. Then 2·7 + 240 + 1 + 91 ÷ 1000 = the number of units to be used before the reduced price is charged = 58·9. The maximum current you use is shown on the indicator by the height of the liquid in the glass tube, and the number of units to be used opposite, as shewn in the sketch.

[6542] **Induction Coil.** "Induction" (Colne) writes: I shall be much obliged for advice on a shocking coil I am making. The core is ⅜-in. diameter, and is made of galvanized iron wire, varnished with shellac. I am intending putting four layers on primary coil of 18 s.c.c. wire, and 1 lb. 30 d.s.c.c. wire. (1) Will the above winding make an efficient coil? (2) What improvements would you suggest? (3) What is the advantage of only having two layers on primary? (4) I note you say that continuous winding is the very worst method of winding a secondary coil. Why? (5) What other methods are there? (6) Why is a spark coil (secondary) not connected to the battery like a shocking coil?

(1) The galvanized iron wire will do very well for the core of a shocking coil; but it would have been much better to have had a

bundle of soft iron wires. Galvanized iron wire is rather hard, and the core should be made of the softest iron you can obtain to get good results. Length of core about 4½ ins. The size of wire for the secondary should be about No. 36; but if you have No. 30 by you, use it, though the coil will not be so efficient. (3) The reason for having two layers instead of four on the primary coil is to keep the number of turns as few as possible, in order that the resistance shall be low, and thus allowing a large current to flow round the iron, and producing a strong magnetic field in the centre. Few turns also prevent self induction in the primary coil itself. (4) Continuous winding does very well for small coils up to those giving ½-in. spark; but for larger coils the winding should be done in sections, as the risk of a break down of insulation is made less. (6) Under certain circumstances, one end of the primary and one end of the secondary coil are joined together in small sparking coils—notably in the case of motor tricycle ignition coils. It may be done in shocking coils to save a terminal, but never in large sparking coils.

At the last monthly meeting of the Aeronautical Institute and Club, held at St. Bride's Institute, on Friday 4th ult., papers were read from Dr. Charles Zimmerman, of Maryland, U.S.A., who explained his cycala flying machine, and also from Mr. Alex. Adams, of Sydney, New South Wales. The meeting was of a private nature; but for the next general meeting, on Friday, August 1st, an interesting lecture by Mr. T. C. Blanchard is promised, dealing with "Wing-flapping Machines and Personal Flight"; and Mr. O. C. Field, the Honorary Secretary of the Aeronautical Institute, whose address is at 20, Adelaide Road, Brockley, states that he will be happy to forward invitation tickets, if those interested will communicate with him.

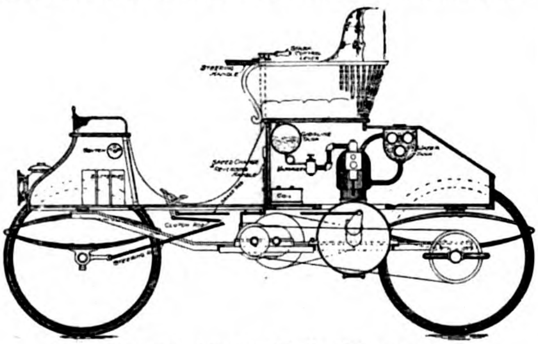
Amateur's Supplies.

[*The Editor will be pleased to receive for review under this heading, samples and particulars of new tools, apparatus, and materials for amateur use.*

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

Light Gasoline Runabout.

The accompanying illustration represents a new "runabout" recently designed by the Lowell Model Co, of Lowell, Mass. The running gear is of flexible construction, with axles of 1¼-in. steel tubing and angle iron reaches. The motor and transmission are



The Lowell Model Co.'s "Runabout."

supported on cross bars bolted to reaches, and so connected that there is no variation in tension of chain even on rough roads. The whole vehicle weighs less than five hundred pounds, and is especially adapted for light road work, carrying two persons One of the principal features of the carriage is the transmission device, this having two speeds forward and one back, the reverse being a special feature not generally used on vehicles of this weight. The speed of the vehicle is variable up to eighteen miles per hour on level roads, and steering may be controlled either with side or centre-steering lever or wheel as desired. The motor used on the vehicle is of the four-cycle type, capable of developing 3½ h.-p. The cylinder, with head and valve chamber, is contained in one casting and is thoroughly water-jacketed. The balance wheels are enclosed within crank case, as are also the cam shaft gears. A variable jump spark ignition is used, by which the speed may be controlled at will. A float feed carburettor is used, and a muffler of improved construction reduces the noise of exhaust to a minimum. Those who wish to construct such a vehicle can obtain all necessary material for the motor, running, transmission, and differential gear, etc., in either rough or finished state from this firm. Complete working blue prints of the different parts are furnished by which construction may be readily understood. The same firm also manufactures a complete line of gasoline motors for bicycles, vehicles, launches, and stationary purposes, and will furnish castings and blue prints for constructing such. Circulars and full information may be obtained by addressing Lowell Model Company, Lowell, Mass., U.S.A., and mentioning this paper. Readers should remember that the postage to the United States is 2½d. for a letter and 1d. for a post-card

*Useful Bolts and Screws.

We have examined with interest a very considerable variety of small bolts, nuts, screws, and rivets, sold by the Liverpool Castings Supply Company. We can recommend these goods to readers who require them at very moderate prices and who do not mind putting a little extra work into finishing off the heads of the bolts when that is required. Suitable taps for the bolts and screws, from 1-16th in. diam. upwards, can also be obtained, and as these are manufactured by the firm from best steel and guaranteed, our readers may be sure of getting the right thing. The address of the firm is 5, Church Lane, Liverpool.

Catalogues Received.

George & Co., Hamble, Hants.—We have received this firm's list "A," giving prices of the various separate parts of their speciality, model permanent way, which was described in detail in our columns some months ago. Those readers who are possessors of model locomotives should write at once for this list, enclosing a 1d. stamp, and mentioning The Model Engineer.

Morris Cohen, 132, Kirkgate, Leeds.—The illustrated price list of screws, bolts and nuts issued by this well-known firm runs to more than 30 pages and comprises every variety of screw, &c., likely to be required by the model maker, for electrical and scientific apparatus, or for clocks and cycles. These bolts and screws are made in steel, brass, and iron, according to requirements. Another catalogue issued by the firm deals with watch and clock makers' tools and materials. This is quite a comprehensive work with more than 170 pages, fully illustrated, and provided with a good index. Many of our readers would find this a useful list, clock materials being in a great number of cases equally valuable for model work.

James Dawson & Son, Ltd., Lincoln. — The well-known "Lincona" belt for motor cycles is the speciality of this firm. An illustrated sheet to hand gives particulars of its use and enumerates some of the points on which is based a claim for superiority over other belts for this class of work.

Mellowes & Co., 28, Victoria Street, London, S.W.—This firm, whose speciality is the patent "Eclipse" roof-glazing method, send us a tastefully printed booklet describing principally the recent re-glazing of a large portion of the Crystal Palace roof at Sydenham, a work which appears to have been carried out with complete success by the company.

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 6s. 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," 37 & 38, Temple House Tallis Street, London, E.C.

All correspondence relating to advertisements to be addressed to The Advertisement Manager, "The Model Engineer," 37 & 38, Temple House, Tallis Street, London, E.C.

All subscriptions and correspondence relating to sales of the paper to be addressed to the Publishers, Dawbarn & Ward, Limited, 6, Farringdon Avenue, London, E.C.

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THE

Model Engineer

AND

Amateur Electrician.

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

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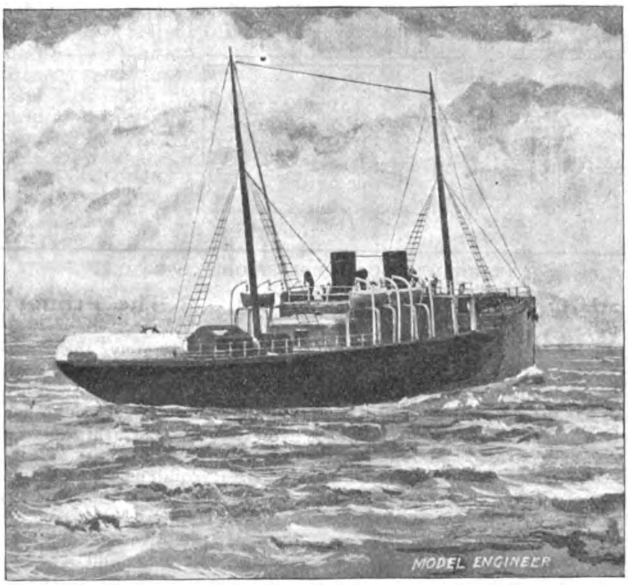
A Simple Model Steamer.

By W. J. Nicholas.

THE accompanying drawing is a sectional diagram of my model steamboat of the following dimensions:—Length, 2 ft. 10 ins.; beam, 7 ins.; and depth, 6 ins. The boat is not a scale model, but was designed with an eye to neatness of general appearance, without cramping either engine or boiler, though great speed was not aimed at. The idea was to make a model which could steam at a moderate speed for about half-hour without any attention whatever beyond turning about at either end of a pond or lake. I find it is good policy to give all model engines plenty of steam, and have accordingly provided a large boiler in this boat with success. The burner is fed with methylated spirit through the fore hatchway by a pipe.

The boiler is cylindrical in shape, measuring 6 ins. long by 2¼ ins. diameter, and is made of copper, with one flue in about the middle of its length. By looking at the diagram readers will see that the centre or point of flame just enters the flue, which terminates in the aft funnel; but, as a matter of fact, this flue can only take a portion of the flame, the rest spreading over the bottom half of boiler (which is enclosed in a sheet iron box), finding its way to the other outlet at extreme end of boiler, which is at a higher elevation, and then emptying into fore funnel. I can slide burner forward or back if necessary.

The boiler is supplied with water by disconnecting safety-valve, which is situated on top between the funnels. To gauge the water I push a thin slip of wood through this opening down to the bottom of boiler, while by drawing it up again I can see how deep the water is. I must explain my reason for doing this. In most models it is arranged so that you can lift off a large portion of the deck—in some cases, I believe, the funnels into the bargain. Now I am afraid this arrangement is apt to interfere with the fittings generally. My method is to fill boiler to a mark on the stick, screw down safety-valve, and then pour a measure full of spirit down the pipe in fore-hatch, which finds its way into a reservoir and thence to the burner. I then light the burner through one of the funnels by means of a match fastened to a small piece of wire, which must be done quickly owing to small space in funnel.



A Simple Model Steamer

I oil the engine, which is of the oscillating type, through the little doorway at end of deck-house, and then open a small screw-down valve close to the safety valve, which has a small pipe leading away to the top of one of the funnels. This answers a double purpose—it gives notice when steam is up, and also prevents the engine working and using up the steam in boiler before its proper time. When steam is up the boat is placed in the water and the valve closed, when she is almost instantly ready to start; and by screwing this same valve up or down, I can vary the speed of engine without altering the flame.

In conclusion I may state that the spirit tank or reservoir before mentioned will run short of spirit before the boiler does of water, so there is no need for anxiety about getting the boiler burnt.

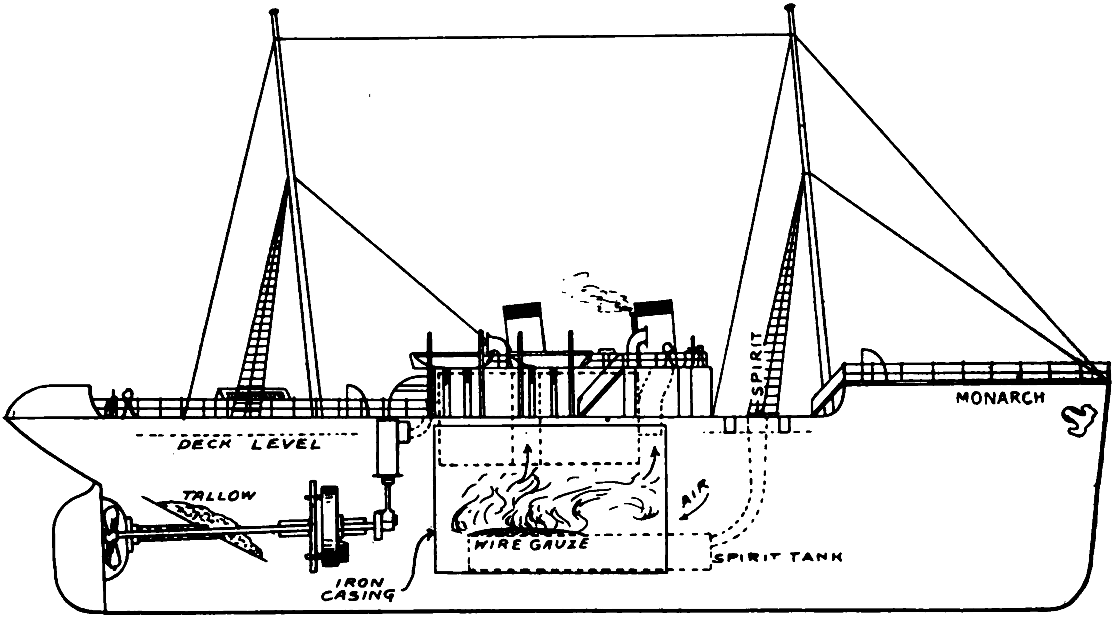
The propeller for this model was cut out of thin sheet metal; it is three-bladed, and is 2 ins. in diameter. I have made several screw boats, and have always found this sort of propeller far superior to the ordinary cast ones.

The engine is ⅜ in. bore by 1⅛ ins. stroke, single acting with heavily-balanced fly-wheels, and makes about 300 revolutions a minute.

The propeller shaft works in a small brass bearing, the hole from this leading to inside of boat, being completely filled with soft tallow, which effectually stops leakage of water through the stern. There is considerably less friction in this arrangement than if a stuffing box and gland were used. The spirit tank is filled with cotton wool, the burner being formed with brass gauze placed over a part of the tank.

number ten, and they are 4 ft. 9 ins. in diameter. There is also a pair of truck wheels 2 ft. 5½ ins. in diameter. The tender has a water capacity of 7000 gallons, and will carry ten tons of the bituminous coal employed for fuel. The diameter of the tender wheels is 2 ft. 10½ ins.

The engine is equipped with the back-pressure brake as well as the regular Westinghouse air brake, both of which will be of use in the heavy freight service over steep grades for which this huge machine has been designed. The use of the back-pressure brake, says the *Railroad Gazette* (from which the foregoing information has been extracted) avoids the application of the full power of brakes to the tyres, resulting in a saving of wear to tyres and brake shoes.



Arrangement of Simple Model Steamer.

The Heaviest Locomotive in the World.

THE Baldwin tandem compound decapod recently built for the Atcheson has the distinction of being the heaviest locomotive engine in the world. It weighs 267,800 lbs., all but 30,000 lbs. being on the drivers, which gives an axle load of 47,560 lbs. Its nearest neighbour in point of weight was built at Schenectady for the same road, but was some 8000 lbs. lighter. The tractive power of the former engine is over 62,000 lbs. The grate area is 58½ sq. ft. The cylinders, which are arranged tandemwise, measure 19 in. and 32 ins. diam. by 32 ins. stroke, and are of the Vauclain compound type. The total height from rail level to top of stack is 15 ft. 6 ins., and the boiler barrel is 78¾ ins. diameter. The heating surface in this boiler is 5,390 sq. ft., divided between tubes, 5,155·8 sq. ft., firebox, 210·3 sq. ft., and "firebrick tubes," 23·9 sq. ft. The tubes are 463 in number, 2¼ ins. diameter, and have a length of 19 ft. between sheets. The firebox has a length of 9 ft., a width of 6 ft. 6 ins., and a depth at front of 6 ft. 8 ins., at back 6 ft. 6 ins., its material being steel. The boiler pressure is 225 lbs. on the sq. in.

The driving wheels of this unique engine, of course,

The Primary Battery.

THERE is, says the *Electrical World and Engineer*, a bigger field for a really good battery than there has ever been before. There are many purposes for which a steady output of a few ampères would be exceedingly convenient, if it could be obtained from a compact and convenient battery at a moderate cost. To meet commercial requirements such a battery must derive its energy from moderately cheap materials, so far as those which cannot readily be recovered are concerned. It must have an electromotive force not less than a Leclanché cell, and must be able to hold it quite steadily until exhausted. These simple demands are easily met, but there are others more difficult. A successful battery must be neither smelly like a Grove cell, nor slimy and troublesome like a gravity cell. It must be capable of pretty thorough sealing if provided with liquid electrolytes, and must neither run down on open circuit nor have a high internal resistance. If a Leclanché cell could be made to stand up for continuous service it would come nearer to filling the bill than any other yet devised; but, in spite of many inventions, it just misses a very large field of usefulness. Undoubtedly there is money in a thoroughly first-class battery to an amount often denied to inventions far more sensational.

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 fortnight before its actual date of publication.*]

London.

NEXT MEETING.

The first indoor meeting after the summer will take place on Tuesday, September 23rd, at 7 p.m. Further particulars of the meeting will be announced in due course.

VISIT TO RUGBY.

A report of this visit will appear in the next issue, if possible.

VISIT TO WATFORD.

On Saturday, July 26th, about twenty members of the London Society visited Watford. The first item on the programme for the afternoon was the entertainment of the party in the very large garden adjoining Mr. P. L. Tatham's residence in Church Road. The model railway laid by Mr. Tatham, junr., which extends some 160 ft., and is provided with a station, sidings, and a tunnel about 30 ft. in length, was shown in operation, the two locomotives built by Mr. Smithies making some very fine performances upon it.

The party then proceeded to Mr. D. C. Glen's house at the other end of the town. Mr. Glen, whose workshop is very complete, containing a Barnes lathe with milling attachment, a ⅓-b.h.p. gas engine, etc., put himself at considerable trouble to interest and amuse the members, explaining the construction of his partly-finished model Caledonian railway locomotive to all comers.

The members were handsomely entertained at tea, and their appreciation of Mr. and Mrs. Glen's kindness was shown by the very hearty vote of thanks passed to them upon the motion of the Chairman, Mr. Marshall.

The thanks of the Society are also due to Messrs. Tatham and Smithies for their trouble and kindness in providing for the interest of the party during the first part of the afternoon.—HENRY GREENLY, Hon. Sec., 2, Upper Chadwell Street, Myddleton Square, E.C.

Provincial Branches.

Bolton.—The monthly meeting of this Branch was held on July 15th, at the Oxford Café, there being fifteen members present. Mr. Booth (vice-president of the Branch) occupied the chair. The preliminaries having been satisfactorily settled, Mr. H. Greenly's paper on "Model Locomotives" was read by Mr. Booth. The paper covers a large ground, and with the aid of lantern-slides, deals in a very comprehensive manner with the subject. A word of advice to intending lantern operators—use as strong a light as possible. A set of horizontal engine castings were on view and should make up into a very neat model. The meeting terminated at 10 o'clock with a vote of thanks to the Chairman. The August meeting will be held on the 26th at the Oxford Café.—ERNEST MALLETT, Hon. Sec., 83, Manchester Road, Bolton.

Glasgow.—A meeting of this Branch was held in the Society's Rooms, 309, Shields Road, on June 16th, but owing to the summer vacation the attendance was small. Mr. McMillan exhibited a very neat ¼ h.-p. water motor made entirely by himself, and which was much admired by those present. Mr. McMillan is constructing a 40-watt dynamo, and some work was done on the field-magnets of it with the 3½-in. screw-cutting lathe which the Society recently acquired. The next meeting takes place on August 14th.—JAMES R. BEITH, Secretary (*pro tem.*), 39, Hope Street, Glasgow.

Leeds.—The members of the Leeds Branch paid a visit to Liverpool on Saturday, July 12th, and obtained permission from Messrs. Ismay, Imrie & Co., White Star Line, to inspect the engines of the ss. *Majestic*. There are two sets of triple expansion engines, the vessel having twin-screws and steam is generated by twelve double-ended ordinary cylindrical marine boilers, with a total of seventy-two furnaces. After a thorough inspection of the engines, which were of especial interest to our members, we were afterwards taken over the rest of the ship by one of the company's officials. The party also visited the electric lighting and power station by permission of the city electrical engineer, Mr. A. B. Holmes. All the generators at this station were found to be worked direct with Willans' engines. A very pleasant and enjoyable day was spent, and the kind attention and respect the members received from the officials of the White Star Company and Mr. Holmes' deputy at the power station, will long be remembered by the Leeds Branch of the Society of Model Engineers.—W. H. BROUGHTON, Hon. Sec., 262, Carlton Terrace, York Road.

THE sixty-eighth exhibition of the Royal Cornwall Polytechnic Society, which is announced to take place at the Polytechnic Hall, Falmouth, from August 26th to 30th, 1902, will afford an opportunity to many model engineers of pitting their workmanship against others, and they may prove successful in securing prizes. The section "Mechanics" will, of course, be that of most interest to our readers, and in this class are divisions for models, mechanical drawing, and essays. Entries have to be made on or before Tuesday, August 19th, and full details and entry forms can be had on application to the Secretary, Edward Kitto, F.R.Met.Soc., The Observatory, Falmouth.

* * *

THE third number of *Flying* is well up to the high standard of interest and usefulness of the previous issues. The article on the late Senor Severo is splendidly illustrated, and the frontispiece is a good portrait of the unfortunate aëronaut himself. Dr. Barton's War-Office airship is described and a model of it is illustrated. Amongst other "plums" in this well-printed quarterly is a description of the Spencer-Mellin airship, a paper on the screw propeller and aerocurve in theory and practice, articles on motor aviation of to-day, the bicycle as an accessory to true flight, motor balloons and the Pole, and various other features. The magazine can be had from our publishers, price half-a-crown, or 2s. 8d. post free.

* * *

ACCORDING to a London daily paper, the chief officials of the Lancashire and Yorkshire Railway Company are considering the possibility of applying electricity to some portions of the line which offer the best prospect of making electric railway traction a successful enterprise. This is expected to be on a branch line running from Manchester or Liverpool through residential districts. Between Liverpool and Southport there is already a fifteen-minute service, and around Manchester some branches have trains nearly as often. With electricity the interval would have to be five minutes, or less. By having the motors under the cars the trains could be made long or short, as the traffic required at different hours of the day. No particular section of line has been chosen for trial, but the practical details of the traffic and management are being worked out with a view to a trial of electrification on the lines indicated.

Model Electric Railways on the "Third Rail" System.

By F. J. BURNHAM.

(Continued from page 31)

THE broad side of the controller, as shown in the drawing, should be placed parallel to the side of the cab, and the connections so arranged that the locomotive would travel in the direction in which the controller handle is moved, thus obviating any doubts as to the direction in which it will travel when the current is switched on.

It will be noticed in reference to Fig. 9 that the controller is shown in two views, one being the back, having the starting and stopping contacts, and the other, the front, having the reversing contacts. For further explanations of the connections, I would refer the reader to the diagram, which shows the whole of the connections. This, I think, will be found easier to comprehend than descriptions. I may add that the reversing of a motor consists in reversing the direction of the current in the armature in reference to the field coils, or *vice versa*, but not on both. This can also be understood by carefully following out the connections shown on the diagram. It is not absolutely necessary to put the contact plates of the reversing switch on the opposite side of the board *q* to the ordinary switch; they may all be placed on one side; but by placing the contacts of the reversing and ordinary switch on separate faces as shown, the springs *t* on the lever *u* are pressing inwards on to the contacts, whereas if the contacts are all placed on one side, the springs, should they not be all of equal strength, would cause uneven pressure, or perhaps some would barely touch, thereby causing heating, which means loss of power.

Fig. 10 shows a form of solenoid brake, which will be found very suitable for a locomotive. It consists of a solenoid *v* wound with several layers of fine S.C. wire; the core *w* is forked at its outer end where it connects to the bell crank lever 1, a link *x* connects this to the brake lever *y* on the break-shaft *z*, from where the usual brake mechanism can be adopted as illustrated. The working of the brake is as follows:—The current enters the + wire, and returns to the rails through the − wire, drawing in the core *w*, and with it the break levers, thereby applying the breaks to the wheels. The maximum power of this solenoid is reached when the core is almost touching the iron plate 2, which is fixed on the back flange 3, and it is upon this careful adjustment that the success of the brake is obtained.

The bobbin of the solenoid should consist of a brass tube 7 with flanges 3 attached thereto, the back flange having an iron plate in place of the hole, as in the front flange. These flanges should be turned to equal diameters, and made a good sliding fit in a piece of tubing 4, about ⅛ in. longer than the over all length of the bobbin; this tube, or casing, should be secured to the underside of the flooring, as shown. As it is important that the core, when being drawn in, should not touch the back plate 2, the bobbin is made adjustable between the lugs 5, 5, which are each fitted with set screws 6, 6, which again hold the bobbin in any desired position rendered necessary by the position of the core *w* when fully drawn in. Fig. 11 is another form of solenoid brake suitable for a truck or coach. It is mounted in a vertical position, the outside appearance resembling an ordinary vacuum brake cylinder; its working is in every way the same as the other previously described, excepting that the core is directly connected to the brake lever *y*, and immediately the current is switched off from the solenoid the breaks will fall off, due to the weight of the core *w* falling to its lowest position; in this case one adjustment screw only is needed, and the bobbin will always rest on it by its own weight.

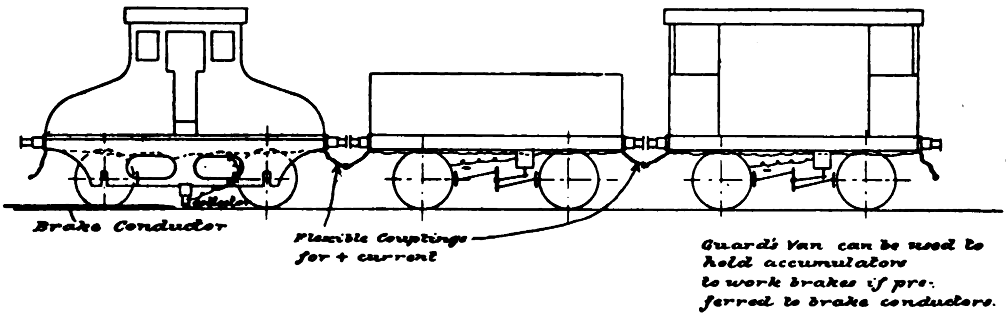


FIG. 12.—ELECTRIC BRAKES: DIAGRAM OF CONNECTIONS.

This system of brakeing can be adopted to any number of vehicles the locomotive may be drawing, but it is not necessary to have a collector on each vehicle. The current should be taken up by the locomotive, as illustrated in Fig. 12, or an accumulator may be carried in the guard's van and the current conveyed along the train by a wire under each vehicle, with flexible wires and connections between each; the negative current from the solenoid on each vehicle returning through the wheels to the rails. It must be remembered that for each vehicle fitted with a brake extra current will be demanded from the accumulator, which must be of sufficient capacity, or buckling of the plates will take place. In conclusion of this subject of electrical brakes, I would mention that no matter how many vehicles the brake may be fitted to, the current, when admitted, will apply them all at once—not successively, as in the case of air and vacuum brakes.

The power required to work the line must, of course, be continuous current, and my remarks do not refer to alternating supplies. The E.M.F. applied should range from 6 to 12 volts, according to the gauge of the railway, although it would appear that a gauge of 3½ ins. is the most convenient. Therefore, if 8 volts is adoped, it will be found very convenient, as portable accumulators suitable for this work can be purchased of any capacity. I should advise an accumulator of not less than 20 ampère-hours capacity; the recharging is only a matter of a few pence. Another method of working the railway would be by connecting up in series to the house mains (if direct

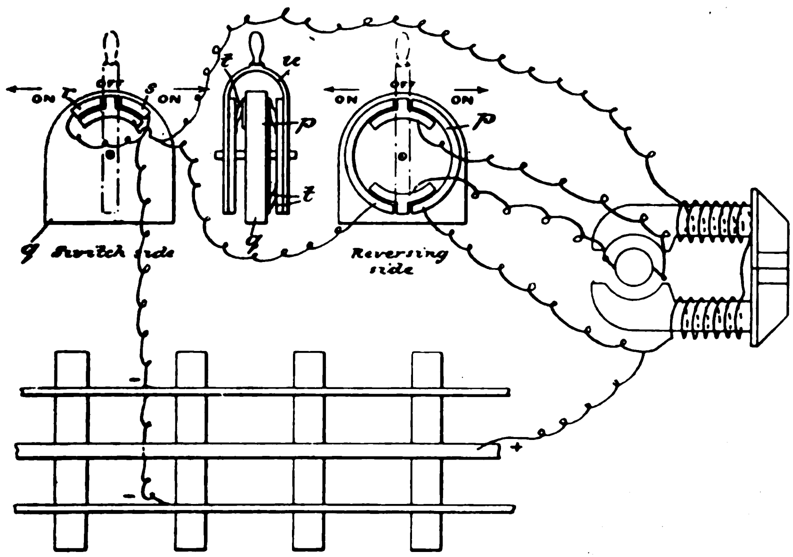


FIG. 9.—DIAGRAM OF SWITCH AND REVERSING CONNECTIONS FOR SHUNT MOTOR.

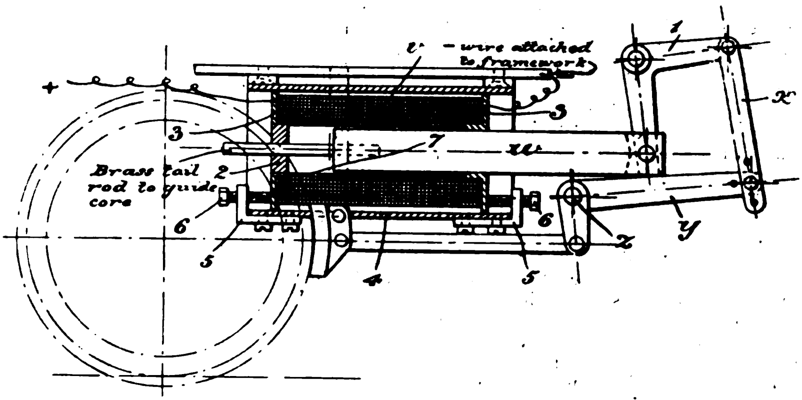


FIG. 10.—ELECTRIC SOLENOID BRAKE FOR LOCOMOTIVE.

(Half Full Size.)

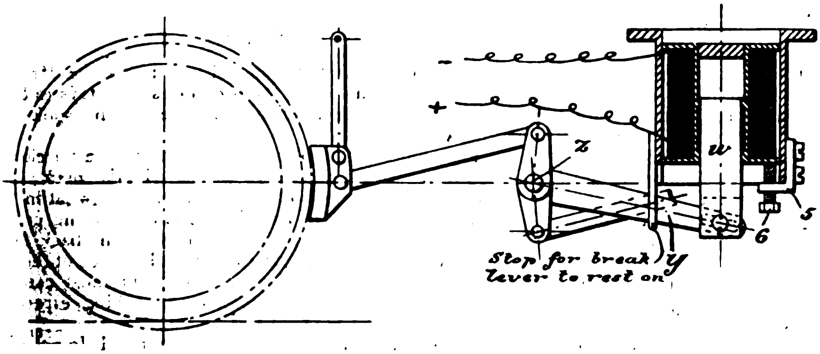


FIG. 11.—ELECTRIC SOLENOID BRAKE FOR CARRIAGES.

(Half Full Size.)

DETAILS OF MODEL ELECTRIC RAILWAY LOCOMOTIVES AND CARRIAGES.

(For description see page 76.)

current is used), on the negative side of a lamp of sufficient ampèrage, but I do not advise this method to those who are not acquainted with electric lighting circuits; house mains with a pressure of 100 or perhaps 200 volts are too dangerous to tamper with.

This I think will conclude my description of the Third Rail System of electric traction, as applied to model railways. I may say that my remarks are all based on my own practical experience, and as I have felt satisfied with the results of the experimenting I have done in this direction, I have pleasure in offering it to the readers of this journal. I hope at some future date to describe, with full working drawings, the building of an electrical locomotive, working on the system I have described.

The Motor Bicycle: Its Design, Construction and Use.

By T. H. Hawley.

(*Continued from page 60.*)

IV.—Converting an Existing Bicycle into a Motor Bicycle.

THE fitting of a motor to an ordinary bicycle is a course not to be advised except in certain cases, where the framework of the machine is of at least what is known as full roadster strength; but at the same time there are many machines which, if altered and reinforced as I shall describe, will be equally safe, and give just as good results as if a special machine had been built for motor purposes.

My principal object in thus opening the subject of the heading of the present article, is to clearly warn readers against fitting a motor to frames of the "light roadster" and "road racer" class, for these machines, in all their parts, are too near the margin of safety as ordinary bicycles, to be considered in connection with conversion to motors.

It may be conceded that so far as the main tubes go it is possible to so strengthen one of these light frames that it would safely withstand the shock of the motor; but the matter does not end there, for the tyres, the spokes, the wheel spindles, and other items, are all too weak to stand the additional strain.

It is, however, difficult and well nigh impossible to lay down any fixed rule, which will enable the owner of a machine to determine for himself whether such a machine is strong enough in its more important features for motor attachment, because in most cases total weight of machine is no guide to total strength.

At the outset it would at least be safe to say that machines of the "racer" and "road racer" class should, on no account, be entertained, and that "roadsters" of less than 35 lbs. should be entertained with suspicion, unless the reduced weight is due to the absence of mud-guards, brakes, &c.; then, again, if the motor to be fitted comes within the radius of the cranks, it is necessary that the "tread" should be the full 5½ ins., otherwise the narrowest motor made cannot be fitted without alterations in one direction or another.

The strengthening of the frame proper I do not hold to be a difficult matter; but the inexperienced would do well to consider tyres and wheel spindles.

Tyres are specially a likely cause of trouble, unless of the very best make, and *full* roadster strength and weight, the driving tyre in particular being subject to severe stresses in starting and stopping, and both tyres being much more liable to wear and puncture than in the ordinary bicycle, with a corresponding difficulty in repair, by reason of the weight and unhandiness of the motor bicycle on the road.

The whole question, therefore, resolves itself into this: if the machine to be converted is known to be well built, and fitted with stout tubing and good thick tyres, it is suitable for treatment; but the owner of a machine which does not in every way comply with the description given, would be well advised to sell out and have an entire new frame specially built for the specific purpose.

There are three prominent alterations which must be carried through in the adaptation of any ordinary bicycle to motor purposes. These are—the reinforcement of the front forks and steering column; the reinforcement of the

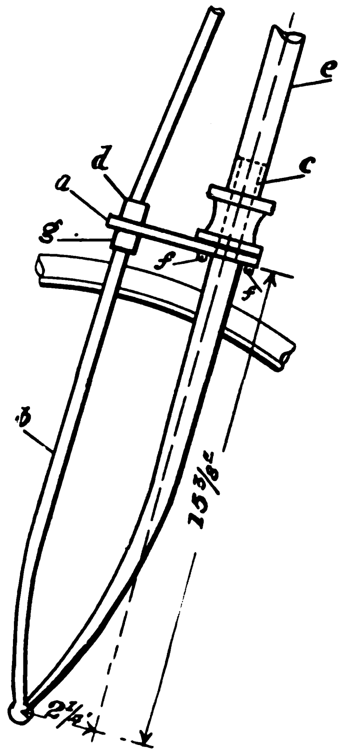


Fig. 21.

bottom bone or lower diagonal tube; and the "splaying" or spreading out of the back forks and stays to clear the large belt pulley, which is attached to the spokes or otherwise.

The reinforcement of the front forks is a matter closely identified with the safety of the rider's neck; the strengthening of the bottom bone bears somewhat in the same direction, but is likewise necessary for the proper working of the engine; the alteration to the back forks and stays is a matter concerning the clearance of the engine connecting pulley only, though in most cases it would be advisable to substitute stouter tubing, especially in the back forks or chain stays.

Of course, in making the above remarks, I do not wish it to be understood that a great amount of alteration would be necessary in order to make a bicycle of roadster strength suitable to carry an auxiliary motor of, say, 1 h.-p.; but as the horse-power of motor bicycles is advancing, and 1¾ h.-p. is now considered the lowest standard for use over average country, I am basing my calculations on the fitting of a motor of something approaching this power.

To take the matter in order, the reinforcement of the front forks and wheel wi'l be the first consideration, and this may be effected in two or three ways; but the amateur who wishes to make the conversion, will, as a rule, look for the most simple and inexpensive method of arriving at the desired end. So that although in most cases it would be better to fit in new forks and steering column of stouter construction throughout, we must find some other method which will not entail the same cost, and which, moreover, will come more within the scope of the average amateur.

We will, therefore, suppose that the present front forks are of 18 or 20 gauge, and the steering column of 16-gauge tube, which is about what the ordinary roadster cycle would be. In order to make this reliable for motor work, we must first fit a bush, not less than 4 ins. long, inside the lower or crown end of the steering tube. This bush should be of 16 gauge tube, and preferably brazed in; but the brazing of this would upset and melt off the front forks and crown, so, on a pinch, it might be soldered in by "sweating" after tinning the two surfaces, using hard or fine tinman's solder.

These bushes or liners, however, lose much of their value unless in direct mechanical contact with the tube, as by brazing, soldering, &c., so that where it is convenient to braze this liner, it should always be done.

The best method of strengthening the existing front forks is by fitting a pair of auxiliary forks with the curve in the opposite direction, as shown in Fig. 21, in which a special sheet-steel bridge piece (*a*) is either brazed or soldered to the top or bottom of the existing bridge piece, and bored with holes to receive the secondary forks (*b*), which are preferably of oval section, but for convenience, may be round of not less than ⅝ in., and preferably ¾ in. diameter, and 18 gauge in the smaller, or 20 gauge in the larger size.

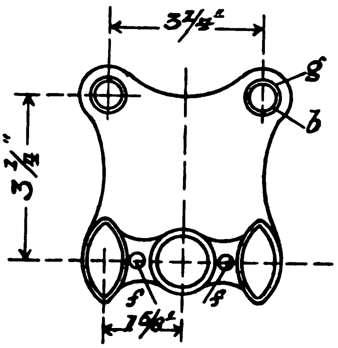


FIG. 22.—SPECIAL BRIDGE-PIECE.

It will be seen that beyond the special bridge piece there is no special difficulty in fitting these forks, as the upper ends are simply clipped to the usual handlebar clip, which is reversed for the purpose, whilst the lower ends go outside the ordinary fork end and merely involve the fitting of a slightly longer axle, though it would be no detriment if the two fork ends could be combined in one fitting and brazed together. On the other hand, if sufficiently stout tube is used, both brazing and bridge piece may be omitted, though this is not at all advised; but it is mentioned in the interest of those who may find they cannot get room in the ball-head length for the insertion of the steel plate *a*.

As I am aware that the majority of machines have no surplus length in the steering column, it is advisable to offer another alternative, in which the extension crown plate is fitted, either by brazing, soldering, or pinning, to the under side of the lower fork crown, and no doubt in most cases this will prove the preferable method; it has also the great advantage that a couple of set-screws tapped into the underside of the fork crown will suffice to keep the auxiliary bridge in position, provided its outline is

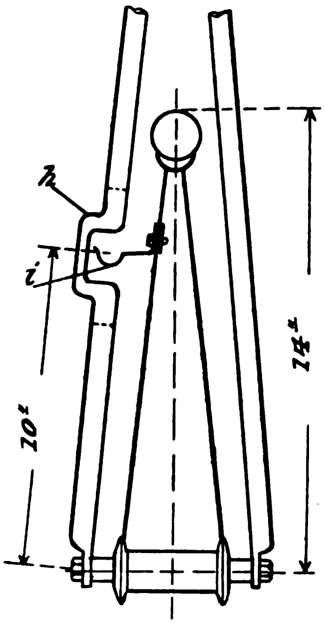


FIG. 23.

suitably shaped to take the bearing on the crown proper, instead of setting up a shearing effort on the set-screws.

The preferable method of providing a bearing for the crown piece in combination with a reinforcement of the steering column is shown in Fig. 21, in which the plate *a* is brazed first to the stout tube *c*, which has been previously fitted to drive tightly into the steering column *e*. This construction permits of the fitting of the extra crown plate without disturbing the brazing of the crown piece proper, as after the set-screws *f* are fixed in position, the auxiliary forks may be brazed up at *d* without interfering with the general structure.

The piece of 16 gauge tubing forming the liner to the steering column should be slightly flanged over the underside of the bridge plate before brazing, and the plate itself should be not less than ⅛-in. sheet steel; and as it will not be possible in most cases to punch the holes *d* and so obtain a flange for the extra forks, it will be well to drill this hole nearly ⅛ in. over the size of the tubing to be employed for the forks, and at this point fit pieces of 16-gauge tube about 1½ ins. long, to reduce the cutting action on the front fork extension, the sleeves *g*, shown in Fig. 21, being brazed up at the same time as the extra forks are brazed to the crown piece *a*.

This will be found a thoroughly mechanical way of getting over the vital point of reinforcing the front forks without disturbing the setting or alignment of the forks proper.

The next point to consider is the setting out of the back carriage, or providing room for the large belt pulley on the rear wheel. Most ordinary bicycles have little more than ¼ in. clearance between tyre and back forks and stays, but the line of the driving belt comes well outside this, and there is pulley clearance to be provided. Of course, in building up a new frame, it is possible, by substituting a wide bridge piece, to use straight tubes for the back frame, or the same end may be gained by using the ordinary bridge piece and cranking the tubes outward a sufficient distance to clear the pulley; but in converting an existing bicycle, the most simple method I can think of is to slip the hack-saw through left hand fork and stay, cutting away about 2½ ins. of each tube at the point where the belt pulley will come, and making up this space by brazing in a cranked forging or bridge-piece, as shown in Fig. 23 at *h*, the grooved pulley for belt being shown at *i*. This bridge-piece may be easily concocted from a rough steel forging, though the work involved will be largely dependent on the section of back tubes; if they are round, then it becomes a very easy matter to crank out the forging and turn up the ends to fit the tube, filing away a portion of the crank outside to form a flat or oval section; but if the forks are oval or D tubes it will be better to make the bridge-pieces of flat stuff of sufficient size to allow of forging or filing up the ends to the shape required to telescope into the fork tubes.

The only careful work about this job is the maintaining of the exact original length of the forks and stays; but this should not prove difficult, as we have the right-hand forks and stay undisturbed, and it is necessary only to fit the bridge-pieces before brazing and place the driving wheel in position, when it will at once be seen in what direction any alteration is required by the wheel rim sittnig more or less out of the centre of forks and stays. Fig. 23, however, will make perfectly clear this part of the structure.

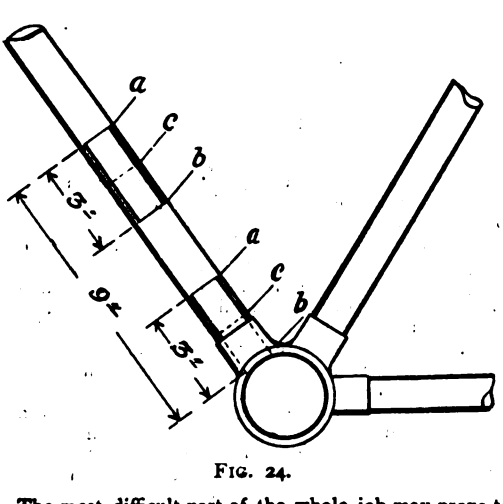


FIG. 24.

The most difficult part of the whole job may prove to be the reinforcement of the tube carrying the motor, and the exact method will vary with the type of motor and the method of fixing it—*i.e.*, the style of clips supplied. There will also be a variation in the plan, according to the position of motor and the particular tube to which it has to be clipped; but, supposing the design of motor permits, it will under every head be advantageous to attach it to some portion of the bottom tube, or to the bottom tube and seat tube at suitable distances from the crank bracket.

But where the type of motor employed is suitable for attachment to a single tube only, it should certainly be the bottom or diagonal tube, because in all machines this tube is of stouter gauge than the rest, and, moreover, the centre of gravity is then kept low, and the cooling effects are better, also allowing more room for fitting tanks and carburator, etc.

I have given considerable thought to this matter, and, although the job may be accomplished in various ways, it is difficult to say which one is best without knowing the design of motor to be fitted, and the machine to which it is to be fitted, but the first thing we have to take into account is the probable gauge of the existing tube, and then whether this tube is fitted with a liner at the crank bracket end, for on this much depends.

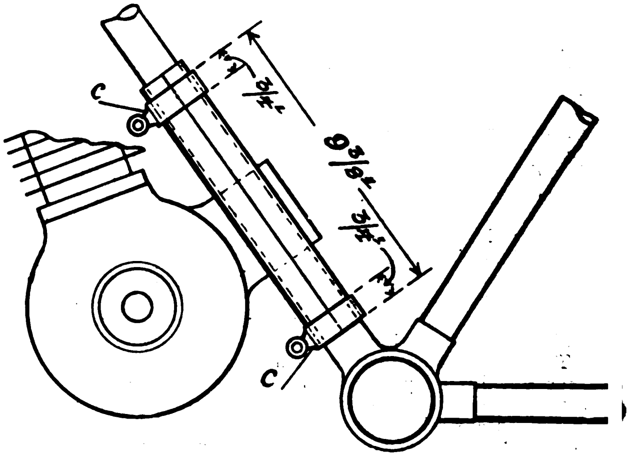


FIG. 25.

Supposing the bottom tube to be fitted with nothing stouter than 20-gauge tube, and no reinforcements at either end—a condition quite likely in even an up-to-date machine of the roadster class—it would be injudicious to depend on such a tube for motor work, however well strengthened from the outside, because the granulating effect would be almost certain sooner or later to cause fracture of the tube at the mouth of the socket.

In such a case as I have supposed, the only safe way would be to put the saw through the tube close to the bottom bracket socket, and then again some 6 ins. distant; then the interior must be cleaned for brazing, and a couple of plugs of 16-gauge tube prepared a good fit to the existing tube, and about 3 ins. in length.

In order to make up the frame again with these two reinforcing plugs, the job must be approached as follows: First braze the plug into the crank bracket end of the tube, so that the plug enters to the inner end of the socket; then dress up the joint around the outside of the plug to receive the original piece of tube cut out of the frame (or another piece of the same size and gauge), a process which may be accomplished without disturbing any other brazed joint, or upsetting the general alignment of the frame.

The difficult point now is to introduce the second plug. First of all it (the plug) should be filed up a fairly easy fit to the bore of the original frame tube, so that it may be pushed all its length up the forward end of the sawn through frame tube, and thus allow of the connecting tube being sprung into position. The next problem will be the drawing back of the plug, so that it may be equally divided between the two pieces of tube to which it has to be brazed. To accomplish this I have at times resorted to the following method:—If the plug or liner be, say

3 ins. in length, drill a series of holes about 1-32nd in. in diameter, in a straight longitudinal line for just one half the length of the bush; in placing the bush in position push all but about ¼ in. of its length up the tube, and then spring the frame until the connecting tube can be passed over the end of this bush or liner, holding a piece of spoke wire or drill end in one of the drilled holes, to prevent the tube liner being pushed entirely into the tube. The short length of tube originally cut out of the frame, must be prepared by filing a V-notch on its under side at the end where the second liner has to be worked into position, this V-notch providing access to the row of drilled holes, so that with the tang end of a file or other instrument the bush may be drawn back within the tube until its length is equally divided between the two tubes to be joined, which position will be known when the termination of the row of holes is reached. The brazing operation will be conducted as described in former articles, and the V notch serves as an entry for the spelter, the neat finish at the joints of the cut tube may be ensured by a wrapping of fine iron wire, which is brazed up solid with the tube and afterwards filed up to a smooth surface.

A reinforced tube, as described above, is shown in section in Fig. 24, the bushes or liners extending from *a*, *a*, to *b*, *b*, the original tube being cut through at *c*, *c*, and, needless to say, when the engine is of the single or double clip-on variety, the position of the saw cuts *c*, *c*, should be made to come within the jaws of the engine clip.

Supposing, however, that it is ascertained that the bottom tube of the bicycle to which the motor is to be attached is sufficiently stout in itself—say, 20-gauge or even 22-gauge, provided it is fitted with a good long liner at the bracket end (which may be determined by passing the finger up through the bottom bracket), we then have a much more simple method of attaching the engine, especially if it be of the "Minerva" single clip type, as described in Article II.

In the majority of machines this tube will be 1⅛ ins. diameter, and for the method of fitting to be described the bore of the engine clip should be 1¼ ins., when all that will be required will be a length of 1¼-in. of 16 B.W.G. tube, cut through down its entire length with either a power hack-saw or a circular saw, so that the two half sections so formed may be clipped over the 1⅛-in. tube, which they will exactly fit in curvature, as shown in Fig. 25, the engine occupying the centre of the reinforcing tube.

The clips shown at *c*, *c* are not really vital, and the same effect might be obtained by a wrapping of copper wire for an inch at each end, with the strands well soldered together, or both might be dispensed with and the two half sections of 1¼-in. tube simply held together by the engine clip; but the job would be far stronger and more workmanlike if finished as described.

Care should be taken that the reinforcing tube comes right up to the socket mouth of the bottom bracket.

Yet another alternative method of fixing the engine to a frame which is suspected of being rather light is clearly shown in Fig. 26, in which A is a length of 16-gauge tube either 1⅛ ins. or 1¼ ins. diameter, according to engine clip, which is brazed up by bridge pieces, or fixed by special draw bolt clips at *b*, *b*, the engine being clipped to the stout tube A, though it is obvious that this method is only practicable where there is plenty of clearance between crank bracket and ground.

With regard to fitting engines of the De Dion type, which are not provided with tube clips, I cannot do better than refer readers to the last article (Figs. 15, 16, and 17), and would suggest that with a pair of clips as described, and the motor fitted as in Fig. 15, the frame would actually be considerably strengthened and stiffened by the presence of the motor.

The one point to watch, however, would be that the clamps surrounding the frame tubes of the bicycle be of ample length—not less than three times the diameter—or otherwise the frame tubes must be reinforced in the same manner as shown in Fig. 25 in the present paper, in which case the split tubes should be not less than four diameters in length, though there would be no especial necessity for brazing them to the frame tubes.

The only other point in conversion that requires special mention is the fitting of the belt pulley to the driving wheel of the machine.

These pulleys are commonly about 20 ins. diameter, and have a flat lip bearing against the sides of the wheel spokes, being attached at each spoke by a small steel plate and a couple of set screws, these plates and set screws being obtainable with the pulley.

The first thing to determine is the width and section of the pulley, which will be required to suit the belt to be used, and the distance of engine pulley from centre line of machine frame, as it is most important that the two pulleys be correctly in line; but it is obvious that a de-

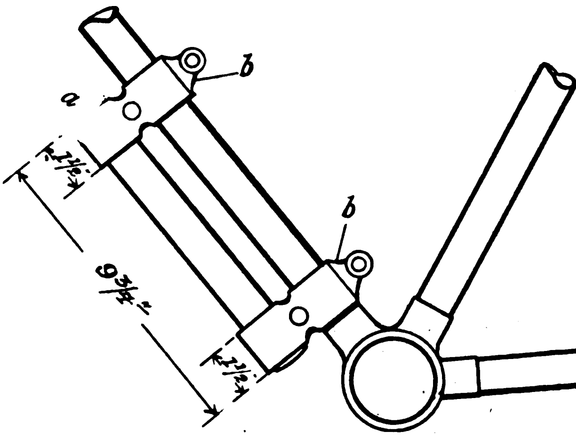


FIG. 26.

finite pattern and width of rim cannot be quoted, as the width apart of rear wheel hub flanges, and the centre to centre of engine pulley will regulate the width of the driving-wheel pulley; but these pulleys are now procurable in quite a variety of sizes and shapes, and no difficulty is likely to be experienced in this direction, provided the setting out of the frame is sufficient to accommodate the pulley.

One point, however, is worthy of mention, and that is, that the driving pulley or rim should be a *true circle* to start with, otherwise it will be extremely difficult to cause it to run true on the wheel, and an untrue pulley, resulting in unequal tension of driving-belt, is an intolerable nuisance, to say the least of it.

The wheel spokes should really be 13 gauge, though if 14 gauge and double-butted, they may be relied on; but if anything lighter than this, I should advise rebuilding the driving wheel, which is not really a very big job, and well worth doing if there is any doubt in the matter.

The setting out of the holes to be drilled in the driving-pulley flange is a rather nice matter, because the holes do not come at equal distances in a wheel of the tangent variety; the way I have approached this job is to find the position for, say, four of the plates disposed at equal distances around the wheel, then with the pulley roughly held in position by these four plates, mark off the drilling holes for all the other spokes.

Or an even better method is to drill four holes in the pulley and four in the rim of the driving wheel, using four short lengths of ordinary spoke wire and corresponding nipples, by which the pulley may be roughly pulled up true with the driving wheel; then the whole of the drilling centres for the attachment plates may be accurately scribed off as follows:

The little plates are procured already tapped, and the holes in each are a like distance apart; one of these will be used as a jig to determine the exact distance apart of the holes, and when this has been found, one side of a fine-pointed and long tapered centre punch is ground away at one side until the distance from the flat ground side to the point corresponds to half the distance between the threaded holes in the clamping plates—plus the thickness of the spoke—*i.e.*, when the punch is laid with its flat side against a spoke and again to the other side of the spoke, the dots made will be the same distance apart as the holes in the plates; thus the rim of pulley is easily and accurately centre-punched for drilling, and the holes should be one size larger than the actual screws; the holes may be drilled in position without removing the pulley from the wheel rim.

In conclusion of this portion of the subject, I would suggest that if either of the tyres are much worn, or if of light weight, they should be properly fitted with a pair of Smith's bands, and in any case with ordinary cycle tyres, the driving-wheel tyre should so be protected.

(To be continued.)

The Institution of Junior Engineers.

ON Saturday, July 5th, the members of this Institution paid a visit to the American Exhibition at the Crystal Palace, the exhibits of Messrs. Babcock & Wilcox, the Fairbanks Co., Messrs. Charles Churchill & Co., Messrs. W. C. Horne & Sons, the Blaxton Engineering Co., the Niles Bement Pond Co., and Messrs. Stirlings Motor Carriages Co., receiving special attention. Another feature of engineering interest noticed was the re-glazing of the centre transept roof, consisting of 100,000 square feet of Mellowes Patent Glazing, in which no putty or paint is used. Previously to entering the Exhibition, Mr. J. W. Wilson and Mr. Maurice Wilson, the Principal and Vice-Principal, showed the members over the Crystal Palace Company's School of Practical Engineering carried on in the South Tower, which is fitted up for instruction in mechanical, civil, electrical and colonial engineering. For the facilities which had been extended in connection with the occasion the Chairman of the Institution, Mr. Percival Marshall, expressed the members' acknowledgments before they dispersed.

DRILLING SMALL HOLES.—X.Y.Z. writes that he has often had trouble when drilling small holes, about 1-16th in. diam., to get them perfectly straight. His remedy or "kink" is to always have the drill sharp and to use it only so long as it cuts freely. Keep several drills of the required size at hand and only drill about ¼ in., then change for another that is sharp. If a hard spot is struck it can best be overcome by lowering the speed. Drilling small holes crooked is a common mistake, even by old hands, and one for which, in the majority of cases, there is no necessity.—*Railway Machinery.*

The First Locomotive ever Made in England.

WE are indebted to Sir Richard and Mr. George Tangye for permission to reproduce the following most interesting account of the famous model locomotive built by William Murdock, the first locomotive ever made and run in England. Murdock's original model, which is an historical relic of the greatest interest and importance, is now being exhibited by Messrs. Tangyes Limited, at 35, Queen Victoria Street, London, E.C. William Murdock was the well-known assistant to James Watt, and second only in importance to Watt himself. He invented numerous devices in connection with steam engines, amongst others the "D" slide-valve, and "Sun and planet motion," and was also the first to use coal gas as an illuminant.

The date of construction is not definitely known. Mr. Murdock's son, when living at Handsworth, informed Dr. S. Smiles that this model was invented and constructed in 1781, but, after perusing the correspondence of Boulton and Watt, Dr. Smiles has inferred that it was not ready for trial until 1784.[1] The model had been continuously in possession of the Murdock family till 1883, when it was purchased from Murdock's great grandson by Sir Richard and Mr. George Tangye. It has since been exhibited at the Melbourne Exhibition of 1889, and at the Birmingham Art Gallery. A copy has been made by students at South Kensington and placed in the museum there.

A note referring to this in the South Kensington catalogue reads as follows:—"This is a copy of the original experimental model made by William Murdock in 1781-6. At the time, Murdock was at Redruth, erecting pumping engines for Messrs. Boulton and Watt, and in August, 1786, the firm's agent writes: 'William Murdock desires me to inform you that he has made a small engine of ¾ in. diameter and 1½ in. stroke, that he has apply'd to a small carriage, which answers amazingly.' In September of the same year, Boulton, in writing to Watt, says that Murdock 'had make his steam carriage run a mile or two in River's great room, making it carry the fire shovel, poker and tongs. William uses no separate valves, but uses the valve piston, something like the 12-in. little engine at Soho, but not quite.' There is good evidence that, altogether, Murdock constructed three locomotives, the last of considerable size: but, under pressure from Boulton and Watt, he ultimately abandoned the invention."[2]

James Watt had, ever since he was twenty-three years of age, when Dr. Robison, of Glasgow University, called his attention to the subject, given much thought to the application of his steam engine to road locomotion, and in 1769 he took out a patent describing a locomotive;[3] but being busy upon other work and experiencing troubles respecting the validity of his previous patents, he did not follow up the matter.[4] William Murdock had doubtless heard of Watt's original speculation, and at Redruth, during his leisure hours, proceeded to construct a model locomotive after a design of his own—of small

[1] Smiles' "Men of Invention and Industry," 1884, p. 134.

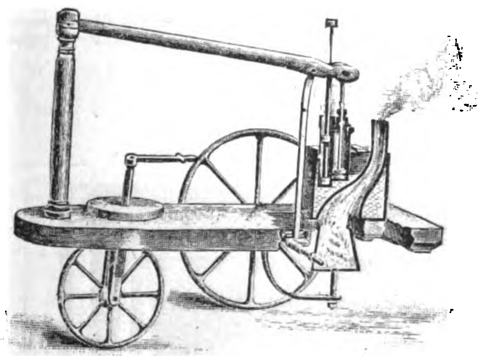
[2] S.K. Museum Cat. Mech. Engineering Collection, 1901 edit., p. 45.

[3] Smiles' "Lives of the Engineers," Vol. iii, p. 74.

[4] Smiles' "Lives of the Engineers," 1878, Vol. iv, p. 267.

dimensions, but sufficiently large to demonstrate the soundness of the principles on which it was constructed.[5] The result of his labours is the engine now shown.

An attentive examination of the model well repays one, and reveals many beautifully simple contrivances, showing Murdock's genius for the adaptation of simple means to secure his desired ends. The height of the small locomotive is about 14 ins., its length 19 ins., and the extreme width over the driving wheels is 7 ins. It consists of an oblong board, mounted upon three wheels, two driving wheels at the rear attached to a cranked axle, and one steering wheel in front arranged under the board, and running in a swivelling fork, which can be set by a tiller handle above. Behind the driving wheels is the boiler, which is a rectangular vessel, 3⅜ ins. high, 4¼ ins. long, and 3⅛ ins. wide, constructed of brazed copper. Through the boiler a flue passes obliquely,



MURDOCK'S MODEL LOCOMOTIVE, A.D. 1784.

contracting from a circular chamber forming the firebox to a small funnel in the top of the boiler, which serves to carry off the products of combustion from a spirit lamp, arranged to burn within the firebox. The steam cylinder of the engine is mounted on the top of the boiler, and the lower part passes into it, and is surrounded by steam. The piston-rod passes upward, and is attached to the end of a vibrating beam; this beam passes to the front of the carriage, and is pivoted in an upright pillar. The little engine is worked by the expansive force of steam only, which is discharged into the atmosphere after it has done its work of alternately raising and depressing the piston in the cylinder. The diameter of the piston is ¾-in. and the length of its stroke is about 2 ins.[6] As the piston moves up and down, it causes the beam to rotate the driving wheels, by means of a connecting-rod attached to the cranked axle. The steam valve is very ingenious, and it is driven from the beam by a projecting rod, so arranged that the valve is moved at the termination of every up and down stroke by the last portion of movement of the beam upwards or downwards. It is a piston valve with two pistons, ground to work easily, but pressure proof, in the valve cylinder. The space between the pistons is in constant communication with the boiler, and the steam is admitted by two ports—one at the top and one at the bottom of the cylinder—so arranged that when the piston valve is up, the steam enters the upper port, and drives down the piston, while the exhaust steam from the under side discharges from the cylinder by the lower port into the air through a tube connecting the two pistons of the valve.

This is probably the earliest (piston) slide valve used in a steam engine, as at the date of its construction, Boulton and Watt did not use Murdock's "D" slide valve in their engines—the patent for the latter not being taken out by Murdock till 1799 (Patent No. 2340), about 15 years later.[7] In this model the idea of the slide valve had certainly entered Murdock's mind.

The safety valve is let into the boiler near the steam cylinder, and it is held down by a little tongue of metal—a very efficient and simple contrivance. A leaden weight is placed above the steering wheel to balance the machine, and to prevent it tipping over when the water is in the boiler. The wheels are constructed of brass tube brazed together. Every part of the engine is both well designed and well made. It is interesting to notice that at some time the wood under the boiler has been on fire, and it still shows the marks of charring. It has evidently been pieced and protected by an iron plate to prevent a similar mishap. In Dr. Smiles' "Men of Invention and Industry," published in 1884, he gives interesting accounts of two experiments with this locomotive. "The first was made in Murdock's own house at Redruth, when the little engine successfully hauled a model waggon round the room." The second experiment was made in the lane leading to the church, and in front of the house afterwards inhabited by the parents of Messrs. Tangye.[8] This trial is thus recounted by Dr. Smiles in the book just mentioned: "Another experiment was made out of doors, on which occasion, small though the engine was, it fairly outran the inventor. One night, after returning from his duties at the mine at Redruth, Murdock went out with his model locomotive to the avenue leading to the church, about a mile from the town. The walk was narrow, straight and level. Having lit the lamp, the water soon boiled, and off started the engine, with the inventor after it. Shortly after he heard distant shouts of terror. It was too dark to perceive objects, but he found on following up the machine that the cries had proceeded from the worthy vicar, who, while going along the walk, had met the hissing and fiery little monster, which he declared he took to be the Evil One in '*propria persona*.'"

When Watt was informed of Murdock's experiments he feared that they might interfere with his regular duties, and advised their discontinuance. He afterwards said that if Murdock was resolved to continue them, the firm of Boulton & Watt would advance £100, and would establish a locomotive engine business with Murdock as a partner, if within a year Murdock succeeded in making an engine capable of drawing a postchaise, carrying two persons beside the driver, with fuel for four hours and water for two hours, at the rate of four miles per hour.[9] From 1786, however, Murdock, as well as Watt, dropped all further speculation on the subject of road locomotion, although persuaded of its practicability, and left it to others to work out the problem of the locomotive engine.

Murdock's model remained but a curious toy which he took pleasure in exhibiting to his intimate friends,[10] and after his death it was kept by his descendants until it came into the hands of Sir Richard and Mr. George Tangye, as before mentioned.

[5] "Men of Invention and Industry," p. 133, 1884.
[6] "Men of Invention and Industry," p. 134. The S. K. Museum catalogue says that stroke is 2·125 ins. (See footnote, p. 82 *ante*.)

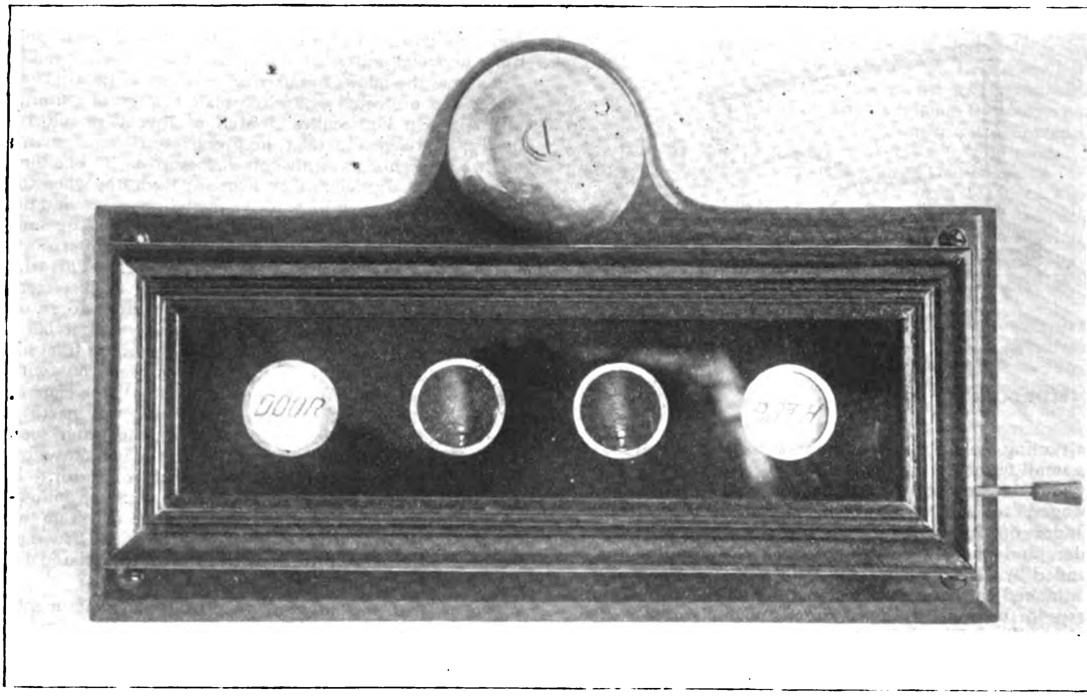
[7] "Men of Invention and Industry," p. 139.
[8] Sir Richard Tangye, "One and All," p. 17, 1889.
[9] "Lives of Boulton and Watt." Smiles, p. 337.
[10] "Men of Invention and Industry," p. 135.

Models Made Without a Lathe.

III.—The Construction of an "Electrical Indicator."*

By Geo. W. Stead.

THERE are many young amateurs who, having taken up electricity has a hobby, very soon get tired of the somewhat dry and monotonous text-book experiments, and desire to go in for something more practical, such as the construction of some model or machine that will not only give them pleasure in the making, but will fulfil some useful purpose when finished. To those who find themselves thus placed, the following description of a 4-hole indicator just lately made by the writer may be of interest. It can be made without a lathe or other expensive apparatus—in fact, the only tools required will be those found in almost any amateur's workshop. Of course, those who *do* possess a lathe will notice many articles herein described, which can be made far easier by that means, but the writer had not the good fortune to possess one of these much desired tools, and this article is written expressly for those who are placed in the same position. A few words of explanation as to the principle and working of indicators may not be out of place here—especially to the young and inexperienced amateurs, who have not had an opportunity to examine the mechanism of these instruments. Briefly, then, an indicator system—complete—consists of an electric bell to give the alarm or call attention, a movement which "swings" or "drops," as the case may be (to indicate where the call has been made), and a suitable containing case for the same. There are two principal kinds of movement, viz.—"pendulum" and "drop." The pendulum movement is shown diagrammatically in Fig. 1. A is a soft iron armature, which is suspended on the centre B so as to work very freely, and has attached to it a length of wire, at the end of which is a small flag or card C, bearing a number, or, in some cases, a printed description of a certain room, etc. Suppose contact now be made by pressing the push P, the current from the battery Z will flow through the bell B causing it to ring, then forward through the wire of the electro-magnet M, the pole of which becoming magnetised, attracts the armature A, thus causing it to swing backwards and forwards like the pendulum of a clock, when the press P is released. The dotted lines show the path of the pendulum. A well-made movement of this pattern may swing for sixty seconds or more. The chief advantage of this pattern is that it does not require setting after a call has been made, and is, therefore, always ready to indicate a fresh call.



The Finished Indicator.

The drop movement is shown diagrammatically in Fig. 2. The soft iron armature A is attached to a brass lever which works on the shaft C. This lever is made slightly heavier from C to K than from C to A, so as to keep the armature the requisite distance from the poles of the electro-magnet M, and also to cause the catch D to automatically engage and retain the lever F when resetting the movement. The stop E prevents the lever working too far. The lever F, which works on the shaft G, has attached to it a tin sign (shown in dotted lines to avoid confusion), which bears a

* This article gained a prize in our recent Competition No. 20.

number or other distinguishing device. If contact now be made by pressing the push P, the current from the battery Z rings the bell B and passes forward through the wire of the electro-magnet M, the poles of which attract the armature A, thereby lifting the catch D and allowing the lever F to fall on the stop H, and showing the sign S opposite one of the holes of the indicator case, as shown by the dotted lines. Of course, the sign remains down until replaced by the rod R.

This latter style of movement is the one adopted in this article. All things considered the drop movement is equally as good as the pendulum, and in some cases far better. The only objection that can be raised to it is that it requires to be set after each call, but this is only a very trifling matter considering the advantages gained; for when once a call has been made, the indicator sign remains in sight until re-set, and, therefore, does not require a second ring to call the attendant should that person not be near at hand at the moment the call is made. But with the pendulum movement, as soon as it has ceased to swing, there is nothing to indicate that a

one at the boss and the other at the top of the lever, as shown by dotted lines in Fig. 7. When the patterns have been made they must be given a coat of shellac varnish, and when dry rubbed very lightly over with smooth sand-paper, and another coat of shellac varnish put on. This is to protect them from the damp sand whilst being moulded. If this precaution is not taken there is every probability of them dropping to pieces, owing to the glue becoming softened by the damp. These drawings are shown full size, and the easiest way to make the patterns from them is to get a piece of transparent tracing paper as used by draughtsmen, and which can be bought very cheaply at any stationer's, place it over the drawing, and with a fine-pointed black lead pencil trace them all out, adding the dotted lines and circular dots for guidance when fitting together. Paste these tracings on the wood you intend to use, and when dry they can easily be cut out with a fret-saw. By this means all measuring and drawing is dispensed with, and a very accurate pattern obtained with the least possible labour.

FIG. 1.

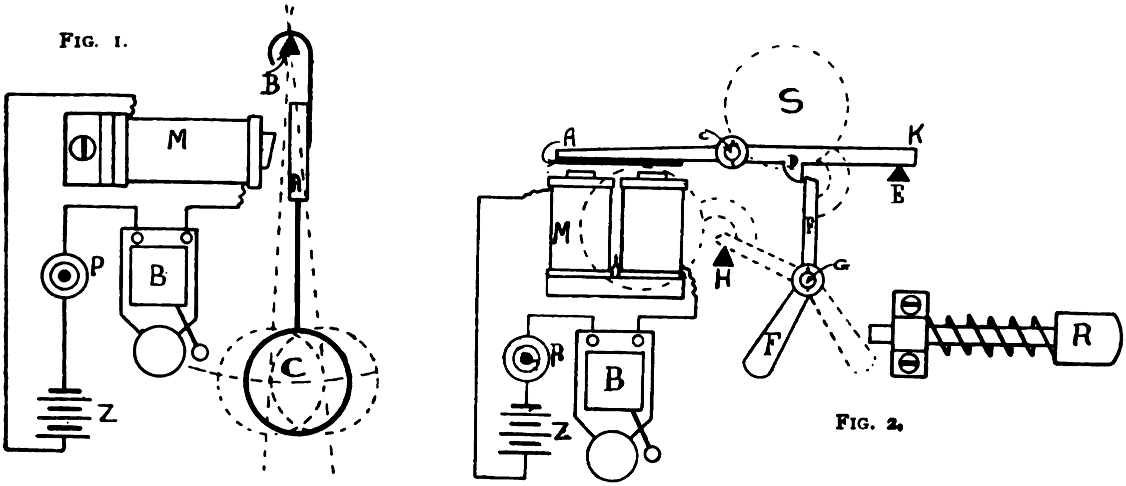


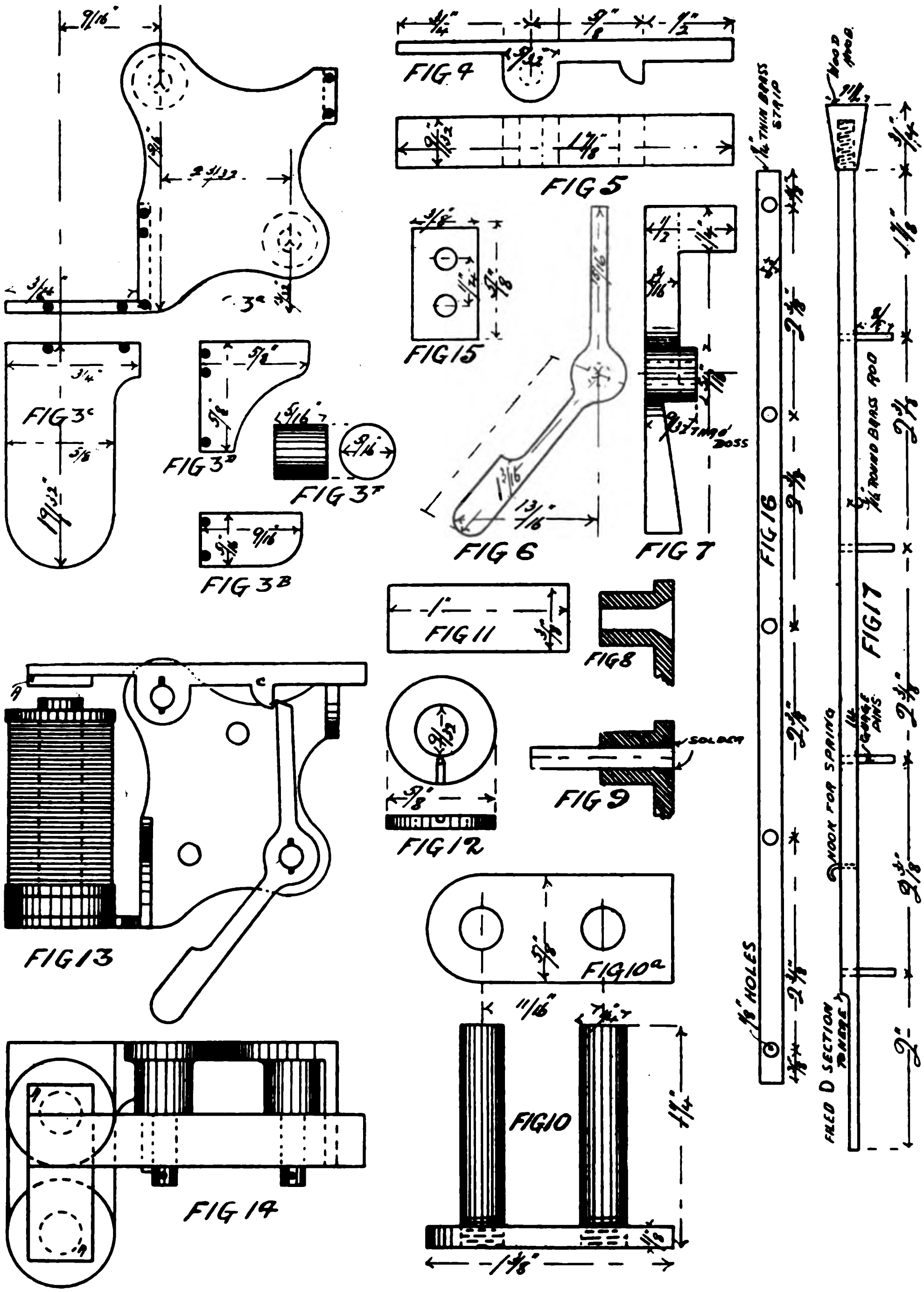
FIG. 2.

DIAGRAMS EXPLAINING THE TWO TYPES OF ACTION OF ELECTRICAL INDICATORS.

call has been made. From this short description the reader may have formed some idea of the principles on which indicators work, and may now proceed to make the patterns for the movement which will be three in number, viz., the frame—the top lever—and the side lever. These must be cast in brass, and as it is a 4-hole indicator, four castings off each pattern will be required. Fig. 3A shows the principal part of the frame, and must be cut out of wood 3-32nds in. thick. Figs. 3B, 3C, and 3D can be cut at the same time, and then filed down to 1-16th in. thick. Fig. 3F is a circular piece 5-16ths in. diameter, 5 16ths long; two like these will be required. The dotted lines on Fig. 3A show where these circular pieces are to be fixed. When all have been cut and smoothed with sand-paper, Fig. 3A is laid flat on the bench, and Figs. 3B, 3C, 3D, and 3F each glued on to their respective places, each one at right angles to Fig. 3A. The dotted lines and circular dots show clearly where each part fits. The top lever, of which Fig. 4 is a side elevation and Fig. 5 a plan, needs no special comment.

The side lever, of which Fig. 6 is a side elevation and Fig. 8 an end elevation, is rather more difficult to make. The best way is to cut out of wood 3-16ths in. thick to the shape of Fig. 6, and then add the two small pieces;

Having got the castings, file off all roughness, and bore ⅛ in. holes through the two bosses of the "frame"; these should be slightly countersunk at the back, as shown by Fig. 8, which is a section. Into these holes are fitted the shafts on which the levers work. To make these shafts procure some ⅛ in. round brass wire; straighten, and cut off eight pieces 13-16ths in. long—two for each movement; one end may be slightly flattened with a hammer so as to just drive tight into the hole—a very slight blow will suffice. The other end is filed true and smooth, and a hole about twenty-four gauge bored 1 16th in. from the end to take a small pin which is to prevent the levers from working off the shafts. Fig. 9 is a section of one of the bosses with shaft in position. The countersunk hole has a drop of solder round as shown, which is a safeguard against the shaft working loose. Other two ⅛ in. holes are now bored through the frame. Fig 13 shows the position of these, which are for screws to fix movement to backboard. Now take the top lever, Fig 4, and bore a ⅛-in. hole through the boss as shown by the dotted lines. The armature, Fig. 11, is soldered on the underside of this lever—in the position shown at A, Fig. 13, and Fig. 14—and consists of a piece of soft iron 1 by ⅛ by 1-16th in. thick. The side lever,



DETAILS OF ELECTRICAL INDICATOR.

Scale: FULL SIZE.

Fig. 6, has a ½ in. hole bored through its boss. The sign, which is shown in Fig. 21 and 21A half-size, is soldered to the top part of this lever: it is cut out of thin tin to the size and shape of Fig. 21, and then bent to the shape of Fig. 21A. It is not shown in position in any of the drawings, being left out to avoid confusion. Its proper position is found by placing the side lever on its shaft, and allowing it to drop on to its stop. The tin sign should then be perfectly central each way with the indicator bobbin. A glance at the photograph will show this.

The electro-magnet next claims attention. Fig. 10 is a front elevation and Fig. 10A a plan. It is made of soft iron to the dimensions given, the poles being ¼ in. iron rod: they are not turned but are filed smooth and true, and are screwed tightly into the flat piece as shown. This is sweated on to its support on the frame (Fig. 3C). The bobbins for the electro-magnets can now be made. Ten will be required—eight for the movements, and two for the bell (to be described later). Twenty bobbin ends will be required (see Fig. 12). These are cut with a fret-saw out of 1-16th in. ebonite: half of them must have a small hole drilled as near as possible the inner circle and a groove cut to the outer edge; this is for the wire to lie in, so that the bobbins can be pushed down flat on to the yoke of the electro-magnet. To make the tubes, get a ¼-in. rod used for the poles of the electro-magnet just described—about 6 or 8 ins. long and file smooth; wind on three or four layers of good thin brown paper well treated with very thin hot glue. These tubes may be about 3½ ins. long and will then make two bobbins. Slip them off the rod as soon as wound and put to dry. Five of these tubes will be required.

(To be continued.)

The "Arrow," Fastest Steam Vessel in the World.

By Jefferson S. Briggs.

THE twin-screw yacht *Arrow*, built for Mr. Charles R. Flint, of New York, is undoubtedly the most notable recent example of a boat intended to attain the highest possible speed by the use of the most advanced and refined features of engineering practice. Particular interest attaches both to the design and construction of the hull and machinery. The problem invokes, first, the design of a form of boat suitable for the development of the most extreme speed; and, second, the construction of the boat and machinery with a minimum weight of materials. The realisation of such an ideal involves so many special problems of design and construction that the following description of the boat and her machinery will be of interest to all who are concerned with the attainment of extreme speeds and the development of a maximum of power on minimum weight.

The chief dimensions of the *Arrow* are as follows:—

Length, extreme	130 ft. 4 ins.
Length on water-line	130 ,,
Beam, extreme	12 ,, 6 ,,
Normal draught of hull	3 ,, 10 ,,
Draught under screws	4 ,, 11 ,,
Depth amidships	9 ,, 4 ,,
Displacement, normal (draught of 3 ft. 10 ins.)	78 tons
Coal bunker capacity	17 ,,
Water tank capacity	1,800 gals.

Although the *Arrow* was designed to attain a speed of 40 knots an hour, the accommodations are in no sense limited by the machinery necessary to propel the craft at this unprecedented speed, there being sleeping accommodations for no less than twenty-five persons. The furnishings are luxurious, and she is handsome enough to please the most critical.

The general construction of the boat is composite in character. The frames are steel below the water-line and aluminium above, except through the boilers and engine spaces, where they are steel throughout. All frames and reverse frames not included between these spaces, also clips, bulkheads that are above the floor, are aluminium, also coal bunkers, stiffeners on the outside of bunkers. The boiler saddles, engine foundations, coal bunkers, bulkheads, floor plates, clips, stays, coal bunker, stiffeners which are below the floor or inside of bunkers, as the gussets and fastenings, are steel, which conform to the requirements of the specifications. The planking, keel, stem and stern post, flooring, guardrail, and certain bulkheads, pilot-house, joiner-work, and companionways are well seasoned and selected wood of such kinds as were specified. The keel is of well-seasoned white oak, protected by sheet copper. The stem is also of oak, having a natural crook, as is also the stern post. The traverse frames are of steel and aluminium, bulb angle bars, 1¼ ins. by 1½ ins., 1 65 lbs. per ft. for steel, and of 0·55 lb. for aluminium. They are spaced 18 ins. centres throughout the length of the boat, except between frames Nos. 45 and 47, where they are spaced 12 ins. apart, there being an extra frame, No. 45½, to take the boiler saddles. They are irregularly spaced in the engine-room, so as to accommodate the main bearings of the engines. The steel frames are in one continuous piece to where they join the aluminium frames, where they extend to the gunwale, and are secured to the deck beams by gussets and attached by clips to keelsons and stringers, except in wake of coal bunkers, where the frames are all of steel. The reverse frames are of steel angle bars, weighing 1·65 lbs. per ft. The floor plates forming the saddles weigh 5 lbs. per sq. ft. The reverse frames are in one piece, well riveted to the top of the floors and the frames, and end just above the water-line.

The deck-plating throughout the boiler-space is of aluminium, 3-23rds in. thick. Except over the boilers, the deck is of white pine, 1⅜ ins. thick. The deck is covered with canvas treated with paraffin wax, and secured by waterproof cement. All the hatches are of aluminium. The sides are doubled planked with mahogany, brought to a smooth face surface and highly finished. The vessel is provided with steam and hand steering-gear.

A question of the greatest interest is in regard to the speed which may be expected. Here again predictions are unsafe for want of a precedent approaching the great increase of power per unit of displacement; but considering that the form of the boat has been especially designed for the attainment of the highest possible speeds, involving a large amount of model experiment, and assuming that 4000 i.h.-p. and probably more are developed on a mean displacement of 70 tons, or somewhat less for a speed run, a speed of something over 40 knots, or 46·25 statute miles per hour may be confidently expected.

The hull was constructed at the yard of Samuel Ayers and Son, of Nyack, N.Y., who also built the *Ellide* and other fast boats. The boilers were built at the Crescent Shipyard, Elizabeth, N.J. The main engine and auxiliaries were built by L. Wright Machine Works, Newark, N.J., excepting air and feed pumps, which were built by W. Forbes & Co., Hoboken, N.J. Decorations by E. Caldwell & Co., of New York. The machinery was installed and boat completed under the supervision of the writer.—*The Stationary Engineer and Machinist* (N.Y., U S A.).

A Model Electric River Launch.

We have been enabled, by the courtesy of Mr. Stuart-Turner, to prepare and reproduce drawings of a model of an electrically-driven river launch, such as is commonly navigated upon the upper reaches of the Thames. A model of this type of boat has the advantage that it can be strictly correct in miniature —by which we mean the character of the propelling apparatus may be the same in the model as it is in the real vessel, without in any way occasioning trouble in "making the thing go"; besides which there is much less difficulty in arranging the machinery than there is in a model steamboat of the same size. It has also been found that taking two boats with equally well-designed and perfectly-constructed means of propulsion—one worked by steam power and the other by electricity, using either accumulators or primary batteries—the electrical model will surpass the steam vessel in point of efficiency and length of time working without attention. The best model steamship we have seen of approximately the dimensions of the boat now under consideration would work for about an hour without the slightest attention

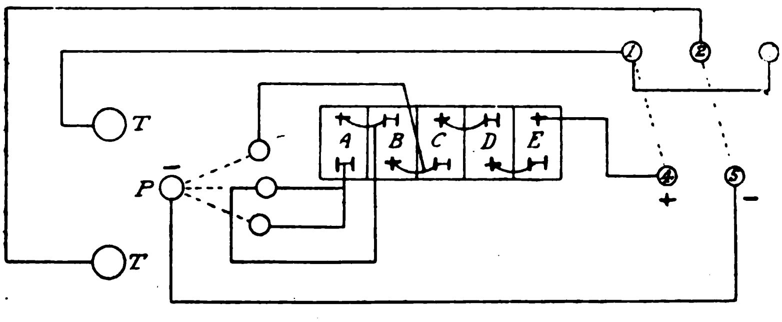


Diagram of Connections.

to the fuel or water, whereas it is quite possible to get an electric launch to run for four hours continuously. These remarks are by the way, but serve as an introduction to the description of the model here illustrated.

The hull of the boat is built of pine, in strakes about 2 ins. wide by 3-16ths in. thick, upon ⅜ in. by 3-16ths in. ribs spaced with centres some 1¼ ins. apart. A lead keel is fitted and extends the full length of the boat. To bring the craft to proper trim, a little lead was added in the fore peak. As is shown on the plan on page 89, three bulkheads are arranged; to the aft one the motor is attached, and between this and the next is the space reserved for the accumulators.

In spite of their weight, Mr. A. H. Avery's five No. 2 glass cells have been used as the source of energy, having a charging and discharging rate of 1 ampère and a capacity of 5 ampère hours. They weigh each 2 lbs. 3 ozs., and are shown in Fig. 4. It is recommended that the cell-case (Fig. 4) should be soaked in hot paraffin wax, or receive several coats of "Griffiths' Anti-sulphuric Enamel." However, some shellac varnish will be found to be fairly good and cheap. The reason the Avery cells were adopted is that these batteries have the plate fitted into grooves formed in the glass cases, thus preventing either their changing shape or being jerked into contact with one another. The accumulators have been in use for three years, and are still as good as new. When standing idle they have received an occasional charge at a low rate to keep them in good condition.

The method of charging employed is to place the cells on a 100 volt continuous current circuit in series with one 16 candle-power lamp. In the boat four cells are found to be sufficient for the motor for the first two hours of discharge, and, as will be seen by the diagram of connections, it is possible to switch in the fifth cell when the E.M.F. requires to be brought up somewhere to its original strength. The sheer and deck plan (Figs. 1 and 2) show the position of the pointer of the controlling switch, which moves over a division plate, laying flat on the deck. The divisions are engraved respectively "off," 3, 4 and 5, representing the position of the switch underneath the removable cabin, when, as the connection diagram will show, the current is off, and when 3, 4 or 5 cells are switched in. This method of speed regulation eliminates all the losses which arise from the common method of controlling by means of resistances. The wires are also lead to the fore peak, where, in order to preserve the exactness of the model, the reversing switch is situated. This is of the usual pattern, externally—a lever projecting vertically from a segmental brass cover, which is engraved in three positions—"ahead," "stop," and "astern." The construction is made clear by the diagram, Fig. 5. The steering wheel, near the reversing lever, is made of brass, left bright, and attached to the bulkhead; it is, however, only for ornament — the steering gear proper is at the stern. It may be worked by cords passing between pulley wheels and the socket for the flag mast from a following boat, or may be set by means of a screw which can be engaged into any of the holes in the brass sector attached flat to the deck on the right hand side. (See Deck Plan, Fig. 2.)

The motor is an Avery tram-car type No. 0, and is slung from the bulkhead by two angle brackets, which are permanently screwed to the latter above and on each side of the field-magnets. Into the field-magnets, between the core and the pole-piece, vertical studs are screwed. These are fitted with nuts for attaching the motor to the brackets. On to the armature shafts a jaw coupling is fitted. This not only drives the propeller shaft, but provides for any irregularity in alignment in the two shafts. The thrust block is just aft of the coupling. A plain gunmetal bearing is screwed to a block of wood fixed to the bottom of the boat, and a loose collar is slipped on and secured by a set-screw to the shaft at the rear of the bearing to take the thrust when going ahead. For the reverse direction the catchplate of the coupling is placed close up to the bearing on the other side, and also does the duty of the feathers in a thrust block, but, of course, for going astern only.

The propeller is continued through a brass stern post, which is provided with a horizontal flange to support the continuation of the keel and to form a footstep bearing for the rudder pillar, the angle being made rigid by a feather. The boat is made watertight by a stuffing-box (with screwed gland), cast solid with the stern post. The diameter of the propeller is 3 ins. It has two blades and was carefully filed up from a casting obtained from one of the model dockyards. The pitch of the screw was arrived at experimentally. In this operation the boat was placed in the water and the stern lifted until the water-line was at the centre of the propeller. The flow of the water was watched while the motor was running with the propeller

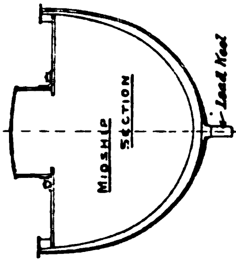
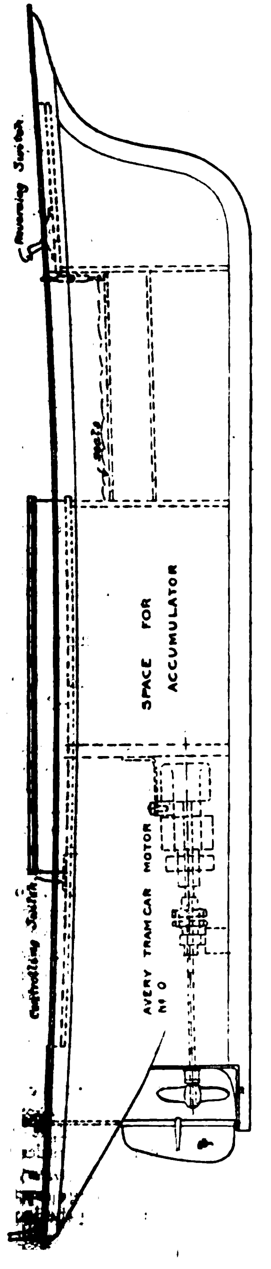


Fig. 3.



SHEER PLAN
Fig. 1.

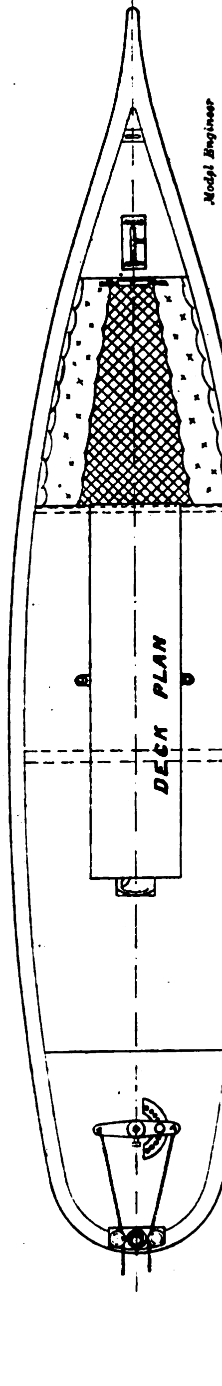


Fig. 2.—Plans of Model Electric Launch (⅛ Full Size.)

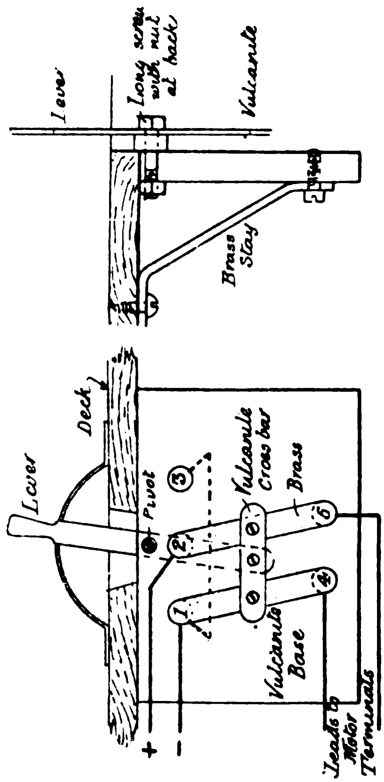


Fig. 5.—Reversing Switch and Lever.

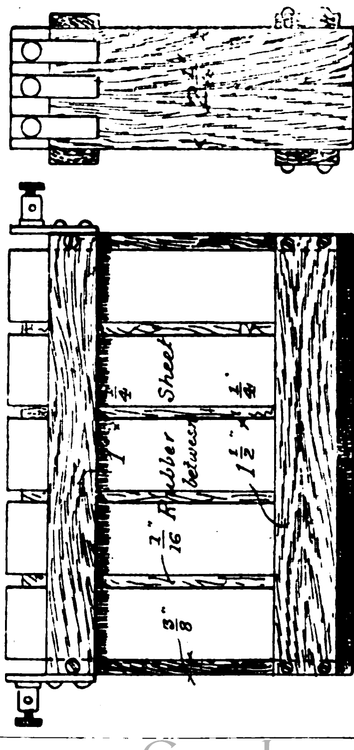


Fig. 4.—Arrangement of Storage Cells for Model Electric Launch.

at various pitches made by bending its blades with a pair of pliers. When the flow of the water was the maximum and the speed of the motor about the most desirable one for its efficiency, the propeller was allowed to remain and has been found to work very well in ordinary running.

The model is painted white nearly up to the top, an edging of polished mahogany being left all round for about ¼ in. deep. The seats are fitted with silk cushions, a silk flag is provided also. The floor at this part is covered with linoleum to complete the realism. The raised cabin is entirely removable by undoing the two terminal nuts which attach it to the deck on either side, as is shewn on the Deck Plan (Fig. 2) and midship section. This facilitates the easy removal of the accumulators, and any inspection of the wires and motor. The decks and cabins are of pine, finished with varnish.

For the Book-shelf.

[*Any book reviewed under this heading can be obtained from* THE MODEL ENGINEER *Book Department, 6, Farringdon Avenue, London, E.C., by remitting the published price and cost of postage.*]

PATTERN MAKING. By Joseph G. Horner, A.M.I.M.E. Third Edition. London: Crosby, Lockwood & Son, 7, Stationers' Hall Court, Ludgate Hill. Price 7s. 6d. net. Postage 4d. extra.

This practical treatise on pattern-making for all the main types of engineering construction is a closely printed, fully illustrated volume of some 370 pages. The name of the author goes for something in a work of this sort, and his dedication of it to workmen, draughtsmen who have lacked a training in the shops, to pupils and employers alike, is an indication of the scope and character of the book. The present (third) edition is improved by the addition of matter relating to patterns for plate moulding, storage of patterns, etc. The main portion of the book treats on designing and pattern-making of toothed wheels and all their numerous adaptations, on core prints, engine cylinders, flywheels, and, indeed, every variety of engine work and moulding generally. It is essentially a book for the practical man, who would find it invaluable.

SELF PROPELLED VEHICLES. By James E. Homans. New York: Theo. Audel & Company. Price 21s. net. Postage 6d. extra.

The aim of the author of this book is a high one, since it is intended to include the "theory, construction, operation, care and management of all forms of automobiles"! A book with that programme before it obviously needs a very careful examination in each of its departments, if a final verdict is to be rendered of its usefulness. Without going so far, however, we may record our appreciation not only of its generally satisfactory nature, but also our conviction that it is the most complete exposition of the subject yet published. We have examined some of the sections closely; that, for example, dealing with the electrical ignition of internal combustion engines. It is here that so many writers of otherwise good books fail to give a good account of themselves—or of the subject—and for that reason we are pleased to find no appreciable errors, no vague statements, and, in short, none of that half-acquaintance with electrical matters so often displayed. The author does not undertake the expression of decided opinions between this and that engine or between rival mechanisms at all. That is not his business. He describes all, as we think, impartially, giving the good points due prominence and being not afraid to state the "other side of the case." The amount of constructional matter in the book is really surprising, as is also the extent to which principles are explained, so that the volume is by no means of that degenerate type which is outwardly good and complete but inwardly is made up of catalogue blocks and makers' descriptions! It is only fair, considering the necessary brevity of this notice, to enumerate the contents of the volume in some detail. These contents include chapters on the names and varieties of motor carriages, a history of the subject, "How a motor carriage turns," steering, underframes, springs, wheels, tyres, steam boilers, liquid fuel burners, the use of steam, steam engines, principles of gas engine action, gas engine efficiency, carburettors and vaporizers, ignition of charge, transmission gears, electrical principles, storage batteries, brakes, ball and roller bearings, lubricants, hints on steam vehicle and gasoline vehicle management. In this list we purposely choose only the "heads" of the more important subjects; but these are surely sufficient to indicate to every practical man that the volume is encyclopædic enough to be of the greatest utility. Undoutedly it should be regarded as part of his equipment.

THE MOTOR CAR: Its Nature, Use and Management. By Sir Henry Thompson. London: F. Warne and Co., 15, Bedford Street. Price 2s. 6d. Postage 3d. extra.

This volume does not pretend to be an exhaustive treatise upon the motor car, but is a little book written by one whose acquaintance with the autocar is comparatively recent, and therefore is eminently useful for those who are commencing to use the new method of transport. Sir Henry Thompson, in the preface, says that as soon as he had become possessed of a car he "was naturally anxious to learn the *modus operandi* of the machine—its anatomy and physiology," and to help others in like circumstances may be taken as the object of the book. The book is well written and nicely printed, treating the subject more or less in a popular style. Besides dealing with motor mechanism, it gives sound advice to those who drive, and concludes with a series of routes for touring with a car all over the country, the distances in miles from the starting-point being indicated. Owners of autocars should possess this handbook.

NOTES ON THE CONSTRUCTION AND WORKING OF PUMPS. By Edward C. R. Marks. Manchester: The Technical Publishing Company, Limited, 31, Whitworth Street. Price 3s. 6d. nett. Postage 3d. extra.

It is hardly possible, within the space available, to give the reader an exact idea of the scope of this admirable volume. The earlier chapters deal with the conditions affecting the working and arrangement of all kinds of pumping machinery, and the remainder for the most part consists of descriptions of the various types of pumps, together with practical comments upon the especial features and uses of each machine. The book is one which ought to be in the possession of every engineer who has to do with pumps of any description, as well as the student of mechanical engineering. It also appeals to the purely model engineer as it is likely to prove of considerable assistance to him in the making of model pumps and pumping machinery.

A TRAIN on the Pennsylvania Railroad recently completed a run from Pittsburg to New York, a distance of 438 miles, without a stop. This, we understand, is the longest run of a passenger train on record. In order to accomplish this feat, says the *Mechanical Engineer*, it was necessary for the locomotive to carry a large supply of coal, and this was only possible by enlarging the locomotive tender.

The Editor's Page.

OUR remarks in our July 15th issue on the subject of working drawings, appear to have been fully appreciated by many of our readers, as witness the following two letters, which we quote from a number written in the same strain. We only hope that what we have said will make an equal impression on those advertisers to whom our criticisms applied.

* * *

"E M." (Wolverhampton) writes: "I was very pleased indeed to read your remarks on page 41 in current number about the working drawings sent out by some firms. I purchased a short time ago a set of castings with 'working drawings,' and the latter fully bear out what you say; and when I wrote asking if they were the correct things, I was curtly told 'that they were the only ones issued.' On the other hand, it is gratifying to find other firms who supply really good drawings, which go such a long way to assist model engineers in fitting up the goods that are advertised, and it is to be hoped that your remarks will do good. I consider that you deserve the hearty thanks of all readers of our up-to date modellers' magazine."

* * *

"G. E. C." (Moscow) writes: "I was very pleased to see you call attention in the last issue to the necessity of good, accurate working drawings before any work of construction can be properly commenced, and to the fact that sellers of sets of castings do not always furnish such drawings. It is not so much the absence of proper working drawings that I object to when buying castings from some makers, as the fact that these makers make a special point in their advertisements of stating that they present with each set of castings working drawings free, with a big line under the 'free,' when such a statement is, to say the least, a long way from the truth. Just at the present time I am about to commence building my first model from a set of bought castings. A paragraph in the seller's price list assured me that 'working drawings were sent out with every set, so that no difficulty would be found in fitting together.' I therefore naturally expected that I should have nothing to do but commence work, taking my measurements from the drawings. What was my surprise, however, on receipt of the castings and *working drawings* to find that the drawing, although it resembled in the main the engine which the castings were intended to make, differed in several details from the castings—in fact, some of the parts were of quite a different pattern to the actual castings, the requisite proportions were not strictly adhered to, and worst of all the drawing was neither full scale nor any other scale, and was therefore absolutely useless. The fact that I had been deceived was really the only part of the business that annoyed me, as I am a firm believer that every amateur mechanic should certainly make his own drawings, and I should imagine that if he is unable to make good and accurate drawings of the article he intends to construct, he stands very little chance of becoming a successful constructor. One has a very much better knowledge of the dimensions and form of the various parts after having made complete working drawings, than one has after simply looking at a drawing made by another party. The making of proper working drawings may cost several hours of tedious work, but this is amply compensated for by the knowledge gained, and the confidence that one can commence work in full assurance that the parts when made will be correct in form and size. My advice to amateur mechanics is do as much as ever possible yourself, and do not rely too much on the assistance of others. I do not, however, say that books on mechanical subjects and hints and suggestions by others are to be despised. I have learnt many wrinkles from books, and also from the query columns of mechanical journals; but I have sometimes found the advice given in books impracticable in my own particular case, either from lack of the proper tools, or some modifying circumstance, and I have generally found in my own brain the solution of the difficulty."

* * *

The same correspondent also sends us the following:—"What I consider a very curious thing happened the other day when I was cutting a screw on a stuffing-box gland in the lathe with a chaser. I have had no experience in the use of this tool, but having no stocks and dies of the requisite size, I thought I would try this method. After one or two preliminary trials on pieces of waste material, I screwed my stuffing-box and gland with what appeared to me a tolerably straight and even thread and a nice easy fit. On trying to screw in the gland, however, I found it would not go at all. I succeeded in getting it in a short distance, when it stuck tight and partly skewed. I was sure the diameter was right, and was at a loss to make it out until I examined the thread carefully by wrapping a piece of black sewing cotton round it. It then became evident to me that, instead of one thread being formed spirally round the screw, there were two distinct threads, so that the screw advanced with each turn through a distance equal to twice the pitch of a single thread, and as the inside thread was, as I ascertained, correctly formed with a single thread, it became evident that I had spoilt my gland. This happened quite by accident and not by design, and the chaser is the same as I afterwards cut a single thread with. Now, I am in the curious position of not knowing how I did this. Of course, I could find out by a few trials with different methods of holding the tool; but I should like to know if the same thing has happened to anyone before, and if this peculiarity of the chaser is generally known, or have I made a discovery?"

* * *

The "discovery" our correspondent has made is one which is also made by many other amateurs during their early experiences with hand-chasing tools. The explanation is that he failed to make the teeth of the chaser during the second cut fall in the groove started during the first cut, and, consequently, he started a second series of grooves in between the grooves of the first thread. During the subsequent cuts of the chaser, the teeth probably dropped first into one thread, and then into the other, until the two threads were fully worked up. It is, however, a coincidence that the cuts should have alternated so regularly that a difference in the depth of the two threads should not have been noticed, and thus aroused a suspicion that all was not going well. An experience of this kind is a very useful lesson, which our correspondent will no doubt duly profit by in his future work with the chaser.

* * *

A correspondent writing to our Query Department for some information, "takes the opportunity" to offer a little criticism and his advice. His opinion is quite definite—THE MODEL ENGINEER contains too much locomotive and steamer matter—and he is so convinced of this that he "would have not more than one locomotive article a year," and would give the "A.E. part of the journal a chance!" Obviously, it is the turn of the locomotive enthusiast to speak; will he demand that electrical articles be confined to one per year? With only one steamer and one locomotive and one electrical article in the year, our pages would look rather blank; and we wonder whether either of the critics would be satisfied? As a matter of fact, we do our best to cater for a very wide circle of readers, the majority of whom are *interested* in most of the matters we deal with, though possibly only one or two items may be of especial value to them. A hard worker in any branch of model engineering would, we venture to say, always find enough in our pages to keep him busy in his workshop; and this really is the case with most of our readers. No doubt our critic thinks THE MODEL ENGINEER very good indeed, but wants it to be better. Of course, we would agree with him there; but we have our own opinion as to the policy of the change he advises, and he will have seen the force of this by the time he has read so far.

Answers to Correspondents.

"WELL-WISHER" (London, W.C.).—A handbook in THE MODEL ENGINEER series on the subject, is now in the press, and will be issued shortly. Thanks for the suggestion.

"G. E. C." (Moscow).—Thanks for your letter, which you will see we have used. We shall be pleased to have a description of the engine when it is completed.

"W. M." (Bradford).—A reply to your letter has been unavoidably crowded out of this issue.

"E. C." (Dewsbury).—Your query is not within our scope, and we are of opinion that the scheme is impracticable.

"A. E. L." (Prince's End, near Tipton).—This would require more space than we could afford, and would not, we think, prove of sufficient general interest. A "simple design" is out of the question—from the very nature of the case.

A SHEFFIELD firm, Messrs. Jonas and Colver, have invented and perfected a new tool steel (which they call the "Novo") of remarkable properties. It can be so tempered that a tool of the finest edge can be driven at speeds never before attempted. A machine toolmaker experimented with a 7-16ths in. square Novo steel in a tool-holder. Eight pieces of machinery steel 1⅝ ins. in diameter and 34 ins. long, were roughed out to 1 9-16ths ins. at 108 ft. per minute.

Prize Competition.

Competition No. 22.—Two prizes, value £2 2s. and £1 1s. respectively, are offered for the best and second-best designs (to include full description and working drawings) for a working model flying machine. The size, type, and propelling power of the model are left entirely to the choice of the competitor, the main stipulation being that it shall be capable of successful working. The model must have been actually made, and the prize winners will be required to send in their models for inspection and trial by the judges before the actual awarding of the prizes takes place. The last day for receiving entries is October 31st, and the usual general conditions apply in this Competition.

GENERAL CONDITIONS FOR ABOVE COMPETITION

1. All articles should be written in ink on one side o' the paper only.
2. Any drawings which may be necessary should be in good black ink on white Bristol board. No coloured lines or washes should be used. The drawings should be about one-third larger than they are intended to appear if published.
3. The copyright of the prize articles to be the property of the proprietor of THE MODEL ENGINEER, and the decision of the Editor to be accepted as final.
4. The Editor reserves the right to print the whole or any portion of an unsuccessful article which he may think worthy of publication, unless the competitor distinctly expresses a wish to the contrary.
5. All competitions should be addressed to The Editor, THE MODEL ENGINEER, 37 & 38, Temple House, Tallis Street, London, E.C., and should be marked outside with the number of the competition for which they are intended. A stamped addressed envelope should accompany all competitions for their return in the event of being unsuccessful. All MSS. and drawings should bear the sender's full name and address on the back.

A Model Steam Motor Car.

STANLEY D. ARNOLD is the twelve-year-old son of an eminent Chicago electrician, and this lad, working on information got from his father, and gained by experiments made by himself in a small machine-shop at his home, where he has the use of a small lathe and drill press, has designed and built a model steam motor car, which is said to work perfectly. The complete car can be packed in a box measuring 12 ins. long by 8 ins. deep. The water-tube boiler is 4 ins. by 3½ ins., and has a heating surface of 34 sq. ins., and the burner is 3½ ins. This combination failed to give sufficient steam, but a feed-water heater was added, and it now gives steam in abundance. The engine cylinders are ⅝-in. bore by 1¼ ins. stroke, and the engine drives a countershaft by bevel gearing, the drive to the rear wheels being by side chains. The steam is controlled by a throttle valve at the right side of the seat. Wheel steering is fitted, and the body is supported by four semi-elliptic springs. The engine boiler, water tank, &c., are under a readily removable bonnet in front, and the petrol tank is under the seat. Every part of the machine (with the exception of two or three very small valves which he could not possibly make with the tools at his disposal) was made by the boy, and this fact becomes even more remarkable when it is remembered that he has had no ordinary mechanical training. A couple of photographs of the motor are reproduced by the Chicago *Motor Age*.

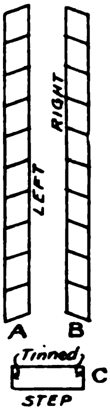
Practical Letters from Our Readers.

[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.]*

Ladders for Model Steamboats.

To the Editor of *The Model Engineer*.

Dear Sir,—I consider myself amply repaid for the trouble taken in making model ladders in the following way:—They are made entirely from scraps of brass, the sides being 1-24th in. thick and the steps 1-48th in. thick, and are thus built up. First cut the sides to the required size (which, of course, depends on the scale to which the boat is built), and carefully mark off in equal lengths; the distance between the steps should be about the same as the width of the step itself. Now make two cuts in a mitre box to the required angle (mine slope at 60 degs.), and with an ordinary dovetail saw make a cut about half-way through at each of the marks for the steps to fit into. The steps can now be cut out of the thinner brass, the length being about three times the width. Now, with



Method of Making Ladders for Model Steamboats.

soft solder, tin the ends of each step, and also between each cut on the sides. If the solder fills up any of the saw cuts it can easily be removed by the saw. The top and bottom steps should first be soldered in, care being taken to get the whole perfectly square. Now get a piece of flat wood, place the ladder face downwards on it, and drive in a tack at each corner so that the whole is firmly fixed to the wood. Slide in the rest of the steps, keeping the tinned side to the bottom, and after making sure that they are all level, hold behind a gas jet and blow the flame on it till the solder runs. When it is quite cold the tacks can be drawn out and all the surplus solder filed off. With reasonable care the result will be ladders very neat in appearance, and at the same time very strong.—Yours truly, J. L. G.

Watford, Herts.

Making Small Milling Cutters.

To the Editor of *The Model Engineer*.

Dear Sir,—Seeing your note in the editorial column in a recent issue of The Model Engineer respecting the wish of several correspondents for information on milling cutters, I should like to give my experience.

Presuming, in the first place, that the better plan would be to obtain one of the 1s. or 1s. 6d. cutters advertised by the Pittler Company, which are made to run true, and are properly tempered, and consequently give good results, I will describe how I have made several cutters at an infinitesimal cost which have answered the purpose well.

My first was made from a broken stay busk—the large spoon-shaped part. This was centred with a punch; and circle described with compasses as large as the steel would take—viz., about 7/8 in. It was then nicked across with file and broken, corners broken off, and then ground to a circle. The hole in centre was punched through, a little at a time, the burr being taken off the other side with a file until it was large enough to fit spindle. The spindle was of 1/4 in. iron turned down to 1/8 in. at the end and fitted in the drill chuck. The cutter was riveted on. The teeth were cut as follows:—Cutter was fixed in vice, and one division filed in edge; a piece of sheet brass 1-16th in. thick, and 2 ins. long was placed in cut, and held at an inclination of about 60 degs., the three-square file laid on this and the next division filed, and so on all round, the brass acting as guide and spacer. It is surprising how regular the teeth may be made if a little care is taken, and how quickly the whole may be cut. The rapidity with which this cut up sheet brass, etc., was a revelation to me. It will be seen that my wish was to avoid softening and retempering the steel as I had had so many failures in my attempts to do this.

My next attempt was to make a disc fly-cutter to cut teeth in wheel of a very small musical box. This had only three teeth, two were short and bent out in opposite directions to shape tops of wheel teeth, the middle one cutting the depth, but although I think the idea good it was not successful with me—owing probably to my lathe being very light and the chattering and vibration very great. After this I invested in a cabinet-maker's steel scraper at a cost of threepence, this was 2 1/4 ins. wide, and after softening it I cut off a piece 1 1/4 ins. wide, dividing this gave me two pieces 1 1/4 square—the plate will cut four of these. These were made round and toothed as previously described, except that the discs were turned circular in lathe, and as I had by that time come into possession of a 5-16ths in. saw spindle the cutter was drilled out to fit.

After hardening and letting down to straw colour I commenced to use it for cutting a lever lock key. The cutter slipped, and upon tightening up the nut it cracked across. This was only to be expected, as it had no doubt warped slightly in the hardening process. I then put a small pin in spindle and filed keyway in the next cutter, and let down the temper of centre of cutter to blue. To do this, after the hardening and tempering has been done, take a piece of round iron, small enough to go into hole in cutter, make it red hot and insert, watch carefully to ensure that the blue does not extend to the teeth, and when colour has spread sufficiently (about half-way, or rather more), knock cutter off the iron into a basin of water.

The teeth were made of ordinary shape about 1-16th in. apart, and this appears to be the most suitable size for these small discs, as they cut well.

The same method can be adopted for making gear-cutters, but the steel will then have to be as thick as a whole tooth and space, and turned to shape (before cutting teeth) so that it will cut half the tops of two adjacent teeth as well as the space between.

The usual plan of driving saw spindle with carrier has the serious disadvantage of occasionally rapping one's fingers, and as such small cutters as these must be driven at a considerable speed I fitted a tube drive to mine as follows:—Procure a piece of tube-iron or brass to fit centre chuck, and of sufficient length to project about an inch from centre point. Cut a slot at one end to pass the screw that fixes driver in chuck, also two slots at the other end. Drill hole through saw spindle and drive in taper pin to engage in the two slots in tube. File pin down level with outside of tube and round off the end of tube, so that there is no sharp edge. This will be found to be a very safe and satisfactory drive either for cutters or for emery wheel and can be made in a few minutes.

As the steel mentioned is barely 1-16th in. thick two or more cutters may be mounted side by side if it is required to cut a wider slot—that is, of course, provided they are made of the same diameter.—Yours truly,

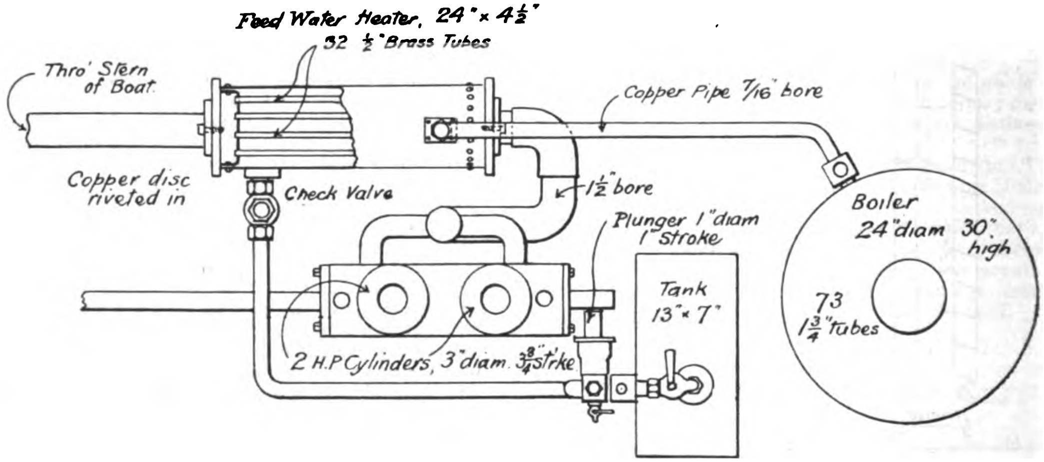
Leyton. ARTHUR GREEN.

Some Notes on Improving a Steam Launch.

TO THE EDITOR OF *The Model Engineer*.

DEAR SIR,—I understand from one or two of your replies to correspondents, that you are pleased to receive any practical experiences as regards results from actual observations, I therefore send you all particulars I can think of regarding the mechanical part of my steam launch, hoping that I may be of service to other readers very suitable for small crankshafts and is so much easier to work up than a forging, which, being small, is nearly sure to be fairly rough. My connecting-rods are 1-in. diameter at big end, tapering to 13·16ths-in. at smaller end. I drilled a ⅜-in. hole clean through, which made them considerably lighter. My feed pump for a long time failed to act, the reason being that I had not got a check-valve between feed water heater and pump. It was a silly thing to omit, but I now think it was excusable, as one or two clever engineers (one a consulting engineer in London) could not make out why the pump failed to throw enough water. As you will see by enclosed sketch (not to scale) of my engine, &c., I do not exhaust into chimney, but out at the stern of boat. I do not use a blower or steam jet. I have a reversing lever and sector with notches, and usually run cutting-off at 33 per cent. I can run forty-eight miles on 1 cwt. of coal at 75 lbs. pressure, 350 revolutions per minute. I have had steam up twelve minutes after lighting-up, using shavings—*not paper*—and two bundles of wood.—Yours truly, FRANK H. KEATS.

Waterbeach.



ARRANGEMENT OF MACHINERY IN A 26-FT. STEAM LAUNCH.

of THE MODEL ENGINEER; should they ever require information on steam launch work, some of these notes may be of service to you. My launch is 26 ft. long, 5 ft. 6 ins. beam, 2 ft. 6 ins. draft, and when I bought her, had a horizontal boiler 2 ft. diameter, 5 ft. 6 ins. long, with twenty-eight 1¾-ins. tubes, firebox 18 ins. by 26 ins. It took from 1 to 1½ hours to get up steam. The engine had a single cylinder 3¾ ins. bore, 5 ins. stroke, and exhausted up funnel. I then could burn 1¼ cwts. of coal in a run of twelve miles.

I built a new engine, 2 h.-p., cylinder 3 ins. bore, 3¾ ins. stroke. I spent two years over her, so you may know I did not scamp work. I made my own drawings, patterns, &c., also forgings (all Bessemer steel), and the turning was all done on a 4½-in. screw-cutting lathe. The engine is the usual high pressure type. The crankshaft is of the web pattern as on locomotives; it is 1¼ ins. diameter and is made of malleable cast iron and was sixteen days in the "oven." It has had, at least, one severe test, as when running at ten miles per hour a piece of willow wood 3 ins. diameter got in the propeller and, of course, stopped the engine dead. I have also reversed once or twice, when running about the same speed. The former, I think, was an extra severe test, and there was no damage done at all, so I think malleable cast iron is

New Design of Model Tank Locomotive.

TO THE EDITOR OF *The Model Engineer*.

DEAR SIR,—In reply to F. J. K. in the August issue of your journal, I think your correspondent does not quite understand what actually happens in the smokebox of this model locomotive. The superheating coil must, for practical reasons, be placed in the front of the chimney, and a reference to the drawing will make this clear. Also I think that the temperature of the gases in the smokebox does not vary to the extent that F. J. K.'s letter would suggest. True, the gases at the front may be one or two degrees less in temperature than at the tube plate when the engine is standing, but when it is working hard the velocity of the products of combustion up the flue tubes is such that they are likely to be projected nearly to the smokebox door. As stated in the article, the smokebox wrapper is lagged to prevent the paint burning and damage to the driver's fingers. This fact would also conduce to a very even temperature in the smokebox at any given moment. The smokebox door being bare is always very hot.

The idea of the superheater was to provide for the collection and use of the hot gases which otherwise would be wasted, which gases, from my observations of the working of other models fitted with oil fuel, seemed to be of very high temperature, and it was arranged that if the superheater was not found to be advantageous, all that was necessary to replace it was the unscrewing of two unions and the insertion of a short piece of tube—another reason for its position. Yours truly,

London, E.C. H. G.

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, *37 & 38, Temple House, Tallis Street, London, E.C.]*

The following are selected from the Queries which have been replied to recent y : -

[6592] **Model Loco Queries.** C. J. C. H. (Bourne End) writes: (1) Do you not think it would be better if the "Primus" burner were made oval instead of circular, thus conforming more to the usual shape of a firebox; and if you do, would it be possible to have one specially made that shape? (2) Would ⅜ in. water space round the firebox be too little for a ¾ in. scale model? (3) Is there any distinct advantage in having a plug in the crown of the firebox, as illustrated in the recently described 10-wheeled tank loco? (4) Could you tell me to what class of engine the "Wynnstay," G.W.R. belongs?

(1) "Primus" silent burners can be pinched in when necessary. This may be done in the vice without serious risk to the burner. The 2⅝ in. burners can be made to go into a firebox 2⅛ ins. wide; see issue of August 1st, 1901. (2) We should advise not less than 3-16ths-in. water space. (3) The advantages of the fusible plug are many. It is, as is mentioned in the article, a very efficient telltale, and prevents serious damage to the crown of the firebox and other parts of the boiler. It only takes a quarter of an hour to replace the plug, and the rush of steam and water puts the burner out instantly should anything go wrong with the boiler, and it run short of water. (4) Quite out of our scope. Address this query to one of our locomotive engineering contemporaries.

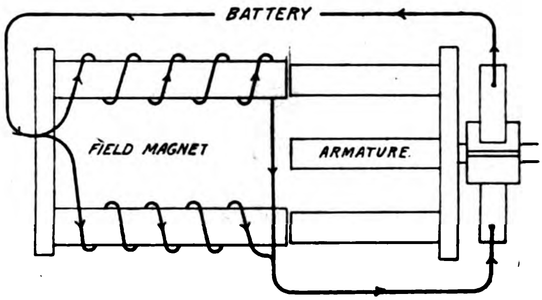
[6607] **Dynamo for Charging Accumulators.** O. H. D. (Harrow) writes: I should be much obliged if you could give me a rough design of a dynamo for charging accumulators, having an output of about 25 ampères at about 15 volts pressure; the power available is ½ horse-power. Please state dimensions, also amount of wire on field-magnet and armature. I should like the field-magnet to be of two poles and in two pieces. Would a "Manchester" type dynamo be suitable? Not being experienced in dynamo construction, and seeing that you have given so many people such useful information in your paper, I thought it best to apply to you.

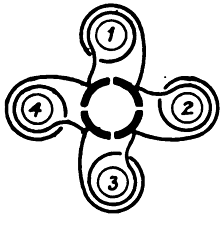
Will not one of the dynamos described in "Small Dynamos and Motors" suit your purpose? You require a machine of about 375 watts output, and without going into a considerable amount of calculations, we cannot give you anything nearer than one of the 400-watt dynamos described in the above book. If this does not enable you to design the machine complete, please let us know your difficulties, when we should be glad to assist you further.

[6579] **Motor Bicycle.** J. B. (Rotherham) writes: I have read with much interest in your esteemed paper, Mr. Hawley's article on "Motor Bicycles," and I should like to be enlightened on the following points:—(1) What is about the total cost, or rather outlay, for I do not include my own work? (2) In what state are the B.S.A. fittings when obtained? (3) What is the best way of getting them, direct or through an agent? Where do you get your special tubing? (4) What do you value the machine at when complete?

(1) Your first query is rather vague, as you do not say whether you wish to purchase rough castings or the complete motor equipment. Mr. Hawley states that he has not yet got to the point of giving the names and addresses of makers of cycle motors and castings; but if you are prepared to work from rough castings you can get them at from 40s. to 50s. with certain intricate parts already finished. The total outlay on above lines in order to finish the machine, *i.e.*, the work which an amateur could not do, would be about £22, and this would include finished B.S.A. fittings as hereafter described. (2) B.S A. special motor bicycle fittings consist of finished bottom bracket with chain wheel and cranks, hubs with clutch, complete ball head assembled, machined back fork ends, seat lug, and all other parts necessary for completing the mere frame, just leaving the brazing to be done. All the finished parts are nickel-plated and ready for the complete machine. (3) Unless you are in the cycle trade you would not be able to buy direct from the B.S.A., but you might get some local cycle agent to carry through your order by way of Brown Bros., of Great Eastern Street, London, E.C., who would also be able to supply the special double-butted tube. (4) The completed machine, with first grade tyres, would stand at £45 retail, though with certain extras about to be described the machine would touch the £50 level. If you are anxious to get on, buy a complete "Minerva" set and a B.S.A. special motor set, fit the machine with Clipper Reflex tyres, and you will have no cause for regret.

[6641] **Simple Electro Motor.** J. A. C. writes: (1) An account of an electric motor was given on pages 206-7, Vol. V, 1901, as fitted to a model electric torpedo boat destroyer. Can you give me sketch of connections to commutator, etc.? (2) Please state the size of motor. I have a large amount of 22 C.C. wire, and I should like to use it. Please say how much should be put on armature and field-magnet.





SIMPLE ELECTRO MOTOR.
Query No. 6641.

(1) All four poles are wound alike, and there are four sections in the commutator. The finishing end of the wire on the first pole you wind is to be bared, cleaned, and twisted up with the commencing end of the next pole. This twisted wire is to be joined to the nearest commutator segment. The finishing end of the second core is to be joined to the commencing end of No. 3 pole, and both to the second commutator segment, and so on. The accompanying diagram will make this clear. (2) Most of the dimensions, of any importance, are given or can be judged from the article and illustrations. The cores of the armature are 1⅜ ins. long, and may be about ¼ in. or 5-16ths in. diameter. The yoke-plate may be ⅛ in. or 3-16ths in. thick. You may use the No. 22 wire to wind the motor, winding each armature core until it is three times the original diameter. The field cores may be ⅜ in. diameter, and should be wound until they are 1 in. diameter each. To get the best effect with No. 22 wire on field-magnets as well as on armature, the two limbs of the former must be connected in parallel. To do this they must be wound as in above diagram, differently from the usual magnet winding. The connection is in series as indicated in the sketch.

[6672] **Pole Finding Paper.** J. C. (Glasgow) writes: Can you tell me how to make efficient pole-finding paper?

Make a thin solution of white starch and soak strips of thin white blotting-paper in it, and set aside in a clean place to dry. Then dissolve ½ oz. of potassium iodide in 1 pint of water. Immerse the strips in the solution for a few seconds, and again dry. This paper, when moistened and used in the usual way, turns violet at the positive pole.

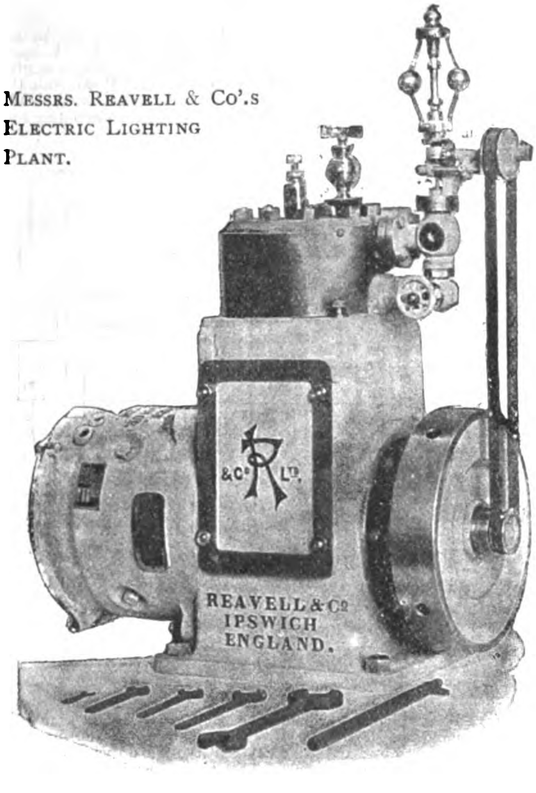
Amateur's Supplies.

[*The Editor will be pleased to receive for review under this heading, samples and particulars of new tools, apparatus, and materials for amateur use.*

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

Self-contained Electric Lighting Sets.

The illustration below gives a good idea of a line of self-contained electric light sets, full particulars of which can be obtained on application to the makers, Messrs. Reavell & Co., Ltd., Ranelagh Works, Ipswich. The photograph shows—better than we could describe—the very compact arrangement adopted, making the sets specially useful for private house lighting, or for other similar purposes. Amongst these may be mentioned the lighting of small workshops, yachts, and small vessels generally. The engines work silently at high speeds, driving the dynamo direct, and the revolving parts work in a bath of oil, so that a minimum of attention is required to



MESSRS. REAVELL & CO'.S ELECTRIC LIGHTING PLANT.

keep the machine in order. Owing to the style adopted, the weight has been kept low, although we understand that the parts are substantial, and the whole so simple that anyone of ordinary skill can erect the engine and have it running in a very short time. The sets are made in six sizes, having various outputs capable of lighting from 13 to 150 8-c.-p. lamps, or doing equivalent work. Other details and prices can be obtained from Messrs. Reavell & Co. as above, mention being made of THE MODEL ENGINEER when writing.

A Novelty in Paper Weights.*

Messrs. W. J. Bassett-Lowke & Co., of Kingswell Street, Northampton, have produced quite a novel paper weight in the shape of *a model* of a working model vertical engine and boiler such as they supply in the ordinary way. The paper weight or ornament, for it can serve the latter purpose admirably, is about 3¼ ins. high, about quarter full size of the working engine, and is very well made and finished. Its moving parts are not altogether "dummy," the flywheel and axle with crank, connecting-rod, eccentric sheave and strap, handles of whistles and taps all are capable of movement. The price of the article is 3s. 7d. carriage paid. Readers will oblige by mentioning THE MODEL ENGINEER when writing.

A Lathe Milling Attachment.

From the Croker-Barnes Tool Company, 12, Smithdown Road, Liverpool, we have received an illustrated descriptive sheet, giving particulars of a patented milling and grinding device for use in the lathe. The claim is made for this apparatus that with it not only all kinds of milling—gears, worms, wheels, reamers, slots etc.—can be done, but that accurate spacing, external and internal grinding, are all within its capacity, and able to be done by either hand or power. Certainly, a good milling attachment to a lathe may be a great saving in machinery, and is always a convenience. The present tool can be run at any speed from 60 to 15,000 revolutions per minute, according to its class of work; it is said to take a good cut, and is accurately graduated wherever that is an advantage. The price of the "No. 1" size (there are three sizes), suitable for lathes to 6-in. centres, is £10 10s. net, complete. Readers corresponding would oblige by mentioning this journal.

American Patents.

Many of our readers may find it useful to hear that Mr. Orlan Clyde Cullen, Patent Lawyer, 700, Seventh Street, N.W. Washington, D.C., U.S.A., will be very pleased to correspond with anyone wishing to take out American patents. In writing, correspondents should remember that the postage to the United States is 2½d. per half-ounce.

A Book of Yacht Designs.

Mr. F. W. Martin, of Waukegan, Illinois, U.S.A., has now ready the new edition of his book on yacht designs. This firm have built and are building many varieties of small boats, row boats, sail boats, launches, and small yachts, and state they are well prepared to supply anything in this line. A novel feature of this business is the building of boats, or rather the assembling of frame and hull according to the drawings, and then "knocking down" and crating the parts "all marked" for shipment to any part of the world. Anyone interested in boat-building should address them for circulars, not forgetting that the postage to the United States is 2½d.

Catalogues Received.

Page & Co., Kimberley Gardens, Green Lanes, London N.—A new list, dealing with lamps, accumulators, and other electrical sundries has been issued by this firm. Either glass or ebonite cases are supplied and parts can be had separately. Electric scarf pins, motors, bells, &c., are amongst the other items in Messrs. Page and Co.'s list, which can be had by any reader mentioning this journal and enclosing a penny stamp.

Universal Motor Co., Copeland Street, Derby—This firm manufactures a small motor for cycles, and supplies castings, finished engines, or accessories at modest prices. A good blue-print accompanies the sets of castings to enable the mechanic to fit them up, and the firm guarantees to supply sound castings. Prices are quoted for machining any of the more difficult parts, and these and other particulars can be obtained on application to the firm, this paper being mentioned.

Madison Co., Woolrych Street Works, Derby.—For three penny stamps readers of THE MODEL ENGINEER can obtain from this firm a well-printed list of small gas and oil engines, motors for cycles, launches, &c., and dynamos, motors, and electric lighting sundries. These lines are all supplied either as finished work or in the rough, so that the catalogue should prove a useful one to many readers. Small petrol motors for bicycles are a speciality of the firm, who will be glad to quote readers for whole sets or parts.

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 6s. 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," 37 & 38, Temple House, Tallis Street, London, E.C.

All correspondence relating to advertisements to be addressed to THE ADVERTISEMENT MANAGER, "The Model Engineer," 37 & 38 Temple House, Tallis Street, London, E.C.

All subscriptions and correspondence relating to sales of the paper to be addressed to the Publishers, Dawbarn & Ward, Limited, 6, Farringdon Avenue, 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.

THE

Model Engineer

AND

Amateur Electrician.

A JOURNAL OF MECHANICS AND ELECTRICITY FOR AMATEURS AND STUDENTS.

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

VOL. VII. No. 80. SEPTEMBER 1, 1902. PUBLISHED TWICE MONTHLY

The Society of Model Engineers' Excursion to Rugby.

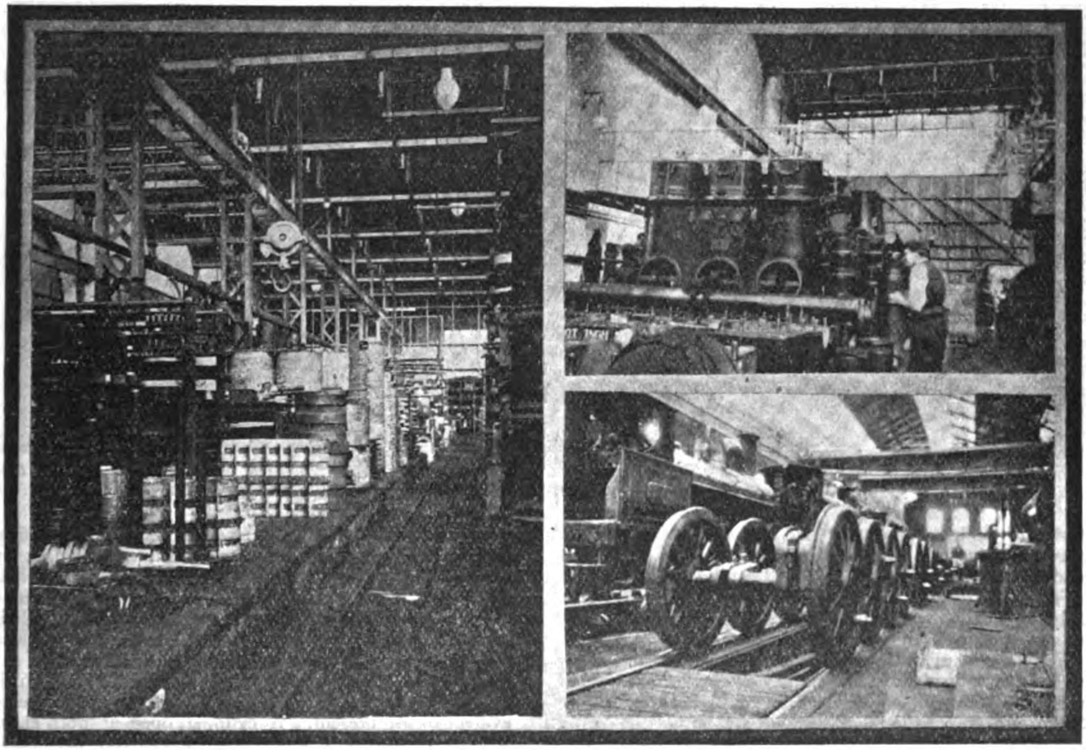
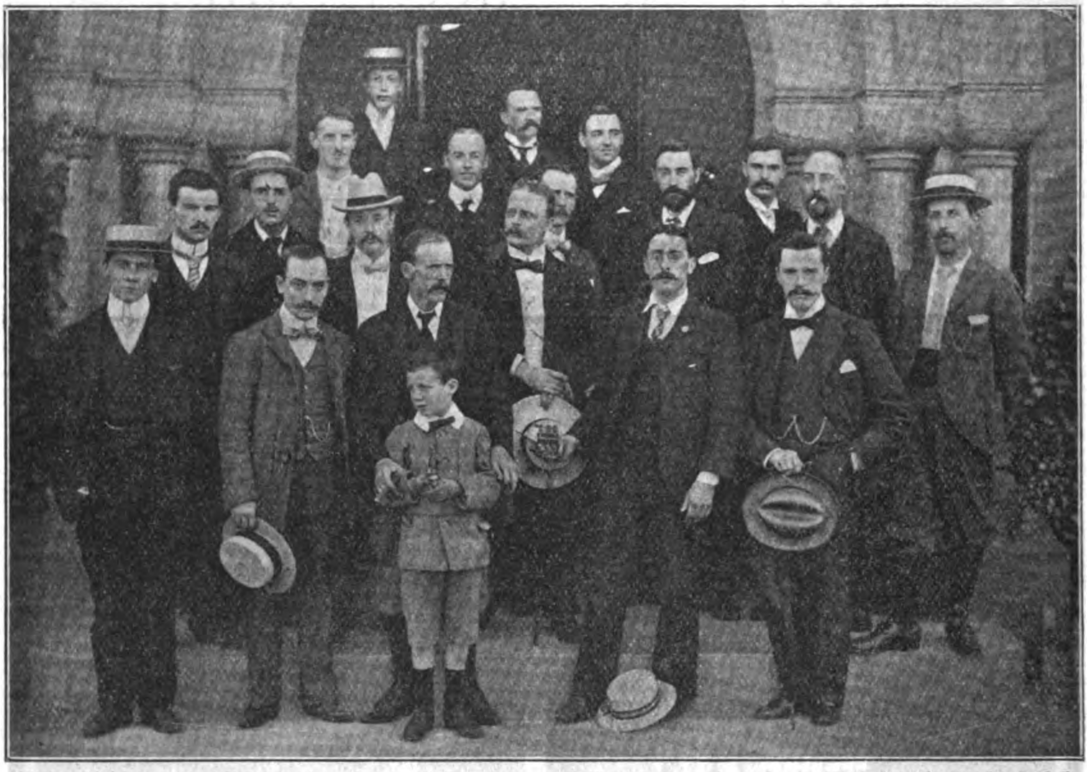


FIG. 1.—MESSRS. WILLANS & ROBINSON'S WORKS: MANUFACTURED STORES. FIG. 2.—ERECTING SHOP.
FIG. 3.—L.N.W.R. REPAIRING SHOP, RUGBY.

ON Thursday, July 17th, the London members of the Society of Model Engineers held their fourth annual summer excursion, in accordance with the arrangements announced in previous issues. In time for the 10.5 a.m. express, about eighteen members presented themselves at Euston, and with the regularity o. speed and punctuality for which the L.N.W.R. is noted, were transported in a comfortable saloon carriage to Rugby, the scene of the day's amusement.

Mr. C. J. Bowen Cooke, the District Locomotive Superintendent, so well known to all interested in railway work as the author of "British Locomotives," met and conducted the party over the whole of the departments under his control. We were agreeably surprised with the large number of interesting features present in Rugby L.N.W.R. running shed. The visitors were first shown over the shed proper, Mr. Cooke and his assistants kindly explaining the details of the diagrams of engine working, drivers' tickets, repair books, time lists, notices and other small but important items connected primarily with the supply of motive power to the line. In the shed all



Photograph by] [*W. T. Barker, Member S.M.E.*

THE SOCIETY OF MODEL ENGINEERS AT RUGBY.

classes of engines were seen and inspected, from four-wheeled shunting tanks to eight-coupled compound goods, and the latest four cylinder express locomotives.

The method of dealing with "hot boxes," the bugbear of the railway man, was very kindly shown in operation. Instead of lifting the engine or tender, as the case may be, the vehicle is placed over special pits, in which is arranged an underground lift. The wheels to be removed are run upon this lift or "drop table," and after the horn-stays are taken out the table descends and with it the pair wheels and axle boxes. When the table is at its lowest point a loose piece of rail is arranged in the vacant places and the engine is moved clear of the pit, so the wheels may be brought to the surface again and the axle-boxes removed for re-metalling, a process which was seen in another part of the depôt.

In the shops adjoining the shed (see accompanying views—Fig. 3) the visitors were able to see all classes of locomotive repair work in progress, and amongst the most interesting machines which happened to be in use at the time of our visit was an electrically driven tube cutter. This machine can be made to cut off all the ragged ends of new tubes so that they all project the same amount from the tube plate, and is especially useful in removing the tubes. For the latter purpose it cuts the tube just behind the tube plate, each operation taking about ten or fifteen seconds. The travelling crane was also seen at work, lifting an eight-wheel tank engine as easily as can possibly be imagined.

After lunch at the station refreshment rooms, we proceeded to the works of Messrs. Willans & Robinson, where we were cordially received on behalf of the firm by Mr. Fergusson, who acted as our guide in the journey through the various shops. The departments visited were the erecting shop, manufactured stores, machine shop, foundry, pattern-maker's, and testing-house. It is well known how accurate and well-finished the work of Messrs. Willans is, and as an instance of this, in the machine shop the visitors were shown a test by which the degree of perfection of the work produced was made evident to all present. A cylinder, open at both ends, with finished flanges, was laid upon a surface plate, and into it placed a plain test piston (without rings) of the standard size. Without opening a cock fitted to the piston to let out the air, it would not descend in the cylinder at all, even with a man standing and jumping on it, and when placed at any part of the bore, upon hooking the piston to the hook of an overhead crane it was possible, so perfect was the fit of the piston and so truly faced the flanges, to lift also the cylinder and the surface plate as readily as if they had been all bolted together.

In the manufactured stores, where so many parts of each of the standard sizes of central valve engines are stored ready for immediate erection, the superiority of Messrs. Willans' methods over the old-fashioned way of making engines and machines was again demonstrated. Nothing faulty in any material degree will be received into this department, and all imperfections noticed by the examiner in charge are recorded in proper books, with the decision of the managers respecting the article along side of it. Messrs. Willans & Robinson were amongst the first in this country to adopt the limit gauge method of manufacture, and we should say from the success attending this system that it will be even more widely used than at present. The matter of scientifically testing the working of finished engines, is another matter to which Messrs. Willans pay great attention, and it is found by consulting engineers to be an inestimable advantage to all concerned. In the testing department—a separate building—apparatus is installed by which it is possible to measure the efficiency of a machine under ordinary conditions of working to a very small fraction. The model Willans engine, which was recently illustrated in THE MODEL ENGINEER, was on view, and, in conjunction with a full-size sectional model of a Willans engine, formed a considerable source of interest to all.

The hospitality of Messrs. Willans & Robinson, Ltd., did not end with the intellectual feast provided by the visit to their establishment, for Mr. Lazenby, one of the directors of the company, very graciously entertained the party at tea in the Board room. During the course of this repast, our worthy Chairman, Mr. Marshall, on behalf of the members, in a few well-fitting words, thanked Messrs. Willans, and Messrs. Lazenby and Fergusson in particular, for the very kind way in which they had made provision for our interest and comfort during the afternoon. For a long while to come the visitors to Rugby will remember how they were royally treated by this firm of engineers; and without recourse to comparisons, all those who took part in this will agree that this excursion takes the highest rank amongst the several visits the Society of Model Engineers have made to places of engineering interest.

Returning by the 6.30 p.m. train, the members soon after leaving Rugby held a formal meeting, and passed a hearty vote of thanks to Mr. F. W. Webb, the chief mechanical engineer of the L.N.W.R. Company, for the permission to visit the running shed, and expressed at the same time their appreciation of the efforts of Mr. C. J. Bowen Cooke, his assistant, in personally conducting the party. Thanks are also due to Messrs. Barker, Williams, and others for the photographs reproduced herewith.

Society of Model Engineers.

NOTICES AND REPORTS.

London.—The next indoor meeting of the Society will be held at HOLBORN TOWN HALL, Gray's Inn Road, W.C., on Tuesday, September 23rd, when the railway track will be shown in operation. Readers of THE MODEL ENGINEER who are interested in the work of the Society and would like to join will please communicate with HENRY GREENLY, Hon. Sec., 2, Upper Chadwell Street, Myddleton Square, E.C.

Oldham.—The monthly meeting was held at the Oriental Restaurant, Church Terrace, on Tuesday, the 22nd July, Mr. Buckley occupying the chair. After the formal business had been disposed of, Mr. Carter, of Manchester, exhibited a small model of a loco 1 in. gauge, also a 1-in. scale of a Great Central single express loco. Mr. J. Dellow also brought for inspection a model horizontal engine; Mr. S. Tattersall a few finished parts of a compound marine engine, designed by Mr. G. Penlington, a member of the Society.

On Tuesday, the 29th July, the members of the branch visited the Oldham Electric Generating Station. The party was conducted over the partly finished station by Mr. Newington, the Manager, the boiler house claiming their first attention. There are already four dry-back marine boilers and three "Climax" tubular boilers in position. The party then proceeded to the engine house, where a Willans high-speed engine has been fixed, with room for ten more. In the old station the members were shown ten Willans engines, ranging from 100 h.-p. to 600 h.-p. at work, also a Parsons turbine, running at 3000 revolutions per minute, driven by eight Lancashire boilers. The most interesting feature was a half-finished "Climax" boiler, which caused a great amount of discussion amongst the visitors. Hearty votes of thanks were accorded to Mr. Newington, and to Mr. Kay, the leader of the party.—R. L. COLLINGE, Hon. Sec., 16, Don Street, Middleton.

Tyneside.—At the August meeting of this branch, Mr. Patterson (in the absence of the president) being in the chair, it was announced that a visit to the Newcastle Tramway Company's power station would be made on Saturday, August 30th. Members are requested to meet at Stephenson's Monument, at 2 p.m. prompt, upon that day.

Mr. Fenwick exhibited a 6-volt accumulator and a small motor working a fan, which was the source of some interest to the meeting. After a general discussion *re* rules, membership cards, &c., the meeting closed with a hearty vote of thanks to the Chairman. Next indoor meeting September 6th.—GEO. F. ADDLESHAW, Hon. Sec., 2, Gladstone Street, Newcastle.

[*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 fortnight before its actual date of publication.*]

The Aeronautical Institute and Club.

A LECTURE was delivered under the title "Wing-flapping machines and personal flight" before the monthly meeting of the Aeronautical Institute and Club, August 1st, at St. Bride's Foundation Institute, Ludgate Circus, E.C. The lecturer—who is not an aeronaut, professional or otherwise—has given the subject attention for some considerable time past, and his lecture, which showed an original mind as well as familiarity with the ground traversed, was listened to with marked attention throughout. Dr. E. Barton was in the chair and introduced the lecturer, Mr. T. C. Blanchard. The lecture was followed by a discussion in which Sir V. Kennett Barrington and Messrs. Senecal, Andersen, and others took part. Mr. Carter then showed a "Balloon Sonde" which had been sent up from Mr. Alexander's works, Bath, coming to earth near Ipswich. The recording apparatus was opened first at the Meeting and the diagrams examined. Mr. Carter fully explained the mechanism and his explanations were followed by the members with very great interest. Mr. Aug. Gaudron exhibited a large number of pictures dealing with aeronautical subjects which met with much appreciation.—O. C. FIELD, *Hon. Sec.*, 20, Adelaide Road, Brockley.

THE warships under construction in the United Kingdom on June 30th last amounted to 57, of a displacement of 327,140 tons. Sixteen of these vessels were being constructed in Government yards.

Model-making for Beginners.

[This series of articles is especially intended for those amateurs whose stock of tools is a minimum, and for those whose practical acquaintance with model-making is equally limited. In order to make the articles as useful as possible, it is the special desire of the writers that readers shall discuss their difficulties with them, directing their queries to "Beginner," c/o The Editor, THE MODEL ENGINEER, *37 & 38, Temple House, Tallis Street, London, E.C., a stamped addressed envelope being invariably enclosed for reply. Where the reader is unable to get a model to work, or to locate the fault, the model itself should be sent, carriage paid both ways, when advice on it will be freely given.*

Practical suggestions from readers will be gratefully received, and the Editor, will be glad to hear from those who wish to make any special model. Such suggestions will, where possible, form the basis future articles.]

X.—A Home-Made Gramaphone.

By R. A. WARNER.

THE object of this article is to tell how the writer constructed, from material costing less than four shillings, a talking-machine, using the disc records, fastened to a base having a moulded edge, by screws driven from the under side and counter-sunk. (See A, Fig. 1.) Cut a notch 3 ins. from corner 2, Fig. 2, 1 in. wide, ¾ in. deep. A cover is now to be made that fits inside the box and rests on four posts 2½ ins. long and ¼ in. square, glued in each corner. (See A, Fig. 1).

With cover in place, but not fastened, lay out a centre line, and also 5 ins. from corners 2 and 4 the line bisecting it. At the intersections of these lines (B,

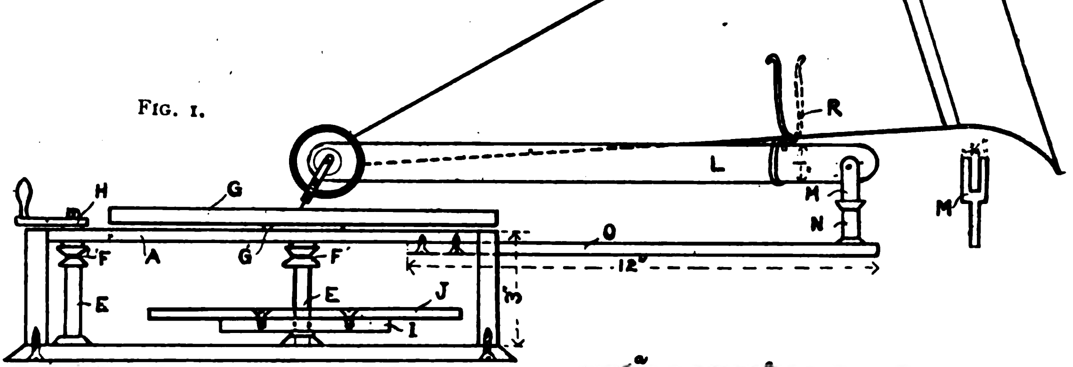



FIG. 1.

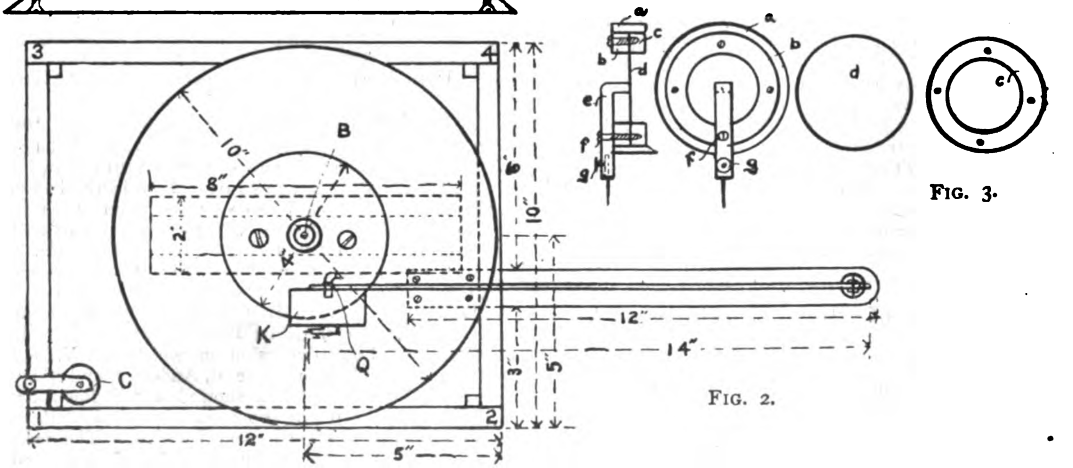


FIG. 3.

FIG. 2.

A SIMPLE HOME-MADE GRAMAPHONE.

with which many a pleasant evening has been spent. It is of such simple construction that our youngest readers can build one like it. It consists principally of four parts: the motor, the sound-box, sound-box holder, and regulator—each of which will be briefly but fully described.

First, make from ½ in. pine a box 10 ins. by 12 ins. outside measurement and 3 ins. deep. This is to be

Fig. 2,) bore a hole in which a smooth, straight lead pencil will turn easily. Lay off a diagonal from 1 to 4, and 1 in. from corner 1 make a similar hole.

Directly under these holes on the bottom of the box fasten the flaring ends cut from a spool to form bearings. These must be reamed out with a round file, so the lead pencil will turn without binding. Cut two pieces of a very hard round lead pencil (E and E',

Fig. 1,) 4 ins. and 4½ ins. long, respectively; the lower ends should be bluntly pointed, to reduce the friction, one end of the 4-in. length being squared to receive the crank (H, Fig. 1)

Procure two large spools such as linen thread is wound on, or a large spool of any kind, the size being immaterial, the holes in the spools being a tight fit for the lead-pencil shafts; fasten so that the tops will be ½ in. below the cover, as shown at F, F', Fig. 1. Loose wooden washers made from sections of a spool should be put between the spools and cover, to prevent the shaft from jumping out of the bearings in the bottom of the box. Cut grooves with a round file on the spools for the belt to run in. Take a thoroughly seasoned piece of hardwood ½ in. thick and cut a disc 10 ins. diameter (G, Fig. 1,) and a smaller disc of ¼ in. wood 4 ins. in diameter; fasten the latter to under side of G, and carefully bore a hole through both pieces to tightly fit shaft E', so that the disc G will turn as true as possible. A cardboard washer may be put under this to reduce friction. Cover the top of disc with felt or baize, to provide a friction hold for the record disc. Make a small wooden crank (H, Fig. 1,) which will clear the disc G, and fasten to the squared end of shaft E. The regulator, I J, consists of a wooden disc (I, Fig. 1,) ⅜ in. thick, 4 ins. diameter, to which should be fastened, with two screws, a strip of iron (J, Fig. 1,) ¼ in. thick, 2 ins. wide, 8 ins. long, a hole being bored in the centre for the shaft. Fasten as shown at E', Fig. 1, with a washer under the disc. Connect the spools with a belt—a leather shoestring makes an excellent one—and the motor is complete.

Now comes the sound-box (Fig. 1), on the construction of which will depend the clearness and volume of the tones produced. It must be remembered that to secure the best results all parts must be constructed so as not to jar or rattle, and this applies particularly to the sound-box. Fig. 3 shows detail of parts. Procure from a druggist a round wooden pill-box 2 ins. in diameter and 1 in. or more deep. (See *a*, Fig. 3) *b* and *c* are two wooden rings ⅜ in. thick, made to fit the inside of the box *a*; these may be cut out with a knife or fret-saw. *d* is an isinglass diaphragm, the same size as the rings. This should be placed between the rings and all fastened with three fine screws (the fourth screw also holds the needleholder in place). The thickness of the isinglass is best ascertained by experimenting until the best results are obtained. The diaphragm should now be glued securely in the box *a*, with the outside ring flush with the edge of the box. *e* is a piece of steel bent or filed to shape as shown, and should have a hole bored at *f* for a long, slender screw, that binds both rings together. A 1-16th in. hole should be bored in the end ⅜ in. deep; a small thumbscrew at *g* holds the needle in place. This part of the apparatus can be made up by a jeweller at small cost, if the reader has not the necessary equipment for making it. The end that rests against the diaphragm should be smooth and rest flat, being kept in contact by melting a little sealing-wax and pouring around it. Get two short gas-pipe nipples and a ¼ in. elbow, and fasten by screwing into the bottom of box *a*, in hole previously made. (See Fig. 4.) This completes the sound-box.

Take a piece of hard wood (L, Fig. 1,) 1 in. wide, ¼ in. thick and 14 in. long, and bore a hole in one end, fastening to the sound-box by screwing nipple through it to sound-box. (See L, Fig. 1.) Make another piece ½ in. thick, 1 in. wide and 12 ins. long (see O, Fig. 1), on one end of which fasten another spool, N, by nailing up through strip into spool. Make a fork, M, as shown in Fig. 1. This should be connected to arm L, and should turn easily in spool N. The height of the spool and fork should be such as to cause the arm L to rest parallel with disc G. This completes the machine; but before fastening, it should be adjusted. Turn the sound-box so the needle slants about the angle shown in Fig. 1. The arm O should now be pushed forward or backward in notch until the needle-point rests on a line with B on disc G, and the two arms L and O are in line with each other. (See Fig. 2.) The arm O may now be screwed to under side of cover. The records come in two sizes: 7 ins. at 2s. 6d. each, 10 in. at 5s.; the 10 in. record producing much the louder tones and longer pieces. Also get a package of needle-points: 2s. 6d. 1000. A horn may be made of heavy paper, or a metal one can be bought for two to five shillings. It should be fastened securely

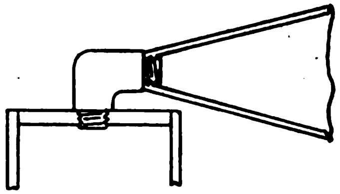


FIG. 4

to the nipple and be supported by wire, R, attached to the arm L, resting under the horn. To operate, place a record on disc G, swing the sound-box by the arm L, so the needle-point rests on the outside edge of the record; then turn the crank, and if you have followed these directions you will be well repaid for the time and trouble you have used.

The description of this machine has intentionally been as simple as a cheaply made machine will allow, and outside of the cost of the records should be built for less than four or five shillings for materials. After the success of the machine has been assured, another may be constructed as elaborately as the builder may wish. Made with hardwood and metal parts, it will compare favourably with a machine of many times its cost. If several are made in one neighbourhood, records may be exchanged, thus getting a variety of pieces at little cost.—*Amateur Work*, Boston, U.S.A.

WELLINGTON'S *Monthly Motor-Car Register and Advertiser* is a useful publication for those owners of motor cars and cycles who wish to sell or exchange them, and it is, of course, equally valuable to the purchaser, who will find attractive bargains in its pages. The June issue can be obtained from the publishers, Frank F. Wellington, Ltd., The Towers, 36, St. George's Square, Regent's Park Road, London, N.W., price 1½d., post-free; or a year's subscription can be sent (1s. 6d.), when the *Register* will be duly forwarded each month.

VULCANITE, or ebonite, which is greatly used in electric industries on account of its high insulation resistance, is met with in the workshop mostly in the form of rods and sheets, and must be worked with the same tools as are used for working metals The best qualities show on fracture a lustre something of the nature of jet, and the poorer qualities show a corresponding dulness. Although easy to machine, says *Electricity*, it is hard on tools; and in sawing, turning, planing or milling, the best speed is that at which brass is machined.

THE North-Eastern Railway Company have decided to instal electric traction on certain of their branch lines, commencing with the Newcastle to Tynemouth, the Gosforth to Ponteland, and the Quayside branches. The North-Eastern will be the first great English railway to adopt electric haulage.

Railway Photography.

WE reproduce herewith the prize photographs, supplemented by two other interesting pictures, received in connection with our recent Competition, No. 19.

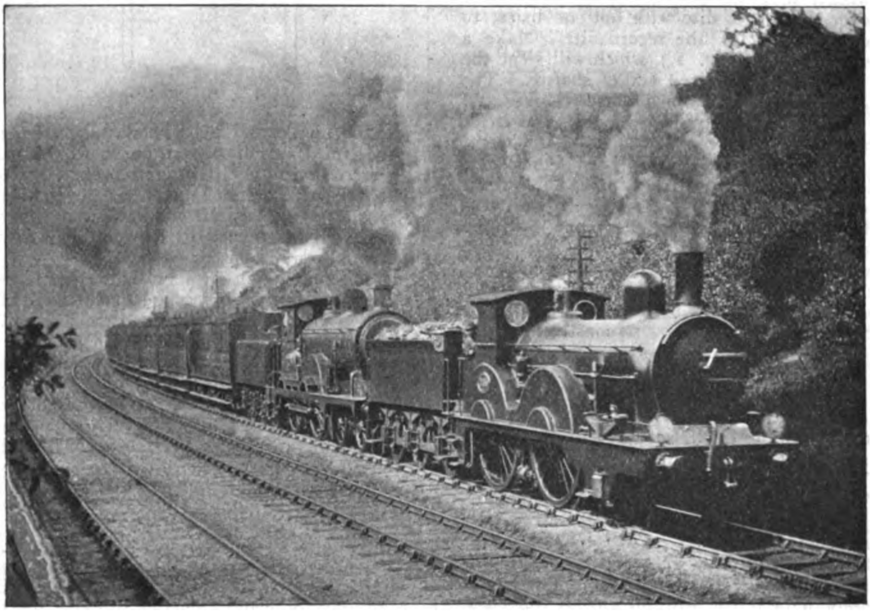
The first prize* was gained by Dr. Tice F. Budden (Crouch End, London, N.), and the photograph sent in (see below) was taken on a Cadett "lightning" plate, with a Wray RR lens at *f*/8, and a Thornton-Pickard focal plane shutter. The exposure was about 1-500th second, and the train was travelling at about thirty-five miles per hour.

Mr. P. W. Pilcher's interesting photograph† represents the L. N. W. Ry. North Wales Express; engine, "Oceanic," No. 1302. Lens of camera used by Mr. Pilcher was a 7½ in. landscape by Wray; stop *f*/8; shutter, Thornton-Pickard special speed; 1-150th second exposure; ¼-plate "Imperial" flashlight.

Mr. Herbert Bairstow (Halifax) used a ¼-plate Miral Reflex camera, with a Cooke 5½ ins. lens, at *f*/6·5; Imperial flashlight plate (backed); exposure about 1-80th second, at 5 o'clock p.m. The subject‡ is a Lancashire and Yorkshire Railway engine, near Copley Station (see page 105).

The American engine also depicted on page 105, is one running from Littleton to Christchurch, N. Zealand. The picture‡ was secured by Mr. M'Intyre, with a Thornton-Pickard shutter, with an exposure of about 1-90th second.

Competition No. 19.—*First prize, £2 2s. †Second prize, £1 1s. ‡Honourably mentioned.



G.E.R. YARMOUTH EXPRESS; by Dr. TICE F. BUDDEN.
First Prize in Competition No. 19.

Testing Small Engines and Boilers.

By B. S. K.

WHAT has struck me most in reading THE MODEL ENGINEER is the lack of information concerning the capabilities of small engines and boilers possessed by a large number of those who are responsible for their manufacture. I refer in particular to the pages at the end of each number of the *M.E.* devoted to "Queries and Replies."

The questions with which the Editor is bombarded show, in a great number of cases, a marked lack of knowledge and independence on the part of a certain section of the readers. Some of the questions are, it must be admitted, puzzling enough; but the hopeless lack of data in many cases must make the answering to a great extent a matter of guess-work. The majority of questions asked might easily be answered by the interrogators themselves, if they would only make use of their advantages in already possessing engines and boilers.

By observing and making notes of the idiosyncracies of machinery already in their possession, they would accumulate an amount of knowledge which would well repay the trouble of making the various models, and would render the asking of so many questions quite unnecessary.

For instance, the running of half a dozen trials of one or two engines would settle such questions as: The approximate power developed by certain sizes of cylinders. The amounts of feed and fuel used per hour by various engines and boilers, both with and without a feed heater. The relative advantages of different fuels, etc. The evaporative efficiency of various types of boilers might also be determined, as well as the amount of steam used per minute by different sizes of cylinders at different speeds and powers, and consequently the evaporative efficiency necessary in a boiler to supply such cylinders.

All these things, and many others, can easily be found out by anyone who chooses to take the trouble. And if it is worth while making an elaborate engine, surely it is worth while finding out what it will do, and whether it is superior to another type of engine of the same dimensions.

Having a note-book well filled with information gleaned at various trials, it is obvious that the future work of the designer and engine builder will rest on the solid basis of actual facts and recorded experience, and not on vague ideas, combined with the advice of others who are similarly handicapped by want of sufficient practical knowledge of the particular case in question. It is my object in this article to endeavour to show how without any great scientific knowledge or expensive apparatus a great deal of most useful information may be obtained from ordinary engines and boilers such as are constantly being described and illustrated in this journal.

Let us suppose that the gear to be tested consists of an ordinary 2-cylindered high-pressure launch engine, with cylinders 1 in. by 1 in. or thereabouts, and a water-tube or other fast-steaming boiler working at 40 lbs. or so, fired with some sort of liquid fuel.

The first thing to do is to get the engines, etc., firmly fixed to a bench and to rig all connections such as steam, exhaust, and feed service pipes. Fill the boiler to working level, making a note of the amount of water used, and couple up the feed pump suction to a tank.

The next thing is to rig up the gear for taking the horse-power of the engine. This consists of a wooden brake arm with a half-round rubbing block of hard wood affixed to it. The rubbing block is held in contact with the flywheel by an adjustable band brake, as shown in the accompanying drawing (Fig. 1, page 104).

The band brake consists of a band of annealed copper fixed to the brake-block at one end, and at the other to a screwed spindle fitted with a milled nut, passing through a bracket at the engine end of the brake arm. The brake-block should have a slip of sheet brass on each side to form flanges, as shown in the drawing. These flanges keep the gear from shifting sideways during the trial of the engine. It should be remembered that when the engine is running with the brake at work the flywheel and band should be kept well lubricated, or the action of the gear will be jerky, as there will be a tendency to "seize" and "fire up," and it will be very difficult to take readings from the spring balance. The best method of effecting lubrication is to bore a ⅛-in. hole through the brake arm and block, and to keep the hole filled with tallow, which will be melted and rubbed off as it is needed.

If the engine flywheel is of a heavy type, without spokes, it will be found advisable to arrange a water service, so that a constant drip of cold water falls on the wheel to keep it cool. If this is fitted, a tray with an overflow pipe should be placed underneath, to avoid a general flood.

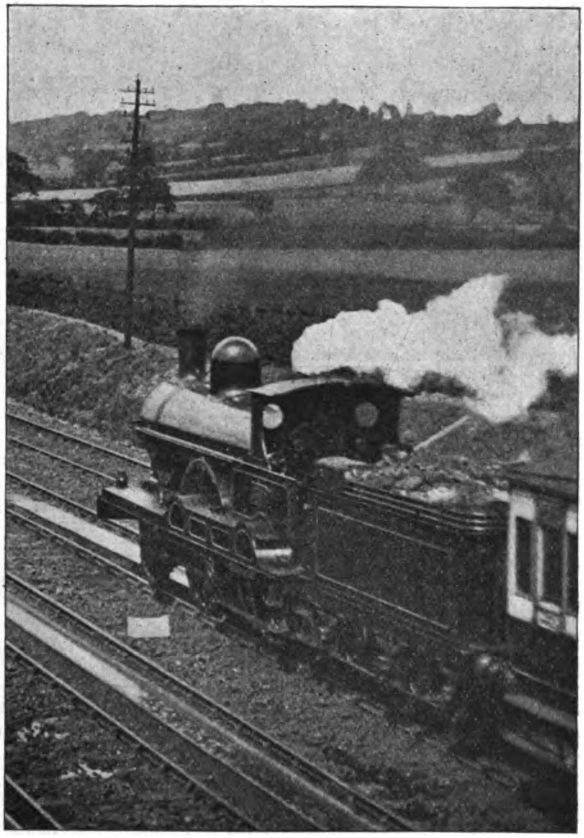
Water is not needed, however, if the horse-power developed does not exceed one-eighth, or if the wheel is of lighter design, with spokes.

The other end of the brake-arm is supported by a finely graduated spring balance, hanging from a gantry or gallows, as shown on the drawing. The cord or wire suspending the spring balance should be adjusted so that the brake-arm is slightly inclined upwards from the engine shaft end, when the engine is standing. This provides, when the engine is running and the brake in operation, the arm being approximately horizontal.

A spring balance, weighing up to 1 lb., is very suitable, as the graduations are large and clear. Balances such as these are made by Salter and Co., and cost about a shilling, and are extremely accurate.

Fig. 2 shows an arrangement for counting the revolutions, which I have found very successful, as, of course, it is impossible to count an engine running at 1000 or 1,200 revs. per minute, in the ordinary manner. A small counter-shaft, having a curved slip of thin springy brass, soldered into a saw draft at one end, and having a gear wheel on the other, is mounted on a bracket, as shown, and placed so that the gear wheel engages with a smaller one on the end of the engine shaft. The gear wheels can easily be got from an old clock, and should have a ratio of 1 to 4, or 6 or 8, according to the speed of the engine at full power. In this case 1 to 6 will be a convenient ratio.

The method of counting consists in placing the finger in such a position that the slip of brass on the counter-shaft just brushes it at each revolution. The operator



L. & N.-W.R. North Wales Express; by P. W. Pilcher.
Second Prize in Competition No. 19.

should have a watch before him, and count the number of taps received in one minute, and multiply by six, which gives the speed of the engine.

The brass slip should be curved in its length, like a sickle, so that the convex side precedes the concave as it rotates. By this means it is allowed only to brush the finger lightly, and without shock.

To arrive at the brake horse-power it is necessary to know the following formula :—

$$\text{B.H.P.} = \frac{W \times D \times R}{33\,000}$$

Where :—

W = Pull registered in lbs.

D = Circumference of virtual wheel in feet. (The *radius* of the virtual wheel is the distance from the centre of engine shaft to point of support of brake arm.)

R = Revolutions per minute.

Let us for present purposes make the distance from the centre of the engine shaft to the point of support of the brake arm by the spring balance 21 ins., as shewn on the drawing, and then the diameter of the virtual wheel will be 42 ins. and the circumference of the same 132 ins.

Having fixed the circumference at 132 ins. and the ratio between the speed of engine and counter shafts at 6 to 1 the formula becomes—

Brake horse-power =

$$\frac{w \times d \times n \times 6}{33{,}000 \times 12 \times 16} = \frac{w \times 132 \times n \times 6}{33{,}000 \times 12 \times 16} = \frac{w \times n}{8000}$$

Where :—

w = Pull registered by spring balance in *ozs.*

d = Circumference of virtual wheel in *inches.*

n = Number of revolutions per minute of *counter-shaft.*

For example, suppose that during a run the spring-balance registered a pull of 6 ozs. and the revolution of the counter-shaft were 200 per minute, then the horse-power would be—

$$\frac{6 \times 200}{8000} = \frac{6}{40} = \frac{3}{20} = \cdot 15 \text{ of a horse-power.}$$

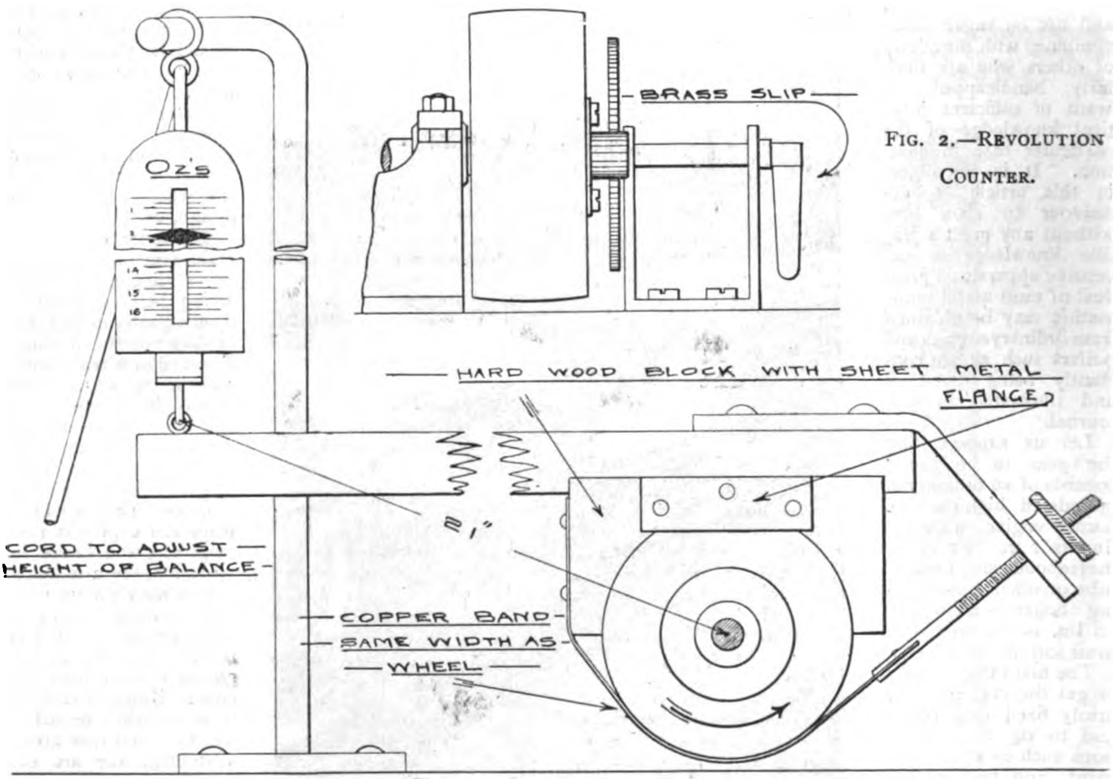


FIG. 2.—REVOLUTION COUNTER.

FIG. 1.—BRAKE FOR TESTING SMALL POWER ENGINE.

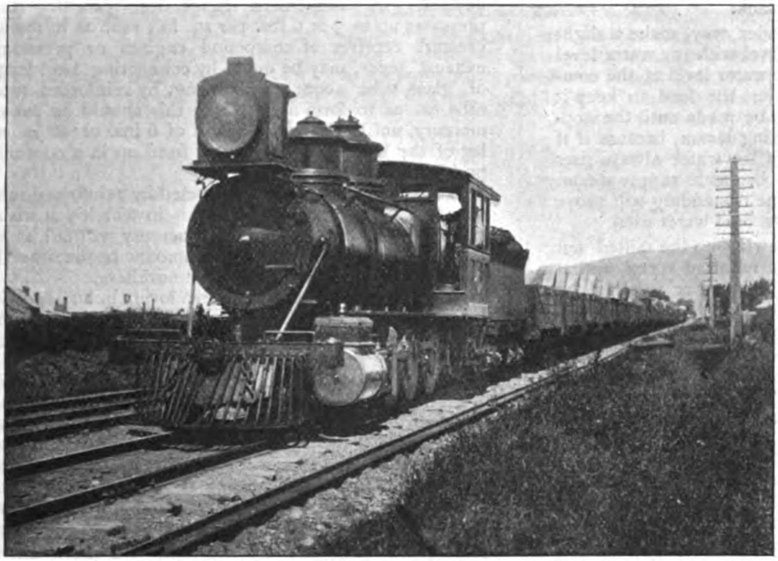
Having got the brake and counter gear in position, and the boiler filled to working level, the next thing to do is to fill up the fuel reservoir with a measured quantity of oil or spirit. An amount of fuel judged to be sufficient for the trial should be weighed off if solids such as charcoal, coke or coal are employed.

The handiest way of registering liquids is, I think, in fluid ozs., 20 ozs. being 1 pint. An ordinary 10-oz. graduated glass measure, such as is used for photographic purposes, will, therefore, be necessary.

Having filled the fuel reservoir, pour a measured quantity of water into the feed tank, and then light up the furnace and note the time of so doing.

Before starting the engine, slacken the brake band on the wheel, and make a note of the weight of the arm as recorded on the spring balance, which weight must be, of course, deducted from the total pull registered on the balance each time a reading is taken. If preferred, however, the brake arm may be balanced so as to cause the pointer on the spring balance to stand at zero when the

PHOTOGRAPHS IN OUR RAILWAY SNAPSHOT COMPETITION.



SNAPSHOT BY A. C. M'INTYRE, CHRISTCHURCH, N. Z.

HONORABLY MENTIONED.

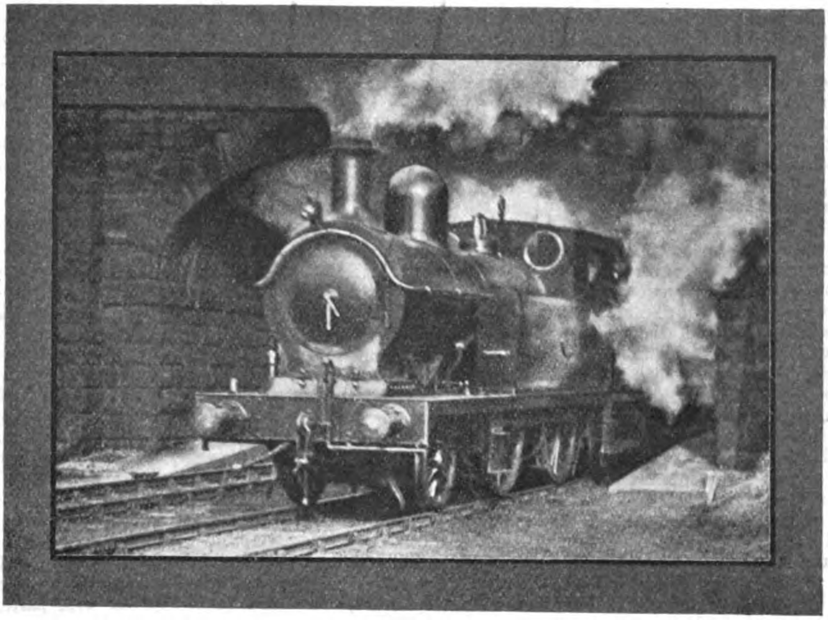
EXPOSURE, 1-90TH SECOND, WITH THORNTON-PICKARD SHUTTER.

AN AMERICAN LOCOMOTIVE IN NEW ZEALAND.

SNAPSHOT BY HERBERT BAIRSTOW HALIFAX.

HONORABLY MENTIONED.

TAKEN WITH A MIRAL REFLEX CAMERA. EXPOSURE, 1-80TH SECOND, AT 5 P.M.



LANCASHIRE AND YORKSHIRE RAILWAY ENGINE, AT COPLEY.

brake band is slack and the engine is standing, so that only the pull of the engine is recorded instead of the pull *plus* the weight of the arm.

As soon as the steam pressure rises to the working level, note the time again, and ease the stop-valve and start the engine with the brake band slack.

As soon as the engine gets under way, make a slight scratch on the boiler front, just level with the water level in the gauge glass, to record the water level at the commencement of the trial, and adjust the feed to keep it constant. This mark should not be made until the stop-valve is open and the engine taking steam, because if it is a water-tube boiler the level of the water always rises in the gauge as soon as the boiler begins to supply steam, and a mark made when the engine is standing will prove a source of error in calculating the feed water used.

Now adjust the brake by screwing up the milled nut until the engine is running at the required speed, and at the same time keep an eye on the water level in the boiler, and adjust the feed to suit the heavier load on the engine. The fire should also be "shaken out" and increased according to requirements.

I may say here that the starting of a trial is always the tricky part, as there are so many things to be nursed up together, and it is at the start, if at any time, that two pairs of eyes and hands will prove most useful. In fact, if any real accuracy is required, there ought to be one person to attend to the running of the gear, and another to take the readings, as it takes some practice to do both one's self. A little practice will soon enable the operator to gradually work up the power without altering the water level or pressure in the boiler to any extent. Having got all the adjustments fairly correct and the engine running at the required speed, it only needs a little manœuvering with the fire and stop-valve to keep her running at a steady pace without allowing the safety-valve to lift.

Take the horse-power reading every five minutes, at the same time noting down the time, and boiler pressure, and anything worthy of record in the running. Keep an eye on the feed water tank, and replenish it when necessary with recorded quantities of water.

At the end of an hour from opening the stop valve, shut down the engines and extinguish the fire, and measure the feed left in the tank, and also the remaining fuel, and deduct the remaining quantities from the total quantities.

Towards the end of a trial take especial care to see that the water level in the boiler corresponds to the mark made at the commencement of the trial.

Of course, it is an axiom that the longer a trial lasts the more accurate are the results; so, if it is convenient, it is as well to run the trial for two hours, or even three if greater accuracy is required. An hour, however, should give results quite accurate enough for all practical purposes if the readings have been taken carefully.

Another method of ensuring greater accuracy is to have the feed and fuel tanks fitted with gauge glasses, with graduations marked on a piece of paper stuck to the tank, just behind the gauge. Then the engines can be worked up to the required power at one's leisure, and, on starting the trial proper, a note may be made of the quantities of feed and fuel in the tanks. If the graduating of the tanks is carefully done, this method eliminates any inaccuracies due to not getting away smartly at the start.

I have, however, found the first method quite accurate, and have run similar trials of the same engine at different times, and obtained identical results to the third place of decimals in the readings, and I imagine this is sufficiently accurate, and more so than is necessary for ordinary purposes. But it is as well to remember that it is difficult to obtain real accuracy on so small a scale, and the more care taken to ensure it the better.

A little ingenuity will discover a variety of trials which can be run with the same engine and boiler to show the relative advantages of various dodges and devices. A convenient gauge for recording slight pressures up to 5 or 6 lbs. per sq. in., such as in the low-pressure receiver of compound engines or pressure in exhaust pipes, may be made by connecting two lengths of glass tube about 18 ins. long, by reinforced rubber tube so as to form a U. Into this should be put your mercury, until there is a height of 6 ins. or so in each leg of the U, and the apparatus fixed up in a convenient position.

If the top of one leg be connected by reinforced rubber tube to the casing or whatever it is in which you wish to ascertain the pressure, then the mercury will fall in that leg and rise a corresponding amount in the other leg, which is open at the top to the atmosphere.

The difference between the two levels in inches divided by two will give you the pressure in pounds per square inch. In the same way, if there is a partial vacuum in place of a pressure in the casing, the mercury will rise in the leg connected with the casing and fall in the open topped leg, and the difference of the two levels in inches is the number of inches of vacuum in the casing. If the pressure to be recorded fluctuates much, as it may do in the low-pressure receiver of some compound engines, then a cock should be fitted on the casing or receiver, which should be slightly closed to throttle the communication between the casing and the gauge. This will prevent the mercury jumping up and down and render readings possible.

I hope to be able, in a future article, to describe a handy method of testing small boilers.

MR. HUGH MCGILLIVRAY, of Newcastle, has patented an apparatus for the automatic lighting of tramcars in cases of accident to the regular supply of electricity. In the apparatus is an accumulator which is constantly kept charged by the main current from the overhead wire. When the trolley wire becomes disconnected the ordinary lights are extinguished, and by an ingenious arrangement auxiliary lamps are immediately lighted from the accumulator. If three auxiliary lights are fitted in a car they will remain lighted for ten hours if necessary. The makers of the apparatus have made an offer to the Newcastle Corporation to instal two in the city electric trams and to allow them to remain three months free of charge. The cost is from £14 to £16 each. Recently a number of local electrical engineers were present at a demonstration of the invention, which was lucidly explained by Mr. McGillivray.

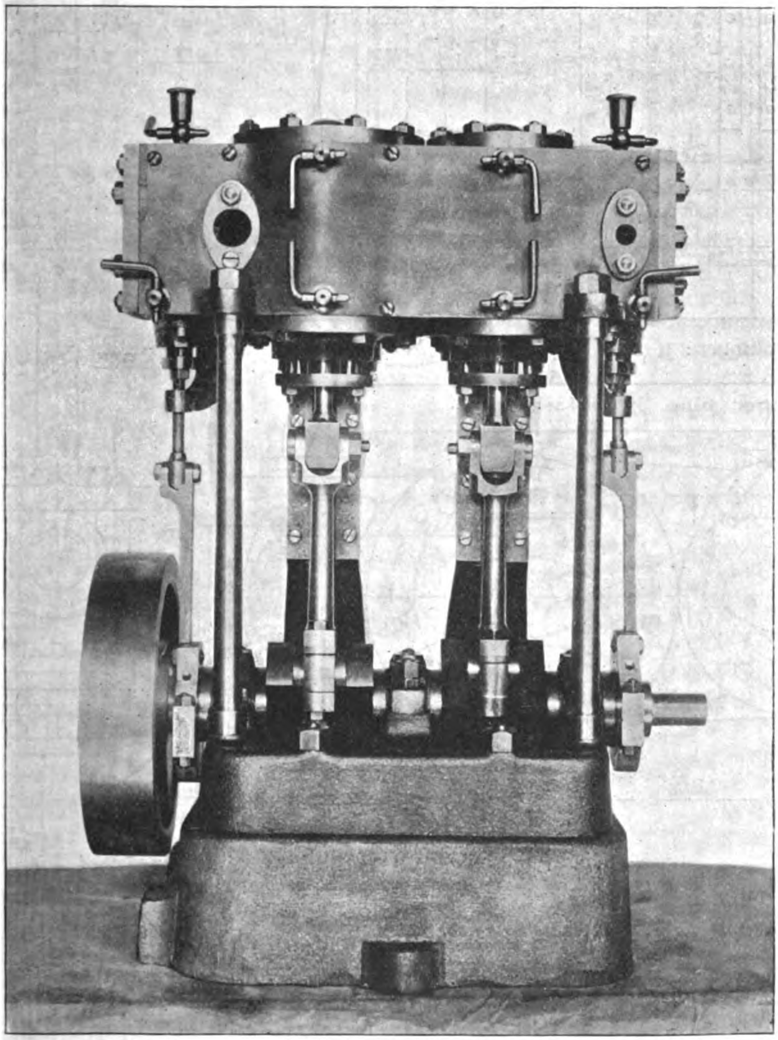
THE following method of blacking small articles of polished brass is taken from the *American Machinist*:—Make a strong solution of nitrate of silver in one dish, and of nitrate of copper in another. Mix the two together and plunge the brass into it. Now heat the brass evenly until the required degree of deep blackness is obtained.

READERS interested in wireless telegraphy experiments may be glad to hear of a novel coherer, for which a patent has been issued to Harry Shoemaker in Philadelphia. This coherer has a number of small steel balls in a tube, together with particles of carbon. The balls do not touch each other, being separated by the granulated carbon, and according to the specification, this arrangement dispenses with the need of a decohering device, carbon and steel having the quality of decohering themselves

The Stuart Compound Vertical Engine.

OUR readers will doubtless notice with pleasure that in this issue of THE MODEL ENGINEER, on pages 108—109, we reproduce the working drawings of a really smart design for a high-speed compound vertical engine of fair size and power, and one suitable for a multitude of purposes. We are again indebted to Mr. Stuart-Turner for permission to use these drawings, and, in sending us the particulars, he also encloses some photographs of a finished engine.

The engine was designed primarily for high speeds for electric lighting, a multipolar dynamo being coupled direct to the engine. With some sort of reversing gear, either link motion or shifting eccentric, the engine would do admirably for driving a small boat or canoe. In designing this steam engine, the end kept in view was to provide a perfect model of the type selected without sacrificing in any respect its utility as a practicable and workable steam engine. We have had the pleasure of visiting Mr. Stuart-Turner's workshop, and have inspected another finished compound engine of this design, with link motion. We can speak highly of the accuracy of the workmanship and the finish, as well as of the design.

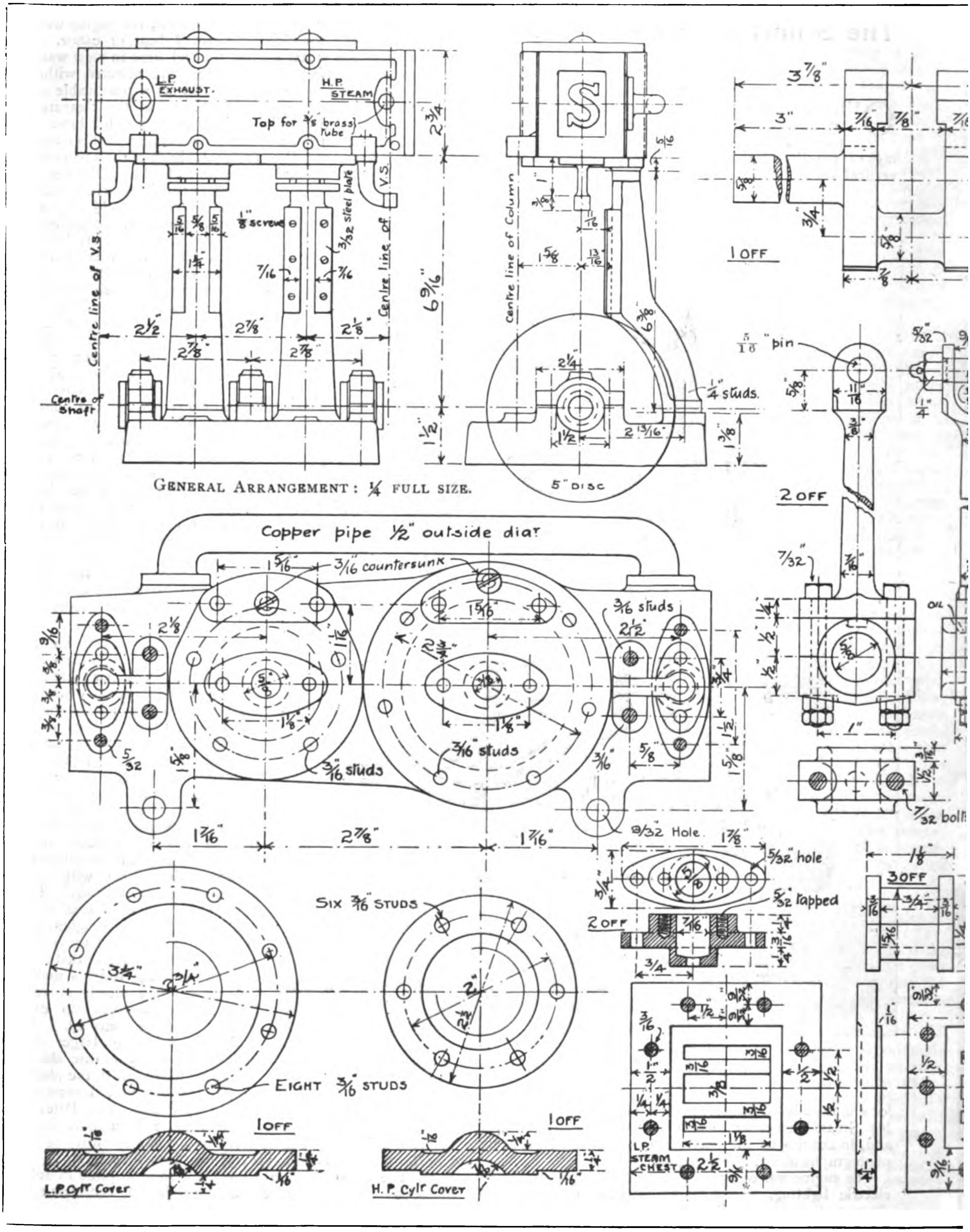


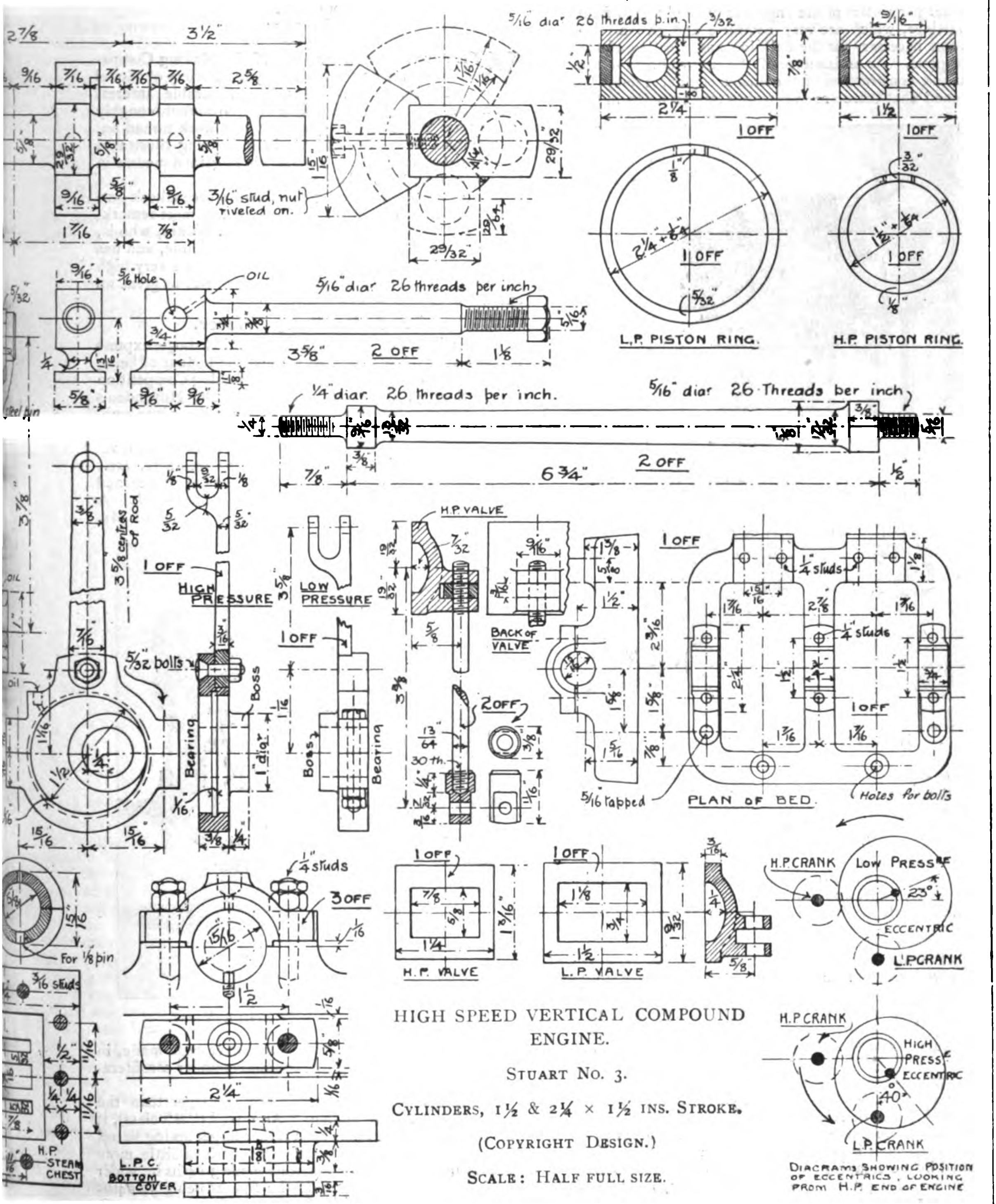
STUART NO. 3 COMPOUND VERTICAL ENGINE.

Coming to the machine itself, the cylinders are 1½ ins. and 2¼ ins. diameter, respectively, with a common stroke of 1½ ins., but Mr. Turner's pattern for the cylinder castings is, it is stated, arranged so that the cylinders may be bored out to 1⅝ and 2⅜ diameter, without unduly weakening the walls. The two cylinders and valve boxes are cast in iron, all in one piece. This renders the machining of the top and bottom surfaces, which are, by the way, perfectly plane surfaces parallel to each other, a very easy matter. The slide faces can be readily milled out either in a proper machine or by fixing the casting on a vertical slide in the lathe, using an end milling cutter, fixed in the chuck, and as a vertical slide now forms part of every well equipped amateur's workshop, the latter method is to be preferred.

The valve gear is very strong, and is provided with ample wearing surfaces. The ports are also of proper porportions, considering the speed at which the model is intended to be worked when coupled direct to a dynamo. The steam in the high-pressure cylinder is arranged to be cut off at ⅝ of the stroke and in the low-pressure cylinder at ⅞ stroke. The valve spindle stuffing-box, it will be noticed, is a separate casting, and is bolted on to the valve chests with two 5-32nds in. studs and nuts. The crankshaft is of mild cast steel, and the balance weights are arranged to be bolted on to the webs. It is found that the addition of these weights makes the engine very steady at very high speeds, and in no case should they be omitted. An ordinary flywheel of larger diameter than the 5-in. disc shown on the drawings and in the photograph, may be used if required, and use of the base is also optional. The latter is necessary where an Avery multipolar dynamo is fitted, as it brings the engine shaft to the same centres as the No. 2 Stuart engine, viz., 3⅝ ins. from floor level.

The piston and crosshead are in one piece of solid forged steel. The connecting-rods and eccentric-rods are mild steel cast to the required shape. The two


L.P. EXHAUST.
H.P. STEAM
Top for 3/8" brass tube
1/8" screws
3/32 steel plate
Centre line of V.S.
Centre line of V.S.
Centre of Shaft
Centre line of Column
1/4" studs.
5" DISC
GENERAL ARRANGEMENT: 1/4 FULL SIZE.
1 OFF
5/16" pin
2 OFF
Copper pipe 1/2" outside diaᵀ
3/16 countersunk
3/16 studs
3/16" studs
3/16 studs
9/32 Hole
5/32" hole
5/32 tapped
2 OFF
3 OFF
7/32 bolts
OIL
SIX 3/16 STUDS
EIGHT 3/16 STUDS
1 OFF
1 OFF
L.P. Cylʳ Cover
H.P. Cylʳ Cover
L.P. STEAM CHEST



HIGH SPEED VERTICAL COMPOUND ENGINE.

STUART No. 3.

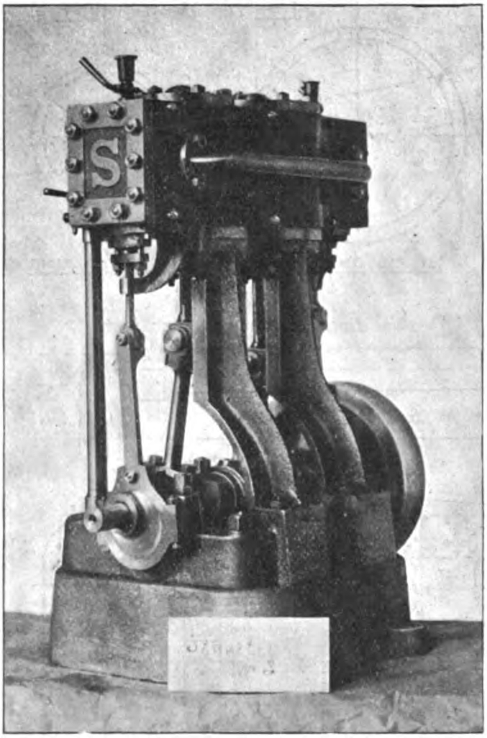
CYLINDERS, 1½ & 2¼ × 1½ INS. STROKE.

(COPYRIGHT DESIGN.)

SCALE: HALF FULL SIZE.

standards are usually cast in iron, but when specially required they may be obtained in phosphor bronze.

Further particulars of the engine may be obtained from the drawings, which are very complete and give all information necessary for the finishing and erecting of the several parts. As an instance of the thoroughness of the design and construction of the steam engine, it may be mentioned that there are over eighty tapped holes in the



STUART ENGINE—BACK VIEW.

cylinders and their connections. The castings are stated to be the finest possible. All gunmetal parts have a liberal allowance for machining, and the cast steel portions will be found to be very easily worked and have no hard skin. We are informed—and the sample tested bears out the statement—that a fairly high speed, worked dry, is the best method of turning these parts.

The studs, bolts, and nuts used in the engine are all steel, and are all specially made for the "Stuart" engines.

THE Prussian railway shops use the following alloy for locomotive bearings:—2 kilos. antimony are added to 1 kilo. melted copper, and to the fused mixture is added 6 kilos. pure tin. The mixture is cast into thin plates, and 9 kilos. of this metal are melted with 9 kilos. pure tin; the mixture is cast into plates 12 mm. to 15 mm. thick.

* * *

A NEW machine for the economical production of liquid air was recently described by M. Georges Claude at a meeting of the Paris Academy of Sciences. Worked by an engine of 30 brake horse-power, about 20 litres of liquid air per hour is produced, and from a second engine operated by the escaping gases about 6 brake horse-power is obtained, this producing about 1 litre (1·76 pints) of liquid per 1 brake horse-power.

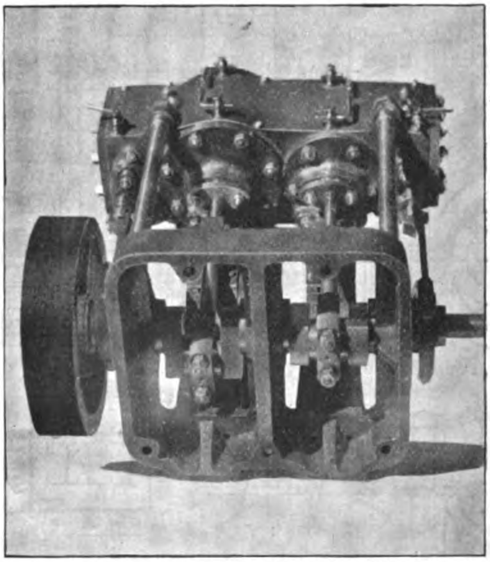
S.M.E. Medallists and their Work.

WE have no doubt that the Model Making Competition recently organised by the Society of Model Engineers, has aroused considerable interest among our readers, and to enable them to more thoroughly understand the splendid quality of the work turned out by members of the Society, we intend giving illustrated articles describing all the models which gained medals in the above-referred-to Competition.

As a first instalment we give below, in the maker's own words, a detailed description of one of the most remarkable pieces of work yet attempted by Dr. Winter, who is, perhaps, the Society's best amateur mechanic, and has the uncommon accomplishment of possessing a very high degree of inventive talent in conjunction with as great an amount of skill in workmanship.

Dr. J. Bradbury Winter.

The engine, a model of a L.B. & S.C.R. bogie express locomotive, "Goldsmid," which had the honour of being awarded a silver medal at the Model Making Competition of the Society, was built to run upon Dr. Hovenden's model railway. A description of this railway was published in THE MODEL ENGINEER for November and December, 1899, and since that time various improvements and additions in signalling arrangements, etc., have been made, but at present we are only concerned with a portion of the additions to the rolling-stock. A motor coach and a partly finished model of one of Mr.



STUART ENGINE—ANOTHER VIEW.

Stroudley's single drivers ("G" class) have been made, in addition to the bogie express locomotive under consideration.

This (the latter) engine being slightly larger than the front coupled express engine, "Arundel" ("B" class), it was possible to find room for a rather larger spring barrel as regards diameter, and in order to obtain a little more breadth of spring, the frames were made 3-64ths in. wider apart, the measurement inside the frames being 59-64ths in. as compared with ⅞ in. in the previous engines. It was found that the "Arundel" was never required to exert its full power in ordinary running, and also being a tender engine she very rarely had to run backwards; the extra power in the spring of the "Goldsmid" was, therefore, utilised for enabling the engine to run two complete trips with one winding instead of only a single journey; and reversing gear was omitted.

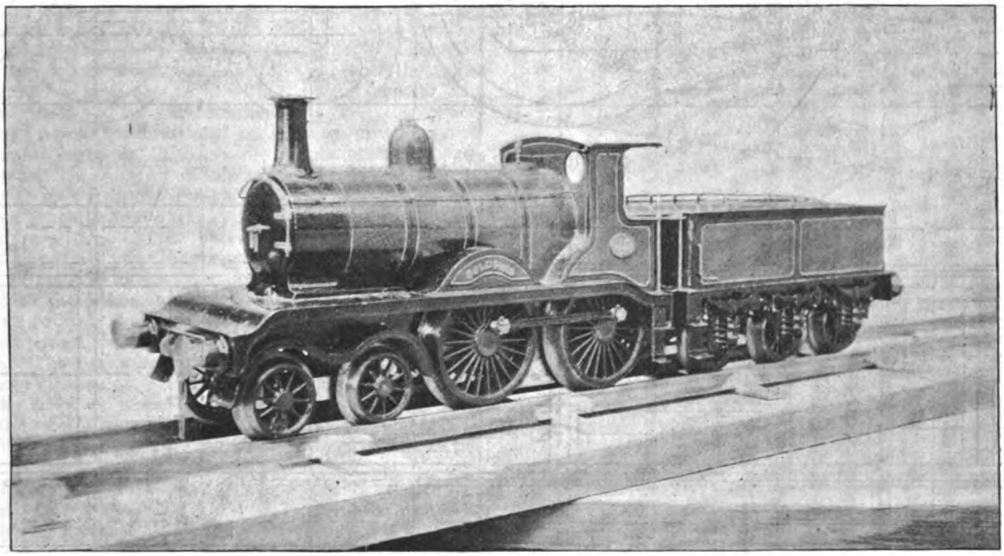
The chief improvement in this engine was the introduction of a weighted wheel mounted on a worm, gearing with a worm wheel on the trailing axle, similar to the worm gear carrying the fan in a musical box. The object of this arrangement was to make the engine start and stop gradually like a real one, and the result was most satisfactory, the inertia of the wheel producing exactly the same effect as the inertia of a heavy train on a real engine; this wheel was made of steel, hollowed out and filled with lead, being in the shape of a solid disc about 1 in. diameter by ¼ in. thick.

The gearing was very simple, there being only one spindle between the barrel and the trailing axle, which was the real driving axle; the middle wheels were coupled to the trailers by the outside coupling bars, but were not coupled by cog wheels as in the other engines, and the coupling bars alone were found to be perfectly satisfactory; these bars are fluted in the real engine and the fluting was made in the model by means of a small milling tool made on purpose; the depth of the fluting is about 1-48th in. The spokes of the wheels were cut out of the solid as in the previous models.

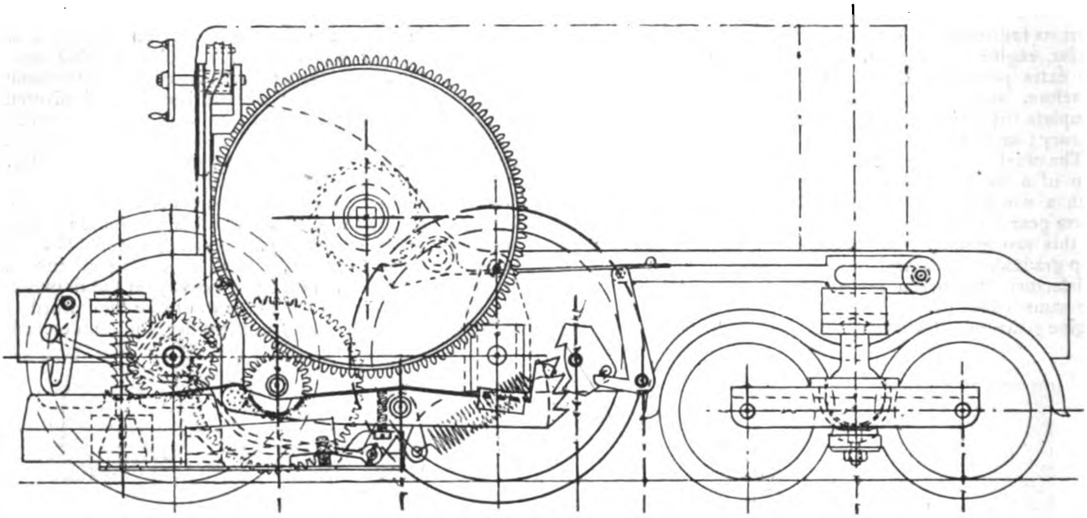
The axle boxes were on the same principle as before, but slightly modified; each box could slide out separately instead of being joined to the other boxes on the same side, and the axle passed through a hole in the box instead of revolving in a split bearing, one-half of which was the box and the other the frame. When a pair of wheels is drawn out, the axle boxes come out with them and cannot be removed from the axle. The form of governor used in the previous models was not fitted in this case, as the worm gear and weighted wheel prevented the engine running away; at the same time, in order to keep the speed uniform in ascending and descending the steep gradients on the line (1 in 12), an entirely new form of governor was introduced. The drawbar connecting the tender to the engine was fixed near the back of the tender to one end of a vertical lever "A," pivoted at its centre and carrying at the lower end a rod which passed forwards and was kept pressing lightly against the weighted wheel in the engine by a spring (see page 112).

This spring was adjusted so that when the engine was exerting its full power it could just keep the rod away from the weighted wheel; at all other times the rod was pressing more or less heavily, and acting as a slight brake. It will be seen, therefore, that in ascending an incline the weight of the train dragging heavily on the draw-bar caused the pressure of the brake-rod to be diminished or entirely suppressed, while, on the other hand, in descending, the train would try to force the engine on, and the pressure on the draw-bar, instead of counteracting the spring, acted with it, and pressed more heavily on the weighted wheel. This arrangement was a complete success, and kept the speed wonderfully uniform.

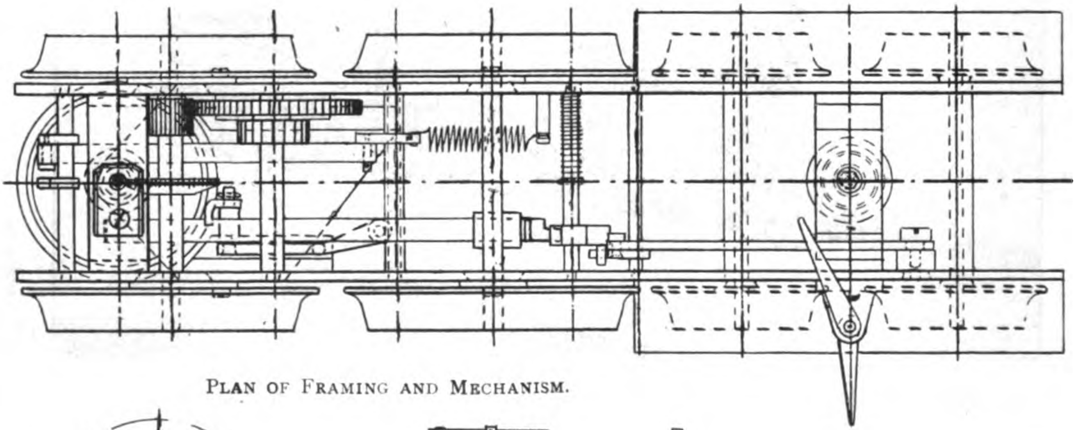
A curious phenomenon arose from the use of this mechanism. If the engine was moving slowly and a light push was given it to help it on, it would stop; while if (as occasionally happened) it did not start at once when "steam" was turned on, a slight pull back would at once set it going. The brake-rod was also connected with the starting gear, so that at the instant of turning on the regulator the brake was removed, but immediately applied itself again when the finger was removed; without this the weighted wheel could not have started, though once started the brake was not sufficient to prevent its speed accelerating. Although in the diagram the lever A is shown as a simple bar pivoted at the centre, yet in the actual model this lever was a link with a sliding fulcrum, arranged so that the fulcrum might be in any position between the attachment of the two rods. If, therefore, it was placed near the brake-rod, a very slight pull of the draw-bar would release the brake, and the engine would run fast; but if the fulcrum



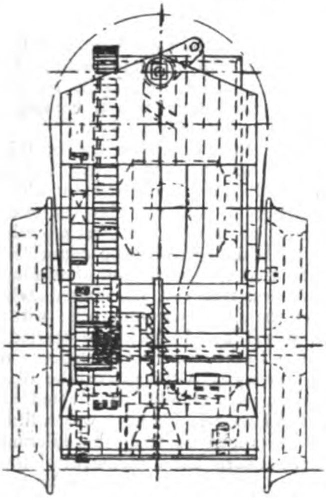
Dr. J. B. Winter's Clockwork Model L.B. & S.C.R. Locomotive, "Goldsmid."



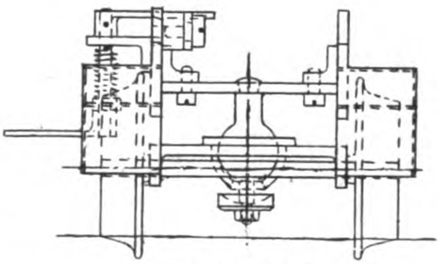
Sectional Elevation.



Plan of Framing and Mechanism.



Section at Trailing Wheel.



Front View of Bogie.

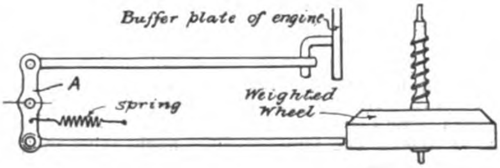


Diagram showing arrangement of Drawbar Governor.

DR. J. B. WINTER'S

SMALL CLOCKWORK

MODEL L B. & S.C.R

LOCOMOTIVE,

"GOLDSMID."

Scale:

Full size.

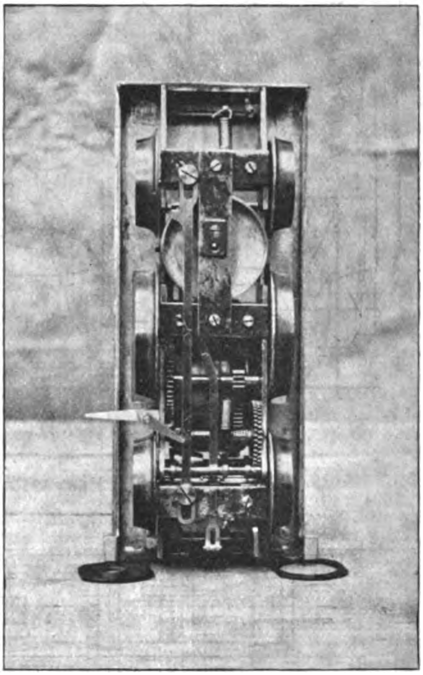
were near the draw-bar, it would have very little effect in easing the brake pressure, and the engine would run dead slow. Any intermediate speed could, of course, be obtained. This arranging for the speed was quite an independent action to turning on steam. The position of the fulcrum was first adjusted, and then steam being turned on the engine slowly started, the speed gradually increasing until that speed was reached which corresponded to the position of the fulcrum, after which the speed kept constant.

The cap over the water hole at the back of the tender was utilised for adjusting the speed link. By turning it round, a cam, connected with it by a rod passing down through the tank, actuated a lever, which worked the movable fulcrum of the link. A mark on the cap showed at a glance for what speed the engine was set. The water cap was also made to serve another purpose. It had been found with the previous engines that the regulator in the cab was rather small and inconvenient for starting them; in the present engine, therefore, in addition to connecting the starting gear with the regulator, it was also connected with the water cap, so that the engine could be started either by moving the regulator or (as was the invariable practice) by pressing down the water cap. In this case, the regulator also moved, but when the finger was taken off, the cap sprang up again to its normal position, while the regulator remained full on until the brake was applied, when it turned to the "off" position. This brake for stopping the engine was, of course, quite independent of the governing brake just described, and was a great improvement on that fitted to the other engines, inasmuch as it allowed the engine to stop gradually (say 4 or 5 feet), and yet the exact spot at which it would stop could be gauged to an inch. The brake consisted of a piece of watch spring, pivoted at one end, and caused by another spring to press on the weighted wheel. It was, however, normally held off the wheel by a catch engaging with a segment of a toothed wheel exactly like the pallet and escape wheel of a clock.

The catch or pallet was connected by rods to the side-lever, which projected at the side of the engine just over the bogie. When this side lever or trigger was touched, it allowed one tooth of the escape wheel to disengage with the pallet, and the watch spring pressed slightly on the weighted wheel, so that the speed gradually slackened and the engine would come to rest in about five or six feet if travelling at full speed. When, however, the engine entered the station at this reduced speed, the trigger was touched a second time, allowing another tooth to slip by and putting on the brake harder, the engine would stop in about six inches. The touching of the trigger was done either by clips which could be fitted on to the edge of the platforms wherever required, or by brass castings placed against the line so that as the engine passed, the trigger touched the casting or clip. With a very little practice, the engine could be made to stop with perfect accuracy at the desired spot. Of course, on pressing down the water cap, the escape wheel was turned back and the watch-spring raised off the weighted wheel.

The casing and outward parts of the engine were very carefully made, the greatest difficulties occurring in the tender, the outside axle-boxes of which were made by hammering small blocks of lead into a steel die made with the correct number of slots and impressions for webs and rivets. Solid lead boxes sound heavy, but the size was so minute that the weight was negligible. The outside springs were made of one piece of brass with lines scratched on them in the lathe to represent the leaves. The amount of work in making this model may be gathered from the fact that it occupied nearly one thousand hours, in addition to more than one hundred hours work of designing.

When this engine was tried on the railway for which she was designed, it was found that, in spite of being geared up to do two trips with one winding, she was still as powerful as the "Arundel," and could take a bigger load up the inclines than she would ever be required to



CLOCKWORK MODEL L.B. & S.C.R. SINGLE EXPRESS LOCOMOTIVE—VIEW OF UNDERSIDE.

do. Designs were therefore got out for another express engine of Mr. Stroudley's single driver ("G" class), which was to do three trips with one winding. The frames, wheels, and motion were completed, and in this condition it was handed over to Dr. Hovenden for him to make the casing and tender; this is not yet finished, but the engine has run frequently on the railway in its present state. Almost the entire weight rests on the driving-wheels, the engine almost exactly balancing on them. This was aimed at in the design to prevent slipping, as this was the first clockwork engine without coupled wheels (the motor coach wheels were coupled by cogs). If the leading and trailing axles had simply passed through holes in the frame, then as the engine passed a spot where the gradient changed from level to up-hill, the driving-wheels would have been lifted off the lines; the leading and trailing axles were therefore fitted into vertical slots in the frames, and a lever pivoted in the frames was pressed on the centre of each axle by a light spring. Axle-boxes were not used in this engine, but each axle was made in two halves, joined by a steel tube (see page 114), and in this way the wheels could be easily taken out.

In running the engine, the driver might easily forget how many journeys it had done since being wound up, and he might start it on a fourth journey and find it stop half way. To prevent this, a means was provided for

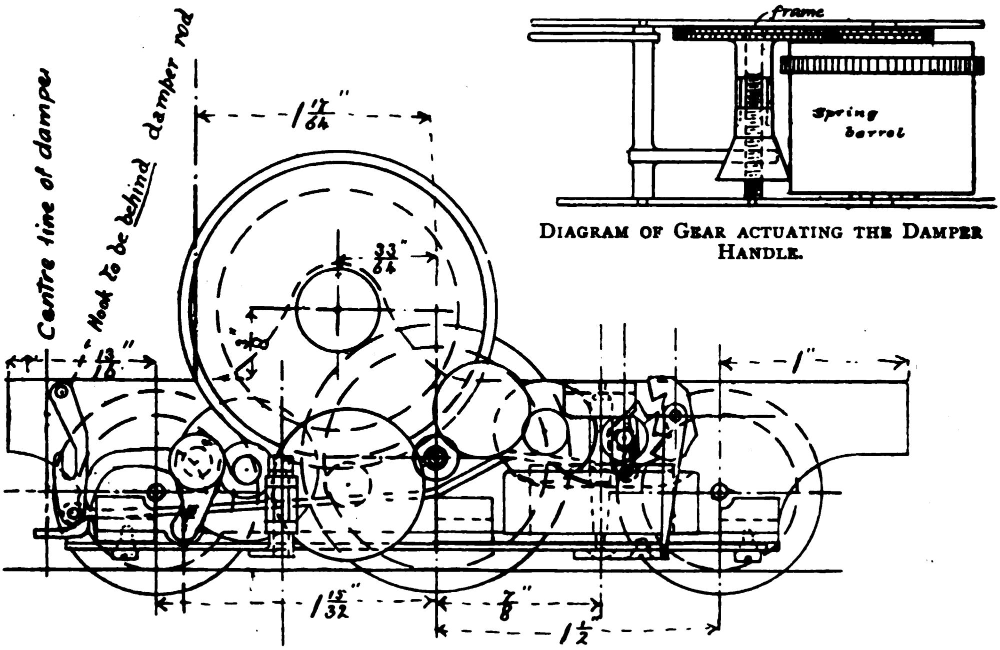
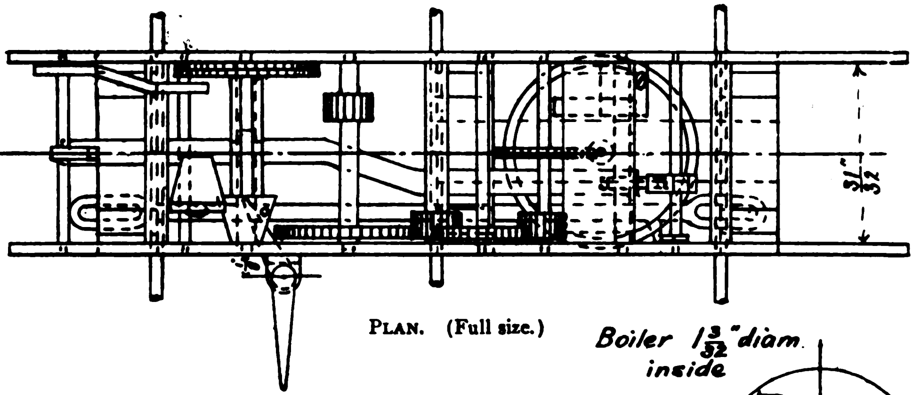
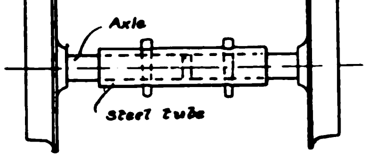


DIAGRAM OF GEAR ACTUATING THE DAMPER HANDLE.

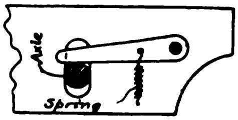
SECTIONAL ELEVATION SHEWING MECHANISM. (Full size).



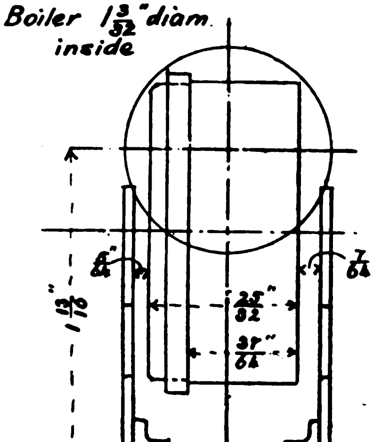
PLAN. (Full size.)



AXLE OF CARRYING WHEELS.

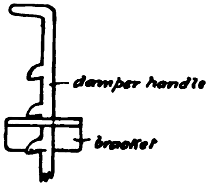


BEARING SPRING FOR CARRYING WHEELS.



DR. WINTER'S CLOCKWORK MODEL L.B. & S.C.R.
SINGLE EXPRESS LOCOMOTIVE.

indicating the amount of power left in her; the damper handle in the cab was used for this purpose; it had three hooks on it, and the number of hooks visible above the bracket indicated the number of journeys she could run. In the accompanying figure, two hooks are showing above the bracket, meaning that she can run two more trips. It is rather difficult to explain shortly how this



POWER INDICATOR FOR CLOCKWORK LOCOMOTIVE.

was arranged, but the accompanying sketch (page 114), which is purely diagrammatic, and does not show all the necessary details, may give a rough idea.

Between the spring barrel and the frame two very thin steel cogwheels were fitted—the inner one riveted to the barrel, and the one nearest the frame fitting on a square on the arbor. The latter wheel engaged with a wheel fixed to a spindle having a screw cut on it for part of its length, while the wheel riveted to the barrel engaged with one fixed to a loose sleeve on the screwed spindle, and this sleeve had finger-like projections fitting into slots in a cone shaped sleeve, which was on the screwed part of the spindle. A lever was held against the cone by a light spring, and on the pivot of this lever another arm was fixed on which the lower end of the damper-rod rested. Now, in winding up the main spring, the barrel and its cogwheel kept still, but the wheel near the frame revolved, turning the wheel on the screwed spindle. The cone on this spindle could not revolve on account of the finger-like projections engaging with the attachment to the other wheel on this spindle which engaged with the stationary wheel on the barrel. The cone, therefore, being kept from rotating while the screw inside revolved, travelled along the screw, and in so doing pressed down the lever touching it, which raised the damper-rod. When, however, the engine was running, the arbor kept still, so that the screw spindle was at rest, but the barrel wheel and the wheel on the loose sleeve were rotating, and the rotation was communicated by the fingers to the cone which travelled along the screw in the opposite direction to the former case, thereby allowing the damper-rod to drop by its own weight on the descending arm. In order to make room for these wheels by the side of the barrel without reducing the width of the spring, the frames were put still further apart than in the "Goldsmid," the measurement between them being 31-32nds in. instead of 59-64ths in. This only allowed 1-64th in. clearance between the outside of the frames and the carrying wheels, and the work had to be done carefully to avoid any rubbing.

Another small improvement was the action of the brake for stopping the engine. Very occasionally the "Goldsmid" would hang fire for an instant when steam was turned on, and since, when two or more trains were running simultaneously, they were timed to pass each other at a particular spot, a delay of a second in one of them might spoil the effect. To overcome this, the watch spring, which pressed on the weighted wheel to stop the engine, instead of lifting straight off when steam was turned on (as in the "Goldsmid"), was made to slide off in the direction that the wheel would turn, so that the act of turning on steam actually gave a slight flip to the weighted wheel in addition to removing the brake.

When this engine was tested, it was found that owing to the high gear there was a decided difference in the speed between the first trip after winding and the last. A very light extra brake was therefore added, which pressed on the end of the spindle of the worm wheel, and therefore had very little power. This brake was connected by a spiral spring to the cone lever working the damper-rod, in such a manner that when fully wound, the lever pulled the spring and kept the brake pressing on the worm spindle, but as the main spring unwound the tension on the spiral spring was gradually relaxed, owing to the movement of the cone lever, until, during the last revolution of the spring barrel, all tension was removed and the brake no longer affected the spindle; this kept the speed quite uniform, whether fully wound or not. This engine had, in all, three brakes—the one just described; the watch spring brake for stopping it, worked as in the "Goldsmid" by an escapement action; and the brake for governing the speed on inclines operated through the draw-bar and sliding link in the tender.

For the Book-shelf.

[Any book reviewed under this heading can be obtained from THE MODEL ENGINEER *Book Department, 6, Farringdon Avenue, London, E.C., by remitting the published price and cost of postage.]*

ELECTRICITY AND MAGNETISM. By Dugald C. Jackson and John Price Jackson, London. Macmillan and Company, Limited. Price 4s. 6d. Postage 4d. extra.

The latest addition to a long list of books on the general subject of electricity and magnetism does not pretend to any novel treatment in its exposition of the elementary laws; on the contrary, it follows generally accepted lines. The claim of the author is that the volume will lead a student step by step from the earliest stages right away to the threshold of the higher and advanced section of the subject. The claim is well sustained, and although it may seem a big step from the "electrical properties of amber" to the discussion of ether-transmitted electricity and Roentgen rays, the path is really made an easy one, well graded and made interesting with good illustrations and descriptions of suitable experiments. Of course, the book is properly one for use in conjunction with laboratory work—no text-book can very well be other than that—but, nevertheless, the solitary student would find it suitable, provided he performed the more striking experiments himself. There are nearly 500 pages in the volume and a good index, and it appears to be well up-to-date.

THE STEAM TURBINE. By Robert M. Neilson, A.M.I.Mech.E. London: Longmans, Green & Co., 39, Paternoster Row, E.C. Price 7s. 6d. Postage 3d.

Readers whose study is the steam engine will heartily welcome this publication, which is, as far as we know, the first book dealing only with the steam turbine upon the market. The scope of the book is wide; it is well illustrated, and commencing with some general remarks upon the various kinds of steam turbines, it traces the history of the machine, and more particularly deals with the development of the Parsons turbine. The construction, action, and design of the steam turbine is pretty thoroughly considered, and altogether the engineer, the student of engineering, and amateur, will find much information of practical value within the covers of this volume. The concluding chapter is devoted to the propulsion of ships by turbines, and in an appendix is given (for the benefit of inventors and others) a list of all the British patents for or relating to steam turbines, from the earliest records up to the end of 1899.

The Editor's Page.

WE would commend to the special notice of all our readers who are possessed of some degree of mechanical skill, the article on model electric railways, which was concluded in the last issue. To our electrical readers this recommendation is, perhaps, hardly necessary; but we believe many other readers who have so far only touched steam working models will find a new centre of interest in model electrical traction. So much real engineering work of this kind is going on in all parts of the country that the amateur should have little difficulty in becoming acquainted with the general principles of traction work, and in getting ideas which he can turn to useful account in his own models.

* * *

"W. M." (Bradford) and a friend have been having a little scientific argument, and, being unable to come to a mutual agreement, have requested our services in arbitration. "W. M." states his case as follows:—"A friend of mine asserts that there are only three mechanical powers—the screw, the wedge, and the lever. I assert that there are six—three primary, and three secondary—the pulley, the inclined plane, and the wheel and axle. We should esteem it a favour if you would answer in your correspondence column."

* * *

Our verdict is that it is a drawn battle, since neither contestant is, strictly speaking, correct. A so-called "mechanical power" is a device by which a small force is enabled to overcome a greater one, although the small force has to operate through a distance proportionately greater than that through which the resistance of the greater force is overcome. Writers on mechanics differ as to the number of types of appliances which are entitled to rank as "mechanical powers"; but all are agreed that however many types they quote, they are all capable of being grouped under two specific "powers" only—viz., the lever, and the inclined plane. The wheel and axle, the pulley, and toothed gearing (which some writers quote in addition to those mentioned by our correspondent), are all based on the principle of the lever, and the wedge and the screw are both based on the principle of the inclined plane.

* * *

"G. M. V." (Leeds) wishes to build a motor car. He does not believe in petrol cars, which, in his opinion, have not come to stay. He proposes to build an electric car, and he seeks our advice through the Query Department. It is a pity we cannot help him very far, because his car would undoubtedly be a novelty. Says our correspondent: "The only objection is the weight, and I propose to use aluminium wherever possible; but I think an electric motor and a small dynamo, and as few cells as possible, not more than six, say, would not weigh more than a petrol motor, water and tanks, benzine and tanks, exhaust boxes and silencers, and radiators, and pumps, &c.; do you? I want to have a motor of about 4 h.-p., made on the principle described in the 'A.B.C. of Dynamo Design,' but using aluminium wherever possible. I should also want a small dynamo to run through the cells, the idea being to have enough current in the cells to start the motor, when the dynamo would then come into action to drive the motor, and, if possible, light the lamps at night. (!) Now will you please give me the specifications for constructing motor and dynamo, sizes of wire for both, voltage and ampères produced and required? I have 4 lbs. of No. 20 S.W.G. D.C.C. and varnish, which I should like to introduce into one of the machines. Please give a rough sketch of car (plan), showing position and connections of motor, dynamo, and cells, and please state speed. I want car to run on level from 4 miles to 16 miles per hour. If you will give me full instructions, size of armature and of shaft, and all particulars you think necessary, you will greatly oblige. Please say where aluminium may be used, and also total weight of motor and dynamo separately, as near as possible."

* * *

The writer of the above claims to have served two years with an electrical engineer, and is at present working in a motor car factory. Of course, we have no comment to make, and only this advice to offer to "G. M. V." Let him study the principles of electrical action in a good text-book and the construction of motor cars—electrical and otherwise—in other books and journals devoted to the subject, when he will realise the heavy task he has set us—and himself.

Prize Competition.

Competition No. 22.—Two prizes, value £2 2s. and £1 1s. respectively, are offered for the best and second-best designs (to include full description and working drawings) for a working model flying machine. The size, type, and propelling power of the model are left entirely to the choice of the competitor, the main stipulation being that it shall be capable of successful working. The model must have been actually made, and the prize winners will be required to send in their models for inspection and trial by the judges before the actual awarding of the prizes takes place. The last day for receiving entries is October 31st, and the usual general conditions apply in this Competition.

General Conditions for above Competition.

1. All articles should be written in ink on one side of the paper only.
2. Any drawings which may be necessary should be in good black ink on white Bristol board. No coloured lines or washes should be used. The drawings should be about one-third larger than they are intended to appear if published.
3. The copyright of the prize articles to be the property of the proprietor of The Model Engineer, and the decision of the Editor to be accepted as final.
4. The Editor reserves the right to print the whole or any portion of an unsuccessful article which he may think worthy of publication, unless the competitor distinctly expresses a wish to the contrary.
5. All competitions should be addressed to The Editor, The Model Engineer, 37 & 38, Temple House, Tallis Street, London, E.C., and should be marked outside with the number of the competition for which they are intended. A stamped addressed envelope should accompany all competitions for their return in the event of being unsuccessful. All MSS. and drawings should bear the sender's full name and address on the back.

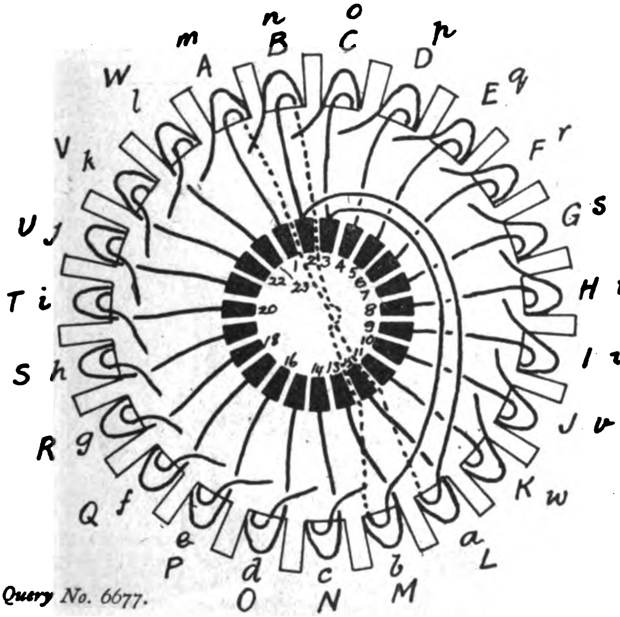
Queries and Replies.

[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, *37 & 38, Temple House, Tallis Street, London, E.C.]*

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

[6677] **Winding a 23-slot Armature.** C. S. (Chelsea) writes: I have a 12-slot drum armature, wound with No. 36 D silk wire; also a 23-slot 23-segment drum armature, wound with No. 30. I



Query No. 6677.

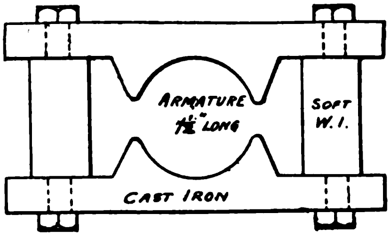
WINDING A 23-SLOT ARMATURE.

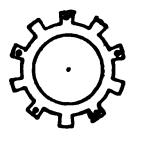
should be very pleased if you could give me the diagram of windings and connections to commutator, as they require re-winding, and having got the wire by me I have a great desire to do them. They are run as shunt motors for 100 volts.

The method of winding a 12-slot armature for a 12-part commutator is shown in our Handbook, "Small Dynamos and Motors." With regard to the other armature, it is an extremely difficult matter to describe on paper the winding of a drum armature, and in your case the windings ought to be done on formers, in the Eick meyer style; however, the following may help you. Referring to the diagram, which shows a 23-part armature with a commutator of the same number of segments, it will be seen that the coils are wound in nearly opposite slots. Two coils are shown in their entirety, the first being wound in slots A and *a*—there are ten slots to the right and eleven to the left of A, *a*. The starting end of this coil is joined to the commutator segment 1, the finishing end to segment 2, and the coil occupies half the depth of the slots. Joined to the finishing end of the coil (and, therefore, to the segment) is the commencing end of the second coil, which is wound precisely in the same way, in the slots B, *b*. Its finishing end and the beginning of the third coil are joined to the commutator segment 3, and the above winding is continued in each pair of slots in succession. When eleven coils have been wound it will be found that the next coil will have to go on top of the wire already wound in the slot *a*. This twelfth coil is shown by letters L, *l*, the part L being wound on top of coil *a*, but the portion in the opposite slot occupying the bottom of slot *l*. The next coil, M *m*, will, however, be wound on top of wires already wound in both slots, namely, *b* and A, and thereafter all the coils will take outside places until every slot has a double winding in it. The last end of the twenty-third coil, namely, that wound in slots W, *w*, will be found to join up to the commencement of the first coil, which is connected, of course, to the commutator segment No. 1. We hope this is clear. It is a description which will apply to any armature with a large unequal number of slots. We do not care for unequal numbers, but with a fairly large number there are not so strong objections to the method. You do not say anything as to the size or power of the armature or motor.

[6681] **Manchester Dynamo, 50 watts.** J. F. (Rio de Janeiro) writes: I shall be much obliged if you would give me the following particulars. I have made a little dynamo, from which I enclose a sketch. (1) Will you kindly give the best winding for it? (2) What output I can expect? (3) What should be the speed of this dynamo? (4) I have plenty of D.C.C. wire, Nos. 18 and 22: can I use it?

(1) The armature will require 30 yards of the No. 18 wire, twenty-four turns in each slot. The field-magnets will require 3 lbs. of the same wire, but would give better results if wound with 2 lbs. No. 19. (2) About 50 watts; 5 amps. at 10 volts. (3) 2,550 revs. per minute. (4) Use No. 18 as above. If the No. 22 must be used, about 2 lbs. of it may be wound on the field-magnets, and the armature in this case may be wound with 60 yards No. 21. Connect in shunt.





MANCHESTER TYPE DYNAMO, 50 WATTS.

Query No. 6681.

[6695] **Electric Pendulum.** E. C. G. (Edinburgh) writes: I beg to enclose you two sketches of a pendulum arrangement which I have made. The sketches (not reproduced) are very rough, but you will see the idea of the thing. It is a horizontal type of armature; it is balanced dead level when both the contacts are together. When the current is in, the armature is pulled down, and, of course, the circuit is broken immediately, and then, by gravitation, it comes back to make contact again. The contact-breaker is the same as used for bells. I have got it to work very well and steady. The armature beats about twice to the second. What do you think of the idea? And if, by the second sketch, would it be possible to fix two pins to drive a wheel for a clock, what cells would you recommend for working it? I have at present a Leclanché cell, of agglomerate form.

We do not think there is any great advantage in your design. From the nature of the mechanism the action is very delicate, so that it would be powerless to do more than move the wheel—if it could do that. It *might* work with an escape wheel of a clock, but we doubt if it would. You see, although the lever works in a different position there is really no practical difference between your arrangement and that of an ordinary magnetic contact-breaker. Leclanché cells, in one form or another, are certainly the best for this type of work.

[6575] **Model Steam Launch.** C. W. T. (Buckhurst Hill) writes: I have a model steam launch, a single-cylinder ¾-in. by 1-in. s.-v. engine, working a 3-in. three-bladed propeller, and a rather common-soldered copper, saddle-shaped boiler; water and steam space, 7 ins. by 5 ins. by 2½ ins. The joints in boiler are not riveted, and I have never tested for the actual pressure at which it works. The boiler is fired at present by a three-burner ordinary spirit lamp, but the conta'ner is an awkward shape, and will not go into my new hull as designed. This engine and boiler has worked very fairly for some time in a heavy wooden 3 ft. 6 in. hull, very roughly made by myself when some years younger, and I now propose to make a new metal hull, and fit the boiler with gauges, pump, etc. (1) Is tin or zinc more suitable for a 45 in. hull, and about what gauge metal do you advise? (2) What pressure, roughly, should a boiler of the kind described work at with safety? (3) Is it necessary for pressure gauge to be connected to boiler by a syphon tube, and what is the object of such an arrangement? (4) Would it be better to have a feed-pump worked from an eccentric or by a hand lever, and what size pump, suction, and delivery pipes would be most suitable? (5) If I used a hand-pump, where could I obtain a cheap and reliable one? (6) Is a check-valve necessary between delivery tube and boiler? (7) Is the propeller mentioned of suitable dimensions? (8) Would an adaptation of firing arrangement described on page 2 of January 1st, 1902, issue, worked with methylated spirit, be suitable, or would an ordinary spirit lamp, with a differently shaped container to fit hull, be sufficient? (9) Would the water gauge No 8,475, p. 44, of Messrs. Bassett-Lowke & Co.'s catalogue be efficient, and would it be safe if simply sweated into boiler?

(1) Tin plate, about No. 26 S.W.G. (2) If not stayed, only about 10 lbs. per square inch. This, however, is but an approximation. (3) Yes, the syphon tube is very desirable. Many gauges show incorrect readings through this precaution not being taken. The syphon allows a layer of cool water to intercept the working tube of the gauge and the hot steam. Gauges should not be subjected to the heat of the steam. (4) Depends upon the boiler. If it will run without water for, say, twenty minutes, a hand-pump may be used. For a boiler with a smaller range of water, a constantly running pump is practically a necessity. (5) Hand pumps may be obtained from any of our advertisers who sell boi'er fittings, viz., Bassett-Lowke & Co., B. Garside, and others. About ⅛ or 3-16ths internal bore. (6) Not absolutely necessary where a powerful hand pump is used. (7) As far as we can tell, yes. (8) A matter for experiment. (9) Yes. Bring the steam pipe through the furnace, as at the above low pressure of steam cylinder condensation is likely to be evident. This will dry the steam thoroughly. A very good pump for low pressure may be made from *small* oscillating cylinder, bore ½ in., stroke ⅜ in. Connect what would be the steam pipe to the water supply, and the exhaust to the boiler, or *vice versa*. Work the cylinder through the medium of an axle and crank, geared down from main shaft. Put a cock on delivery pipe to adjust water supply to boiler.

[6714] **Contact-Breaker for Induction Coil.** J. E. H. (Dublin) writes: I have a 3-in. spark coil, and am desirous of getting a very high rate of "make and break." Would you be kind enough to say—(1) Would a Wehnelt interruptor work on 6 volts? (2) An idea of cost of small Wehnelt? (3) Should the condenser be taken off and why? also does this decrease the spark length? (4) What explodes or decomposes the gas which is formed? (5) Could I manage any other way without getting a Wehnelt break, and without incurring any heavy expense?

(1) No. (2) The cost would be very little, as the parts consist of a strip of lead, some glass tubing, and a short piece of platinum wire. (3) No, leave the condenser on if you use the break. (4) We could not answer this question in brief. (5) If you make the spring of the ordinary break very short and stiff, you would get the desired result. Another method is to use a separate mercury break; and yet another is to employ some form of mechanical break in which a wheel can be revolved at a high speed by hand.

[6764] **Model Locomotive Queries—Steam Raising.** H. G. (Teston) writes: Would you kindly answer the following question as soon as possible:—Having made a ¾ in. scale locomotive, the boiler having ten 7-16ths in. (thin) brass firetubes, and nine 3-16ths in. cross water-tubes in firebox, the same being 2⅛ × 4⅜ × 4 ins. high inside, I find that in burning methylated spirit in an 8-wick lamp, burners being 7-16ths in. diameter, they burn the air out and the flame comes down and around the outside. I have tried various heights, but with poor results. It is all right when steam gets up with exhaust up funnel, and keeps up 30 lbs. of steam, which is necessary. So I thought of going in for a "Primus" burner, but would like to know—(1) The address of the maker? (2) The size and price that would be suitab'e for my model? (3) Also, if having reservoir in tender, how would a flexible connection be made, as rubber will not stand oil? (4) Would these burners want a blower to get up a draught? (5) Do they smoke or smell?

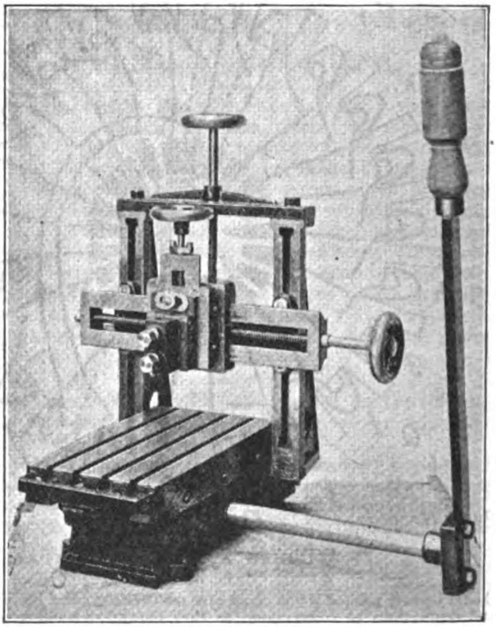
The reason of the failure is easy to understand. The locomotive boiler depends for its successful working largely upon the draught, and you should, if not already provided, fit a steam blower to your model, so that the flame may burn properly and not come down outside. You will quite see that there is some resistance to the products of combustion passing through a number of small flue tubes and then again through a chimney of still smaller total area, and unless there is some outside means of quickening the draught the fire will be choked. Methylated spirit requires a large amount of air in burning, but you will do little better in steam raising with a "Primus" burner. These give a greater heat and are cheaper to work, but would give the same trouble in raising steam. Before you try a "Primus" burner make an extension stack (see issue of October 1st, 1901), and fit a nozzle about 1-16th in. in diameter concentric with the funnel. Couple this to a bellows or one of the air bulbs used on hairdresser's sprays, and work this until the steam is raised to about 5 or 10 lbs. per square inch, and then turn on the steam blower. This blower should only have a hole in its nozzle of about 1-20th to 1-30th in. diameter, and should be kept as low as possible; the same applies to the blast pipe. Read the recent articles on "Ten-wheeled Tank Locomotive" for information concerning the adjustment of the parts connected with steam raising. Messrs. Nurse & Co., 182 Walworth Road, S.E., and Messrs. Bassett-Lowke & Co., Northampton, will supply oil burners and fittings. Kindly refer to THE MODEL ENGINEER of August 1st and October 1st, 1901, for arrangement and manipulation of the "Primus" burner for model locomotive of similar dimensions to your own. With reference to your fourth query, please see issue of June 1st last. If the draught is insufficient, "Primus" burners (or for that matter any kind of burner) will either smoke or not give out the fullest amount of heat available. Before the steam is up you should not urge the fire too much. You would do better with only, say, four or six wicks until the blower is in action—that is, if the extension stack is not adopted.

Amateur's Supplies.

[*The Editor will be pleased to receive for review under this heading, samples and particulars of new tools, apparatus, and materials for amateur use.*
**Reviews distinguished by the asterisk have been based on actual editorial inspection of the goods noticed.*]

*A Substantial Hand Planing Machine.

Some months ago we illustrated a brief notice in these columns of Messrs. Geo. Goodman & Co.'s hand planing machine which the firm had introduced for amateurs and small engineering generally. Since that time, a very great improvement has been made in the



MESSRS. GOODMAN'S PLANING MACHINE.

design, so that the new machine is in every way a better tool. We have examined one of the later specimens, and have tested its capabilities in a practical fashion, and the result leaves no doubt in our mind that Messrs. Goodman are offering a sound substantial tool that will serve the purpose of the special class of work admirably, and at the most moderate price. A few of the more prominent details of the machine will be of interest, as, for example, its capacity. The maximum size of any piece of work it will take is 10 by 6 by 4½ ins., and the surface it will plane is 10 ins. by 6 ins. The construction is sound, the feed screws are square-threaded (cut in the lathe) and the total weight is 2 qrs. 11 lbs. Messrs. Geo. Goodman & Co. (whose address is at East Hayes, Bath) have wisely arranged not only to sell complete finished machines, but will also supply castings, machined or rough, feed screws and nuts, and other parts separately, as required. A set of castings in the rough comes to 24s., and machine planed, 44s. 6d. They also fit the planer with double raising screws, and this is a commendable feature when the slight extra cost is not objected to. Although primarily a hand-worked machine, power attachment is applicable, with automatic action and self-feed to any adjustable stroke; a larger bed than the usual size can be supplied and also a strong stand with cast-iron legs. Altogether we can thoroughly recommend the production, and agree with the makers' statement that they are giving the lowest quotations for a really good article. Our readers will oblige by mentioning this journal when writing Messrs. Goodman on the above matter.

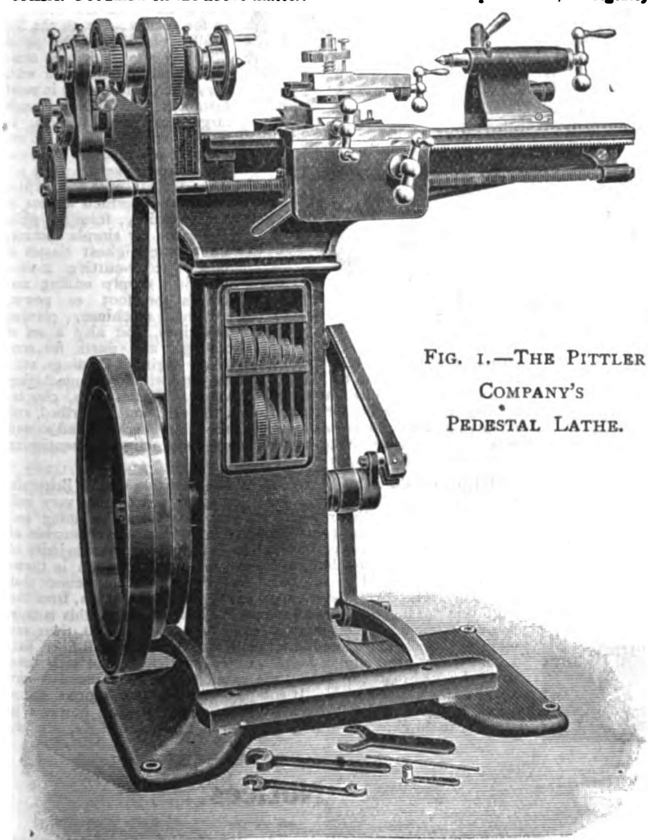


FIG. 1.—THE PITTLER COMPANY'S PEDESTAL LATHE.

*New Lathes for Amateurs.

We show in the accompanying illustrations two new types of small screw-cutting lathes introduced by the Pittler Company (Mr. George Adams), 144, High Holborn, London, W.C. The first of these (Fig. 1) is the "A and B" pedestal lathe, which takes 20 ins. between centres, the latter being 5 ins. high. The total length of bed is 40 ins., the swing in gap is 16 ins., and the lathe will cut from three to sixty-four threads per inch, the leading screw having a V-thread. The most noteworthy features of this tool are its pedestal support in place of the usual standards, its large hollow mandrel having a bore of over ⅞ in., and the fact that the headstock and bed are in one casting, thus tending to increased accuracy and rigidity. The mandrel has a two-speed pulley corresponding with the two speeds on the driving wheel, the outer step of the latter being merely a rim to give extra weight. Back-gear is fitted, and also a ball-bearing back-thrust. The pedestal contains a cupboard, which is divided into convenient spaces for taking the change wheels. Balanced handles are fitted to all the slide screws. The tailstock can be set over for taper work. Fig. 2 shows another new "A and B" lathe of a somewhat different type. This is made in two sizes, 5-in. and 6-in. centres, and with three different lengths of bed. The lathe bed is mounted on standards in the ordinary way, and has a three-speed driving pulley, and back gear. The mandrel is hollow, the smaller of the two sizes having a bore of 29-32nds in., and the larger a bore of 1 in. The diameter of mandrel nose in former is 1 in., and in latter 1¼ ins. The tailstock is locked to the bed by an eccentric lever and can also be set over for taperwork. The bed has a gap with bridge-piece, and the saddle and tailstock are carried on V-slides. The slide-rest is adjustable for turning cones, and the screws are covered in to protect them from dirt. The saddle can be operated either by the lead screw or by a rack and pinion, and in the model "B" of this lathe there is an automatic cross-feed. All the change wheels are cut from the solid metal. Both the lathes we illustrate are unusually moderate in price, and as the result of a careful examination, we can confidently recommend them as good value for money. They are well suited for the amateur as well as for cycle and motor makers, electricians, and other people who have occasion to do light accurate mechanical work. Full descriptive circulars of these lathes may be had from the above address by all readers sending a stamp for postage.

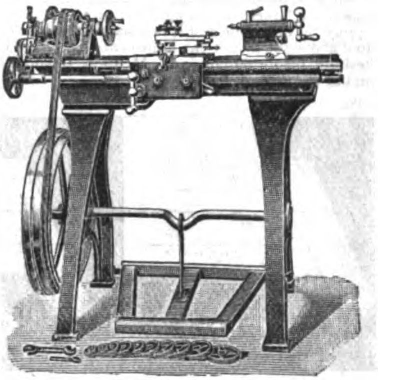


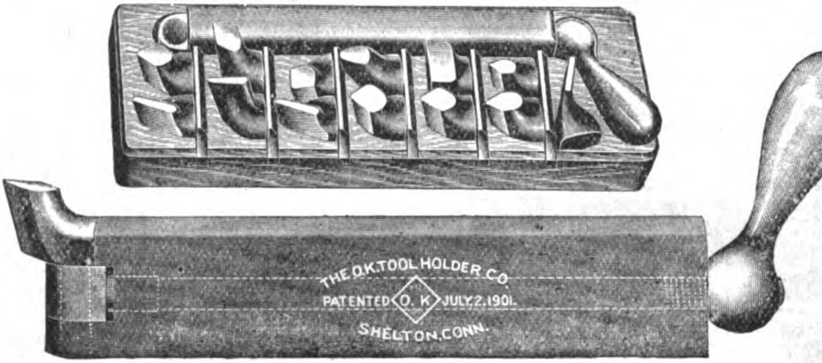
FIG. 2.—THE PITTLER COMPANY'S NEW "A AND B" LATHE.

A Change of Address.

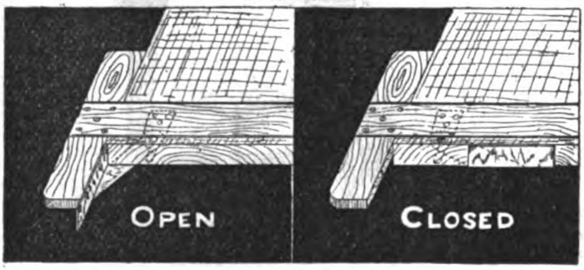
Messrs. Lucas & Davies, who will be well known to most of our readers as one of the oldest firms in the model-making business, have lately moved from the premises in Farringdon Road with which their name has been associated for so many years. They have taken the lease of a three-floor engineering works at 9, Wickham Street, Lambeth, S.E., a turning out of Tyers Street, and close to the Victoria Embankment and Lambeth Bridge. Here they will have considerably increased accommodation, which will prove a convenience to many of their customers. On the ground floor are the heavy lathes and machine tools driven by a 6 h.-p. Crossley Gas Engine, and also the offices. The first floor will be devoted to light turning and general fitting and erecting, and has excellent lighting at both ends. The second floor will be used as a store room, where, in addition to a considerable quantity of patterns and raw material, there will be kept the very large assortment of model engine castings, of which Messrs. Lucas & Davies make a speciality. We recently paid a visit of inspection to the new works, which assured us that this firm will be in a position to deal promptly, not only with the construction of inventors' and experimental models, but also with the execution of all kinds of turning, planing, screw-cutting, and similar work for amateurs and others. Those of our readers who are not familiar with Messrs. Lucas & Davies' catalogue may like to know that they issue a well-produced illustrated list of model and small power engines, including separate parts and castings. This may be had post free for 4½d. The firm will be pleased to see their old customers at their new address.

*The "O.K." Lathe Tool Holder.

We are able to illustrate a very neat set of lathe tools and holder which is being supplied by Messrs. C. W. Burton, Griffiths, & Co., Ludgate Square, Ludgate Hill, London, E.C., and which we have inspected. The idea involved in this holder is a very ingenious one, yet simple, as a lathe tool holder should be, and the special advantage claimed is in regard to the facility with which tools can be changed. Any of the various tools supplied with the holder can be removed and another substituted without disturbing the holder when once placed in position on the lathe or shaper, and the change can be made expeditiously. With the holder are furnished all shapes of tools in common use, and these are held very firmly by a quarter-turn of a handle at the back end of holder. The tools are drop-forged, and are accurately ground for clearance, etc. The makers state that "any tool can be furnished promptly and at a price less than the cost of re-dressing and grinding an old-style tool." From our own inspection we can say that the holder and tools are of finest quality, and are beautifully made. They are supplied in three sizes, the holders in each case being respectively ⅜ in. by ⅝ in., ½ in. by 1 in., and ⅝ in. by 1⅛ ins., in cross section. A full set includes not only cutting tools, but boring and tapping bars, knurling tools, etc., neatly packed in a case. For the convenience of many readers, a "working set" has been arranged in each size, as is shown in our illustration. This costs only half the amount of a full set, and consists of thirteen tools, case, and holder, any combination of tools being supplied to suit the purchaser. As this holder is designed for American lathes, we should advise an intending purchaser to make sure that his slide-rest is not so high as to throw the point of the tool above the line of the lathe centres; on no other point need he hesitate before purchasing. Mention should be made of this journal in correspondence.



THE "O.K" TOOL HOLDER AND SET OF TOOLS.



THE "CARTENEOGRAPH" DRAWING BOARD ATTACHMENT.

An Invention for Draughtsmen.

The two illustrations above represent an exceedingly clever yet simple appliance devised for the benefit of draughtsmen, to whom it will hardly need long explanation. It is to enable the T-square to be used at the bottom of the board without any of the usual uncertainty and inconvenience of that position, and consists of a hinged projection, which can be turned up flat against the bottom edge of the board when not required. A spring catch holds it in the correct position, and, it is stated, the device can be easily attached to any existing board. The "carteneograph," as the appliance is called, is, in our opinion, a sensible and practical invention, and our own experience commends the idea. The cost of a single instrument is 2s. 6d., but special discounts are offered for quantities, which should be an inducement to those who order supplies for drawing offices, and the attachment can be obtained from Mr. L. J. Tibbenham, 13, Arboretum Avenue, Lincoln, THE MODEL ENGINEER being mentioned.

For Testing Glow Lamps.

Most people know the principle of lamp-testing by means of the photometer, an apparatus of comparatively simple construction. This has been put on the market in very compact form, and with it a set of instructions will be found useful by those who do much electric lamp testing. The set is sold at a shilling, which does not, of course, include a standard glow-lamp, which is also required in the work. Messrs. Everett Edgcumbe & Co., 151, 152, Great Saffron Hill, London, E.C., who supply the set, also make electrical measuring instruments of every description, lamp-testers, etc., and their list should be secured by those interested in the subject, THE MODEL ENGINEER being mentioned when writing.

Catalogues Received.

Henry Milnes, Ingleby Works, Brown Royd, Bradford.—The lathes made by this firm are well-known to a large number of our readers, and we have always had uniformly good reports as to the excellences of these tools. Those who contemplate purchasing either a lathe, planing, or milling machine, or any of that large class of goods known as "accessories," will do well to secure the new list prepared by the firm, and a copy of which has been forwarded to us for review. As to the list itself, this is on the same lines as the previous catalogue, but is illustrated with very fine photo blocks in most instances, and details a much larger assortment of tools. It is well bound, printed on art paper, runs to more than 100 pages, and is sent to any address for 3d., post free. Apart from lathes—which appear in every variety, from the plain foot-lathe for simple turning, up to the highest classes of power screw-cutting tools—the firm supply milling machines for foot or power, drilling machines, planing machines, and also a set of castings and parts for constructing a strong ½ h.-p. horizontal steam engine. Castings, etc., for lathes are supplied by Messrs. Milnes, who will do any machining on them if so required at little extra cost. Headstocks, chucks, milling cutters, drills, &c., are fully illustrated and described, and no lathe user should be without a list so comprehensive and so well produced. When writing, correspondents will oblige by mentioning THE MODEL ENGINEER.

Britannia Co., Colchester.—The latest edition of the Britannia Co.'s catalogue is a bound book of some 240 pages, very well printed and fully illustrated. It comprises lathes, planing and drilling machines in great variety, besides a large number of machines which have, perhaps, less interest for the majority of MODEL ENGINEER readers, although important enough in themselves. With regard to the lathe section we note a statement that the firm make 250 different sizes and patterns of lathes, from the engineers' 40 ft. to the smallest bench lathe; and as this is only one department of their work it is to be expected that there are many patterns not included even in the present well-filled list. Lathe accessories, and a large variety of tools of all sorts have space devoted to them, so that the catalogue is an eminently desirable one for any amateur. It can be obtained, THE MODEL ENGINEER being mentioned, for a shilling, which amount, however, is allowed to purchasers sending an order of the value of £2, or more.

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

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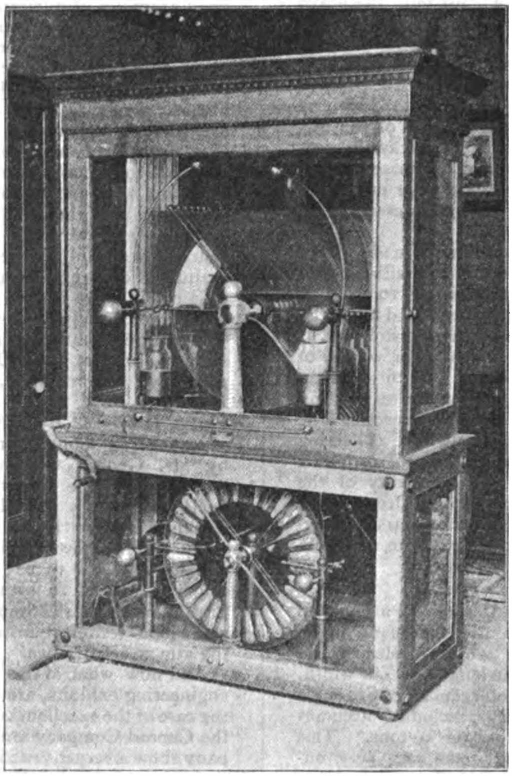
Some Notes on a Large Static Machine.

By ORION BROOKS.

SOME months ago Dr. C. F. Griffin, of San Francisco, who is one of the staff of the Lane Hospital and also adjunct professor of materia medica and therapeutics in Cooper Medical College, was desirous of securing a static electric machine for *x*-ray and general electro-therapeutic work. There were many machines for such purposes to be had, but Dr. Griffin possessed "ideas of his own," and as he was quite familiar with many of the machines on the market, he knew by experience the fickleness of the "static" machine. Accordingly he proceeded to put his own ideas into the form of drawings and specifications, and the following is a description of the resulting machine.

There are really two distinct machines in one case, a "Wimshurst-Holtz" machine in the upper compartment, and a "Wimshurst" in the lower. The case is of massive design and made of quarter sawed oak, 8 ft. high, 5 ft. wide, and 2½ ft. deep (front to rear), with plate glass panels. It is divided into two sections by a marble slab 5 ft. by 2½ ft., and 1½ ins. thick. This feature was criticised by some persons as being likely to lower its electrical efficiency because of the "cold" property of marble, but the performance of the machine fails to support this criticism, and the weight of this slab adds very materially to the steadiness of the machine while running, there being but very slight vibration when the plates are running at their normal speed of 300 revs. per minute.



A LARGE STATIC MACHINE.

The lower machine is, as stated, a "Wimshurst," with two sheet-glass plates 29 ins. diam., and its purpose is to supply an exciting charge to the upper or main machine whenever necessary, and also to supply static effects of lower power (6-in. spark or less) for special treatment. This lower machine is made reliable in all conditions of the atmosphere, without drying material, by having more than the usual number of sectors on the plates, there being thirty-two sectors on each. It can be operated by either hand or foot-power.

The upper machine, which is the most noteworthy feature, has twelve revolving plates of sheet glass, each being 31 ins. diam., and twenty-four fixed plates, 16 ins. by 42 ins., in pairs, twelve above and twelve below the shaft. Owing to the impossibility of getting perfectly flat sheet glass, considerable clearance had to be allowed for the revolving plates. The "inductors," or field plates, are made of heavy bond paper with gilt paper combs placed between the plates of each pair. These field plates subtend an angle of about forty degrees, and the neutralizing combs are adjustable from the rear ends of these inductors about twelve degrees. The rotating plates are held on the shaft by means of compression flanges. The discharge rods are mounted inside the case, as are also a pair of one-half gallon Leyden jars, the former being adjustable from the outside as to separation, and the Leyden jars may also be placed into or out of contact with the collecting comb bars from the outside. A rod leading from the frame of the neutralizing comb permits of adjustment from the outside also. The two knobs of the bars of the collecting comb, with about 4 ins. of the latter, comprises all ot the upper machine that is exposed to the outside air when the upper section is closed, reducing the loss from leakage to a minimum. After the parts of the machine had been made and assembled, and before the case had been closed and dried, it was tested, and when the humidity of the air was below 60 per cent., no difficulty was experienced in making the upper machine take a charge from the exciter and hold it when connected up in the regulation manner; but when, as was often the case, the humidity was above 60 per cent, difficulty was experienced in securing performance in the open air until the writer introduced an idea which he believes is original. This improvement consists in connecting metallically the comb rod on the charging side with the field plates, or inductors, on that side. Thereafter, little or no trouble was met with in charging and working the machine in open air.

In reply to a recent inquiry the owner of the machine says:—"Six months' use of the machine has shown that it does not reverse polarity while in action, and does not require charging except after the case has been left open for a considerable time. I believe that the wires connecting the stationary plate inductors to the collecting rods contribute materially to both these good points."

This machine readily gives 14-in. sparks (the limit of the insulation distance of the machine) and perforates any except the most perfect Leyden jars. Where operated without Leyden jars it gives a "fox tail" discharge 12 to 14 ins. long and 3 ins. diam. When the machine is operated in the absence of any light except its own, the effect is beyond the power of words or pen to describe, and must be seen to be fully appreciated. All parts of the case appears electrified, and sparks may be drawn by approaching the finger if in line with the rods of the collecting comb and when held several inches away and outside of the case, but with a glass panel interposed. The insulating property of glass seems to change or largely disappear under the stress of such voltages as crack across an air-gap of 14 ins.

During the preliminary trials, which were made with a pair of half-gallon Leyden jars attached and with a speed of about 180 revolutions a minute, discharges 10 ins. long were produced continuously at about five second intervals, each discharge being as loud as an ordinary pistol shot.

Two features of the machine which seem worthy of note are a double row of neutralizing pins to secure a more perfect discharge of the plate surfaces after passing the collecting combs, and metallically connecting the inductor field plates on one side with the collecting combs. This latter seems to be a violation of orthodox rules, but it certainly increases the reliability of the machine very much; it does not detract from spark length or frequency of discharge, and it appears to completely prevent reversing of the polarity of the machine. —*Journal of Electricity, Power, and Gas.*

TRIALS WITH AN ELECTRICALLY PROPELLED LAUNCH.—Some trials have recently been made on the Continent by Prof. O. Flamm with an electrically-propelled launch, measuring 52 ft. in length, 8 ft. in width, 2 ft. 8 ins. in depth, and having a displacement of 610 cubic feet. The motor of 60 h.-p. weighs, including accumulator, switches, and conductors, about 9 tons. This weight considered per horse-power compares very unfavourably with steam or internal-combustion motors. The trials showed that at a speed of 10 knots the power required was 59·3 h.p.; at 7·7 knots, 18·1 h.p.; and at 4·9 knots, 5·3 h.p. At speed of 10 knots, the radius of action was 30 miles, while at 4·9 knots this was extended to 220 miles.—*Mechanical Engineer.*

Exhibition Notes from Cork.

By "ATLAS."

IT seldom falls to the lot of Exhibition promoters to have at their disposal so charming a site as that now occupied by the International Exhibition at Cork. Seated in the grounds as I write these notes, I have before me a lovely reach of the River Lee, affording in the distance a peep at a portion of Cork city with the historic "pepperbox" steeple in which were located the famous Shandon Bells. True, the Sylvan beauties of the river are somewhat marred by the intrusion of the inevitable water chute, without which no exhibition is nowadays guaranteed genuine; but so marked is the beauty of the grounds as a whole that it is not difficult to forgive the chute for being the wooden skeleton at the feast.

Of the exhibits there is but little to be said from an engineering point of view, for the Machinery Hall so-called contains but a scanty show apart from the necessary electric lighting plant. Some well-known firms are, however, represented such as Ruston, Proctor and Co., Robey & Co., Mather and Platt, Reavell and Co., Greenwood, Batley, & Co., Crompton & Co., Brush Electrical Company, Hornsby, Crossley Bros., and Tangyes; and the specialities of these and similar firms are naturally well worth inspection by those who have not many opportunities of becoming familiar with good examples of modern engineering practice.

Probably the most interesting section in the Exhibition is that arranged under the auspices of the Department of Agriculture and Technical Instruction for Ireland, and this piece of educational enterprise is worthy of the highest praise. Irish industries, both technical and agricultural, are shown in operation, and there is an excellent collection of the latest machinery and appliances used in connection therewith. A specimen workshop fitted out with benches and tools for manual training in woodwork is on view, and classes open to public inspection are held every evening to show the lines on which proper instruction should be given. Collections of representative examples of work from the principal technical and training schools in the United Kingdom supplement this demonstration in a very useful fashion. A number of scientific apparatus firms are represented by special exhibits, and of these I may select for mention the names of Elliott Bros., J. J. Griffin & Co., Ltd., Harvey & Peak, Yates & Son, Newton & Co., and Philip Harris & Co. A particularly complete display of engineering models for instructional purposes is shown by Mr. George Cussons, of Manchester, and I noted that two of the sectional steam engine models were being driven by an electric motor, so that their working could be readily appreciated. Technical education is just beginning to get a foothold in Ireland, and it is to be hoped that the present Exhibition will do much to further the movement. A revival in Irish industry is a consummation to be earnestly desired, and sound technical instruction is a preliminary step of the utmost importance.

And now what of the models? These, like the larger engineering exhibits, are but few in number, save only in the case of the excellent collection of ship models for which the Cunard Company are mainly responsible. This company show a very instructive series of models, ranging from their pioneer steamer, the paddle boat *Britannia*, built in 1840 with a h.p. of 403 and a displacement of 2,850 tons down to the magnificent present-day liners *Campania* and *Lucania*, the intervening models showing practically the developments in steamship practice during the last half-century. Other ship models of interest are some

Donald Currie boats built by the Fairfield Company; some models shown by the Cork Steamship Company, Ltd., and the Clyde Shipping Company, Ltd.; and a model of the new twin-screw steamer *Scotia*, built by Messrs. Wm. Denny and Bros. for the L.N.W. Ry. express service between Holyhead and Dublin. This is a 22-knot boat of just over 1,800 tons.

A large model of the St. James's Gate Brewery of Messrs. Guinness, Son & Co., of Dublin, is noteworthy on account of its including a portion of a model railway for running the grain, &c., about the works. The locomotive in real life is worked by steam, but in the model electricity is the motive power adopted, the motor being concealed inside the boiler. Unfortunately, however, for visitors interested in model work, the loco is *hors de combat*, probably resting content with the laurels it gained at the Paris Exhibition. Another industrial model worthy of inspection is the model of a steam bakery shown on the stand of Messrs. W. and R. Jacob & Co., Ltd. This not only includes several models of biscuit-making machines, but also a neat model horizontal engine and the usual shafting and gearing for power transmission. A pleasing feature of this model is the effect gained by the preservation of scale throughout all the details. A sectional model of a double vortex water turbine is also shown by Messrs. Gilbert Gilkes & Co., of Kendal.

The L.N.W. Railway show an attractive working model of the "Dreadnought" compound loco, this being set in motion by the usual penny in the slot. Of course I tested it; but my penny failed to make the wheels go round until a smart tap on the side of the case had given the final impetus necessary to make it "touch the spot." A native exhibition attendant, who had observed the hitch in the operations, favoured me with a little expert advice. "Shure," said he, "the slot's a bit rusty, sorr. It just wants a few oily pennies droppin' in to lubricate it, sorr, and then it will work iver'y toime."

Full-sized locos are on view to the number of two only, but these are not without some interest. The first in point of date is quite an old stager, being No. 36 of the Great Southern and Western Railway of Ireland. It was built in 1847 by Messrs. Bury, Curtis and Kennedy, of Liverpool, and between December of that year and June, 1874, accomplished a mileage of 487,918¼. The cylinders are inside, and are 16 ins. diam. by 20 ins. stroke, and the single driving wheels are 6 ft. diam. Next to this is one of the same company's latest tank locos for passenger traffic, built at their Inchicore works in 1902. This is quite a smart-looking engine of the four-coupled type with leading bogie, the cylinder dimensions being precisely the same as the old engine previously referred to.

From these notes it will be gathered that the Cork Exhibition in itself is worth seeing, or not, according to the requirements of the visitors; but the fact remains that as a holiday centre Cork is hard to beat. With its splendid harbour, its charming river scenery, and the world famed beauty spots of Glengariff, Killarney, Blarney Castle, and Bantry Bay all within easy reach, the town-tired model engineer might well do worse than visit the shores of the Shamrock's Isle.

THE Lancashire and Yorkshire Railway have constructed, to the designs of Mr. Hoy, the locomotive superintendent, a powerful eight-coupled goods engine, similar in all respects to the standard locomotive of this type designed by Mr. Aspinall, with the exception that the boiler is fitted with a *cylindrical corrugated firebox*, having an internal diameter of 4 ft. 9 ins., and a length of 9 ft. 11½ ins.

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 fortnight before its actual date of publication.]*

London.

THE next indoor meeting of the Society will be held at HOLBORN TOWN HALL, Gray's Inn Road, W.C., on Tuesday, September 23rd, when the railway track will be shown in operation. Readers of THE MODEL ENGINEER who are interested in the work of the Society and would like to join will please communicate with HENRY GREENLY, Hon. Sec., 2, Upper Chadwell Street, Myddleton Square, E.C.

Provincial Branch.

Liverpool.—A meeting of this Branch was held on Wednesday, August 13th, at the Balfour Institute, and after the minutes of the previous meeting had been read over and passed, Mr. Reeves made a few remarks with reference to marine engine fittings, etc. Mr. Kirby then gave a short description of the construction and working of a novel type of electric bell, his remarks being illustrated by means of drawings and a bell complete with battery and switch. He also exhibited a small vertical engine, which was much admired by the members.

The Secretary would be pleased to hear from any persons wishing to become members; subscription for the half year, 2s. 6d; entrance fee, 1s.—F. T. STEWART, Hon. Sec., 33, Cowper Road, Old Swan, Liverpool.

Difficulties of Soldering Aluminium.

THE one great drawback to the application of aluminium for a large number of uses in the arts for which its lightness, colour, resistance to oxidation, and the ease with which it can be rolled, drawn into wire, pressed and spun up into various shapes, etc., is the difficulty of soldering joints. The reasons why this difficulty is encountered are not generally understood, and are explained in the following note from the *Journal of the Franklin Institute*:—The difficulties encountered are threefold: (1) The high heat conductivity of aluminium, which abstracts heat rapidly from the joint, and (2) galvanic action between the aluminium and the metals of the solder by which the aluminium (the more electro-positive metal) is corroded and the joint destroyed. It is comparatively easy to make an apparently perfect soldered joint of aluminium with various mixtures of zinc and tin, for the reason that when freshly made the adherence is all that could be desired. The effects of the galvanic corrosion may make themselves apparent after the work has been exposed to atmospheric influences for some months. The rapid heat conductivity of the metal can be practically obviated by applying artificial heat to the joint while the solder is being applied. It has been proposed to use aluminium in considerable proportions in the solder to avoid the effects of galvanic action, but while this artifice might accomplish the desired result, the joints cannot be made with the soldering iron, because of the high heat required to melt the alloy. A perfect solder for aluminium is still to be found.

OWING to inconvenience caused by storing vehicles on board, the Belgian Government have decided not to undertake the transport of motor cars on the steamer service between Dover and Ostend.

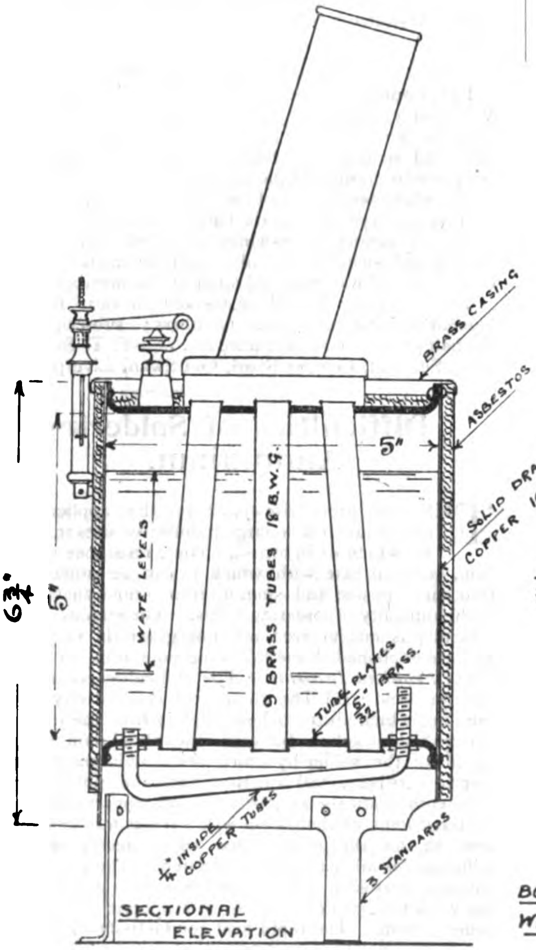
A Model Vertical Boiler.

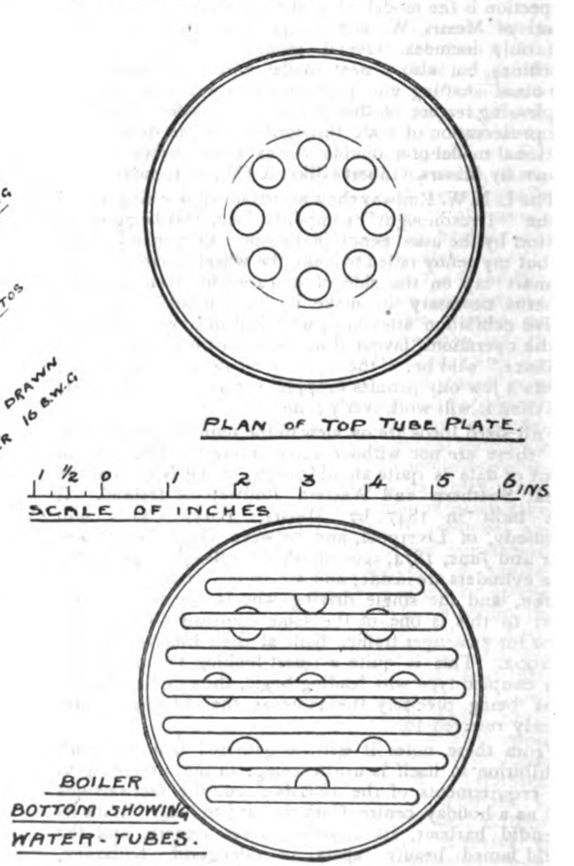
By Frank J. Payton.

This boiler, which is eminently suitable for use in a model steam launch, has been designed with two especial objects in view, viz.—safety and efficiency. It is a boiler which is not likely to burst provided the safety valve is suitably adjusted, and it is well within its power to supply steam at a fair pressure to an engine with two high pressure, say ½ in. bore by 1 in. stroke. The heating surface works out at 105 sq. ins. and with a good lamp it should evaporate quite ⅜ cub. in. of water

The barrel is intended to be solid drawn copper tube 16 B.W.G. thick (·065 inch) which gives an ample margin of strength, the bursting pressure being about 700 lbs. per sq. in. The vertical tubes (½ in. diameter) are simply expanded in and over the ends, except the one in the centre, which may be, if thought desirable, a thicker tube fitted with a nut at either end on the outside of the tube plates. The water tubes in the bottom are shown secured by lock nuts both inside and out, which, however, is only necessary if a very high steam pressure is employed, as they have proved under ordinary pressures quite satisfactory if only tightly fitted and soldered. In any case a little leakage through the solder fusing would be the worst failure that could happen to them, as it is very doubtful if both ends of the tubes would be blown out together.

The lagging should receive special attention, and if





A Vertical Boiler for a Model Steam Launch.

per minute. When designing a boiler it should, of course, be borne in mind that all flat surfaces will require to be adequately stayed, and if the barrel is cylindrical the longitudinal seam should be a properly proportioned riveted one. Brazed or soldered seams cannot be always relied upon, particularly the latter, but a piece of solid drawn copper or brass tube makes a very good boiler shell indeed.

With the boiler in question the circular seams are single riveted, and the rivets pitched about ½ in. apart.

neatly finished off with thin sheet iron and a brass flanged cap around the uptake the appearance of the boiler will be greatly improved.

The materials for this boiler can be obtained from most of the model firms whose speciality is tubes and boiler fittings, and the total cost ought to be somewhere about 15s. The boiler should prove to be a good steam raiser, having ample heating surface; and as it also provides a very fair range of water there is another point in its favour.

Models Made Without a Lathe.

III.—The Construction of an "Electrical Indicator."

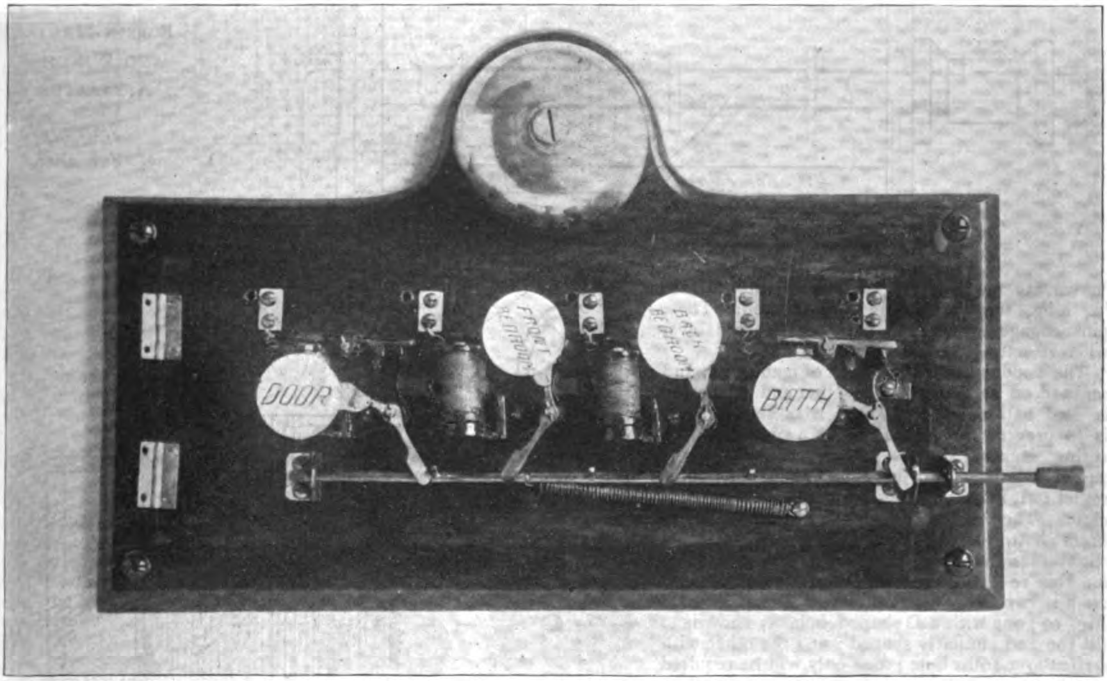
By Geo. W. Stead.

(*Continued from page 87.*)

THE gauge, Fig. 18, may now be made to the dimensions given, out of ⅛ in. fret-wood—its object is to make all the bobbins exactly the same length—and to get the ends perfectly true, and with a little practice, bobbins can be made by this method almost as true as in a lathe.

the gauge (which rests on the box end) against the bobbin ends; this straightens them, and makes them run true, besides getting them all the proper length. The gauge is shown in position in the sketch by dotted lines.

All the bobbins are made in this manner, and must be done quickly or the glue will set before getting them true. As each pair are finished, they are carefully slipped off the rod and allowed to dry. This arrangement also serves to wind the bobbins. Of course, it must be understood that the box is either weighted or screwed down to the bench. The bobbins are wound with 26 or 28 silk-covered wire, just full. They must be placed on the rod to wind exactly as they were when made, the grooved ends always to the left. All must be wound in the same direction, the wire being slipped through the small hole



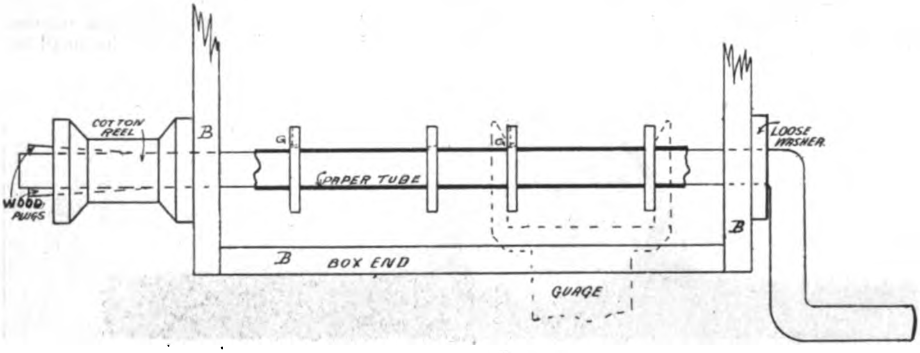
Photograph of Electrical Indicator with Cover Removed.

The sketch (page 126), which is to scale, shows the method of making and winding the bobbins. B is a cigar-box; a ¼-in. hole is bored (½ in. or ⅝-in. from the end and top) through each side of the box, a piece of ¼ iron rod about 9 ins. long is bent with a handle or crank as shown; a thin loose washer is now passed on, and the rod just pushed through the box side. A paper tube is now procured, and four bobbin ends slid on—two plain ones and two with grooves in—placed alternately as shown, the grooved end always to the *left* hand, as shown by G. The rod may now be pushed right through the tube and the hole at the other side of the box. An empty cotton reel is now placed on this end that protrudes, and small wood plugs driven in this prevents all end play. Now get some hot thin glue and lightly coat round a portion of the tube; slide one of the bobbin ends over this, and proceed with the other end likewise; get these ends as near the proper places as possible. Then with the right hand revolve the rod slowly by the handle, and with the left gradually bring

in the bobbin end when starting; when wound full, the last turn may be tied down by a silk thread to prevent unwinding; a few inches are left spare at commencement and finish for connections. When a pair have been wound, a sharp penknife is run round the paper tube close to the bobbin ends while still on the shaft. They may then be slipped off the shafts, and the two *starting ends* bared of their insulation for about ¼ in., twisted tightly together, and just a drop of solder put on. They are now ready to be placed on the poles of the electro-magnet. Fig. 13 shows a front view of the complete movement, and Fig. 14 a plan. The sign is not shown.

Before leaving the movement it must be adjusted, which is done as follows: Place the top lever on its shaft, when the armature should clear the poles of the electro magnet about 1-16th of an inch; if closer than this, it can be rectified by filing the stop on which it rests at its other extremity. The side lever is now placed on its shaft and slowly raised until it engages the catch C (see Fig. 13). It should lift this about 1-32nd of an inch.

This lever has been left sufficiently long in the patterns to allow of this "fitting" here. The movement is now practically finished, and the next that claims attention is Fig. 16, which is shown half size. This is a very thin strip of brass, ¼ in. broad, drilled with ⅛-in. holes as shown; it fits behind the movements (see Photo and Fig. 32), and if of any appreciable thickness a shallow groove must be filed at the back of the movement frame to receive it. Its object is to convey the current from each of the electro-magnets on the movements forward to the bell. Fig. 17 is the re-setting rod shown half-size; it is made of 3-16ths in. round brass rod. The pins



BOBBIN-MAKING AND WINDING APPARATUS.

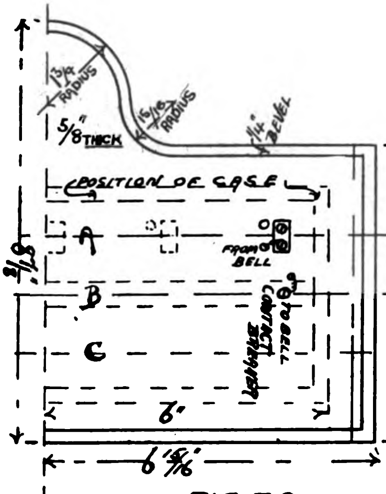
Scale: ¼ Full Size.

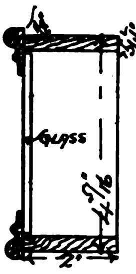
shown are made of 14 gauge brass wire, 9-16ths in. long, screwed tightly into the rod. These pins engage the bottom part of the side lever when re-setting the movement.

The wooden knob is filed out of mahogany, and screwed on as shown. The other end of the rod is filed half away, or D section as shown: this is to prevent the rod turning; a small hook for spring is also shown. The spring is simply 24 gauge brass wire coiled round a piece of 3-16ths round rod, it is about 2½ ins. long, with its coils close. The other end is fastened by an ordinary brass button-head screw to the backboard, a slight tension being given to it. The bearings for this re-setting rod are shown in Figs. 19 to 20 B: two will be required of the pattern of Fig. 19; one with a D shaped hole as shown, to fill the rod similarly shaped; and the other with a circular 3-16ths hole; one only will be required of Fig. 20. This fits on the outside of the case, and it will be noticed there are two holes in this, the bottom one is 3-16ths in. diameter for the re-setting road, and the top one is ⅛-in.; a button-head brass screw passes through this and into the end of the case, and acts as a lock to prevent inquisitive people meddling with the movements. A glance at the photograph will show that the case comes between this bearing and the other bearing (Fig. 20), and to allow it to close properly a small sawgate is cut 1-16th in. larger than the rod, and ⅝ in. long. These bearings are made out of 19 gauge sheet brass, and are bent to shape in the vice. The terminal plates (Fig. 15) are also made out of 19 gauge sheet brass, five of these being required.

The bell is of the circular pattern, the gong covering all the working parts. Electric bells have been described previously in the pages of THE MODEL ENGINEER, and are so simple that almost every amateur understands them. Therefore, no apology is needed for treating this part somewhat briefly. Figs. 22 to 24A are drawings for the patterns of the bell frame, being shown full size. The same course can be adopted as with the movement patterns. The dotted lines and circular dots show where each part fits. Fig. 22 is 2¾ ins. outside diameter, 3-32nds in. thick; Fig. 22A is 1-16th in. thick; Fig 23 is 3-32nds thick.

Fig. 29 is a side elevation and Fig 29A a plan of the pattern for supporting the gong. These are cast in brass, only one of each (Fig. 22 complete, and Fig. 29) being required. Fig. 27 is a section—full size—of the contact-breaker, showing it insulated with fibre, from the bell frame. It is made out of ¼ in. round brass rod, the screwed part being filed down by hand in the vice. It will be noticed that the two ¼-in. nuts are below the



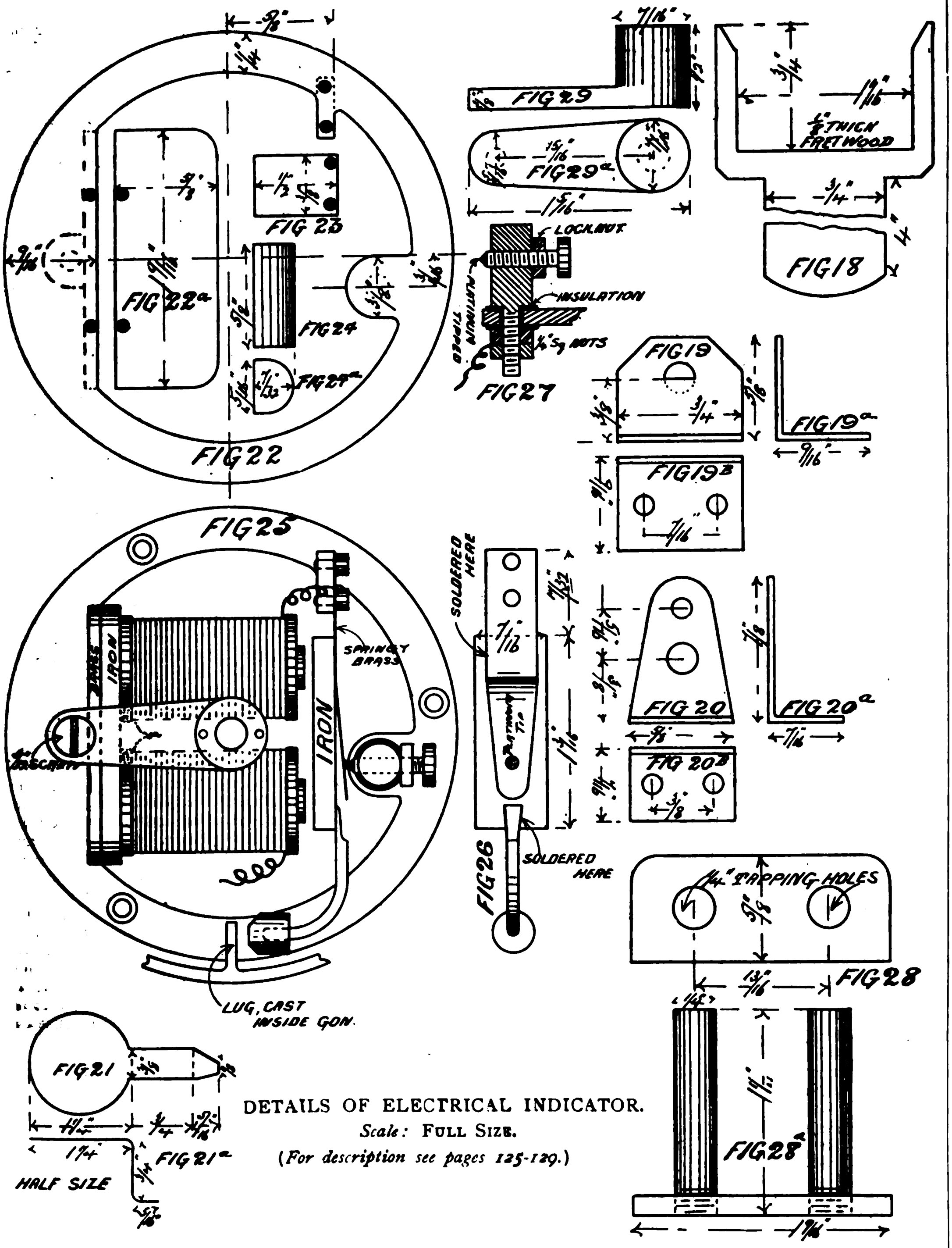


Scale: ¼ Full Size.

CONSTRUCTION OF BACKBOARD AND CASE.

underside of the bell frame. A ¼ in. hole is bored right through the backboard for these to fit into. The wire shown clamped between these nuts passes through this hole to the back of the backboard, and then through a small hole to the front again, and is fastened under No. 5 screw at the end of the brass strip. (See Fig. 32.) The frame is held down on the backboard by three small screws passing through the rim. The electro-magnet, of which Fig. 28 is a plan and Fig. 28A a front elevation, is made exactly in the same manner as the "movement" electro-magnets, and is sweated on to its support (Fig. 22A).

The bobbins are the same size as the indicator bobbins, and are wound up with the same gauge of wire and in the same direction. The two starting ends being con-



DETAILS OF ELECTRICAL INDICATOR.

Scale: FULL SIZE.

(*For description see pages 125-129.*)

nected together, one of the other ends goes to the small screw that holds the armature spring; the other end going through the backboard, then back again on to No. 5 terminal plate (see Fig. 25 and Fig. 32). Fig. 25 is a plan of the bell complete—full size—and explains itself. Fig. 26 is a front elevation of the bell armature, spring, and hammer. Fig. 30 is a half-plan of the black-board; this is mahogany, ⅝-in. thick; a ¼-in. bevel is made all round the edge for appearance sake. A shows the centre of the terminal plates, B the centre of the brass strip (also the centre of the movement), and C the centre of the re-setting rod.

The case is mahogany, 5-16ths in. thick, 12 ins. long, 4 5-16ths in. broad, outside measurements. It is dove-

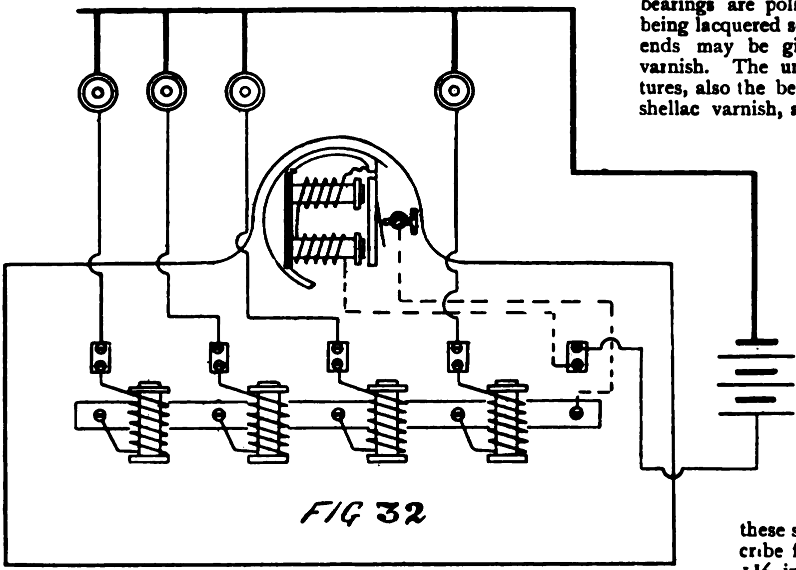


Diagram of Connections.

tailed together, and a 1-in. mahogany moulding run round the front and mitred at the corners. The glass front of the case rests against the inner portion of the moulding, and is held in position by a small piece of wood screwed at each end on the inside of the case. Fig. 31 is a section of the case. Two small hinges are fitted, and are clearly shown in the photograph. The indicator is now ready for fixing together; but this presents no great difficulty. The case is placed on the backboard exactly central, and its position marked with a pencil thereon. It may now be removed, and the brass strip laid in the centre (see B, Fig. 30). The movements can now be placed on the top of this strip, and the signs dropped as they would appear if a call had been made. In this position they should be perfectly central with the case, and should work out to 2⅜ ins. centres. Before fastening down, try the re-setting rod in position. With the signs down, the pins of the re setting rod should clear the levers about 1-16th of an inch. When these have been made satisfactory, the whole can be crewed firmly down using brass button-head screws.

The holes of the brass strip, and also the terminal plate, should come midway between the movements (see Fig. 32): ⅛-in. holes are bored through the back-board, just to the left of the terminal plates, for the wires from the different pushes to pass through. The bell is placed in position, and insulated wires run in grooves (taken as shown by dotted lines in Fig. 32) at the back of the backboard. When all has been fitted to satisfaction, get a few cells and try the bell and movements separately, to see if in proper working order. If so, the whole may be pulled to pieces again, and the finishing touches put on. The whole of the woodwork is French polished, but if the reader does not feel that he is sufficiently competent to do this class of work, it may be varnished. The whole of the movement frame (except, of course, the shafts) and the bell frame are given two coats of chocolate enamel. The top lever is polished on the top and front, the other parts being enamelled vermilion. The front only of the side lever is polished, the other parts being enamelled vermilion. The re-setting rod, the brass strip, the terminal plates, and the bearings are polished all over—all polished work being lacquered so as not to tarnish. The bobbin ends may be given a coat or two of shellac varnish. The underside of the movement armatures, also the bell armature, may have a coat of shellac varnish, and while wet, a strip of thick brown paper put on and then another coat of shellac varnish. This prevents the armatures striking to the poles of the electro-magnets.

The glass front of the case has four clear glass circles, around each of which is a gold band, almost 3-16ths in. broad; all the rest is painted black, so that nothing shows except through the clear glass circles. To prepare this glass, which is 3⅝ by 11¼ ins. take your drawing board and draw a diagram exactly this size; now divide it into equal parts—the centres of your movements—these should be 2⅜ ins. centre; describe four circles at these four points, 1⅛ in. diameter; and then another circle round this 1½ in. diameter; then describe a smaller circle, ½ in. diameter; join four lines to this, making it a square ½ in. each way; place your glass over this square, draw a line across the corners, and where they cross will be the centre of the square. Get some wax or seccotine, and fasten these squares on the glass exactly over the squares on the paper. Now put about a tea-spoonful of isinglass into a small wineglass, and nearly fill with warm water; when dissolved, float some of this liquid on the glass, over the circles; do not go just on the lines, but overlap them, as it will wash off afterwards. Gold leaf is now laid over the circles—that is, when the isinglass you have put on is nearly dry—just in that position called by painters "tacky." To do this, borrow a cushion from a painter. This is something like a soft piece of felt. Place a sheet of gold leaf upon it, and with a gilder's knife cut into strips about 5 16ths in. wide—do not touch the leaf at all with your fingers or you will spoil it. Take up a strip of gold with the "tip," which is a brush of fine camel hair, very few hairs, and about 4 ins. broad, and lay this over the circle. Proceed in the same manner until all four circles are completely covered with gold leaf. Leave this a day to dry; then take your compasses, take out the pencil and in its place put a fine camel-hair brush, dip this into black varnish, and from the centre of the cardboard describe a circle with the black varnish over the gold leaf (1⅛ in. inside diameter, 3 16ths broad). Do this at all four points. Leave a day or two dry. Then take a sponge, and, having removed the bits of cardboard, gently sponge all round the varnish with warm water; this re-dissolves the isinglass and the superfluous gold comes away with it, leaving a clear gold circle protected by the varnish. The whole can now be coated with the black varnish, two or three coats being required. Fig. 32 is a diagram of the connections, only one indicator bobbin being shown. The thick line shows the "main" wire, which is carried to every push, and should preferably be of some different colour from the rest, so as to be able to distinguish it should any additions be necessary, or should anything go wrong. The indicator is fastened to the wall by four screws, one at each corner, as shown in the photograph. Three No. 2 Leclanché cells will be required to work it. If carefully made to the foregoing instructions, it will be a useful addition to any home, and will amply repay any one for the trouble involved.

The Construction of "Dug-Out" Model Yachts.

By W. H. Wilson Theobald, M.A.

A "BUILT-UP" model is not an easy job for an amateur to tackle, and moreover, so far as actual sailing qualities go, it is a moot point if, after all, the "dug-out" craft does not give the better results. Practical tests tend to show (in the smaller classes, at any rate), that, size for size and equality so far as constructional strength is concerned, the latter craft will have an advantage in "weight of hull" over a boat "built-up" from the same lines.

The "dug-out" plan further has the advantage of being far easier for the amateur to undertake. It is really simply a question of careful use of the chisel and spokeshave.

The most primitive way of digging out a model is to obtain a block of wood of suitable dimensions and cut away outside until the lines "please the eye," and inside until sufficiently thin. This was in olden days, before the theory of "lines" and "centres" was much troubled about, the plan adopted by builders for obtaining fair lines for boats they proposed building.

When, however, a boat as large as a 10-rater is required, difficulties arise; the most important being that of obtaining a piece of wood of suitable size, and, secondly, the enormous amount of manual labour which has to be expended on the piece of wood when found. As an example, suppose a 10-rater is 55 ins. long, 11-ins. beam and 6·5 ins. deep (including above and below water body). A piece of wood of these dimensions would contain just about 4000 cubic inches, or about 2·31 cubic feet. A cubic foot of red pine weighs 40 lbs.; the log, therefore, would weigh 92·4 lbs. As the hull when finished would turn the scale at about 4 to 5 lbs., it will be seen what an enormous amount of hard work would be required in the digging-out process.

It is now customary to build a model of any size by means of layers, commonly called the "bread-and-butter" plan.

When a design has been chosen, it will first be necessary to calculate whether the various water-lines are conveniently spaced. Take the L.W.L. as the base line and measure downwards in inches (1 in. being a nice size plank to work with). Supposing the boat is 3 ins. below water (a fin boat is assumed); then three planks will be required; if a trifle less than 3 ins., the same number will answer equally well. But suppose the hull is only 2½ ins.; in this case the bottom layer would be inconveniently small, both in length and thickness. To remedy this, either a larger plank must be chosen to dispense with the bottom one, or the base line must be drawn above or below the L.W.L., so as to bring the depth a multiple of one. When the number of planks necessary for the under water body has been decided upon, measure upwards and arrange the top half of boat in the same way. If a boat is to be designed for building in this manner, a lot of trouble is saved if this planning of water-lines is thought out before the drawing is started.

The top layers are apt to give a little trouble in consequence of the difference in height at stem and least freeboard. In the design given the height at stem is 4 ins., and the least freeboard is 2¾ ins. If, therefore, 1-in. planking were used for all the layers above the L.W.L., the top plank would break off somewhere between sections No. 3 and 4, as in Fig. 1. There is no reason why it should not do so; but a better finish will result if the top layer is made from planking sufficiently thick to avoid this break. In the design given it is suggested that 1½-in. plank be used for the top and second layers. This will leave 4 ins. from W.L. No. 2 to the bottom of hull, and four 1-in. planks can be used.

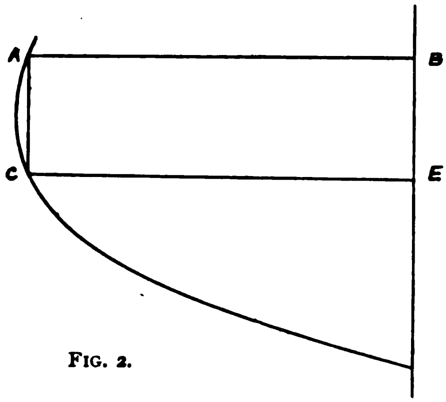


Fig. 2.

Another difficulty may arise with the water lines above the L.W.L. if the boat has what is called a "tumble home" (shown in Fig. 2). In cutting the plank for the layer represented by the rectangle A, B, C, E, if the distance AB is taken, the edge of the plank will fall plumb down from A to C, and the curve of the section from A to C will be entirely lost. It is necessary, therefore, to examine the sections of a design, and see whether the line AC, dropped at right angles from the end of any particular water-line (or deck curve), cuts the curve of the section or not. If it does so, the distance AB must be increased by the addition of the full width of the bulge, and this measurement substituted instead of AB.

Cutting models from blocks of wood, or on the layer plan, always entails a lot of waste; but with a little ingenuity a great saving can be effected. The system will now be explained.

It is clear, if a piece of wood were marked out exactly as the "half breadth" plan, and cut out at the water-lines, that the pieces, if held up above one another, would form a midship section, like Fig. 3A, and a sheer plan, as in Fig. 4A*; if let go, they would promptly shut up flat again, as shown in Fig. 3B, and Fig. 4B. What is required, therefore, are ledges at *a*, *b*, and *c*, to prevent this collapse. For simplicity, only two water-lines, representing two layers, will be taken. On referring to Fig. 5A it will be seen that a ledge is required on the inside edge of the larger water-line, which will rest on the smaller layer when the former is placed on the latter

* This only shows up to the top of W.L. No. 2.

To obtain this ledge a new centre line (CD) is drawn above AB, and from this new centre line the larger water-line is drawn, as shown by the upper line. Now, supposing the wood were cut out first along the smaller *original* water-line from G to M, and afterwards along the new larger water-line from N to O, and then placed one on top of the other, the two lines AB and CD, being the centre of the boat, must, of course, be exactly over one another, and the inside edge of the larger layer (represented by the curve of the smaller water-line) will lap over the smaller layer, as indicated by the inside dotted line, and the ledge necessary for the support will be formed.

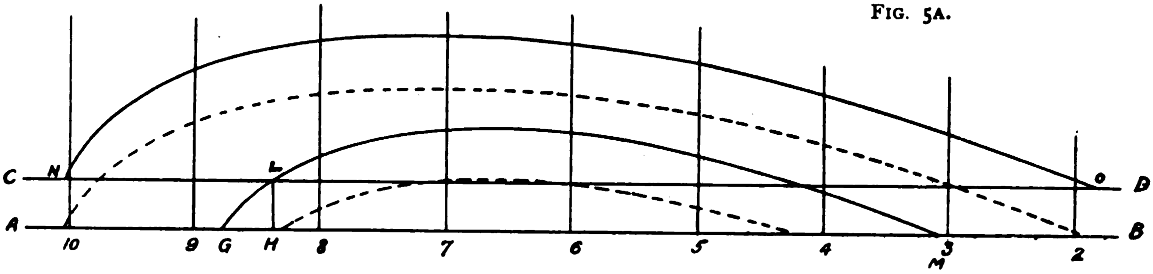
FIG. 5B.

used for these measurements, they being fuller here than at the bow end.

Assuming the water-lines of the design to have been suitably spaced, and the examination of the sides of the boat made for any variation of measurements owing to "tumble home," the working drawings can be made. The details will, of course, refer to the design given.

A full-size drawing of the sheer plan should be made; the "buttock," however, may be left out, but another curve must be drawn in showing the thickness to be left at the keel, stem, and stern (see Fig. 6). For the half-breadth plan draw the centre line AB, and lines at right angles to represent the sections. Draw in the curve for the *top* of the bottom layer—viz. W.L. No. 5. Now, by the rule already given, find the distance between the centre line AB and the new centre line CD, from which the distances on the sections for the next layer are

FIG. 5A.



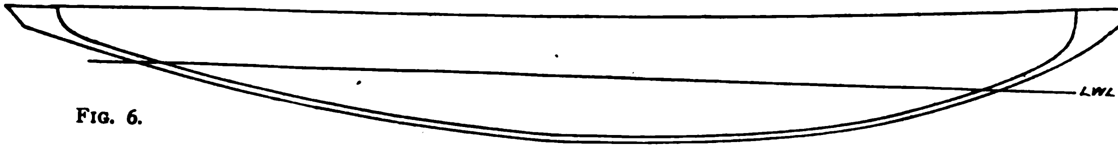


FIG. 6.

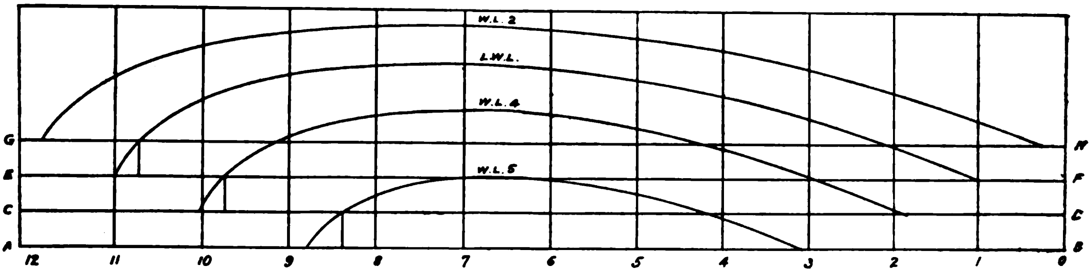


FIG. 7.—CONSTRUCTION OF "DUG-OUT" MODEL YACHTS.

Thus, from a piece of wood of the length necessary for the larger curve and only the distance between the lines AB and CD wider than the width of the larger curve, both layers have been cut.

To obtain the distance necessary between the two centre lines, proceed as follows:—Fig. 5B represents part of the sheer plan with the thickness of wood intended to be left when the inside of boat has been dug out; EF represents the joint of the two layers, the curves of which are shown in Fig. 5A. Measure the distance along EF, and transfer to the water-line as GH. From H draw HL at right-angles to AB, and where this line cuts the water-line at L will be the point through which to draw the new centre line CD.

It will be found that the fuller the water-lines are at the ends, the greater will be the distance from H to L, and the *after* ends of the water-lines should always be

to be measured; this is water-line No. 4. Proceed in this way with a new centre line for each water-line, until water-line No. 2 has been drawn in. This is the top of the fourth layer (counting from the keel), and the finish of the layers to be cut from the 1-in. plank (Fig. 7) gives the drawing of the water-line layers.

On another piece of paper mark out a centre line and sections, draw in water-line No. 1, and having found the distance from this centre line to the new centre line for the deck, draw in the latter curve. These two layers are, as before stated, to be cut from 1½ in. wood. Allowing 1 in. each end, and ½ in. extra breadth, it is found that *half* the boat can be made from two planks—one 49 ins. long, 11 ins. wide, by 1 in. thick; and the other 54 ins. long, 9 ins. wide, by 1½ ins. thick.

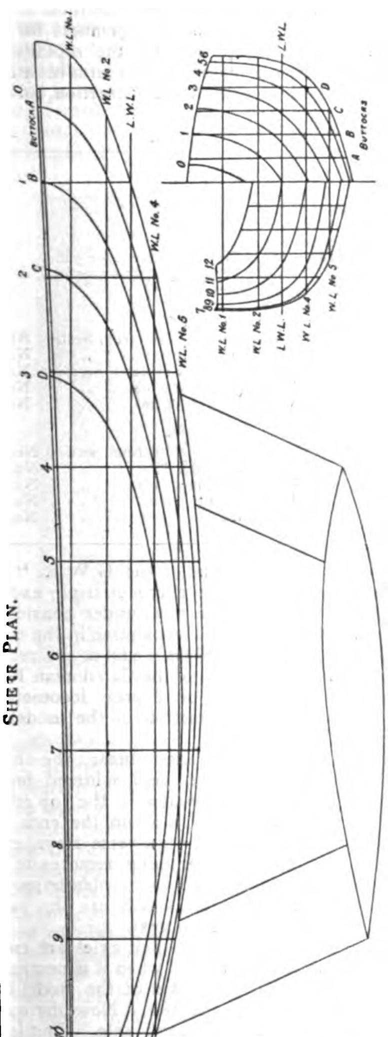
If each layer had been cut from a separate plank it would have been necessary to procure a plank 150 ins.

THE CONSTRUCTION OF "DUG-OUT" MODEL YACHTS.

BY

W. H. WILSON THEOBALD, M.A.

(*See pages 129 132.*)



SHEER PLAN.

BODY PLAN.

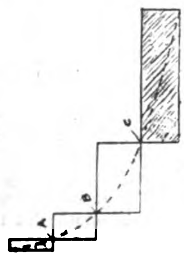
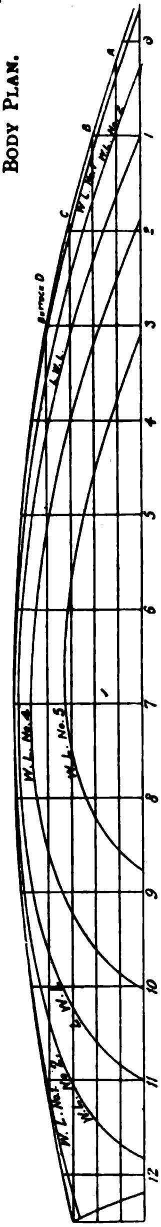


FIG. 3A.



HALF BREADTH PLAN.

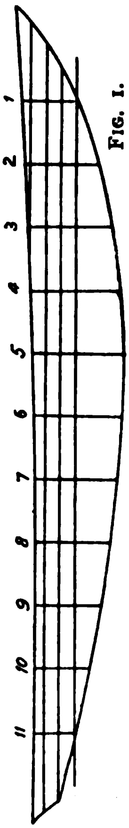


FIG. 1.

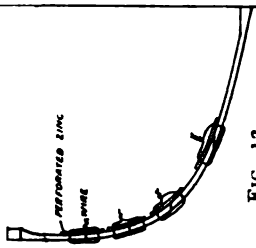


FIG. 12.

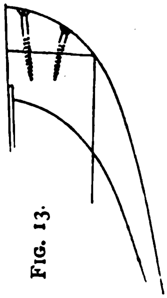


FIG. 13.

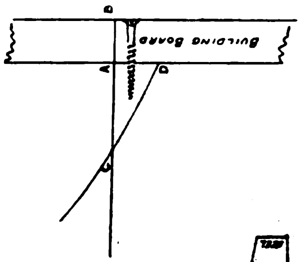


FIG. 9.

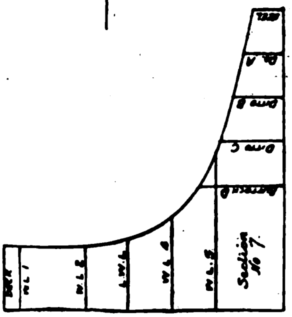


FIG. 8.

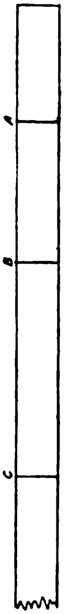


FIG. 4B.

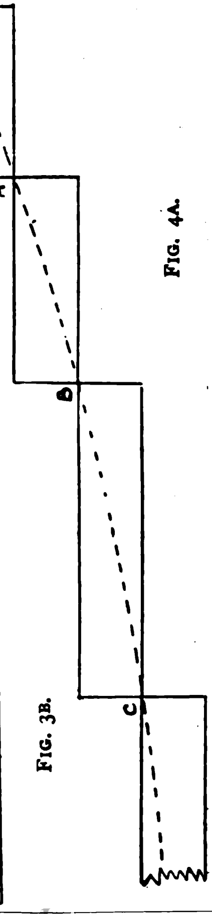


FIG. 4A.

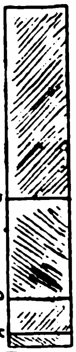


FIG. 3B.

long, 6 ins. wide, by 1 in. thick for the four bottom layers, and another 106 ins. long, 6 ins. wide, by 1½ ins. thick for the two top ones; and in this case the *whole* of the inside would have been solid, whereas in the system explained there are only the edges of the planks to smooth down on the inside. Templates of the half-sections must now be made from thick cardboard, or better, thin sheet brass. Each one, when made, should have the L.W.L. and other water-lines, and the height of the under side of deck marked on it, and should be numbered as the section in the design (see Fig. 8).

The wood can now be bought, and it will be a great saving of time and work to have it planed up to its exact thickness by machinery. Each of the 1 in. planks should be marked out as the paper pattern shown in Fig. 7, and the 1½-in. planks as the paper pattern, showing W.L. No. 1, and deck curve. To save re-measuring on to the wood, cut out the paper pattern to the *largest* water-line first, and, placing the paper on the wood, draw round it on the wood. Then cut down to the next water-line, but be very careful to get the paper in *exactly* the same position on the wood. To ensure this, draw a centre line on the wood and a few of the sections, and see that these coincide every time the paper pattern is replaced. Don't destroy the paper layers when cut, as they will be required again. All the centre lines must appear on the wood at each end of their respective water-lines. The planks should be cut out with a band saw, starting from the smallest layer; remember that the various layers are measured from different centre lines; the second layer is measured from CD (see Fig. 7), and there must be no wood left *below* the centre line CD. If the planks are taken to any sawmills to be cut out, be there to see no mistake is made, and instruct the machinist to follow the curves so that, when cut, the pencil lines are just visible. The second layer from the top, representing the curve of water-line No. 1, is solid, and must be cut out before the layers are fixed together for fairing. Find, from the sheer plan paper pattern, the distance the centre line for this layer should have been placed above the centre line for layer at water-line No. 2, had the two been cut from the same piece of wood. When found, place the *paper* pattern, representing the water-line No. 2, on the *wood* representing the layer to be cut out, and shift the paper pattern down until its ends are distant from the edge of the wood a distance equal to the length between the centre lines. Mind the lines representing the sections are exactly over one another. Run a pencil mark round the paper pattern on the wood, and then this amount of wood can be cut away from the layer. Each half of the boat is finished separately, and the layers must be held together in some way while this is done. For those who find such useful, a Table of Offsets is given below.

(To be continued.)

TABLE OF "OFFSETS" FOR 10-RATER.

Sections.	Half Breadths.						Heights & Depths.		Buttocks.			
	Deck	W.L. No. 1.	W.L. No. 2.	L.W.L. No. 3.	W.L No. 4	W.L No. 5.	Deck	Keel.	A	B	C	D
Bow.	..	..	..	..	..	..	4	4	..	..	..	..
0	·72	·48	..	..	..	..	3·9	1·5	..	..	..	..
1	2·04	1·82	1·08	..	..	..	3·75	..	·85	3·5	..	..
2	3·08	2·96	2·42	1 58	·2	..	3·56	1·1	52	4	2·7	.
3	3·96	3·88	3·5	2·88	1·72	..	3·4	1·95	1·46	·84	·16	..
4	4·62	4·58	4·32	3·88	3	1·3	3·25	2·54	2·15	1·67	1	·18
5	5·06	5·06	4·9	4·6	3·9	2·44	3·1	2·9	2·58	2·2	1·68	·94
6	5·36	5·36	5·24	5·06	4·46	3·12	2·95	3	2·75	2·45	2·06	1·46
7	5 4	5·4	5·38	5·22	4 7	3·25	2·85	2·85	2·66	2 42	2·1	1·62
8	5 35	5·35	5·3	5·12	4·48	2·36	2 76	2·46	2·32	2 1	1 64	1 38
9	5·15	5·15	5	4·64	3·44	..	2 75	1 85	1·7	1·5	1·22	7
10	4·75	4·72	4·36	3·45	·22	..	2·75	1·05	·85	·6	·24	·5
11	4·22	4·12	3·1	..	..	..	2 75	..	·18	·44	·92	2·12
12	3·46	3·25	..	..	..	..	2·76	1 22	1·43	1 7	2·28	..
Stern.	3·04	2·74	..	..	..	.	2·78	..	..	..	..	..

L O.A. = 52 ins.
L.W.L. = 40 ins.
Beam of L.W.L. = 10·4 ins.
" Extreme = 10 85 in.
Sections are 4 ins. apart.
Between W.L. No. 1 and No. 2 = 1·5 in.
" W.L. Nos. 2, 3, 4, and 5 = 1 in.
Buttocks are spaced 1 in.

Fore.

End of bow is 2 ins.	..	from Section	No. 0.
" W.L. No. 1 is 1·35 in.		"	No. 0.
" W.L. No. 2 is 2·8 ins.		"	No. 1.
" W.L. No. 4 is ·5 ins.		"	No. 2.
" W.L. No. 5 is 3·6 ins.		"	No. 4.

Aft.

End of Stern is 2 ins.	..	from Section	No. 12.
" W.L. No. 1 is 1·8 in.		"	No. 12.
" W.L. No. 2 is 3·3 ins.		"	No. 11.
" W.L. No. 4 is ·12 in.		"	No. 10.
" W.L. No. 5 is 3·08 ins.		"	No. 8.

S.M.E. Medallists and their Work.

W. T. Bashford.

MR. BASHFORD, the present vice chairman of the Society, is well known by the members for his skill in workmanship, and for the rapidity in which he produces very fine models. He turns his attention principally to model locomotive construction, and is at present building a model of one of the G.W.R. "Atbara" class, and has also on hand a model triple expansion marine engine. The engine now under consideration, like Mr. Bashford's G.N.R. locomotive in the competition held in 1900, gained a silver medal at the recent event, and is a ¾-in. scale model of the Caledonian Railway "Dunalastair 2nd" class of express locomotive. The maker describes the construction of the model as follows:

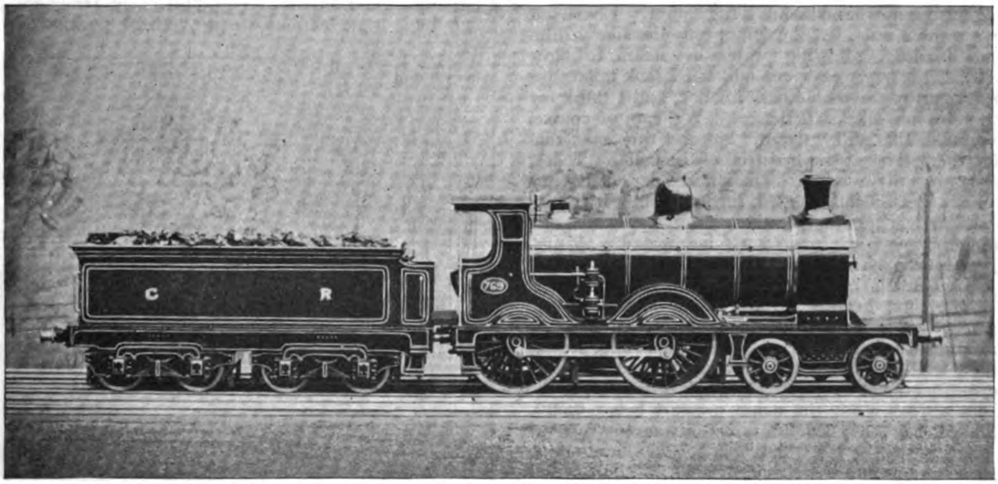
The frames are made from sheet brass, the horn blocks being small castings, riveted and soldered on to the frames. Angle brass was riveted to the top edges for attaching the footplating, and also on the ends for holding the buffer planks. The transverse stays, etc., required fitting next, when the framing requires to be made perfectly square and true, so as to obtain proper alignment of the wheels and axles, which are the parts the builder will prepare for erection next.

The trailing coupled wheels with their axles are comparatively simple matters; but it is when it is necessary to make the crank axle that the maker of the model has his engineering ability put to the test. Now there are two or three ways of making a crank axle. One is to turn it out of a solid piece of mild steel, rather a big job; secondly, it may be made from a piece of flat steel 2 ins. by ½ in. section, cutting out the webs roughly, making it red hot and giving it a quarter twist, finishing up finally on the lathe. The plan adopted for the Dunalastair model now under consideration was one which I considered highly satisfactory, and also the easiest of the three methods. I first of all procured four pieces of mild steel, 1¾ ins. by 1 in. by ¼ in. thick, roughed them each into an oval shape, and then marked them with two centre-punch marks 13-16ths in. apart (stroke of piston, 1⅜ ins.). The next operation was to drill two ⅜-in. holes through one end of each piece, and place them upon a short piece of ⅜-in. round steel. The whole lot were then drilled at once with a 7-16ths in. drill, the method ensuring, of course, the holes being absolutely the same distance apart. I next obtained a round piece of mild steel, about 6 ins. long and ⅜ in. diameter (I generally use for this purpose what is called American rolled steel, which is quite bright and fairly round), and centred it in the lathe.

Putting the latter piece of steel on one side, I took a shorter length, and from it turned the crank-pins. At the bearing the pins were left ½ in. diameter and reduced to 7-16ths in. diameter with a square shoulder at the ends that fit in the webs, the ½ in. portion being 5-16ths in. wide and the ends ¼ in. full. Whilst in the lathe, I made several grooves about 1-16th in. deep on each end. The four webs were then placed upon the long length of ⅜-in. rod with one of the pins in each pair

shaping the side frames from sheet metal, and filing up and fitting the transverse casting. The horn blocks were castings riveted on to the side plates, and afterwards sweated. The equalising bars were built up from steel plate, and the springs made from purchased clock spring, fastened by brass buckles, fixed to the bogie frames and hung on to drop hooks from the equalising bars. The bogie truck is attached to the engine frame by a centre pin with a lateral sliding piece controlled by side springs intervening as in the real locomotive. The driving wheels are hung on spiral springs, and trailers upon laminated bearing springs, made from clock spring, and attached to the engine frame in the usual manner.

The cylinders are arranged in the proper manner, with valves held in buckles between them. The valve rods pass through the back cover. The steam ways were bored, and the ports, after being drilled down from the face, were cut out with the chisel; the steam ports are 3-32nds, exhaust 3-16ths in. by ⅜ in. long, and port bar



MODEL CALEDONIAN RAILWAY LOCOMOTIVE BY MR. W. T. BASHFORD.

of webs which were spaced out to the required distance apart, according to the drawings, so that the centre of the bearing coincides with the centres of the cylinders. Three holes 3-32nds in. diameter were bored through the webs into both axle and pin; three small rivets were placed in the holes—not absolutely a tight fit, as they were intended to prevent any turning when the axle was finally finished. At this stage the work was brazed at all joints and rivets. The reason of the groove being turned in end of pins is obvious: the spelter running through the rivet holes makes a thorough job of the brazing. After cooling, the scale was removed, and the crank-axle put between lathe centres, the journals and centre portion of shaft being turned up for axle-boxes and to receive eccentric sheaves. The portion of axle from between webs was then cut away and levelled off with the file and the rest finished in as workmanlike manner as one can. It may be said that the crank by this method of manufacture is not likely to be so accurate as when done in other ways; but I have reason to think that this is not so, as by turning a shoulder on the pins the webs are brought absolutely parallel, and, therefore, quite square to the axle; and, provided that nothing is strained when putting in rivets, there is no reason why it should not turn out perfectly true.

The bogie frames were built up in the usual way,

3-32nds in. wide. The crossheads are supported by four guide bars, made from square steel road ¼ in. by 3-16ths in., and are fitted to the piston-rods by tapered pins. The gudgeon pin passes through the crosshead and carry the guide blocks. Flat bar steel was used to make the connecting-rods, proper brasses being used in both the big and little ends of the rods. The eccentric sheaves were cut in halves and sweated together again before being bored out to fit the axle. Two screws in each sheave were used to connect the halves, and in setting the valves, the eccentrics were moved, whilst the crank was on dead centre, until the port was just upon the point of being opened to steam, when the eccentric was permanently fixed.

There is no need, however, to take up too much space in describing how the engines were made, as so much space has been devoted to the construction of this model in the past, and, therefore, I will pass on to the most difficult part of the locomotive—that very indispensable item, the boiler.

My plan was to procure a piece of seamless copper tube 3⅝ ins. diameter, long enough for the barrel and firebox shell, which I split at one end and then cut crossways, opening out to form a portion of the flat side of the firebox. To make it the right depth, I dovetailed a piece on each side, brazing it with hard brass, finally hammering up to shape on a block of wood made for that purpose. The inner firebox wrapper was bent from a piece of sheet copper over a specially-prepared block. For the tube plates I advise castings in preference to making from sheet metal. When the holes were bored in the tube plates and the tubes were fitted and silver-soldered into the firebox tube plate. The cross tubes in the firebox were similarly silver-soldered in place. I find that to silver-solder successfully, it is best to countersink the holes slightly, and then file three or four little slots, which allows the gas to escape from borax flux. The ends were prepared, and after being tinned, were placed in position. Holes were then drilled through the flanges, tapped with a ⅛-in. tap, and fitted with brass screws riveted down. The back-plate of boiler, which I put in last, after firebox and stays had been fixed, was also secured by screws. These cannot be riveted down; but if properly screwed in and sweated, make a tight joint.

For the stays I advise short screws with a nut inside firebox, for when the whole is finally sweated the solder runs under the nuts, and makes a tight joint. I have put in stays without nuts, but the solder only lies like a film without binding, allowing water or steam to blow through. This *seems* easy enough, but I look upon it as the worst part of the whole performance, and I think my readers have had like experiences. We can, of course, make a boiler that will "steam," but oh! the leaks that develop themselves at the first trial of the boiler. These, however, are only a matter of patient labour, and when each one is located and stopped, further trouble is eliminated, and perfect running possible.

The firebox is 4 ins. long by 2¼ ins. wide by 4½ ins. deep, with four ½-in. cross tubes. The flue tubes are also ½ in. diameter and eleven in number, and 8½ ins. long. The total heating surface of the boiler is 180 sq. ins., which is a very good amount for a ¾-in. scale engine, and with a 2½ "Primus" burner the boiler steams extremely well. The boiler has been tested to 180 lbs. by water, and works at 60 lbs. The engine has pulled 100 lbs. from a dead stop, the steam pressure being 50 lbs. The firebox has thirty side stays, twenty seven from the back-plate, seven in the throat-plate, five longitudinal stays from end to end.

The tender runs on two four-wheel bogies, after the pattern of the prototype. Both engine and tender is fitted with spring buffers; a steam brake is used on the engine and a hand brake on the tender, the Westinghouse donkey pump on the side of the firebox being a dummy.

THE best qualities of vulcanite show on fracture a lustre something of the nature of jet, and the poorer qualities show a corresponding dulness. Although easy to machine, it is hard on tools, and in sawing, turning, planing, or milling the best speed is that at which brass is machined, and milling should always be accompanied by a free use of soap and water. In turning or sawing lubricants should be avoided.

FURTHER experiments have recently been made with the submarine boats at Barrow. No. 2, which has undergone important improvements, both in her steering and driving gear, was subjected to severe tests in the docks. The boat maintained a speed of 12 knots, running with her turret awash, against 10 knots, the result of her previous performance, while the speed submerged has been increased from 7 to 8 knots.

MESSRS. MERRYWEATHER have produced the first English-made motor fire engine. The machine is heated by gas whilst in the station, 20 lbs. of steam being maintained, and on the alarm, a petroleum fuel burner is turned on, and in one minute 60 lbs. of steam is available, and the engine can then propel itself to the scene of the fire.

A Useful Lathe Milling Appliance.

OUR friends will, no doubt, be interested in the following description of a lathe milling appliance designed and made by a reader of THE MODEL ENGINEER, Mr. Joseph Bennett, to suit his own lathe, which is of 4-in. centres. The appliance is capable of milling keyways of any length which can be admitted between centres, fluting taps, rimers, drills, milling cutters, etc., and is also adapted to milling out slots, grooves, etc., without moving the job from faceplate, dog chuck, or centres where same has been turned. The photographs will give some idea of the nature of the milling appliance, which is used as follows. The top slide-rest of lathe is first removed from dowel, leaving the two bolts in place. On the dowel is placed an angle-plate, which is bolted to bottom surfacing slide by means of the two bolts left in place. The top slide-rest, previously removed, is then bolted on to angle-plate in vertical position with two

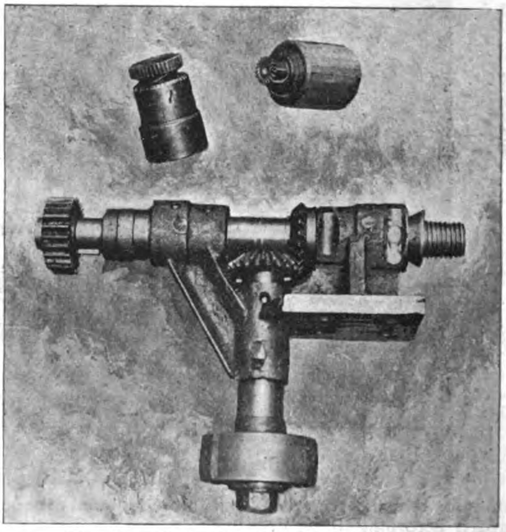


FIG. 1.—FOR CUTTING KEYWAYS, ETC.

holder studs facing the fast headstock of lathe. The appliance itself is then fixed on to slide rest by tool holder studs, the right sized cutter being screwed on nose of appliance (this nose being made same size as that on fast headstock) by small chucks, which can be seen in the illustrations. With this arrangement, any milling cutter can be turned up, fluted, etc., as required, and can be transferred when finished to the appliance. To mill slots such as those in self-centreing chucks, the bevel wheel spindle and driving pulley are withdrawn altogether, and the appliance fixed direct upon the dowel of bottom surfacing slide; the cone mandrel is then reversed end for end, and driving pulley placed on other end. When the appliance is bolted on dowel of bottom surfacing slide, the milling cutters are always in line with centre of lathe, the casting having been originally bored in that position.

The small spur wheel shown in Fig. 1 is used for dividing when fluting or facing milling cutters, &c., on the appliance itself, and is worked in connection with a bracket (not shown in photograph) fixed to bridge-piece of casting, which bracket carries a sliding piece of flat steel that engages with the teeth of spur wheel, and so holds the cone mandrel and work rigid, and accurately divides at the same time.

Fig. 1 may be taken as representing the plan of the appliance when in position for milling keyways, taps, rimers, etc., between the centres of the lathe.

Fig. 2 shows the appliance looking from the tailstock end of lathe towards fast headstock, with chuck and V-shape milling cutter in position for fluting taps, rimers, etc.

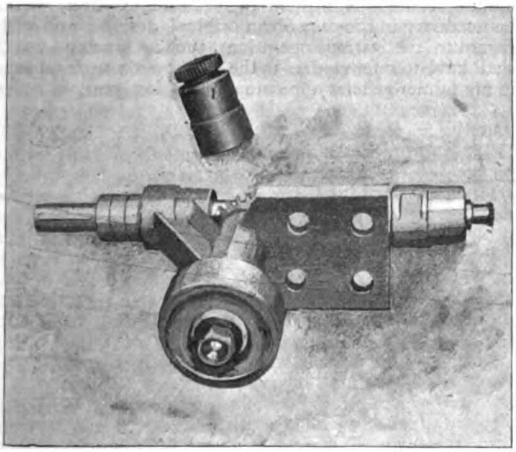


FIG. 2.

Fig. 3 illustrates the apparatus as it would be bolted on dowel of bottom slide (surfacing); but to be correct, the cone mandrel (B) should be reversed, and the bevel wheel and driving pulley withdrawn, as previously explained.

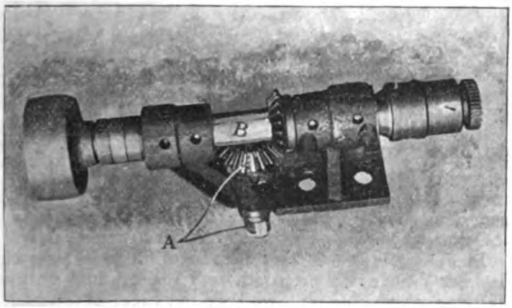


FIG. 3.

The cutters shown in the photographs were made by this appliance, the largest being 1½ ins. diameter by ⅜ in. wide. It has forty cutting edges, is milled on face as well as top, and was turned and fluted on nose of fast headstock without removal.

The small cutter shown is a V-shape ¾-in. diameter, with twenty cutting edges, and with this was fluted the 1½-in. cutter previously referred to. The same cutter is also useful for taps, rimers, etc.

With this appliance, it is immaterial whether the work is done with the milling cutter in the appliance, or in fast headstock of lathe, or between the centres of lathe. The nose of the lathe and appliance being the same, it is possible to have the work on either the fast headstock or between centres or on the appliance itself, whichever the operator finds most suitable for his particular job—all methods working equally well.

With this apparatus keyways have been milled 9-16ths in. wide by ¼ in. deep at one cut with ease; the driving belt for same being 1 in. wide, and the total weight of appliance is about 16 lbs.

Mention has been made of the bracket fixed to the web of the diagonal part of the frame casting. This bracket carries a sliding piece of flat steel which engages between the teeth of the spur wheel shown at the left hand end of the apparatus in Fig. 1, and thus acts as a rigid division plate. The ordinary change wheels of the lathe are used for the spur wheel, so that the number of divisions obtainable is very great indeed.

On this bracket is also carried a back-gear spindle. On the cone mandrel is placed a two-step pulley with pinion attached loosely on shaft, which engages with back gear spindle wheel, and then back again on to the cone mandrel, thus giving a range of four speeds for milling cutters. This method of driving is simply a copy with modifications of the household wringing machine, but is very effective.

The milling apparatus has been used for nearly two years on small jobs and has given uniform satisfaction, its latest application being the milling of a pair of cams for a small gas engine. The maker, Mr. Joseph Bennett, whose address is 16, Mabley Street, Homerton, London, informs us he will be willing to answer enquiries concerning the tool and to give quotations to amateurs for similar appliances.

The Motor Bicycle: Its Design, Construction and Use.

By T. H. HAWLEY.

(*Continued from page 82.*)

V.—ON DESIGNING AND BUILDING THE FRAME.

I NOW approach the most difficult part of the subject—that is, the selection of the best design of motor bicycle for amateur construction.

The single problem of designing an advanced type of machine, which shall prove superior in every respect to present date machines, is, in itself, intricate to a degree, even when the designer has a perfectly free hand; but that problem is further complicated when the designer has to consider at every point the practicability of the design to the average amateur constructor or small cycle maker, so that it is evident that a suitable design must be more or less of a compromise.

It would, of course, be an easy matter for me to simply give instructions for the construction of the average type of motor bicycle of to-day, and such a machine would be quite practical, and give fair satisfaction; but by the time the maker got it finished, the up-to-date machines would be so manifestly superior that a feeling of disappointment would be created.

I have taken considerable time, and given a great amount of thought to this portion of the subject, and have decided to offer two designs—one in which the chief merit will be simplicity and ease of construction with facility for procuring various parts in finished or unfinished state; and the other a more ambitious design to suit those who have the necessary plant for doing special work, and wish to build a high-powered fast machine; but at the same time I have arranged my design as stated in order that the special or original work shall be a minimum quantity for the maximum number of points gained throughout.

For the first design, that is the more simple machine, cannot do better than take the model I built for myself, as detailed in the opening chapter, and which has done such excellent service, adding such improvements and detail alterations as my experience has proved desirable without at the same time interfering with the main structur: of the frame, or the fundamental points in engine design.

Such a machine as I shall first describe will give every satisfaction to those who are content with 1½ h.-p., and to pedal a little to assist up steep hills; but in my second or original design, I hope to provide for an average speed of 25 to 30 miles (if necessary) on the level, and power for climbing the steepest hills without assistance from the pedals.

In both the designs, therefore, I am providing for the contingency of some standard pattern engine being fitted, this being one of the limitations to the designer alluded to above; but, on the other hand, my second design will allow of fairly wide scope in engine design, and the incorporation of certain valuable and original improvements to be described.

We will deal with the more simple design first, and as the machine does not depart much from accepted present day practice, it will not be necessary to enter into minute detailed description to the same extent as would be necessary in the case of an original design; and with regard to the various operations, such as brazing, &c., I shall have to refer readers to the chapters on such subjects in my former articles appearing during last year, in order

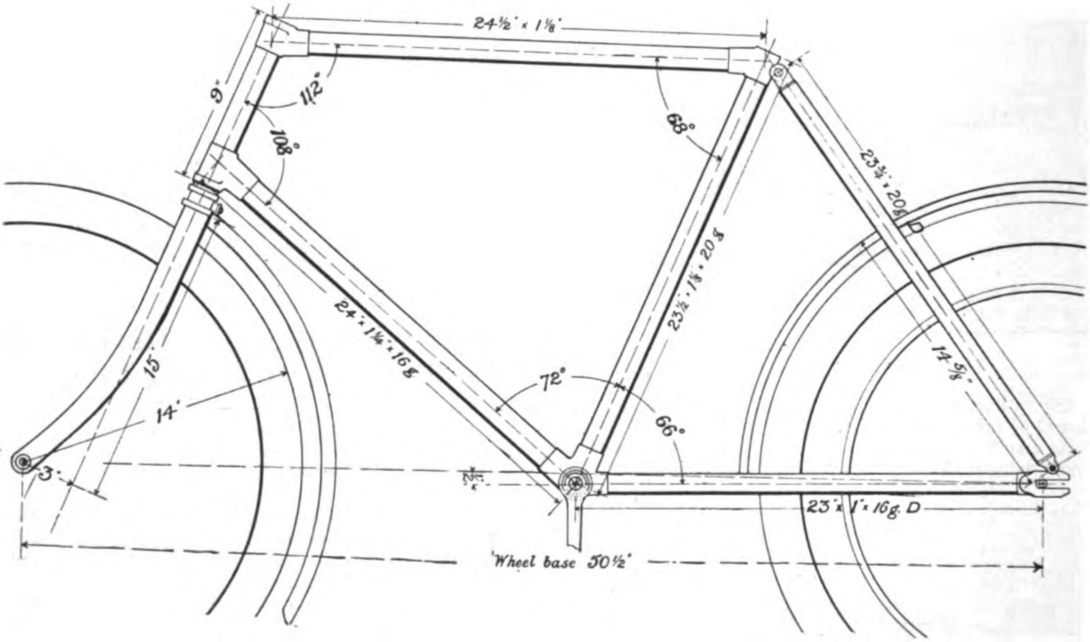


FIG. 27.—FRAME FOR MOTOR BICYCLE.

The present stage of motor bicycle construction provides a satisfactory frame for 1½ h.-p. and an average of 15 miles per hour. But if more powerful engines are to be fitted, the whole frame demands reconstruction not only in the matter of heavier tubes, but heavier sockets, bigger steering heads, and larger ball bearings all round, and the increased all-round weight again involves tyres of greater diameter and strength, or the machine would be unrideable at the higher speeds.

Then there are several other conditions necessary for durability and ease of manipulation, which I shall touch on in proper order.

It is a moot point whether the builder should commence with making his engine first and afterwards build the machine, or *vice versâ*; but I incline to the idea of building the bicycle first and the motor afterwards. At any rate, this course will suit such of my readers who may desire to build the bicycle and purchase their motor equipment all ready finished, and no doubt this will be a pretty numerous class, as the entire job of making machine and motor, with all the accessory equipment, is a rather tall order, and might grow monotonous before the machine was really completed.

to avoid unnecessary repetition in detail; but, at the same time, I will repeat general outlines of such parts of the work as may appear to require special mention.

In Fig. 27 is shown the side view of the motor bicycle, and this drawing is prepared from the original working drawing on which I built my own machine, and which I am still riding. It will be seen that the design differs little from that of an ordinary pedal propelled bicycle, and, indeed, it is purposely made to closely follow this, so that there will be no difficulty in procuring fittings for building the frame. A little study will disclose the fact, however, that, in the first place, the question of position of motor is practically confined to the bottom tube or seat tube (the position over front wheel I do not advocate); but the position on the lower tube may be varied from close to the head on the *upper* side to close to the bracket on the *under* side. The disadvantage of placing the motor on the upper side of this bottom tube is that the space available for the carburettor and petrol tank is reduced, and so almost compels the fitting of a spray carburettor or a considerable reduction in petrol carrying capacity.

In this design I have endeavoured to make the frame socket-angles conform to the latest standard B.S.A

(Birmingham Small Arms) fittings, which are, without question, beyond reproach in workmanship and material, and are easily procurable, in either parts or complete sets, all the world over, at prices which cannot be competed against when the quality of the work is taken into account; and as my own machine is built from these fittings, and has now done some 6000 miles this season without any mishap to the frame—even though I have had one or two nasty spills and a collision with iron railings in the dark—I am not speaking without knowing.

One departure from the B S.A. design which I have made is to lengthen the wheel-base somewhat (distance between wheel centres), being sure that this is a great gain in steady steering and general stability, also in minor other directions.

There will be no difficulty in procuring what are termed "imitation" B S.A. fittings at much lower prices than the original for those who care to take the risk and put up with extra trouble involved by the angles, &c., not working out true, and rough castings of the same parts are easily obtainable—so that it will be seen that so far as the frame portion of this machine is concerned it is eminently suitable for the amateur with but few tools; and in case the full set of genuine B.S.A. fittings be purchased, there is no real necessity for a lathe even, though, of course, certain jobs would be more readily executed on this universal tool.

For those who wish to machine their own bicycle frame fittings I shall not cater, so far as this operation is concerned, because really it does not pay to do so unless compelled through inability to obtain finished fittings for some original design; so I will assume that the constructor of this design is to make a start with a complete set of B.S.A. or other selected fittings.

Before purchasing such a set of fittings, however, there are a few points to be decided on in the specification, the chief one being the matter of the most suitable gearing; and although this will to some extent vary with individuals, it is by no means the same calculation as with the pedal-driven bicycle, and the factor controlling the ratio of pedal gear is not so much the physical power of the rider, as the average country over which the machine is to be used. It might be argued that as the pedals are chiefly used for starting purposes, with an occasional help up hill to the engine, a low gear and short crank would be best; but this is a fallacy, for although the low gear would certainly make starting easier, especially when starting up hill, it is not so suitable for assisting the engine on a steep hill, the reason for this being that the power of the small engine is directly proportionate to its piston speed; and if the engine cannot be maintained at something near the normal number of revolutions, it rapidly loses power, just at the steepest portion of the hill where power is most needed, and with a very low gear the rider cannot pedal fast enough to keep the engine going.

To put the matter in another way. Suppose when running on the level the machine makes twenty an hour with the engine running at something less than its maximum speed, then the pedal gear and crank length should be such as would enable the rider to pedal an ordinary bicycle at a rate of fifteen to twenty an hour, and this means a fairly high gear, because the only way to get up steep hills on a motor bicycle not powerful enough in itself is to "rush" the hill and assist the engine as much as is required to retain the regular beat at normal speed; in other words, the pedal drive should just beat time with the engine, but should *never overtake it*, or the engine is thrown off its beat at a critical moment and a dismount is inevitable.

Now it will be seen why for hilly country a fairly high gear and long crank is required, whereas if the machine were never to run on anything but the dead level a very low gear and short crank would suffice, and would be far more comfortable.

My own machine is geared to 80 ins., with 7-in. cranks, and I can sprint up most hills without undue exertion; but perhaps the more moderate gear of 72 to 75 ins. would suit the majority.

The next question to be decided is the height of frame, and here I can offer a word of warning which will save readers from falling into the same error as myself, for I built my frame just an inch shorter than I ride an ordinary bicycle, thinking that would suffice for allowance for a deep roadster saddle; but this is not nearly enough, and the frame should be 3 ins. lower than would be ordinarily ridden with a road racing saddle, or 2 ins. lower than the roadster equipped machine, not only because it is absolutely necessary on a motor to have a deep well-sprung saddle; but the continuous "free wheeling" for long periods is excessively tiring if the legs are fully extended.

The only other point in specification is to make sure that the crank bracket is of full roadster width, not less than 5½ ins. in tread, measuring from end to end of axle, as the cranks will then only just clear the majority of small motors of 1 to 1½ h.-p., and would have to be wider still to clear a more powerful engine. Then, of course, it must be seen to that the whole of the fittings *are* motor fittings, and not ordinary bicycle fittings, as these must not be used on any account, though some of the items are the same; but the whole of the head and front fork is of special strength in the motor set, the cranks are also stronger, as are the back fork bridge piece, the back fork ends, and the driving hub spindle; it should also be seen that the front forks and back bridge piece are wide enough to give full clearance to a 2-in. tyre.

On receiving the fittings the first thing to be done will be to dismantle all the finished parts, so as to detach the outer sockets and other parts to be brazed, track being kept of each part by marking it in some way, so that it may be replaced in the same position, this applying particularly to the bottom bracket bearing discs. In doing this job be careful not to damage the parts by hammer or vice marks by such jobs as knocking out the crank cotter pins.

The next step in actual work should consist of making a full-sized rough drawing of the frame, the only necessity for exactness being in the matter of the chief distance points, but more particularly the correct angle of the frame joints. It is, of course, an easy matter for one accustomed to the job to get out a bicycle frame without the assistance of full-sized drawings for reference; but the amateur will be well advised to make a full-scale drawing on any suitable surface, say the wall or floor of the shop, so that he may verify his work as he proceeds, by laying the actual work on the drawing, and so comparing the positions and angles. This drawing need not occupy much time, as it is necessary only to give rough outline in correct positions, and I have marked Fig. 27 fully in every respect, in order to facilitate the production of the full-scale drawing.

I think the quickest method to produce this drawing is to draw a horizontal line forming the ground line, and parallel to this draw the wheel centre line 14 ins. above; then on this line measure off the distance of the wheelbase or centre to centre of wheels; next find the crank bracket centre by measurement from back wheel centre, and at the given distance below the horizontal line strike the centre of the bottom bracket. From these three points all the rest of the frame may be projected, the most important point being to strike the correct angle from the bottom bracket centre, so as to bring the bottom tube to the proper distance above the front wheel—then, this being accomplished, it is only necessary to get the seatpost in position when the other positions are easily found, because the steering head and the seatpost form parallel lines. Of course, it will be seen that all the measurements are centre to centre, and do not represent exact tube lengths; also that in constructing the drawing the centre lines only are worked to in finding the positions, the outer diameter of tubes being filled in afterwards.

The value of this drawing will be early apparent, for even before brazing we may fit the various tubes to their corresponding sockets and try them on the drawing to see that the angles are correct; if not, they must be made so one by one before the frame is brazed up, or there will be a discrepancy at the finish which cannot be disposed of, and, at the same time, retain straight tubes—an essential in all good work.

(To be continued.)

Wave Power.

IT is, we suppose, impossible to look at a heavy sea tumbling in on a shelving shore without being impressed by the magnitude of the mechanical work done. When a gale sends home thundering breakers on a rocky coast the effect is yet more impressive. Indeed, few engineers can, we think, fail to feel a regret that these magnificent natural efforts should be barren of useful result. On the other hand, the quiet rise and fall of the tide in a great harbour is scarcely less suggestive. We see thousands of tons of shipping lifted up and suffered to fall again in the course of the day, and we are not surprised that many persons should hold that it is a pity so much energy should be wasted. Ought it not, for example, to be possible to light such a town as Southampton by the mere rise and fall of the water in the docks and tidal basins?

Fortunately or unfortunately, as may be, appearances are in such matters very deceptive, and the power exerted is by no means so great as it seems. When we see how small a pair of engines driving a couple of centrifugal pumps will suffice to empty a large dock in three or four hours, we begin to realise the insufficiency of tidal power at all events to accomplish much. One pound of coal used to advantage will lift, in round numbers, one million pounds a foot high, or 100,000 lb., or more than 44 tons, 10 ft. high. This represents 1,540 cubic feet of water, and would nearly fill a tank 10 ft. square and 16 ft. deep. Let us suppose such a tank fitted to a dock, and that the rise of the tide is 20 ft. the time 6 hours. The total work done would be 2,000,000 foot-pounds raised in 72 minutes, or 27,777 foot-pounds per minute, much less than 1 horse-power. Allowing for waste and loss of efficiency, we may say that a tank about twice the size with a fall of 20 ft. would be required to develop 1 horse-power for six hours. But this is by no means the whole story. If the tank or float were 16 ft. deep, the water in the docks must rise 16 ft. before the float would be able to ascend with the full power due to its calculated displacement as given above. This contemplates a rise of water in the dock of 36 ft. instead of 20 ft. To avoid this the draught of our tank must be shallow, and its superfical area augmented in proportion. If anyone with a knowledge of mechanics will take paper and pencil in hand and try to work out a scheme for obtaining, say, even 1000 horse-power from a system of floats in a tidal dock, he will find that, having any regard whatever for the commercial aspect of the question the work is simply impossible of achievement. The slow rise and fall of a number of tanks; or of one great caisson, extending over a period of twelve hours, must be converted into the rapid rotation of a shaft driving a dynamo. Mechanism can, no doubt, be contrived which would do this, but at what a cost of capital invested in plant and of power spent in overcoming the friction of gearing! Let us suppose the dock spanned by half a dozen gantries. On the gantries are cogged wheels, gearing into huge vertical racks, standing up like masts from the caisson which almost fills the dock. As the water rises, these racks cause the revolution of the geared wheels. These wheels are a little less, say, than 7 ft. in diameter. They make one complete revolution per tide; that is to say, they turn round once in, roughly, six hours. How much gearing would be required to multiply this up to 150 revolutions per minute, the least that would be suitable for a dynamo? We fancy that the facts have only to be stated in this way to condemn a scheme of the kind once for all.

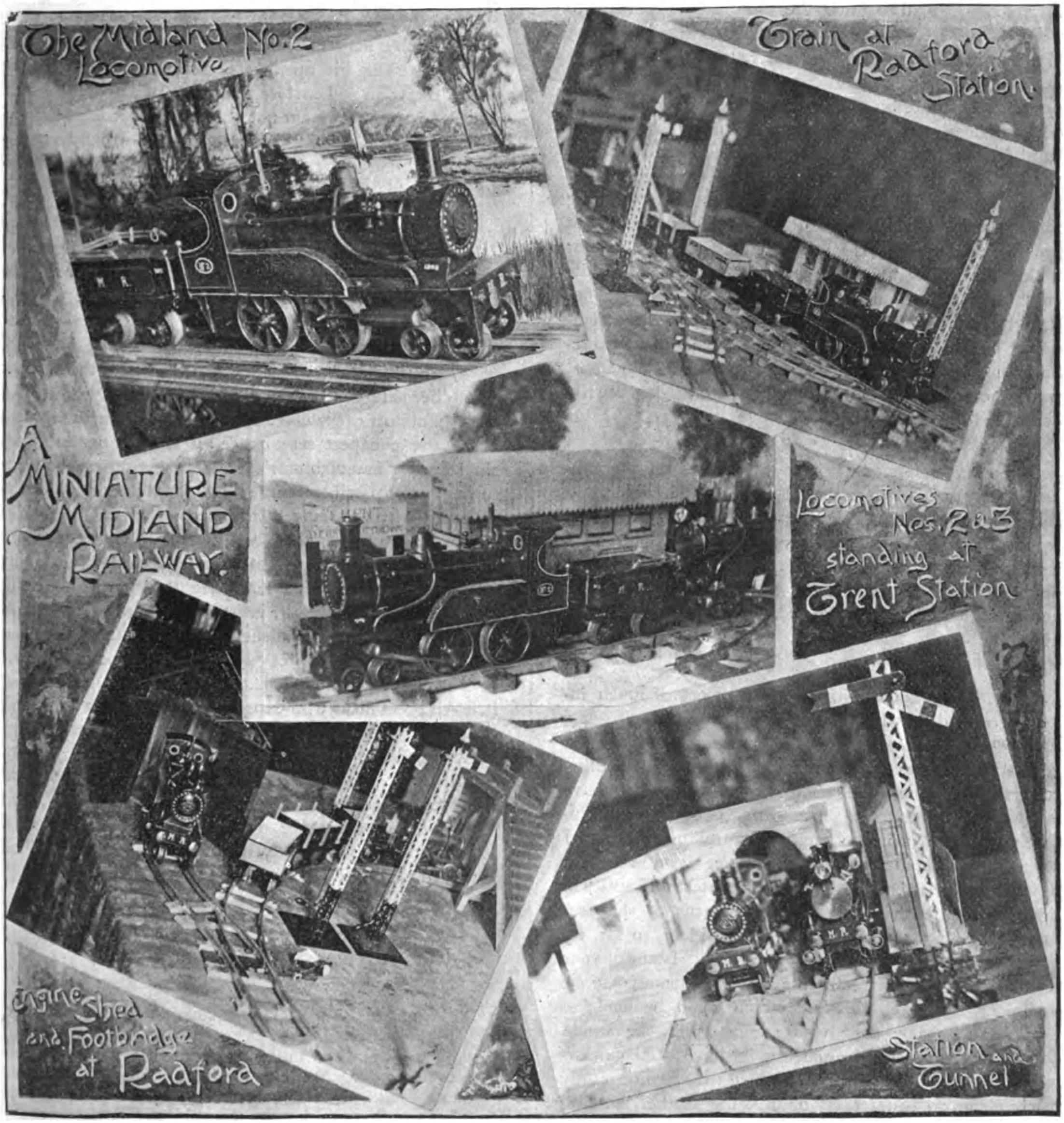
Inventors with better balanced minds have advocated the far more rational scheme of constructing vast basins or reservoirs, to be filled and emptied by the rise and fall of the tide, which will drive turbines or water-wheels. This, of course, is a refinement on the old tide mill. Several such mills have been built in this country and on the Continent, but they are very feeble things, of a few horse-power. The available fall cannot but be small, and when the fall is small an immense quantity of water is needed if any useful amount of power is to be had. In practice, 75 cubic ft. of water, falling 10 ft., would be needed per minute to get a single horse-power. For 1000 horse-power, not less than 75,000 cubic ft. per minute, or 5,400,000 cubic ft. per tide, must be provided. A reservoir 500 ft. long, 500 ft. wide, and 20 ft. deep, is an object of some magnitude. It must not be forgotten, however, that inasmuch as the whole fall of 20 ft. would not be continuously available, a very much larger volume of water would be required. An installation of this kind could not be constructed near a large town. Current could, no doubt, be sent from it over long distances. When we consider what the cost of sea walls usually is, we think enough has been said to show that this scheme also is chimerical; at all events, so long as coal can be had at anything like the present price.

Although we have referred at the outset to wave power, we have reserved mention of it to the last. At one time inventions in this direction were patented in the United States at the rate of two or three a week. We have never yet seen one which possessed any commercial value whatever. There is a story told of an energetic American who erected a machine of the kind for pumping salt water up to a hotel to supply baths. The proprietor of the hotel stated that during the first week of its existence "it did not pump worth a cent." During the second week a moderate gale sprang up, and in a couple of hours the house was deluged with sea-water. In the afternoon, the whole affair was driven into the roadway as a wreck. We fancy that this gives a very fair idea of the probable career of any mechanism intended to utilise the somewhat boisterous play of breakers on a sea shore.—*Engineer.*

THE August issue (No. 2) of *Page's Magazine*, the new technical shilling monthly, contains, with much other interesting matter an, article by Sir W. H. Preece, late Engineer-in Chief to the Post Office, upon "wireless" telegraphy, an illustrated account of the development of the submarine boat, and a contribution upon milling machines and their uses by Joseph Homer. The magazine is very well got up—splendidly illustrated and printed upon good paper. It should prove of universal interest to engineers—electrical, civil, and mechanical—and also those in any way connected with the iron and steel industries, mining, shipbuilding, etc.

A Miniature "Midland Railway."

By Ralph Skelton.



THIS line was originally designed, through force of circumstances, to go on a table 5 ft. long by 3 ft. wide, and it was therefore necessary to plan everything out, so that it would occupy as little room as possible.

The rolling-stock consists of three locomotives, all of which have four-wheeled tenders. Two were supplied by Messrs. W. J. Bassett-Lowke & Co., of Northampton, and are most excellent engines as regards power and speed when the narrowness of the gauge (1¾ ins.) is taken into consideration; though, being "single drivers," they are apt to slip if overloaded. Nos. 1 and 2 have oscillating cylinders, and No. 3 is a slide-valve engine. No. 2 has a leading bogie which enables her to run through points, &c., at a high rate of speed with perfect safety. The stock of waggons consists of seven waggons and one bogie rail car, all fitted with swivel couplings. The footbridge and engine shed shown in the photographs were made by a friend, and the signals supplied by the firm already mentioned. The two stations, "Radford" and "Trent," as also "Radford tunnel," I put together myself out of cardboard. In order to avoid crowding, the engine sheds have been placed in the centre of the table, with suitable points on to the main line at Radford and Trent Stations.

The Editor's Page.

WE are glad to draw the attention of readers to the letter from Mr. J. R. D. Glascott, which appears in our Practical Letters Column. Our correspondent urges very forcibly and succinctly the need for accurate data in regard to models and their performances, and his remarks will surely be of interest to all those who have any right to be proud of their work. The points he enumerates have been urged before, it is true, and the article in our last issue on "Testing Small Engines and Boilers" (by B.S.K.) will no doubt provide a practical basis for the amateur who has little or no knowledge of the proper way to make tests. While on this point, we may suggest that the same line of thought may be applied to other models than those mentioned by our correspondent, actual details of construction and working results of electro-motors, dynamos, water motors, small gas or oil engines, &c., being equally desirable from our point of view.

* * *

Several correspondents have written us on the subject of cutting a double thread with a hand-chaser, and submit an alternative explanation of the result arrived at by our Moscow reader as described in our August 15th issue. Some of them point out that it is possible to cut a double thread by traversing the chaser at double its normal speed, thus producing two separate spirals running side by side.

* * *

H. G. (Cape Town) writes on a subject of much interest to readers who believe in good and up-to-date methods of workmanship: "In your issue of June 1st you ask for articles on making and using small milling cutters in the lathe. The subject is one in which I have taken much interest for some years past; but, unfortunately just now, owing to great pressure on my time, I am unable to detail my actual experience for the benefit of my fellow amateurs. One of the greatest difficulties in my own experience has been a ready means of sharpening small cutters accurately, and the problem, so far, remains unsolved so far as I am concerned. If any of your readers can design a really practicable apparatus to be used apart from the lathe, and which could be made at home, or at a low cost by a manufacturer, he would confer a great benefit on amateurs. I have sketch drawings of a design, but for reasons given the machine is only partly made, so I prefer saying nothing further, holding that such work should be actually carried out before being described. One maker advised me to use small emery wheel in drilling spindle; but I am not partial to that method on a good lathe, and still hope to see a useful article designed. Out here there are no facilities for sharpening small cutters, and it costs as much to send them home for the purpose as to purchase a new cutter."

* * *

The scientist often has to smother his feelings in the presence of ignorant or superstitious people, and the Editor of a technical paper has likewise to keep his equanimity under similarly trying circumstances. The latest of these is a letter from a querist whose *bona fides* are evidently unquestionable, but whose knowledge of electricity is very much "in its infancy." There is no need to quote his remarks in full, but other readers will be interested in his opening sentence, which speaks for itself: "Dear Sir,—I enclose a drawing of a dynamo which I intend to make; I am not able to make it in metal, so will seasoned oak do?" We might reply—briefly—in the words often used by "front-bench" politicians: "The answer to this question is in the negative."

* * *

Apropos of our remarks on the subject of working drawings, as supplied with sets of castings to amateurs, "A Practical Engineer" writes:—"In your issue of July 15th you rightly publish some very caustic remarks respecting the drawings supplied with sets of castings. Now, whilst agreeing with your criticisms, I think there is another side to the question. It is a well-known fact that, in almost every case, an amateur will decide to purchase the cheapest set; hence, it is the 'dealer's' or, shall I say, 'manufacturer's' aim to cut down the price to the lowest possible limit. When a purchaser complains he meets with the reply, 'It is the best we can do for the money'; result—another set kicking about the shop. My advice to purchasers is to carefully consider the details of the respective price lists, see the parts are fully described, and, above all, insist on seeing a photograph or photo-block of the finished article, and not—like the grocer's customer—expect 'a clock with a pound of tea,' or it will surely be found that some part has suffered for it. All good firms who expect a repeat order will send the goods on approval, either on receipt of a deferred P.O. or through the deposit system of THE MODEL ENGINEER. A few of us are endeavouring to supersede the 'screwdriver-and-emery-cloth' style of model, and with the able assistance of the Editor of THE MODEL ENGINEER, who has already done so much to raise the standard of model making, hope to succeed."

Answers to Correspondents.

"BLUEBELL" (Lancaster).—Thanks for your suggestion. The idea has already been utilised—in our second volume—but it is not impossible that it may be employed again. May we point out that you omit your name and address, regarding this, no doubt, as having nothing to do with the subject. Apart from the fact that it is more courteous, we require all correspondents to include their names—not for publication; but in case we require to write them direct. Otherwise, of course, we are under no obligation to take any notice of their letters. This explanation will apply to other readers who have not complied with our conditions.

WILL the reader who wrote to our Query Department with respect to an electric light installation please send us his name and address? Our reply has been returned to this office. The correspondent in question required information about a small switchboard for a hotel.

Prize Competition.

Competition No. 22.—Two prizes, value £2 2s. and £1 1s. respectively, are offered for the best and second-best designs (to include full description and working drawings) for a working model flying machine. The size, type, and propelling power of the model are left entirely to the choice of the competitor, the main stipulation being that it shall be capable of successful working. The model must have been actually made, and the prize winners will be required to send in their models for inspection and trial by the judges before the actual awarding of the prizes takes place. The last day for receiving entries is October 31st, and the usual general conditions apply in this Competition.

General Conditions for above Competition.

1. All articles should be written in ink on one side of the paper only.

2. Any drawings which may be necessary should be in good black ink on white Bristol board. No coloured lines or washes should be used. The drawings should be about one-third larger than they are intended to appear if published.

3. The copyright of the prize articles to be the property of the proprietor of The Model Engineer, and the decision of the Editor to be accepted as final.

4. The Editor reserves the right to print the whole or any portion of an unsuccessful article which he may think worthy of publication, unless the competitor distinctly expresses a wish to the contrary.

5. All competitions should be addressed to The Editor, The Model Engineer, 37 & 38, Temple House, Tallis Street, London, E.C., and should be marked outside with the number of the competition for which they are intended. A stamped addressed envelope should accompany all competitions for their return in the event of being unsuccessful. All MSS. and drawings should bear the sender's full name and address on the back.

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 Hint to Our Readers.

To the Editor of *The Model Engineer*.

Dear Sir,—I have been looking over the back numbers of The Model Engineer, and could not help remarking how much more useful the experiences of some of your contributors would be, if they gave fuller particulars as to the working of their engines, &c.

For instance, it is of little use to say a model boiler "steams freely" or "will supply an engine 1 in. bore by 2 ins. stroke." Different readers might have different ideas as to what this might mean !

It is not a difficult matter to measure the cubic inches of water, evaporated, in a given time, at the working pressure. The performances of various types of boilers could then be compared with some degree of accuracy.

Brake h.p. of models can be very easily measured with simple apparatus.

I should suggest that in future the following particulars be given :—

Boilers.—Dimensioned sketch; weight in working order; working pressure; cubic inches of water evaporated per hour at that pressure; consumption of oil or spirit per hour to evaporate this amount.

Engines.—Type and dimensions; boiler pressure at which worked; revolutions per minute (not guessed but measured); b.h.-p. developed at that speed and pressure; cubic inches evaporated in boiler per hour to produce this power.

Steamers.—Dimensions of hull; full particulars of boiler, as above; dimensions and revolutions of engine; diameter, pitch, and type of propeller; speed of boat accurately taken over measured course. From these particulars the slip of the screw can be calculated, and some notion of its efficiency arrived at.

I should like to know if any one has tried making a model indicator, and with what success. I do not see them advertised by any of the model makers, nor any form of simple revolution counter.

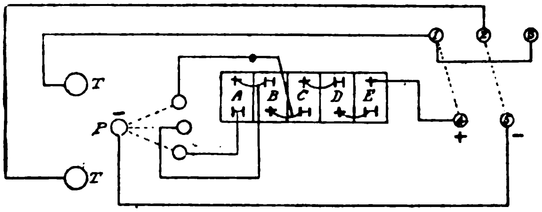
Trusting you will be able to find space for this in your valuable paper, yours truly,

Bedford. J. R. D. Glascott.

Model Electric River Launch.

To the Editor of *The Model Engineer*.

Dear Sir,—I beg to point out a slight error in diagram of the connections on page 88 of The Model Engineer, for August 15th. You will observe there is a line from



Corrected Diagram of Connections.

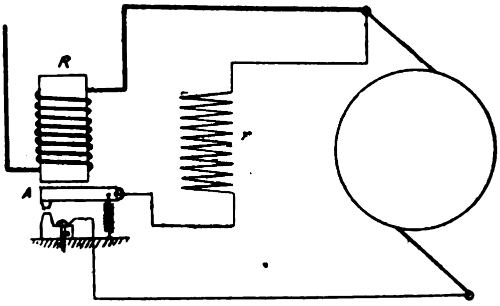
centre contact stud to end cell accumulators, which should be omitted. I enclose corrected diagram, which please insert at your convenience.—Yours truly,

Manchester. H. B. Hunt.

Brake for Model Electric Railway Cars.

To the Editor of *The Model Engineer*.

Dear Sir,—I see in your July 15th and August 15th issues, a very able description of the method of working a model electric railway, from the pen of Mr. F. J. Burnham, in which he describes the use of a "fourth rail"



Brake for Model Electric Railway Cars.

for working brakes. As will be seen from the illustration herewith, this "fourth rail" might be entirely dispensed with, thus simplifying the system and also saving power. The current is switched off in the section on which the train is to be stopped. On entering this "dead" line, the current ceases to flow round low resistance coil on the soft iron magnet (R), and the soft iron armature (A) is allowed to fall, thus completing circuit through resistance (*r*); the motor then acts as a dynamo, the power required to drive which would act as a brake on the car. This I think would prove quite as efficient as that illustrated in the article published.—Yours truly,

Finchley. HARRY HAUGHAN.

For the Book-shelf.

[Any book reviewed under this heading can be obtained from THE MODEL ENGINEER *Book Department, 6, Farringdon Avenue, London, E.C., by remitting the published price and cost of postage.]*

ELECTRIC WIRING. By W. C. Clinton, B.Sc. London: John Murray, Albemarle Street. Price 1s. 6d. Postage 2d. extra.

The principal object of the author of this little book is the production of a volume for those preparing for the preliminary examinations of the City and Guilds of London Institute in the subjects of electric light and bell wiring. We are sure it will prove satisfactory in that respect, and not only so but will undoubtedly be useful to anyone either engaged in the business or contemplating it. The book is well illustrated, and the information clear, concise, and full, and altogether we know of no other book dealing with the subject that could be more safely recommended to those in need of a low-priced but sound guide to electric wiring.

A.B.C. OF THE STEAM ENGINE. By J. P. Lisk. New York: Spon and Chamberlain, 123, Liberty Street. Price 2s. 6d. post free.

This handbook, the title of which is not in our opinion quite suitable to its contents, is in reality a description in detail of one type of steam engine—an American single cylindered horizontal engine of good design, such as would be used in a small factory for power purposes, with some general comments upon steam engine working. Plates showing the general arrangement of the engine, its component parts, and a centrifugal flywheel governor, are given at the end of the thirty odd pages of descriptive matter. It is very probable that beginners whose knowledge of steam engine mechanism is limited, would find the production of great value, and it would also appear to be of considerable use to readers of THE MODEL ENGINEER whose next task is the building of a model of the kind of steam engine dealt with in this book.

CLYDE MODEL YACHT CLUB.—The Clyde Model Yacht Club, which was formed this season, held their second regatta on Tuesday, August 19th, at Strone, Holy Loch. There were thirteen entries of various sizes, from 2½-raters to 10-raters. The course was set for a run to lee-ward and beat to wind-ward; but owing to a strong north-westerly wind and a heavy sea most of the yachts had to be taken ashore, only three of them going round the course. The first prize (one guinea, presented by Mr. Ewing Binnell, Oak Knowe, Blairmore) was won by Mr. J. Ferguson's *Wasp*; the second prize (10s., presented by Mr. Collins, Glen-Corrie, Strone) being won by Mr. A. McAlpine's *Wanderer*, and third (club prize) by Mr. J. Kean's *Thistle*. This club, though yet in its infancy, has every prospect of coming to the front, owing to the goodly number of amateur yachtsmen who have become members.—A. MCKERRELL, 45, Crawford Street, Greenock, N.B.

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, *37 & 38, Temple House, Tallis Street, London, E.C.]*

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

[6659] **Resistance Wire for Electric Kettle.** E. H. (Blockley) writes: Can you please let me know through your paper what kind of resistance is used for heating electric kettles?

One of the high resistance wires, such as manganin, platinoid, etc., is used for the wire, and is embedded in a non-conducting cement, which secures the wires and keeps them from contact with the kettle.

[6841] **Electrical Ignition Apparatus.** J. R. (Shipley) writes: Could you inform me from whom I could purchase the whole apparatus for electrical ignition? I should prefer battery ignition—that is, on the battery principle, not dynamo.

Write to Mr. F. C. Blake, Station Avenue, Kew Gardens, London, telling him exactly what you require, and he will give you all the information you ask, price, etc., if you mention this paper.

[6846] **Dynamo Queries.** T. W. (Jarrow) writes: (1) On which wire, positive or negative, is the ampère-meter invariably placed? (2) A dynamo is working at, say, 350 volts. Now, I understand that is the difference of voltage between the poles or terminals of the machine. Is that so? (3) If I am right in the second question, does it also mean that there is no difference of pressure between the negative and, say, the earth, or practically none, at any rate?

(1) Usually the positive. (2) Yes. (3) We have difficulty in divining your meaning. When a current is led to earth it (the earth) merely becomes a conductor, provided arrangements are made to receive the current back to where it was generated. We should advise you to look up any elementary book on electricity and magnetism in order to get a firm grasp of the principles of electricity, and we shall at any time be pleased to help you with any difficulties you may get into. You do not send your full address.

[6797] **Negative Accumulator Plates.** F. S. (Sutton Bridge) writes: I have been trying to make an accumulator as described in your handbook, but I cannot get the precipitated lead into the grid; it goes as hard as the grid itself when pressed down, and looks just like ordinary lead. I have got one grid done by drying it first and then crushing it up with sulphuric acid; it turns a light slate colour. I use sugar of lead, which I expect is the same as lead acetate. Will the plates made this way be alright?

When precipitating the lead, keep the crystals which are forming under water until enough have been formed to paste your grids. This will keep the crystals from becoming hard. If you do not succeed with this method, use litharge and sulphuric acid for the negative plate. Mix in the same way as you do the red lead for the positive. The negative should be, as you say, a light slate colour. Sugar of lead is the same as acetate of lead.

[6709] **Induction Coil to give 1-in. Spark.** G. H. C. (Tufnell Park) writes: I am making a small induction coil for experimental work, and I want it to give about 1-in. spark. The following are the dimensions:—Core: 6 ins. long, ⅝ in. diameter, bundle of No. 26 soft iron wire. Primary: arranged so that I can use either eighty turns of No. 20, or forty turns of No. 20, or two coils of forty turns each of No. 20 in parallel; length of bobbin, 4 ins. Secondary: length of bobbin, 4 ins; number of turns to layer equals 200; maximum number of layers on bobbin equals twenty (or more if absolutely necessary); wire used equals No. 34 (silk-covered). I have already wound on seven layers of the secondary, and by using one dry cell and making and breaking primary by hand a fair shock is perceptible. I would be much obliged if you could answer me the following questions:—To obtain at least 1-in. spark working with 6 volts (accumulators), and a motor break capable of breaking at least fifty times per second—(1) How many (total) turns of the secondary are necessary? (2) What size condenser? (3) How much current, at what voltage, will the coil carry in the primary for safe working? If the coil will not give 1-in. spark, please tell me how to obtain the maximum. I want the coil for a friend to test a wireless telegraphy receiver over short distances, as his coil is too large for this purpose.

Your coil is not likely to give a 1-in. spark. (1) For the size you give, we reckon there may be 9000 turns in the secondary wire, and, of course, you are only getting 4000. It is inadvisable to use No. 34 wire; No. 36 being correct. (2) The condenser should consist of fifty leaves of tinfoil, 6 ins. by 3 ins. (3) The current of 2 or 3 ampères at 4 to 6 volts would be sufficient. Your coil is not really large enough for the work, and we should not anticipate more than ½-in. spark at the utmost from it. We have a handbook on the subject now in the press in our sixpenny series, and would suggest that you get this for full information.

[6720] **Mercury Break for Induction Coil.** W. L. G. (St. Heliers) writes: Having recently completed a coil to give a 1-in. spark, and being disappointed with the result, I made a mercury break on the lines of the one described in No. 63 of your paper. When using this break with three bichromate cells (zincs immersed 3 and 4 ins.), the spark is at first a good 2 ins. in length, but quickly dwindles down to ½ in. I have tried different liquids to cover the mercury, and find methylated spirits the best; but as soon as the break has been working a few moments the spirits become turbid and the spark length decreases, caused, I presume, by the liquid losing its insulating properties. Will you kindly let me know if this is usual with mercury breaks, or what is the best liquid to use to prevent this, which, I suppose, is really the oxidation of the mercury under the action of the current? I may say the coil is practically a model of the 4-in. coil described by Mr. Hunt in your paper, only mine has ½ lb No. 18 wire for primary and 1 lb. of 38 for secondary, wound in thirty-six sections, with suitable condenser, etc.

We have not had very considerable experience with mercury breaks, but in our experiments have found the same formation of a muddy sediment. In this case it did not appear to affect the working of the break, although it was only tried on ¾-in. spark coil with two (large) bichromate cells in series the amount of current might not be so great as in your case. Authorities state that kerosene or *mineral* oil may be substituted for the methylated spirit with advantage, and we are also under the impression that pure alcohol is preferable to methylated spirit. In a large coil a serious explosion may occur if the mercury break is used with the condenser disconnected, and possibly this points to either a defective state of your condenser or to its insufficiency. This again might be the reason of your failure to obtain a full 1-in. spark *without* the mercury break; a length of spark the coil certainly ought to give. Coil troubles are very difficult to deal with—especially on paper; but perhaps out of the above you may be able to extract the remedy, and if so we shall be glad to hear of the result.

[6571] **G.E.R. Locomotive "Claud Hamilton."** E. L. A. (Stratford) writes: Could you inform me whether any detailed drawings of the G.E.R. Locomotive "Claud Hamilton," No. 1900, have been published in any paper? I wish to build a ¾-in. scale model, everything possible to be scale size, and the dimensions given in your January 15th, 1901, issue are hardly full enough for the purpose.

The *Railway Engineer* of May, 1901, contained a supplement—a large working drawing of the "Claud Hamilton." This plate may be obtained from the office of the above paper, 3, Ludgate Circus Buildings, Ludgate Circus, E.C.

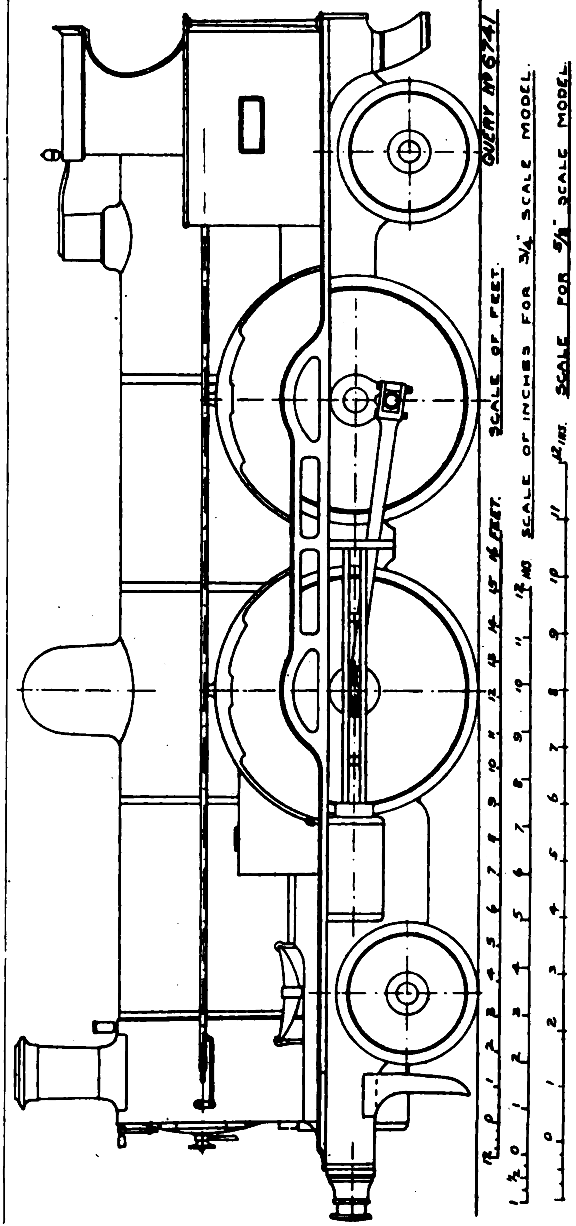
[6569] **Hot-Air Engines.** J. C. (Ludlow) writes: Is it possible to drive a model boat, about 2 ft. long, by hot air? If so, please give drawings. Also, what size cylinder (single-action oscillating), boiler and screw will be required to drive a 2-ft. boat?

It *might* be just possible, but, if successful, the speed would be very, very small. We cannot undertake to design such arrangement, as it is solely one for experiment. You have no clear ideas as to the construction of a hot-air engine, so please see our issues of July 1st and August 15th, 1901. These back numbers can be obtained from our publishers, Messrs. Dawbarn & Ward, Ltd., 6, Farringdon Avenue, E.C. Hot-air engines are very inefficient "heat" engines, and are only used for special purposes; for their power they are also very bulky. An ordinary type of ¼ b.h.p. hot-air engine weighs about 5 cwt., and occupies the space of about 9 cubic feet.

[6741] **L.N.W.R. Compound Loco "Queen Empress."** W. D. (Liverpool) writes: Will you please give me a drawing of the side elevation of the L. & N. Western 7-ft. compound express passenger engine "Queen Empress," and tender, showing shape of engine frames; also the elevation of the front end of the engine? Could you give me the scales for ¾ in. and ⅝ in. models, respectively?

We herewith reproduce a sketch of the eight-wheeled three-cylinder compound express locomotives used on the L N.W. Railway. The scales given at the foot of the sketch will facilitate the construction of a model of any size. We regret that we are as yet unable to give a drawing of the tender, or of the front view of the engine. You will, however, find no difficulty in making the latter, if you go to the nearest L.N.W.R. station and make a few sketches. The distance between centres of outside cylinders is about 6 ft. 5½ ins.; over footplating, 7 ft. 7 ins.; between main frames, 4 ft.; width over cab about 6 ft. 4 ins.; between buffer centres, 5 ft. 8½ ins.

L.N.W.R. Three-Cylinder Eight-Wheeled Compound Locomotive "Greater Britain" Class. — Driving Wheels, 7 ft. 1 in. Diameter. — *Scale*: ¼ Full Size, for ¾ in. Scale Model.



[6831] **Putting Dynamos in Parallel.** "ELECTRO" writes: In some direct current electric light stations, each dynamo is provided with a small variable resistance frame, fixed on the wall opposite to it. I believe it is connected in series with the shunt magnet winding. (1) Is this so? (2) What is the process to go through in putting another dynamo in circuit (parallel) with those already running. How is this variable resistance employed in the operation? (3) If it is used to increase or diminish the voltage of the dynamo, could the same thing not be done by regulating the speed? (4) What is the method of shutting down one dynamo off the mains?

(1) Yes. (2) The machine, which is to be "put on the load," is first of all run up to speed, then the brushes are put down and the exciting switch put in; *all* the resistance is at present "in." The voltage you will observe on watching the voltmeter of this machine gradually increases and finally settles down to, say, 200 volts. Now look at the voltmeter of the other machine. It may be 190 or it may be 210 volts; suppose it is the latter, you now bring the voltage of the first machine to 210 or a shade more, by taking out some of the resistance by means of the adjustable switch, usually just underneath the exciting switch on the switch board. Being now ready to parallel, you put in the two main switches (the "minimum and maximum cut-outs" as they are called). Now watch the ammeter, also the current indicator, and note whether the machine is taking up any of the load. If it is not, then take out more resistance and put *in* some of that of the other machine. By working like this for a few minutes, you will have the load equally divided between the two machines. When the load increases beyond the output of these two machines, another may be put in parallel in the same way, the load being then divided between the three, and so on until you have every machine in the station running in parallel should a heavy load demand it. (3) Of course the speed determines the voltage; but steam engines cannot be adjusted to various speeds whilst running, as is the case with gas engines. (4) This query is not very clearly put. We suppose you mean the method of shutting down one dynamo which has been running in parallel with others? You go through the foregoing process backwards. First throw off all the load of the machine which has to be taken out on to the remaining ones, by putting resistance *in* to it and taking resistance *out* of the others. Watch the ammeter and current indicator as before. When the machine is giving no current the current indicator will be in a vertical position, and then it is time to release the main switches; shut off steam and wait till the dynamo has stopped. Then take out exciting switch and raise brushes off commutator. Care must be taken never to allow the machine which is being put in or taken out to be "motored" by the others. Provided the ammeter is carefully watched, and the moment the load is all off the machine in question, the main switches are released, this motoring will not occur. On putting a machine "in" the voltage should always be 1 or 2 volts more than the circuit upon which it is going.

[6787] **Lamp for Dark Room.** W. H. M. (Rhyl) writes: I should be much obliged if you would kindly give me the following information for developing photographs. (1) Is a 4-volt lamp strong enough? (2) What is the best way of getting the ruby light? Can ruby incandescents be bought (stained glass), and where? (3) In the principle referred to in THE MODEL ENGINEER some time since, where the incandescent lamp was plunged in a ruby liquid, would not the heat from the lamp cause bubbles all over it?

(1) Yes. (2) Small lanterns can be had at many chemists or photographic stores specially made for dark-room use; or you could make one yourself out of a small box, with glass to form one side. Ordinary glass, with red paper pasted over it, answers the purpose very well. Ruby incandescent lamps can be bought, but we hardly think it worth your while to invest in one. (3) The heat generated by a 4-volt lamp is not enough to cause bubbles to form.

[6793] **Lamps for Resistance.** R. B. L. (Bowdon) writes: I should be pleased if you would tell me how many 8-c.p. Ediswan lamps I must run a current of 100 volts through in order to reduce it to 20 volts?

You cannot reduce the voltage of any circuit by putting in a resistance. You do not state what you want to apply the 20 volt circuit to; but, supposing you had a 20-volt lamp which took, say, ½ amp., then, in order to use that on a 100-volt circuit, it would be necessary to put in a resistance of 200 ohms, either in the form of lamps or wire, otherwise the 20-volt lamps would be burnt out immediately, having a resistance of only 40 ohms. You will have to let us know exactly what you want to do with the 20-volt circuit before we can help you further.

Amateur's Supplies.

[*The Editor will be pleased to receive for review under this heading, samples and particulars of new tools, apparatus, and materials for amateur use.*
**Reviews distinguished by the asterisk have been based on actual editorial inspection of the goods noticed.*]

Edinburgh and Midlothian Industrial Exhibition.

We have received the prospectus of the Edinburgh and Midlothian sixth annual competitive Industrial Exhibition, which will be held on the 15th, 16th 17th, and 18th October next, at the Waverley Market, Edinburgh. £300 in prizes is to be awarded for home-work of every description, including painting, photography, needlework, woodwork, carving, and mechanical subjects. Prizes are given for model locomotives engines, and yachts, new mechanical inventions, machine tools, and plumbers' and smiths' work of every description. The closing date for entries is September 27th, and prospective competitors should write at once to Mr. A. S. Hutchinson, 7, North St. Andrew Street, Edinburgh, enclosing 3d. to cover cost of prospectus and postage. This competitive exhibition, which is under very good patronage, should especially appeal to our model-making readers.

A Really "Dry" Cell.

Of course, the term "Dry Cell" is a misnomer, but Messrs. Lever Brothers, of 101, Dawes Road, Fulham, have lately introduced a practically dry accumulator, which should prove a veritable boon to all persons desirous of using this form of electric storage for portable purposes. There is no risk of spilling acid upon the clothes, and for motor car ignition, where the battery is subjected to considerable vibration, it should prove invaluable. Messrs. Lever Brothers' accumulators are too well known to need description, and certainly the addition of this useful adjunct should still further increase the sale they have already accomplished. Full particulars to readers of THE MODEL ENGINEER will be sent post free.

***A Useful Table.**

It frequently happens that readers having business dealings with firms across the "herring pond" are obliged to refer to catalogues and lists of articles sold by American firms in which the prices are given in dollars and cents. The Fairbanks Company, 78 and 80, City Road, London, E.C., and New York, U.S.A., have issued a table for enabling anyone to readily find the equivalent of an amount in dollars in English money, and on page 21 of the book a few notes upon the metric system are given. Only those units which are commonly used in commerce are employed in the metric table, and the rules given for converting the metric into English measures should be found very useful. The price of the table is 6d., and readers should mention THE MODEL ENGINEER in writing.

Catalogues Received.

T. W. Suter, 10, Highweek Street, South Tottenham, sends us his new illustrated lists of electrical and mechanical novelties, including model engines, gramophones and accessories, pocket accumulators, electric jewellery, lamps, and dynamos. This price list may be had by mentioning THE MODEL ENGINEER, and sending a stamp to cover cost of postage.

S. Holmes & Co., Albion Works, Manchester Road, Bradford, Yorks.—This firm's new "Katalog" is now ready, and can be obtained for 6d., post free. It is entitled a "Vade Mecum for Amateurs," and contains illustrations and prices of the cheap lathes and machine tools, which are a speciality of Messrs. Holmes & Co. More expensive tools are also listed, together with smaller accessories of the model engineer's workshop, such as vices, chucks, hammers, pliers, toolholders, etc. At the end of the catalogue is arranged several order forms, upon which, with the carbon paper provided, orders may be written in duplicate, another very good feature. Readers should mention THE MODEL ENGINEER when writing.

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 6s. 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," 37 & 38, Temple House, Tallis Street, London, E.C.

All correspondence relating to advertisements to be addressed to THE ADVERTISEMENT MANAGER, "The Model Engineer," 37 & 38, Temple House, Tallis Street, London, E.C.

All subscriptions and correspondence relating to sales of the paper to be addressed to the Publishers, Dawbarn & Ward, Limited, 6, Farringdon Avenue, London, E.C.

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THE

Model Engineer

AND

Amateur Electrician.

A JOURNAL OF MECHANICS AND ELECTRICITY FOR AMATEURS AND STUDENTS.

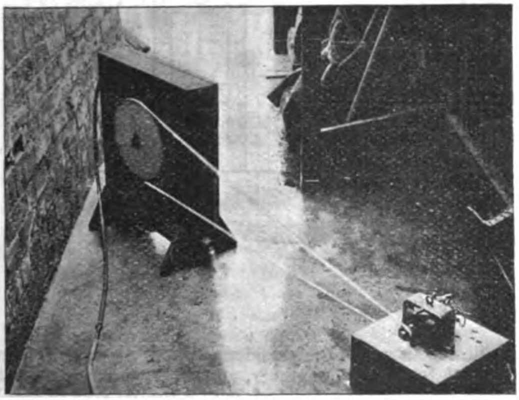
EDITED BY PERCIVAL MARSHALL, A.I.MECH.E.

VOL. VII. No. 82. OCTOBER 1, 1902. PUBLISHED TWICE MONTHLY

A Small Power Water Motor.

By FRANK J. PAYTON.

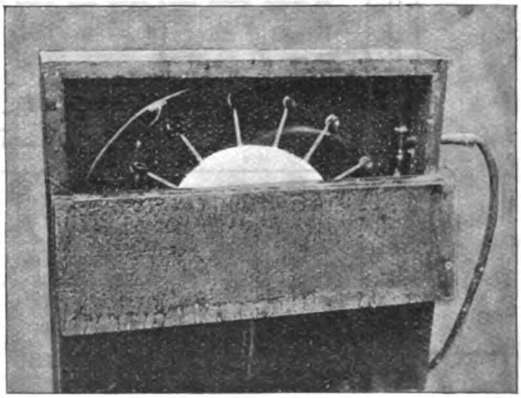
MOTORS of small power appear to be much in demand by amateur engineers and electricians, and the one here shown is of simple construction and might be made at home by anyone possessing a little mechanical ability.



WATER MOTOR DRIVING DYNAMO.

The power developed is about 1-12th h.-p., which is sufficient for driving a 30-watt dynamo at about 2,800 revs. per minute. The pressure or head of water required will be about 70 to 80 lbs. per square inch.

The body of the "Pelton wheel" is of a $1\frac{1}{2}$-in. teak or pine, and say 10 ins. diam. A $\frac{3}{8}$-in. brass or steel spindle, having two holes fitted with taper pins, is passed through the centre and when hammered down against washers on either side of the wood disc hold it firm. A more elaborate method of securing the wheel to the spindle would be the one adapted to secure emery wheels which would necessitate a specially turned spindle. The bearings for the spindle may be of brass or iron, although the former is preferable, and are let in the sides of the wooden casing. The spokes or arms of the wheel are long galvanised iron screws which can be bought at a wire or garden-tool shop. There are sixteen arms, and these are screwed about 2 ins. into the wooden disc, and should fit tightly. The most important parts of the motor are the twin cups which are soldered to the end at the arms. These are made of copper sheet and are formed by beating into shape in a hollow mould in a hard wood block. They should be cut from the sheet in discs about 1 in. diam., and when finished they are, of course, somewhat smaller. The inner edges of these cups are flattened before being fixed to arms and under working conditions the jets of water impinge on the joint of the cups, the water being divided and the direction of the current turned or partially reversed. This is the main point of a "Pelton wheel," as by reversing the current most of the energy in the water is absorbed in the wheel.



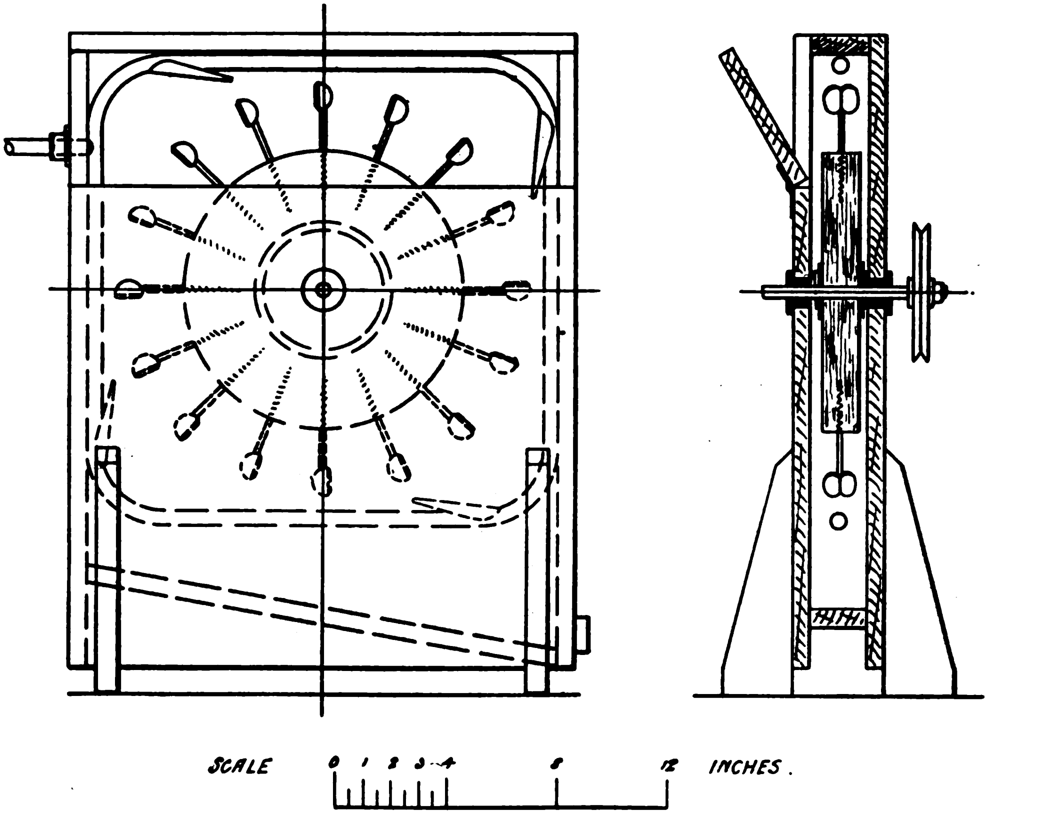
WATER MOTOR WITH CASE PARTLY REMOVED.

The diameter of the water supply pipe is $\frac{1}{2}$ in. inside and orifices of the four jets about 1-16th in.

It is essential that the pressure should be well maintained in the pipe, as otherwise the best results will not be obtained. The most economical speed to run the motor is generally determined by trial as it depends on the water pressure. The proper diameter of the pulley will probably also be a matter of experience.

The pulley may be made of a piece of fairly hard wood

¼ in. thick and grooved in the form of a V round the edge with a reeding tool or rough three-cornered file. The spindle at this end is square, and has a ¼-in. screw thread with a nut and washers for the attachment of the pulley. The casing of the motor is simply a wooden box, say ⅝ in. thick, having a portion of the side opposite the pulley made to open on a hinge for the purpose of inspecting the wheel.



CONSTRUCTION OF ¼ HORSE-POWER WATER MOTOR.

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 fortnight before its actual date of publication.*]

London.

THE next indoor meeting of the Society will be held at HOLBORN TOWN HALL, Gray's Inn Road, W.C., on Thursday, October 16th, when Dr. A. C. HOVENDEN will read a paper on "A Year's Experience with a Steam Car." Readers of THE MODEL ENGINEER who are interested in the work of the Society and would like to join will please communicate with HENRY GREENLY, Hon. Sec., 2, Upper Chadwell Street, Myddleton Square, E.C.

Provincial Branches.

Bolton.—The usual monthly meeting of this branch was held on August 26th, at the Oxford Café, there being a record attendance of 23 members; Mr. Booth the vice-president occupying the chair. The chief item of interest was the description of the making of a ½-in scale model G.N. locomotive by Mr. Wood, who described the several stages of manufacture and the troubles and trials he experienced as pattern-maker, moulder and engineer in general. Afterwards the locomotive was placed under steam and ran splendidly. A very interesting discussion followed in which the president, Capt. Slater, an ardent model locomotive engineer, and others took part. The meeting closed at 10 o'clock with a cordial vote of thanks to Mr. Wood. Members will please note that the president has arranged for a visit to his track.—ERNEST MALLETT, Hon. Sec., 83, Manchester Road.

Liverpool.—A meeting of the members of this branch was held at the Balfour Institute on Wednesday, September 3rd, and, after the minutes of the previous meeting had been read and passed, Mr. Croker gave a short lecture on his patent milling machine. Mr. Thorp afterwards proposed a hearty vote of thanks to Mr. Croker, which was seconded by Mr. Kirby, and carried unanimously. Mr. Reeves had on view a small hand-pump, and upon other general matters being dealt with the meeting terminated at about 9.40 p.m.

The next meeting takes place on Wednesday, October 1st, at the Balfour Institute, at 7.45 p.m., when Mr. Meadows will give a paper on "Moulding and Pattern Making."—F. T. STEWART, Hon. Sec., 33, Cowper Road, Old Swan, Liverpool.

Models Made Without a Lathe.

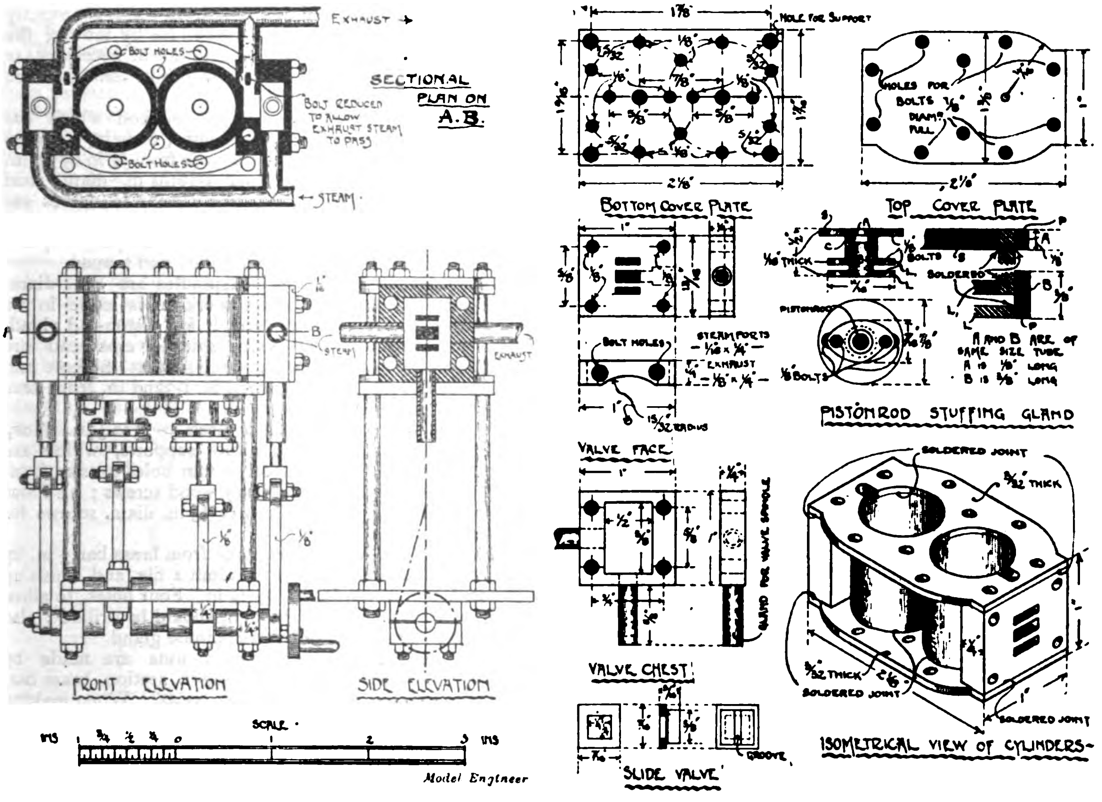
IV.—A Model Vertical Marine Engine.*

By S. Cooper.

THE following notes, in reference to a working model marine engine which I have constructed, will, no doubt, be of interest to the readers of THE MODEL ENGINEER, more especially because I have no lathe, and everything connected with the model had to be made without the aid of so useful a machine.

detail). Leave flanges rather full to allow for trimming up after soldering.

Soldering together Cylinders and Flanges.—This should be done as follows:—Over a small gas stove lay a piece of very thin sheet iron (the lid off a biscuit tin is the best thing), and on it place one of the flanges with the upper surface prepared to receive solder when it comes in contact with it; after coating the ends of both cylinders with solder, place them on the top of the flange and light the gas. As soon as the solder on ends of cylinders melts, sprinkle more solder near the joint, and with a split piece of cane paint with soldering solution all round the joint, when the molten solder will run wherever you



CONSTRUCTION OF MODEL VERTICAL MARINE ENGINE.

Cylinders.—The most difficult part of the engine is the formation of the cylinders. Take a piece of solid drawn brass tube, ¾ in. diam. inside, and 15-16ths in. diam. outside; cut off two pieces, each ⅞ in. long—these are for the cylinder tubes. For the valve faces, cut from a piece of brass bar ¼ in. by 1 in., two pieces each ⅞ in. long, and on one side of each piece file a groove (see detail) to fit outside of cylinder tube; solder valve faces to cylinder tubes and finish with a file to exactly 13-16ths in. long, leaving ends dead square. A flat surface must also be filed on the side of cylinder tubes opposite to valve faces, so that the centres of cylinders are exactly ⅞ in. apart.

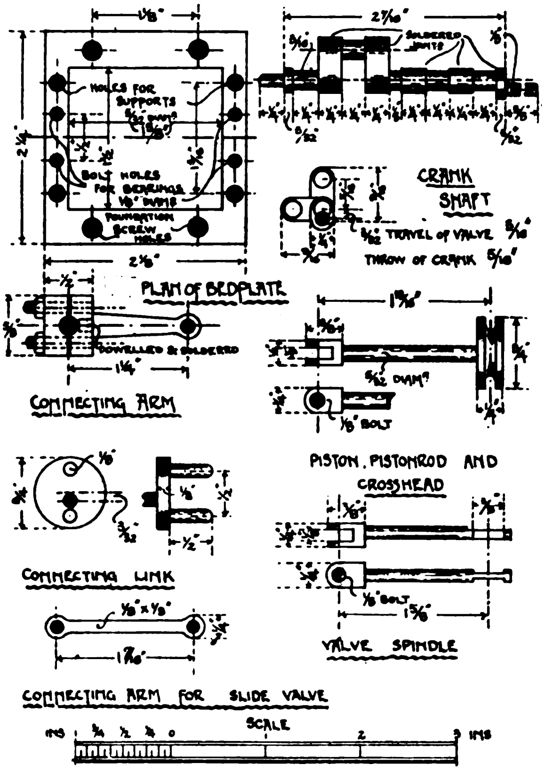
Flanges and Top Cover Plate.—Cut from 3-32nds in. sheet brass the two flanges and top cover plate (see

apply the soldering solution, thus making a strong and neat joint. When you are quite sure that the solder has spread all over the joint, and that the cylinders are in their right position, turn out the gas and let the cylinders cool. In a short time the other flange can be treated in exactly the same manner, leaving but for the holes a structure similar to sketch. The cylinder tubes and valve faces can, if thought necessary, be bound with very thin wire to keep them from separating, but when I soldered mine there was no tendency to move out of position although the solder did melt. This is one reason why ends of cylinders and valve faces should be dead square. If wire is used, a small groove must be filed to receive it on the side of cylinders where they touch one another, or the centres of cylinders will not be the proper distance apart. After soldering is finished, clean up cylinder frame and drill ten bolt holes to allow ⅛ in. diam. bolts to pass through freely, also eight bolt holes on valve faces

* This article gained a prize in our recent Competition No. 20.

(four on each) and tap them for 1/8 in. diam. screws, which should be screwed in the full 1/4 in. before the former ten holes are drilled, as these holes in some cases cut away part of the screws on valve faces. The next thing is to cut away that part of the flanges which at present hides the bore of the cylinders; this can be done by drilling a hole through the flanges, as near as possible to the centre of cylinder bore, and finishing up to 1/4 in. diam. with a circular file, taking care not to file the inside of the cylinders. The steam and exhaust ports are now drilled in the usual way.

Bottom Cover Plate.—This is made from 1/8 in. thick sheet brass, having four holes for supports, tapped to receive 5-32nds in. diam. screws, fourteen holes tapped



Details of Model Marine Engine.

for 1/8 in. diam. screws, and two holes to allow piston rods to pass through (see detail).

Piston.—From a piece of brass bar 3/8 in. diam., cut two lengths 1/2 in. full and dress up to 1/4 in. with a small circular file; work a groove 3 16.hs in. deep all round for packing, and after most carefully finding the centre of piston drill and tap a hole to receive end of piston-rod, which is 5 32nds in. diam.

Piston-Rod Glands.—The glands which are made long are intended to dispense with slide bars, and have, in the engine made by me, proved a success. I have given a small detail of one of them, and also at the side of same an enlarged portion of it, which I hope will make the construction clear. P is a piece of solid drawn brass tube with an inside diameter a shade smaller than diameter of piston-rod; this tube is soldered to one of the lugs L, that holds packing tightning screws. After soldering rime out inside of tube with a parallel rimer. until it is a perfect fit with piston-rods. The best rimer for this purpose can be made from a piece of the same steel rod as piston-rods are made from, thus ensuring a perfect hole. C is a piece of brass tube, the internal diameter of which is a good fit with the external diameter of tube P, thus tube C is soldered to lug L, also to circular plate S, which secures gland to bottom cover plate. The total length of tube C, including parts passing through lug and fixing plate, is 3/8 in. There is also a very short length of tube the same size as tube P soldered into tube C at the end near fixing plate to stop packing from being forced through the hole in bottom cover plate, which is left large to allow slight circular movement to gland, so that if the piston-rod is not exactly central in the piston it can be allowed for by moving the gland to suit; this, however, should not be necessary, as it is far better to construct a new piston than to have an untrue one.

Crankshaft.—This is made by a method which has already been printed in your columns, namely, soldered and pinned joints. The webs are made from 1/4 in by 1/4 in. brass bar, and the shaft from 3-16ths in. diam. steel rod. The small cranks for giving motion to valves are brass, 3-32nds in. thick, with a throw of 3-32nds in. These latter cranks should be soldered in position, and the holes to receive 1/8 in. bolts drilled and tapped.

Valve Spindles.—The valve spindles are 1/8 in. diam. steel rod, and the gland they work in is made in the same way as the piece of tube P for piston-rod gland. The valve spindle and valve spindle crosshead are 1-32nd in. between their centres, so that the hole into which valve spindle is screwed is 1-32nd in. from true centre of valve spindle crosshead.

Bedplate.—Of this a detail is given. It is 1/8 in. thick, with four holes drilled to allow supports, which are 5 32nds in. diam., to pass freely; four holes to take foundation screws, which are ordinary wood screws; and four holes drilled and tapped to take 1/8 in. diam. screws for holding bearings.

Valve Chests.—These are made from brass bar 1/2 in. by 1 in. Drill a hole through to admit a file, and finish up inside dimensions to 1/4 in. by 1/8 in. Four holes, to allow 1/8 in. diam. bolts to pass through, should be drilled; also a hole for steam pipe and valve spindle gland.

Hexagon Nuts.—The hexagon nuts are made by cutting off short lengths of hexagon section brass bar, drilled and tapped for 1/8 in. diam. screws. When making bolts, solder a piece of 1/8 in. diam. screw into a hexagon head, and cut off screw required length.

Steel Hardened by Overstrain.—Steel hardened by overstrain—such as permanent stretching—may have its original properties restored by the usual process of annealing. This may be accomplished at any temperature above 300 degs. C. This tempering may be also applied to wrought iron. Experiments have been carried out by Mr. J. Muir on rods of iron or steel about 3/8 in. in diameter and 11 ins. long, the elastic condition of the material being in all cases determined by means of tension tests made with a 50-ton testing machine at the Cambridge Engineering Laboratory, and an Ewing extensometer. The annealing was carried out in a Fletcher gas furnace 2 ft. long, the specimens being protected from direct contact with the flame by enclosing them in a thick porcelain tube.—*The Practical Engineer.*

To Readers in the "Potteries."—A branch Society of Model Engineers is suggested for this district. Will readers who are interested and will co operate kindly write to Mr. S. H. Miles, 20, Elm Street, Colridge, Stoke on-Trent?

The Construction of "Dug-Out" Model Yachts.

By W. H. Wilson Theobald, M.A.

(Continued from page 132.)

TAKE a piece of wood for a building board, 1 in. thick 60 ins. long and 8 ins. wide, and on it draw out the sheer plan as shown in Fig. 6. The line showing thickness of keel can be left out. All the water-lines and sections, however, must be drawn in. The L.W.L. should be drawn 4 ins. from one edge. Mark on the outside edge of each layer the position of section No. 6.

The layers have now to be secured to the building board, but this requires a little care to avoid any screw from projecting beyond the curve to which the outside of the boat has to be cut down. In the "built-up" model, the building board was placed *parallel to the deck*, and the boat built on to it. In the present case, however, the building board acts as a *centre piece*, each half of the boat being in turn held to it, whilst being faired up.

Assume that a screw 1½ ins. long is to be used—viz., that this screw will project ½ in. beyond the building board. For safety's sake ⅝ in., or, if possible, ¾ in. had better be allowed. Take the paper pattern of the lowest edge, and from the *low* end measure along the centre line until the perpendicular distance from the centre line to the curve of the water-line is in 1 in. Set off this distance along the same water-line in the sheer plan. On any odd slip of paper draw two lines to represent the thickness of the building board (Fig. 9). Mark AB to represent the position of the water-line under consideration. Along BA mark off AC 1 in. in length, the half breadth of the water-line at the point taken for

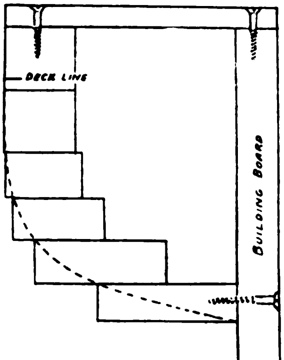


FIG. 10.

the screw on the paper layer. From the sheer plan measure the distance from the trial point to underside of keel, and mark this distance AD on the building board down from A. The curve of the section will run through C to D as shown in Fig. 9. Now test whether it is possible to allow the screw to project through the board ½ in., and still be within the curve. If it is not, the original distance from the end of the water-line on the paper layer must be increased until the distances CA and AD are sufficiently long for the line forming CD to well clear the end of the screw. When a point has been found the position can be marked on the building board. Each end of every layer must be treated in the same way, until all the points are found. There should be no difficulty experienced with the bottom layer, as its inside edge rests against the building board for its entire length, and to hold it firmly a screw can be added at about section No. 6. The other layers, however, only have a small length each end on the board, and it may be found necessary to use a smaller screw, but put in as *large* a one as possible. The layers are further stayed to the board by means of cross pieces placed from the edge of the building board to the top layer, and screwed to both. Fig. 10 gives a view at section No. 6, with the extra screw in the bottom layer. It is scarcely necessary to mention that the layers must be placed so that the top of each is exactly level with the water-line it represents, and the marks representing section No. 6 must be plumb over one another. From the sheer plan measure up from water line No. 1 to the under side of deck, and transfer the distances to the top layer. Bend a spline through these points, and run in the sheer curve. Give and take a little if the curve will not pass through

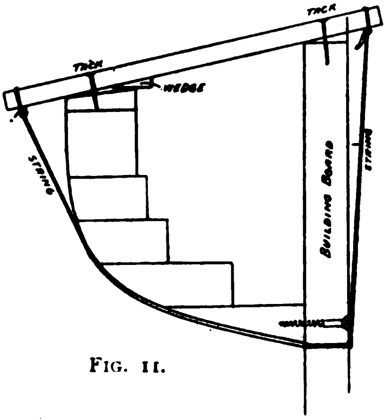


FIG. 11.

all points fairly. With a light saw cut down at the sections (or elsewhere, if the cross stays are in the way) on the top layer to exactly the sheer curve on the outside of boat, but so that the bottom of the cut is a trifle higher on the inside of the layer. This is to allow for the curve of the deck.

Now fix the building board on the bench, and start fairing the outside of the boat with chisel or spokeshave, working carefully from the centre towards bow and stern. The curve of the keel will follow naturally if the curve of the sections are followed properly; but the pencil sheer on the building board will tell if too much is being taken off.

When getting near the finish keep testing with the templates, and be careful not to cut too "flat" in any place. When the curves are very nearly true, the chisel should be laid aside and a coarse sand-paper used; this, in turn, should make way for a finer paper until a finishing polish only is necessary; and this can be left until the two halves are bolted together.

The cross stays can now be removed, and the wood between the cuts on the top layer cut out with a chisel. If the sheer line has become obliterated during the smoothing process—as is probably the case—run in another curve. The sheer can be finished off with a small plane; but still leave a little more than is required. This can be finished when the deck is on. Note carefully that the deck does not run the entire length of the boat, but finishes 2 ins. from the bow and 2 ins. from the stern. It is sunk into the top layer, as shown in the sheer plan of the design.

Mark from edge of deck to keel along the outside of the boat the positions of sections No. 3, 6, 9, and unscrew all the layers except the bottom one. The layers must now be glued together with Prout's elastic glue. A coating should be put on the bottom layer and also on the *under* side of that which rests on it. Before taking the layers from the building board a pencil line should be run along on each layer to show how far the layer above overlaps. This will give a guide as to how far the glue need extend. As soon as the glue is on the bottom layer and under side of next, replace the latter on the building board and screw it home. The screws will naturally cause it to fall into its exact position. Glue the layers in turn until all are back on the board, and they must then be very securely held together until the glue has had time to set. A good way to accomplish this holding together is shown in Fig. 11, boring holes through the board just below the boat, and using the same cross-stays (if they were long enough) as before.

An alternative plan to the above is to *not* screw the layers as they are replaced; but as soon as the top layer is in its place, to unscrew the bottom one and remove the whole half from the board, binding it together, and placing it aside to dry, so as to have the building board ready at once for the second half. The layers are, however, apt to slip, and it is safer to use a new building board for the second half, or to wait until the first half is thoroughly dry before removing.

The two halves are constructed in exactly the same way. Be careful not to make two "port" sides or two "starboard" sides. The bows must, of course, be on opposite ends of the building board if the same side of the latter is used for both halves, and the sections can be renumbered on the board and the sheer drawn in, starting from the opposite end.

The digging-out process can be taken in hand now, or after the two halves are joined up. A cradle should be made, as described in the "built up" boat, on which the half or whole boat can be rested during the process. At the keel the wood should be left about ¼ in. thick, and at the sides ⅛ in., increasing again to ¼ in. at the deck (Fig. 12). At the bow the depth of wood should be 2 ins., and the same at the counter (Fig. 6).

Slots for the fins had better be cut before joining up, half the thickness of the fin being cut away from each half. The recognised way for strengthening the hull is by "wiring." This consists in boring two holes, one on each side of the joint of the layers, and drawing through the holes the two ends of a piece of copper wire. A small groove should be cut between the holes on the out side of the boat, into which the wire will sink, and so be below the surface. The two ends on the inside are run through two holes on a suitable size piece of perforated zinc or a piece of brass, with two holes punched in it, and the ends are then twisted up tight (Fig. 12). The holes should be about ⅜ in. apart, and the joints spaced at intervals of about 6 ins. along each water-line.

Bulkheads must be fitted; one for the mast tube to rest against, one at each end of the hatch, and an extra one aft for the main sheet and to strengthen the construction. Where these bulkheads are placed the top layer can be reduced to the same thickness as the skin of the boat, thus making a recess for the bulkhead to fit into. They should be sufficient to hold the two halves of the boat together, but a few extra wires should be worked in aft of the fins up to the counter, and there will be found sufficient wood at the stem to put in a few long thin screws. These screws should be put in from alternate sides, working round the stem as far as is possible. The counter can have an extra piece of wood screwed on the end, and this will further help to hold the boat together. Glue should, of course, be used between the two halves. The bulkheads must be rounded off to take the deck curve, and the top edge of the first layer can be finished off to suit the same curve.

The construction of the fin and deck supports, deck, hatch coamings, and step for mast is the same as that already described in the "built-up" method. Before painting, the grooves in which the wires are sunk should be carefully filled with white lead or putty, so as to entirely hide the wire and give a perfectly smooth surface. The hull can then be finished off with very fine sandpaper and pumice-stone. Paint inside and out as explained in the previous article.

To prevent the stem from being damaged, some boats are constructed with a small false stem-piece, the layers being cut away and a piece of solid wood, of a harder nature, screwed in the place of that cut away, as in Fig. 13 on page 131.

The Castelli Coherer for Wireless Telegraphy.

THE Italian naval authorities have carried out a series of experiments in wireless telegraphy with a view to testing the practicability of the system as a means of communication between the semaphore stations of the kingdom. These experiments, of which the following

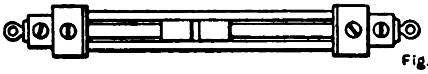


Fig. 1

Fig. 2

Fig. 3

account has been extracted from a foreign contemporary by the *American Electrician*, were based on the Marconi system and the results obtained were somewhat disappointing until telephonic reception in combination with the self-decohering coherer, invented by Paolo Castelli, was tried. Coherers, as is well known, are formed in various ways, the most noteworthy being the so-called powder

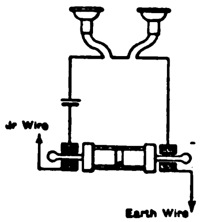


FIG. 4.

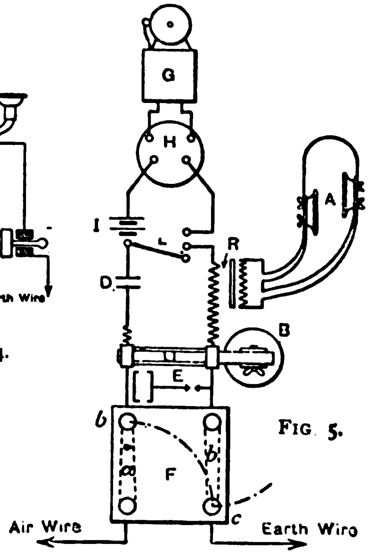


FIG. 5.

coherers, which may be made with silver electrodes and granules of carbon or silver, or silver and nickel. One of these tubes is shown by Fig. 1. The disadvantage of these tubes is that it is necessary to tap them for each wave received, in order to decohere them and render them capable of receiving another signal. But tubes or coherers having iron or carbon electrodes with a drop of mercury between them, as shown by Fig. 2, not only have a high degree of sensitiveness, but have the advantage of decohering completely as soon as the electric waves cease. The tube proposed by Paolo Castelli, shown by Fig. 3, consists of two carbon electrodes enclosing two drops of mercury separated by a small iron cylinder. When used in conjunction with a telephone, the receiving apparatus of the station becomes very simple, as shown by Fig. 4. In practice, the receiving arrangement is a somewhat more complete form, as shown by Fig. 5, which is simpler than previous arrangements, G is the bell, H is the relay, A the telephones, R the induction coil, L, a bell switch, and E a lightning protector. With a good tube, carefully adjusted, the improved form is stated to have been used by Marconi in his first attempts to signal across the Atlantic

The Motor Bicycle: Its Design, Construction and Use.

By T. H. Hawley.

V.—On Designing and Building the Frame.

(*Continued from page 138.*)

As to the tubes themselves, these should be of best weldless steel, the main tubes in frame front being preferably of the "butted" type, in which the ends are for some 3 ins. about two or three gauges stouter than the central body of the tube, though if the motor is to be of the "clip on" variety, and is to be attached to the bottom tube, this tube may as well be 16 gauge throughout.

Vital points in purchasing tube are—see that it is straight and round, to the exact diameter, and free from abrasions or rust; anything not answering to these requirements should be rejected. But if the tubing is procured from the agents of one of the best makers there will be little need for careful examination on any of these points.

I can recommend the tubes of the Shelby Steel Tube Company, Constitution Hill, Birmingham, or the Weldless Steel Tube Company, Icknield Port Road, Birmingham; the one is the best brand of American tube, and the other the oldest firm of English manufacturers; and if either brand be insisted on, there will be no cause for complaint in respect to uniformity and quality of tubing. My own machine is built of Shelby tube throughout, and the frame has never flinched.

The double-butted tubes are usually supplied in about 2 ft. lengths, leaving a little to be cut off each end in dressing up the mitre. In no case should the tube ends be cut off square and so brazed up; the tube end should be mitred and hollowed, so as to occupy every particle of brazing surface within its socket and with the tube end abutting and in contact with the neighbouring tube, passing through the same socket in the opposite direction.

The first actual process in the building up of the frame will be this fitting of the tubes—*i.e.*, filing up the tube ends a good hand fit to the sockets, though, I might add, that if genuine B.S.A. fittings are used, in combination with either brand of tube I have mentioned, there will be no necessity to do more than brighten the surface.

The bottom tube and seatpost should first be brazed into the bottom bracket, the next joint being the head socket to the bottom tube, and the front portion is completed by the addition of the top tube; then when this portion of the structure is tested and found true, the rear frame carrying the driving wheel may be built up, fitting the back forks or chain stays first, and the back or saddle stays as a final.

For the process of brazing I would refer readers to Chap. IV of the former series, which appeared in the issue of April 15th of last year, and in which full details, together with illustrated examples, were given.

But, for the benefit of new readers, or such as may be unable to refer to back numbers, I will endeavour to give a concentrated description of the process of brazing.

In the first case, the surfaces to be joined must be clean, bright, and a good fit. The flux—usually borax or boracic acid—must be applied before or at the commencement of the application of heat, and the flux must be melted into the joint before the spelter is applied, or the two may be mixed and applied together. The *spelter* may be in the form of coarse grains, or rod, or wire; but its character is really that of a hard solder of brassy appearance, and the particular form to be used is dependent on the particular job, and decided by the judgment of the operator. The *heat* is applied by the blowpipe, which is operated by a double blast bellows, worked by hand or foot power, or by a continuous blast fan worked by power, the requirements being that the blast shall be *constant*, and under proper control as to volume and power.

The *gas supply* must also be under delicate control, in order to secure perfect combustion in combination with varying power.

The *brazing hearth* may be an iron slab or tray, or a slab of firebrick, so arranged as to accommodate the work and provide for a "backing" of coke, asbestos, or firebrick, the object of this "backing" being to conserve the heat of the blowpipe, and at the same time (by judicious arrangement) protect certain portions of the work whilst others are being operated on.

Asbestos cubes are better in every respect than coke; they are cleaner, and give off no fumes, and very rapidly gather heat or cool again, whereas coke is apt to burn up into a big hot fire, liable to burn the work. I will give a single example of brazing a joint such as we find many of in the bicycle frame.

The tube, likewise the inside of the socket, is first polished bright with emery cloth, and the fit tried; this should not be so tight as to require the services of a hammer, nor should it be at all shaky, but just a good hand fit.

This being assured, a small hole about 13 B.W.G., or 3-32nds in. should be drilled through the side of socket and tube, and a taper pin driven tightly in to maintain the work in position during brazing. The job is then taken to the brazing hearth, and propped up in such a position as the spelter may most easily flow into the joint formed by the lip of the socket, usually about an angle of 45 degrees, and with one side of the work, which will get the best heat effects, facing the blowpipe held in the left hand, around the back of the joint plant a few cubes of asbestos in such a manner that the flame is deflected back on to the work and a back heat obtained.

On the operator's right hand will be a shallow tin containing borax or boric acid, another containing grain spelter, also a rod of about 18 ins. of stout brazing wire, termed "filling" wire; it is also as well to have a similar length of ¼-in. steel wire, flattened out at one end.

Now the blowpipe heat is started gradually, the flat-ended rod resting near the joint; as the work is seen to approach a dull red, the rod is dipped into the borax, which will froth up and adhere to it; the rod end is then plied around the socket mouth again and again, fresh borax being applied until when the work reaches a good red heat it is seen to flow quietly into the joint, and a mixture of borax and spelter may then follow—applied in the same manner—and finally spelter only, until it is judged the joint is filled, or flushed through, when the heat is shut off.

Of course, this is only a mere outline of the process, and it is subject to innumerable variations; but the principle is the same. For instance, we may use the stick spelter, or wrap thin wire or ribbon around the joint and ply borax only until the brazing wire flows; but there are one or two points the beginner will do well to bear in mind. In the first place, the application of borax should commence directly the work is hot enough—to prevent oxidization or scaling of the surface—and for the same reason, after the heat is once started, the flame must be kept going until the job is done, and it must never be raised to a degree which would turn the work, the art of skilful brazing being to braze at the lowest heat, and as quickly as possible.

The difficulty with the beginner will be that both flux and spelter will show a disposition to go anywhere but inside the joint, with the result that the outside will be badly messed up and take a lot of cleaning off with the file; at the same time scale will be formed which is very bad for the files. These symptoms are caused by an over-generous application of the flux and spelter before the joint is hot enough to receive them; but if once a narrow rim-like line of the flux can be noticed entering the socket mouth, then the quantity can be increased, and wherever the flux flows the spelter will follow, this being one reason why the flux should not be allowed to get all over the outside of the work; a common practice in the trade being to paint the outside of the socket with graphite or blacklead paste to prevent the spelter adhering.

The first brazing job in actually building the frame will be connecting the bottom tube and seat tube to the bottom bracket, both the joints being brazed at one heat; the bottom head socket and the head outer tube will follow next, and here again the two joints are brazed at one heat, and one of the most important points in frame building is to ensure that this head tube is parallel or in line with the seatposts, though it must first be ascertained that the bottom tube and seatpost are perfectly square to the bottom bracket by testing with straightedges laid on either end the bracket. The parallelism of head tube and seatpost can be proved by "sighting" the two tubes in a good light, the one farthest from the eye being chalked on its upper surface to make a clear groundwork for the sighting line. When these two important conditions have been proved, it will only be necessary to add the top tube to complete the frame, and here particular care must be taken that the overall measurement of the head tube is not exceeded, or the other parts will not go together.

A good plan to prove the correctness or otherwise of the angles of the top head socket and seat socket is to fit a length of tube to each, and slip the sockets into position on their frame tubes, when if the two sockets, and likewise the rest of the frame already brazed up, are all in order, the two tubes will lie parallel side by side, but any divergence from the straight line must be corrected by slightly stretching the socket at a red heat with the aid of two steel bars turned to fit.

Of course, the frame will also be tested by the drawing at each stage, and at every operation should any alteration be necessary, it should be made then; for as the work proceeds it becomes more difficult to rectify errors. The back portion of the frame I shall have to leave to be dealt with in the next article.

(To be continued.)

S.M.E. Medallists and their Work.

A. R. M. Simkins.

MR. SIMKINS, a retired electrical engineer, whose occupation has been mainly the superintendence of railway telegraph construction and maintenance in foreign countries, is one of the more recent members of the Society of Model Engineers. His electric

MR. A. R. M. SIMKINS.

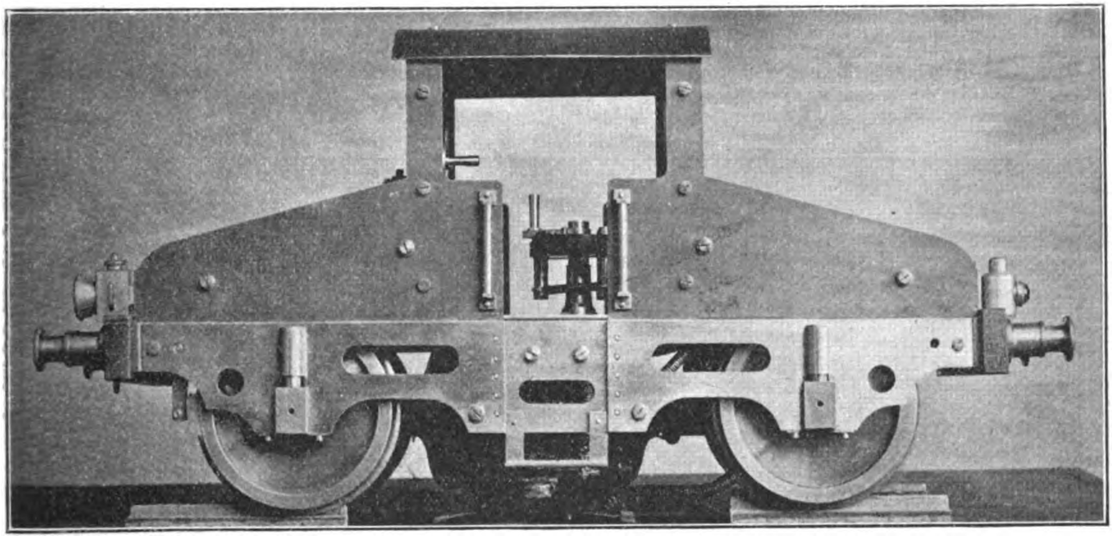
locomotive here described received at the recent Model Making Competition a silver medal, it being adjudged the best piece of work in the electrical section.

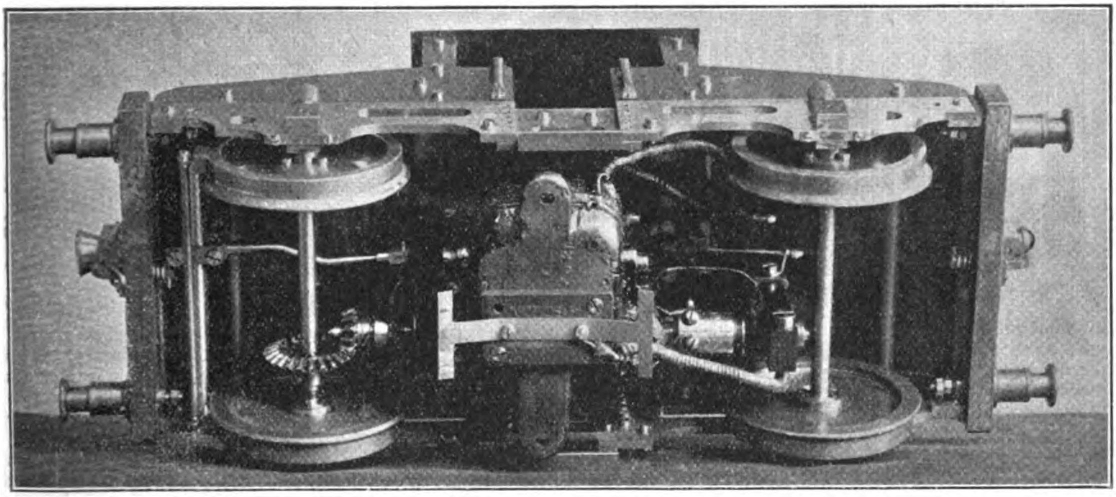
The following are the leading dimensions of the locomotive:

Gauge	3½ ins.
Length over buffers	14 ,,
,, of frame	11¼ ,,
,, of wheel base	7 ,,
Depth of frame	1½ ,,
Thickness of frame	⅛ in.
Diameter of wheels on tread	2 19/32 ins.
,, ,, over flanges	2 15/16 ,,
Width of tyres	⅜ in.
Diameter of axles	7/32 ,,
,, of journals	⅛ ,,
Length ,, ,, ...	⅜ ,,
Height of engine (rail to centre of cab) ...	6¾ ins.
Width of cab inside	4½ ,,
Length ,, ,, ...	3¾ ,,
Height ,, ,, ...	4 ,,
Length of buffer beam	4¾ ,,
Depth ,, ,, ,, ...	⅞ in.
Thickness	11/32 ,,
Length of buffer	15/16 ,,
Diameter ,, ...	9/16 ,,
Axle boxes (height)	⅝ ,,
,, ,, (width)	13/32 ,,
,, ,, (depth)	½ ,,
Bearing spring covers:	
Length	⅝ ,,
Diameter	11/32 ,,

Diameter of brake bevel wheels (each)	...	½ in.
Diameter of gear wheels :		
One	...	1¼ ins.
One	..	$\frac{9}{16}$ in.
Diameter of spectacles :		
Outside	...	1 $\frac{7}{32}$ ins.
Inside	...	$\frac{15}{16}$ in.
Steel and iron used in cab (thickness)	...	048 in.
Total weight	..	9 lbs.

inch. A brass rocking lever working flush with the top of the disc and sloped off so as not to butt on the studs, which are rounded on the ends, depresses them according to its position, and causes either one or other of the springs to be disconnected from the semi-circular piece. The rocking lever is in direct metallic connection with the general metal, and, consequently, with the wheels of the engine. The semi-circular plate is connected with one of the motor brushes.





Mr. A. R. M. Simkins' Model Electric Locomotive.

Motor used—"J," Crypto Company, Clerkenwell Road.

The starting and reversing gear is simple, but probably novel. On the base of an ebonite disc two hard brass springs are attached by two short brass pillars, which serve as terminals. These springs press on a semi-circular piece of brass also attached to the base of the disc by a short pillar serving as a terminal. Resting on the springs are two brass studs, free to work through the disc and projecting above the top surface by about 1-32nd of an

The two springs are connected to the ends of the field-magnet coil, and the other brush of the motor is connected to the spring which rubs on the centre rail. It follows that if the rocking lever is not depressing either stud no current passes through the motor; but when a stud is depressed the current will flow in the direction desired, according to the joining up of the batteries with the rails and centre conductor. This mechanism, therefore, serves as a starter and reverser. The engine works well with

9 volts, but with 18 volts very satisfactory results are obtained. A load of 30 lbs. can be pulled or pushed on the level, and the engine running light maintains a speed of six to seven miles an hour. The accompanying photographs give a very good idea of the arrangement of the locomotive, and also serve to demonstrate the general excellence of the workmanship.

H. Hildersley.

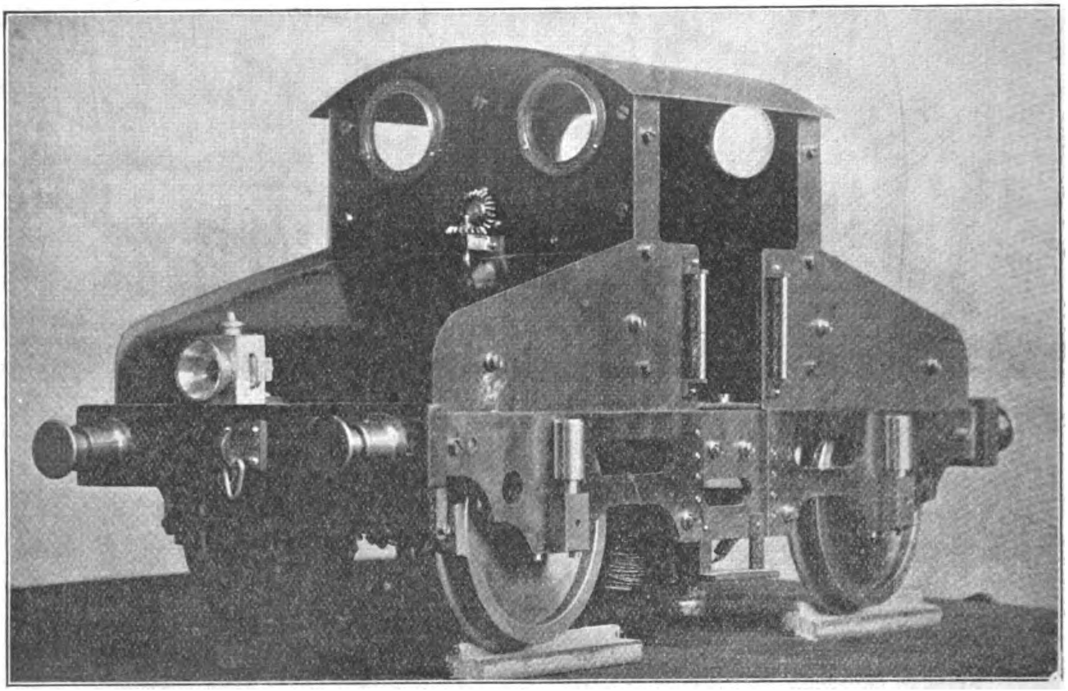
To construct my 5-in. spark induction coil, I first of all procured about 5 lbs. of iron wire, 22 B.W.G., costing 2s. 6d., which I cut into foot lengths, straightening each one by pulling the one end with a pair of pliers while the other end was secured in the vice; there are about 900 lengths in the core, which is 1¼ ins. in diameter. I then tied them into a bundle with wire, keeping them as straight as possible, and put them into the fire and made them thoroughly red hot right through, placing them in the ashes to cool. When nearly cold I brushed them and put them in a tray of melted paraffin wax in front of the fire, thoroughly soaking them, and then took them out and allowed them to get cold.

I next procured a piece of brass tube, 1¼ ins. outside diameter by 13 ins. long, at 1s., trued up the ends and fixed a plug of wood in one end to take the back centre of the lathe. I then mixed equal parts of Prout's elastic glue and paraffin wax to thin it a little in a pipkin, and then rolled a length of stout cartridge paper round the tube with glue, and made a cylinder about 1-16th in. thick. I next got 1½ lbs. of 16 D.C.C. B.W.G. wire at 2s. 3d. for the primary, and wound it on the paper round the brass tube, making a hundred turns along, then brushed some melted paraffin wax over it and wound another layer and put a piece of thread through the first and last layer, and tied them to prevent them coming unwound, then put the whole lot in a tin of melted paraffin wax in front of the fire and gave it a good basting.

I next got two thin sheets of ebonite, 22 ins. by 24 ins. by 1 64th in., from the Britannia Rubber Company, 32, Cannon Street, E.C., at 2s. per sheet. I cut the sheets off lengthways, making two pieces 12½ ins and one 9½ ins., and glued and rolled them round the primary, thus making a tube 12½ ins. long by 3-16ths in. thick at the ends, ¼ in. thick in the centre, for about 9½ ins. in length (Fig. 1), and filled each end up with melted paraffin wax, taking out the brass tube and putting in the core.

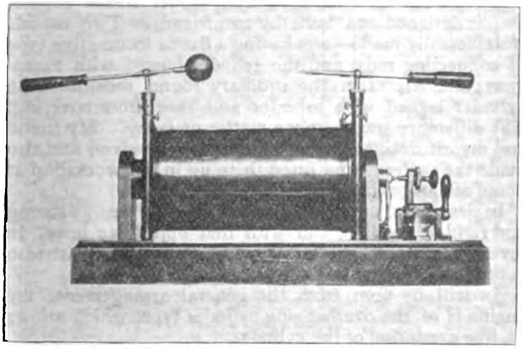
The secondary consists of between 5 lbs. and 6 lbs. of 36 and 38 B.W.G. s.c.w., at average cost of 10s. per lb., which is wound in forty-two sections, ⅛ in. thick, by a special piece of apparatus, consisting of two plates of iron, ⅛ in. thick by 6 ins. in diameter, and mounted on a screwed shaft with a wooden collar with bevelled surface, slightly larger than the diameter of the primary. This apparatus was mounted in the lathe and a framework fixed up to hold a small tray of melted paraffin wax with a small spirit lamp underneath (Fig. 2) and a spindle to carry the bobbin of wire about 2 ft. behind the lathe and about 1 ft. high. The wire was then passed from the bobbin on the spindle at the back, under the sliding pulley in the tray of melted paraffin wax, passed through a hole near the centre of one of the discs, and the wooden collar put on, then the other disc, which was then screwed up tight.

Having adjusted the spirit lamp underneath the tray of paraffin wax, I started winding, letting the wire run through a small piece of paper in my hand to wipe off all superfluous wax. I wound it till the section was about 1 in. deep, and then cut the wire. The discs were taken apart and the ring of wire carefully removed, it being firmly bound together by the wax. I wound thirty discs in the same fashion. I next made another wooden collar the same thickness, but ⅜ in. larger in diameter than



ANOTHER VIEW OF MR. SIMKINS' MODEL ELECTRIC LOCOMOTIVE.

the other, and wound twelve more discs on this, the reason for this being that there is a greater tendency to spark through to the primary near the ends of the coil. I next had cut three hundred rings of stout cartridge paper, which I dipped in melted paraffin wax, and threw on to a horizontal stick to cool.



Mr. Hildersley's 5 in. Spark Coil.

I then borrowed a household flat-iron, which I kept hot on the gas stove beside me, and put two discs of the waxed papers on each side of a section of wire, and stuck them together by passing the warm iron over them, making a small hole near the centre of one side and the rim on the other side and passed the wires through, taking care that the wires came out at the proper sides, so as to be all wound in the right direction. I tested each disc for continuity by laying a small compass needle on the disc and

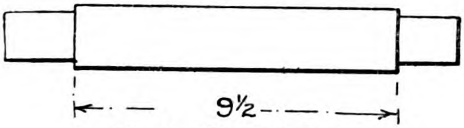


Fig. 1.—Ebonite Roll.

connecting a small battery, and afterwards passed the warm iron over the sides of two discs where the wire protruded from the centre, and stuck them all together in pairs, after which I twisted the wires together, and soldered them, and tucked the soldered ends between the two discs, and covered with a drop of melted paraffin wax. I next took the primary with its insulating tube, stood it on end, and slid one pair of discs to the middle, and ran a warm flat bar of iron all round the centre, and stuck it with the melted wax, slid another disc on, putting two discs of paper between, put the bar of iron in between the two discs, and worked it round to make the wax thoroughly soft, pressed them together tight, and filled up all the gaps with wax. I then soldered the two nearest outside ends together, and tucked them between the discs, taking care that the wire all ran in the same direction until I came to those with a larger aperture, and for these I cut out the centres of the papers, and filled the centres full of wax. I soldered a short length of stout copper wire on each end of the secondary, and passed it through a pile of waxed papers ½ in. deep, bringing the ends out; then put the whole lot in a large tray of melted wax in front of the fire, turning it round and round, and brushing to get it thoroughly saturated through, and after taking it away from the fire, kept turning the coil round in the wax until it chilled, thus making all the outside edges of the discs thoroughly full of wax. Outside this I rolled a large sheet of stout cartridge paper round it, and then the other small sheet of ebonite, sticking it with the glue. After letting it get cold, I put it between the lathe centres, and just trued off each end. I then filled up the space left at each end about ½ in. with melted wax, and pushed the ebonite ends on. These were made out of sheet ebonite ⅜ in. thick by 5½ ins. in diameter, the secondary wires being brought through holes drilled at the sides of the terminals, which are tapped and screwed in. I next made two ebonite supports, 4½ ins. high by 2¾ ins. wide by ⅝ in. thick, then rounded off the two top corners of each, mounted them in the lathe, and turned a hole 2⅛ ins. in diameter, to fit the ends of the primary; these I fixed on the baseboard with two screws each, from underneath.

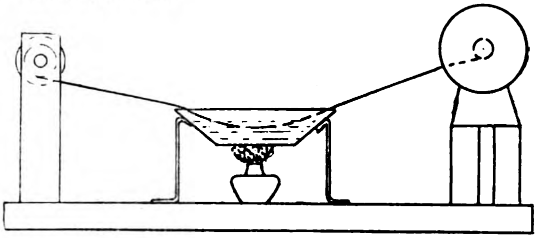


Fig. 2.—Method of Waxing Wire.

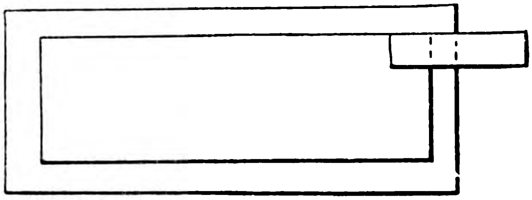


Fig. 3.—Condenser for Coil.

The condenser consists of sixty sheets of tinfoil, 6 ins. by 10 ins., interleaved with sheets of stout cartridge paper, 8 ins. by 12 ins., soaked in melted wax. For the benefit of the uninitiated I will describe how the condenser is made. First lay six sheets of the waxed papers on the board on top of one another and lay one sheet of tinfoil in the centre, leaving a space 1 in. wide all round, putting a piece of tinfoil, 1½ ins. wide by 4 ins long, from the side of one end (Fig. 3), and put another sheet of paper, rubbing a warm flat-iron over it to stick it together; then another sheet of tinfoil, and another strip the same end, only on the opposite corner; then another sheet of paper and tinfoil, same as at first, repeating this with the slips at alternate sides, right through the condenser, ironing it

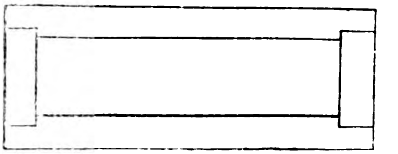


Fig. 4.—Jointing of Case.

quite flat, and trying it on the coil at every ten sheets to see how many are required, as I found that if too many are used, it will take all the current, and the contact-breaker will not work. The base is made of ¾-in. mahogany, 11 ins. wide by 18 ins. long and 2 ins deep, the edges screwed and glued from underneath, ½ in. lapped at the ends (Fig. 4). The contact-breaker is the usual vibrating form with platinum contacts. The discharging pillars are ebonite rod, turned and screwed into the base with ¼-in. gas thread, and terminals are screwed into the top, and have ball and socket joints. The discharging rods are brass screwed into ebonite handles and made to slide in a tube, fixed on the top of the ball and socket joint. The commutator is made in the usual manner, and in case there are any readers who do not know the use of it, I may say it is for turning the current on and off and changing its direction.

MR. H. HILDERSLEY.

I finished off the brass parts by polishing and lacquering. The ebonite I polished by first making it thoroughly smooth with glass-paper, and then rubbing with rotten-stone and oil. I work the coil with six 1-qrt. bichromate batteries connected in three pairs in series, and 6¼ ins. is the longest spark I have ever obtained from the coil. It works a 4-in. Cox's "Record" *x*-Ray tube with very good results, with a screen made of calcium tungstate spread over a sheet of cardboard with ordinary gum.

The above description of the construction of a 5-in. sparking coil was given by Mr. Hildersley in the course of a paper before the Society in March last. Mr. Hildersley's name has been in front of the Society considerably of late, and his work is known for its varied character and general excellence. Although he joined the Society at its commencement, in point of age Mr. Hildersley—a jeweller and diamond setter by trade—is one of the younger members, being now only 23. The 5 in. coil was awarded a bronze medal at the recent model competition.

LARGE LOCOMOTIVE FOR THE GREAT WESTERN RAILWAY.—There has recently been turned out of the Swindon Works what is stated to be the largest locomotive in this country. The engine marks the limits in height and width available on account of the restriction of the loading gauge, the height from rail level to top of chimney and top of cab being 13 ft. 2 ins., and width over cylinder lagging 8 ft. 11 ins., the centre of boiler from rail being 8 ft. 6 ins. The boiler is fitted with a firebox of the Belpaire type, 9 ft. long, and with an extended smokebox. The barrel measures 14 ft. 8 ins. long by 5 ft. diameter. The total heating surface is 2,400 sq. ft., with a grate area of 27¼ sq. ft., the working pressure being 180 lbs. per square inch. The cylinders are placed outside the frames, and are 18 ins. diameter by 30 ins. stroke, and have piston valves 6½ ins. diameter. The engine has six coupled wheels, 6 ft. 8½ ins. diameter.

A Model Built Up Horizontal Engine.

By "HYSPEED."

THE drawings and photographs accompanying this article show a horizontal model steam engine, designed and built by two friends. Two models were actually made—one having a flat or locomotive type of connecting-rods, and the cylinder lagged with mahogany; and the other the ordinary round rods, and the cylinder lagged with asbestos and sheet-iron covering. The difference was merely a matter of fancy. My friend and myself designed every bit of them ourselves, and also made the patterns and fitted them up in our workshop at home after working hours.

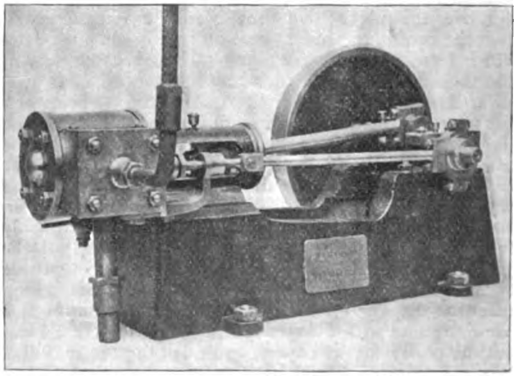
In designing, our idea was to make every part as strong and rigid as possible, and with that object we have, in several places, substituted wrought iron where cast iron is ordinarily used.

As will be seen from the general arrangement, the engine is of the overhanging cylinder type, which allows of free expansion of the cylinder.

The cylinder has a bore of 1 9 16ths ins., with a stroke of 1½ ins., and is bolted to and carried by the slipper trunk, the foot of which fits down into a shoe or recess in the bedplate. It is of cast iron, and the walls and flanges in all places are ¼ in. thick. By using wrought iron for the cylinder covers we were able to reduce the thickness of them to a much greater extent than would have been the case had we made them of cast iron. The steam ports, which are drilled and chipped, are ½ in. wide and ⅛ in. long, the bridges between them being ⅛ in.

The slide valve has 3-64ths in. lap, with 1 64th in. lead; it has no inside or exhaust lap, and the total travel is ⅜ in. The valve spindle is not wholly dependent on the gland for its support and parallelism, as we provided a wrought-iron bracket, bushed with gunmetal to carry it. This bracket is supported from the underside of steam chest by being belted to it. We think it to be most essential to the proper working of the valve rod.

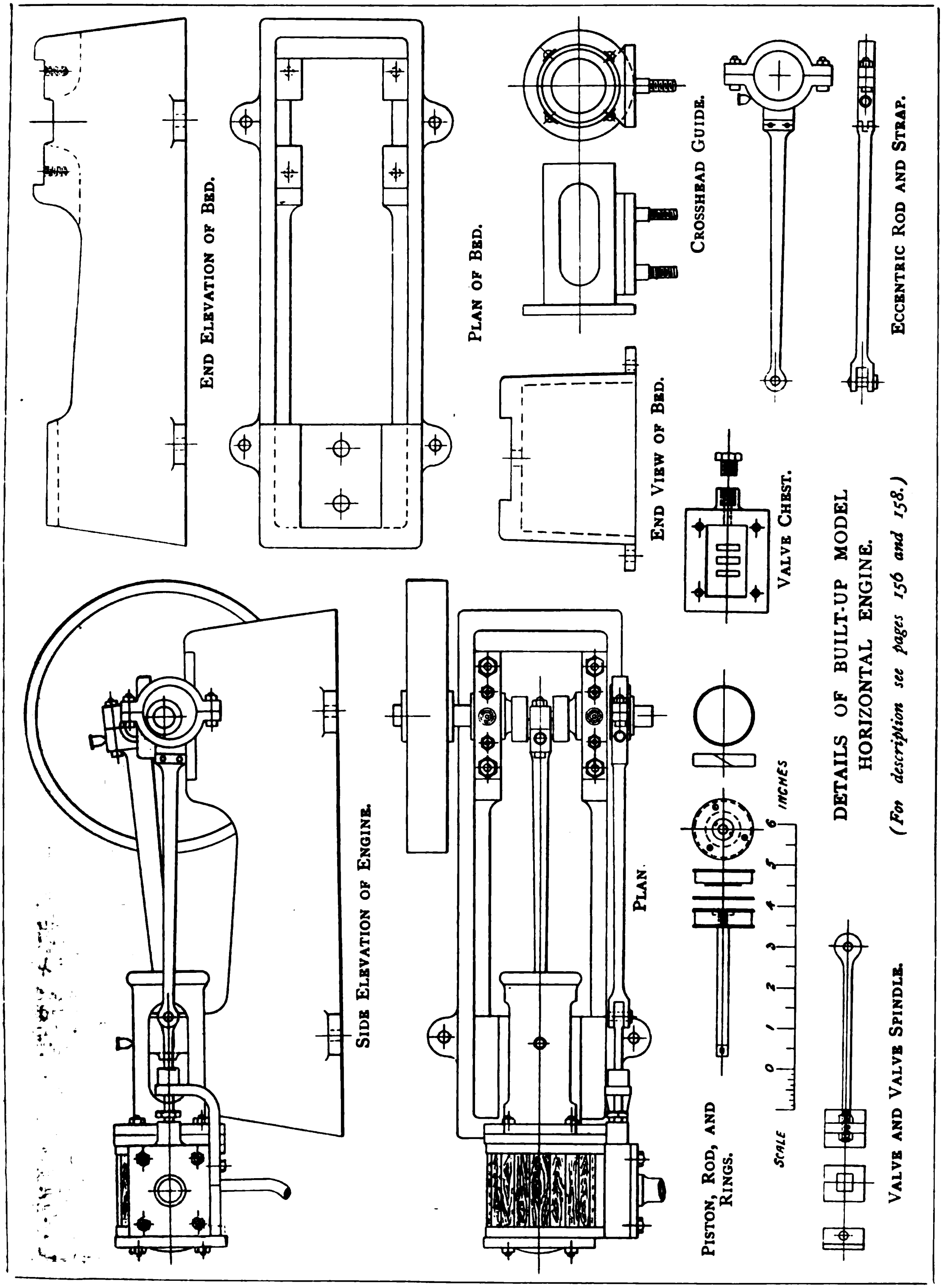
The piston is made of brass, and is fitted with a cast-iron split ring, 5-16ths in. thick. The ring is kept in



A BUILT-UP MODEL HORIZONTAL ENGINE.

position by a brass cover plate fastened to body of piston by three ⅛ in. countersunk screws. The body is attached to the rod by having a collar on the front side and a nut at the back, both of which are partly recessed into the piston body; 1-16th in. clearance is allowed at each end of cylinder.

The slipper is of wrought iron, slotted to receive the brasses, which are kept in position by cap and bolts.



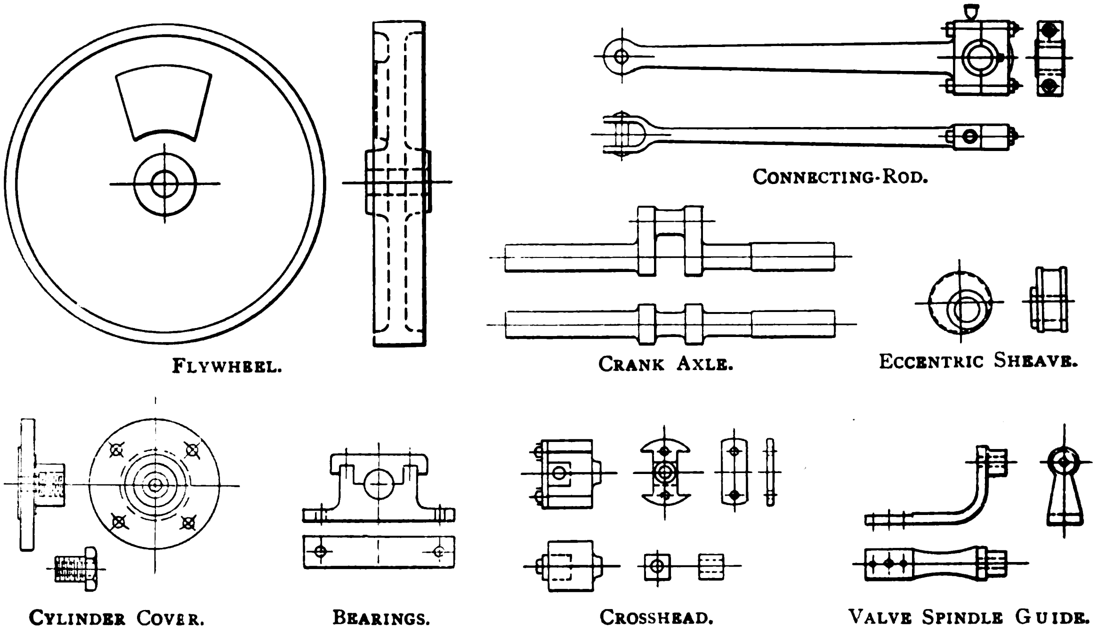
DETAILS OF BUILT-UP MODEL HORIZONTAL ENGINE.

(*For description see pages 156 and 158.*)

The crankshaft is solid and of wrought iron, and in the journals is ½ in. diameter, and has a throw of ¾ in.

The bearings are also made of wrought iron, being 11-16ths in. wide, and are fitted with brasses 1 in. long and ½ in. inside diameter. The bottom brass is pinned to prevent it revolving, and is so placed that the thrust of the engine shall not come upon the joint of brasses. They stand in a recess provided in the bedplate, and are fastened to the latter with stud bolts.

The connecting-rod is 7½ ins. centre to centre, or five times the length of stroke, thus greatly diminishing the friction on slipper. It is made of wrought iron, and the brass in the big end is pinned. A lubricator is also provided.



DETAILS OF MODEL HORIZONTAL ENGINE.

The eccentric sheave is of wrought iron and the strap of gunmetal. Both the eccentric and flywheel are fastened with keys to the crankshaft. The glands for cylinder and valve chest are of the screwed type, with hexagon heads.

The cylinder and steam chest were tested by water pressure to 40 lbs. per square inch, and we failed to find any leakage.

One notable point in connection with this engine was the very small amount of condensation in the cylinder after a two hours' run under steam with a pressure of 35 lbs. per square inch, and making about 2000 revolutions per minute, owing to the fact that the cylinders are lagged, in this case with mahogany.

THE new tandem compound locomotive No. 2309 of the N.Y.C.H.R.R., built a short time ago at the Schenectady Works of the American Locomotive Company, recently hauled a train of 108 loaded cars containing 4,500 tons of freight from De Witt to Albany in eleven hours. This is said to be the greatest tonnage ever moved by a single locomotive on any railroad in the world.

A Cheap Petrol Carburettor for Small Gas Engines.

By C. N. TURNER.

NO doubt many of our readers in country places where there is no gas service have sometimes regretted their inability to make use of the small power gas engines which are now placed on the market so cheaply, and are eminently suitable for running lathes and other light tools in their amateur engineering workshops; also for running small dynamos for lighting purposes, or for charging accumulators, and oil engines are so much more expensive in the first place, and more troublesome to start on account of the vapouriser.

For the benefit of such brother amateurs, I have much pleasure in submitting the following wrinkle, by which they may successfully run a gas engine with petrol or Pratt's motor spirit. To do this, a carburettor is necessary, to evaporate the spirit into an explosive gas by admixture with air.

I give particulars herewith of a very simple one that I have contrived, and which has proved most steady and efficient, much more so than any "surface" or "spray" carburettor, and which has the advantage of being very easily made.

The only things required are a flat biscuit tin for the reservoir, an ordinary tin canister for the carburettor, a piece of thin brass or other tube (such as a ten or twelve bore brass cartridge case), two pieces of perforated zinc of the diameter of the canister, a few lengths of loose cotton wick, and a little fine wire, a ¼ in. stopcock for the air tube, a ⅛ in. or ¼ in. tap for rubber tubing.

The seams of the biscuit box and the round canister must, of course, be soldered, as both will hold the spirit.

Before soldering down the lid of the biscuit box, cut a round hole in the centre the exact size of the outside diameter of the round canister, and a small filling hole near one of the corners (as indicated in Fig. 1), and then solder round the seams and joints, and test it with water for any leak.

When watertight, solder a piece of brass or other tubing to the filling hole in the corner. Now take the round tin canister, and either take out the bottom or else make holes in it, let it through the hole in the biscuit box until the bottom of the canister is within about ⅛ in. of the bottom of the biscuit box (which, by the way, we must now call the reservoir), and solder the canister securely to the reservoir round the opening that has received it. The appearance will now be as Fig. 2, the dotted lines denoting the parts not seen.

secured at one end to the perforated disc by means of bits of fine wire, and the other ends hang down, past the perforated tube into the petrol.

The second perforated zinc disc is intended to go between the first one and the top of the carburettor.

This completes the whole apparatus, a sectional sketch of which is given herewith. (See Fig. 4.)

Now pour petrol into the reservoir through the filling tube at the corner until nearly full. The carburettor itself being either bottomless or having holes made in its base, will, of course, take up petrol to the same level as that in the reservoir.

Slip one end of a length of rubber tubing over the gas tap or lid of carburettor, and connect the other end to

DETAILS OF A SIMPLE PETROL CARBURETTOR FOR SMALL GAS ENGINE.

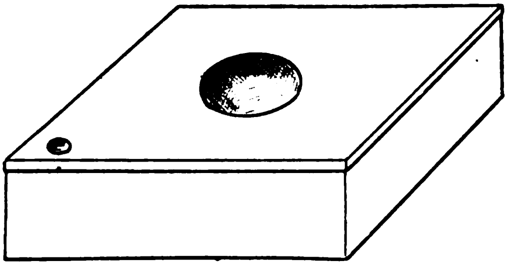


FIG. 1.

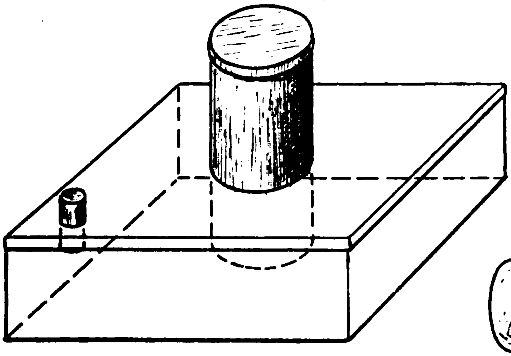


FIG. 2.

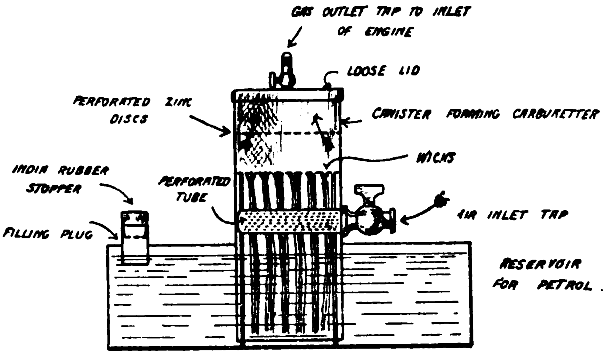


FIG. 4.

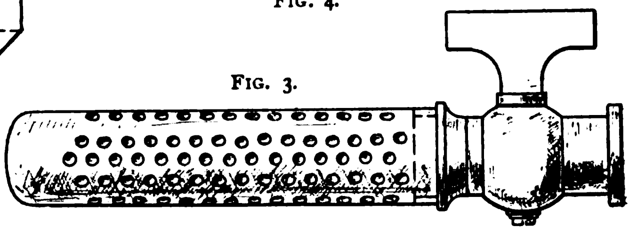


FIG. 3.

The next thing is to take the thin brass tube or brass cartridge case, or whatever metal tube one may use, stop up one end of it (a slice of cork will do very well for this purpose), and drill or file a number of ⅛ in. holes about this tube (see Fig. 3), and solder a ⅛ in. or ¼ in. stopcock to the open end of this tube. (This tube only needs to be a trifle longer than the diameter of the canister whatever diameter this may be.)

Now make a hole in the side of the canister, the same diameter as the perforated tube just described, about ½ in. clear of the top of the reservoir. Push in the tube as far as it will go, and solder round the outside to secure it to the carburettor.

Now get the ⅛ in. or ¼ in. gas tap for attaching to rubber tubing, and make a suitable hole in the loose lid of the carburettor and solder tap into same.

Now we cut out two discs of perforated zinc (or two pieces of tin pierced with a lot of holes will do as well) just the right size to fit easily inside the canister. To one of these attach four wire legs—these should be long enough to reach the bottom, and keep the disc about 3 ins. above the perforated tube, and to the underside of this disc should be affixed several pieces of the cotton wick the same length as the wire legs. These wicks are

gas inlet of engine. No gas bag is needed as there is no pressure from the carburettor.

The action of the carburettor is as follows :—The wicks in the canister suck up petrol, and remain saturated as long as there is any petrol in the reservoir. The suction stroke of the engine draws air into the carburettor through the air inlet tap, and this air, passing through the perforations of the tube, is led amongst the petrol saturated wicks, and becomes charged with petrol vapour. The mixture is still further atomised and more perfectly mixed by being broken up in passing through the two pieces of perforated zinc, and in this state is drawn by the suction of the engine through the top tap and rubber tubing into the mixing chamber, where meeting and mixing with more air it is then drawn through the inlet valve into the cylinder and compressed and exploded in the usual way.

The force of the explosions can be nicely regulated by admitting more or less air to the mixing chamber along with the vapour from the carburettor.

Electric ignition is eminently suitable in connection with this carburettor, but should the usual tube ignition be desired, a blow lamp (paraffin for preference) must be used, as petrol vapour cannot be used for heating the tube.

In the event of tube ignition, the carburettor should, for safety, be placed outside the room and the rubber tubing be of sufficient length to connect up.

This size carburettor and reservoir holds sufficient petrol to run a ¼ h.-p. gas engine all day. By closing the two taps of the carburettor the petrol will keep good and ready for use at any moment, and I am sure those readers who try this plan will be extremely pleased with the result, the mixture of air and vapour can be so easily regulated to the power required. The charge can be increased in richness for heavy loads, and some vapour cut off, or more air admitted when running light. It will also be found very economical with petrol at 1s. 3d. per gallon. Should any part of this article not be quite clear to any of your readers, I shall be pleased to make it so through your columns.

How to Make Experimental Electrical Apparatus.

By T. G. J.

(*Continued from page 82, Vol. vi.*)

The Dip Circle.

THE instrument here described is designed especially to meet the requirements of students, and if carefully made should be capable of giving very accurate results.

The stand or base (Fig. 3) is of walnut, 4½ ins. diam. and ½ in. thick. Three equally distant points should be found on the edge of the disc, and a hole ¾ in. diameter bored at each of these points. These holes are bored ⅛ in. deep, and have their centres ⅝ in. from the edge. Three discs of sheet brass (Fig. 4) are cut to fit the holes, and are fastened down with three very small brass screws passing through countersunk holes. The brass discs are ⅛ in. thick when filed and finished, and have 5-32nds in. holes drilled through their centre. These holes are tapped to take levelling screws 1½ ins. long with head ¾ in. diameter. At the centre of the base a socket (Fig. 5) is fixed to take the supporting pillar. This is a common brass socket ¾ in. long and ¾ in. outside diameter, such as may be obtained from most ironmongers for a trifle. If not well finished when bought it should be re-polished and lacquered. Round head brass or blued screws are used for fixing the socket to base.

The supporting pillar is a brass tube 3 ins. long, and is of such diameter that it fits with very little shake into the socket on the base. Electrical cement is used to fix it in position. The upper end of supporting pillar is provided with the brass fitting shown in Fig. 6. This is a casting made to finish ⅛ in. thick, and is sweated to a socket similar to Fig. 5. The whole is mounted on the end of supporting pillar, and attached thereto with the electrical cement.

Two small screw holes are drilled in each arm, as shown in the figure, to enable it to be screwed to the wooden disc (Fig. 7). This disc is secured to the arms with small screws from underneath; it is 4 ins. diameter, 3-16ths in. thick, and has a 2-in. hole in the centre. The edge of the disc has a rebate cut in it 1-16th in. deep and ½ in. in width. Two semi circular protractors, each 4 ins. diameter and ½ in. wide, are now procured, and the cross-bars cut away, as shown by the dotted lines in Fig. 9. The protractor shown in the figure is only divided into twenty-four parts; but those used must be divided into 180 equal parts, the two protractors thus giving the 360 divisions of the circle when placed with their diameters in contact. It is preferable to use protractors divided into quadrants in the order 0, 90, 0, 90. These protractors are fastened down upon the wooden disc with Seccotine, and if the rebate, which was cut in the disc to receive the protractors, has been carefully made to measurements given, the ends or diameters of the latter should meet exactly when fixed in position on the wooden disc. If this is not so, corrections must be made until the desired end is attained. The frame for holding the upper graduated circle and dip needle is shown in Figs. 1 and 2, and one of the sides in Fig. 12. The bottom of the frame is a piece of boxwood or ebony, 6¾ ins. long, 1½ ins wide, and 3-32nds in. thick. The index of the horizontal graduated circle is shown in Fig. 10; it is cut from 1-32nd-in. sheet brass, and is 2 ins. long. A hole is drilled and countersunk in one end to take a fixing screw. This index is fitted to the bottom of the boxwood cross strip, which is checked to admit the index, so that the latter will be flush with the under surface of the strip. The hole for the fixing screw must be well countersunk, so that the head of the screw will sink below the surface

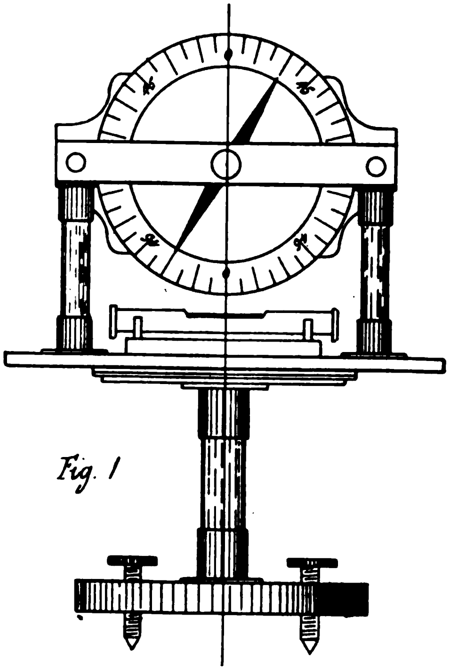


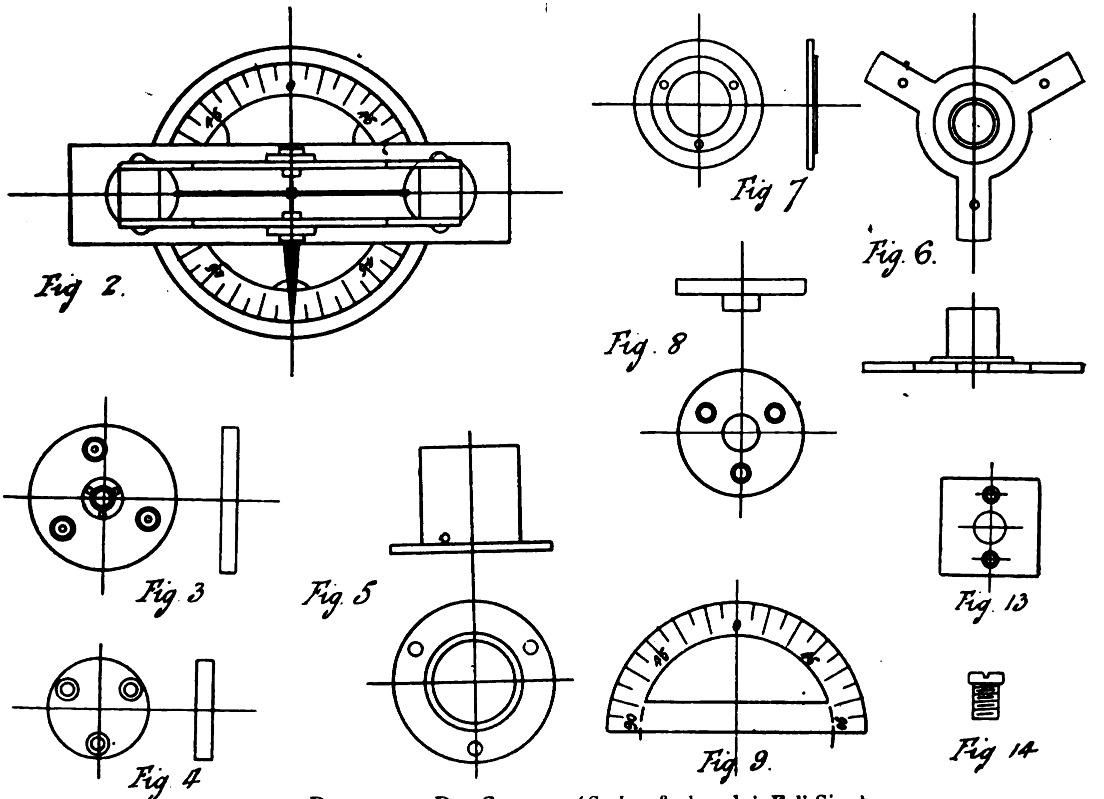
Fig. 1

Complete Instrument (½ full size).

of the index. To the centre of the same side of the cross-piece is attached the centre piece (Fig. 8), also of box-wood. It is of the highest importance that this centre piece be fitted very carefully in the centre of the bottom of frame, and to ensure this proceed as follows:

Carefully mark a centre line along the length of the strip of wood, using square and dividers to avoid error; then mark another centre line across the width of the strip, making right-angles with the former line. Now take a pair of drawing compasses, and strike out a circle on the strip of the same diameter as Fig. 8, and having its centre at the intersection of the centre lines. As the strip is only 1½ ins. wide, and the diameter of Fig. 8 2 ins., it is evident that only a portion of the circle can be drawn. This, however, will be sufficient to meet the case. Place the centre piece on the strip, its edges touching the circumference of the circle already drawn. When truly set in position, place a bradawl in one of the holes in the centre piece, and carefully bore a corresponding hole in the boxwood strip, taking care to avoid moving the centre piece out of its true position. Now place a small brass screw in the hole and screw up, holding the centrepiece in position with the other hand during the operation. The other holes can now be bored and the remaining screws put in. The screw holes in the centrepiece must be countersunk, so that the heads of the screws will sink about 1-32nd in. below the surface. To the other side of the strip are fitted two sockets similar in shape to Fig. 4, but ½ in. outside diameter and ½ in. high. These sockets are fixed on the centre line, and have their centres 1 in. from either end of strip. A glass-rod supporting pillar is fitted into each socket, so that the ends rest on the boxwood strip. These pillars are of such diameter that

which will occupy the back position on the instrument is shaped as shown at Fig. 12. Four very small holes, 1-16th in. diameter, are bored and countersunk in the ends of this piece, as shown in the figure. These are in addition to the holes for taking the screws which fix this piece to the endpieces, and are made to admit the very small screws which clamp the vertical graduated circle to the framework. Two hard brass studs (Fig. 14) should now be procured and their ends made concave by drilling with a 3-16ths-in. bit until the shoulders are level with the edges of the stud. These studs fit into the centre plates, which we screwed to the side



Details of Dip Circle. (*Scales:* ⅜, ⅓ and ⅙ Full Size.)

they just fit the inside of their sockets, to which they are secured with electrical cement. The length of each pillar is 2½ ins., and the upper ends are provided with the brass fitting shown in Fig. 11. This fitting is made from a socket of the same size as those at the lower end of pillars, by filing two opposite sides of the plate until it is only ⅝ in. wide. The other two sides are likewise filed until the length is ¾ in. in this direction. The top part of the frame is 5¼ ins. long, and 1 in. wide—outside measure. The ends are made from ebony, and are ¾ in. by ⅝ in. by ⅝ in. These are secured to the fittings on the upper ends of supporting pillars by small screws inserted from underneath. The sides are boxwood strips, 5¼ ins. long, ⅝ in. wide, and ⅛ in. thick, and are fastened to the ends with round head brass screws. Before finally fitting up, they should have the brass centre plates (Fig. 13) screwed to their outer faces, very small and short brass screws being used for the purpose. If the points protrude through the boxwood strips, they must be filed till flush with the surface of the latter. The side

pieces, and which must be drilled and tapped to receive the studs. The stud which we screw into the back sidepiece must be driven up so that it will remain a fixture. The other must be adjustable.

The vertical graduated circle consists of two semicircular protractors, similar to Fig. 9, except that they are only ⅜ in. wide. In cutting away the crossbars care must be taken to avoid twisting or bending the protractors, or in any way damaging their graduations. Two small holes are bored and countersunk in each side of the protractors, corresponding to those made in the sidepiece of frame. As the utmost care must be taken to fix these protractors in the right position, the following method is employed to ensure that the holes are bored in the proper place. Before fixing the sidepiece to the endpieces, lay the former flat upon the table or other flat surface, and place one of the protractors on top of it. Having made sure that the diameter of the protractor is truly resting on the centre line of sidepiece, proceed to bore the holes through both protractor and sidepiece. It will be as well to have someone hold the pieces firmly during the operation. One of the holes in each side should be bored about 3-32nds in. above the centre line, and the other about ¼ in. above it. Try to avoid, as far as possible, boring through a number or any of the graduations on the protractor. When fixed in position, the diameters of the protractors

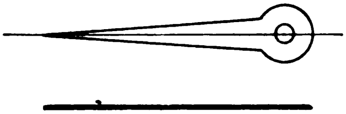


Fig. 10

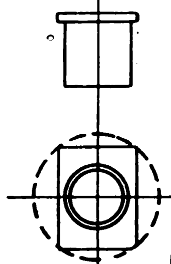


Fig. 11

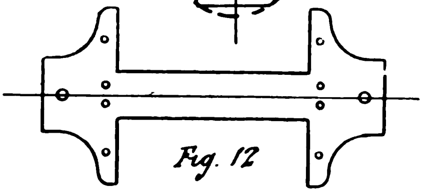


Fig. 12

should meet exactly, and their zero line lie along the centre line of the back sidepiece. Very small brass screws are used for fixing the protractors in position, and the heads must be quite flush with the surface. The

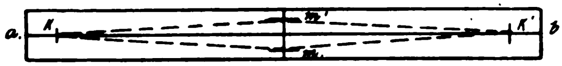


Fig. 15

dipping needle (Fig. 15) is made from good crinoline steel, and is 3½ ins. long, 3-16ths in. wide at the middle, and, tapers to a point at both ends.

The method of marking out the needle is illustrated by the figure. A straight line *a*, *b* is scratched on the piece of steel with a fine, hard point, and another line *c*, *d* at right-angles to it. The points *k* and *k'* are then laid off with dividers, each being 1¾ ins. from the point of intersection of the two lines *a*, *b* and *c*, *d*. In like manner lay off the points *m* and *m'*, each 3-32nds in. from the point of intersection. The other lines can then be easily marked, using a steel rule as a guide. The piece of marked steel is now clamped in a hand-vice, and the needle cut out with a file. A hole is drilled in the centre of the needle to admit a sewing needle, which is to serve as an axle. The needle must now be hardened by wrapping with iron wire and holding in the blowpipe flame until of a bright red colour. It is then plunged vertically into cold water. The piece of sewing needle which is to serve as an axle is ⅝ in. long, and must be reduced to a fine point at both its ends. One end of the piece will already have a sharp point, and it is best to reduce the other on a grindstone and finish on an oilstone.

(*To be continued.*)

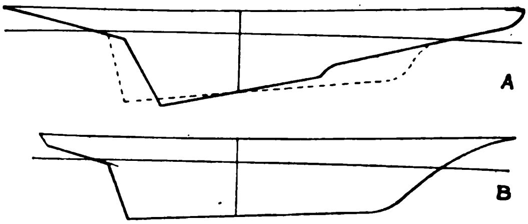
Model Yachting Correspondence.

[*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 should invariably be attached, though not necessarily intended for publications Communications should be written on one side of the paper only*]

The Rating of Model Yachts.

To the Editor of *The Model Engineer*.

DEAR SIR.—I read Mr Theobald's article on the Y.R.A. Measurement Rule in August 1st number with the greatest pleasure. I feel that it is the only one which has a chance of becoming universal as well as the only one which will allow model yachtsmen to be thoroughly up-to-date. His drawings however, are likely to lead the inexperienced into building boats which will prove unmanageable. When fin-keelers were invented, it was found advisable to give "real" yachts short fins, so that they would turn quickly, and to give "model" yachts long fins, so that they would not. In designing real yachts for the new rule, the draughtsman tries to get as near to the pivoty short-fin keeler as the rule will let him. The model yachtsman must seek the opposite ideal. In building a



model from lines published in the yachting press I would advise altering the profile boldly as shown by the dotted lines in the diagram (A). Boats with profiles as shown in Mr. Theobald's article have been tried by different enthusiasts in Liverpool and found quite unmanageable, and I can safely say that if the idea goes abroad that the Y.R.A. Rule will condemn us to boats of this unsteady type, then the rule will make poor progress. If model yachtsmen could see that the rule would bring back the keel boat with long easy lines which can be relied on to sail steadily and clearly in all weathers and which is more shipshape than either the narrow, over canvassed 1730 Rule boat or the broad under-canvassed sail area boat they would accept the rule more readily. In fact, I am inclined to think that boats with sharp schooner bows would hold their own under this rule more successfully than under any other rule. Fig B shows what I mean by this statement.—Yours truly,

Troedyrhiw, R.S.O. N. S.

For the Bookshelf.

AËRIAL NAVIGATION. By Frederick Walker, C.E. London: Crosby Lockwood & Son, 7, Stationers' Hall Court, E.C. Price 7s. 6d. Postage 4d. extra.

This excellent volume deals with the problems of aërial navigation in a thoroughly practical and scientific manner, and those who are interested in the air-ship should make it an addition to their library. The laws of flight, aërodynamics, and the various means of propulsion, etc., suitable for such craft, are very clearly demonstrated, and the illustrations and descriptions of past inventions should also be of great service to the student.

A Model Steam Tug.

By H. C. Bucknall.

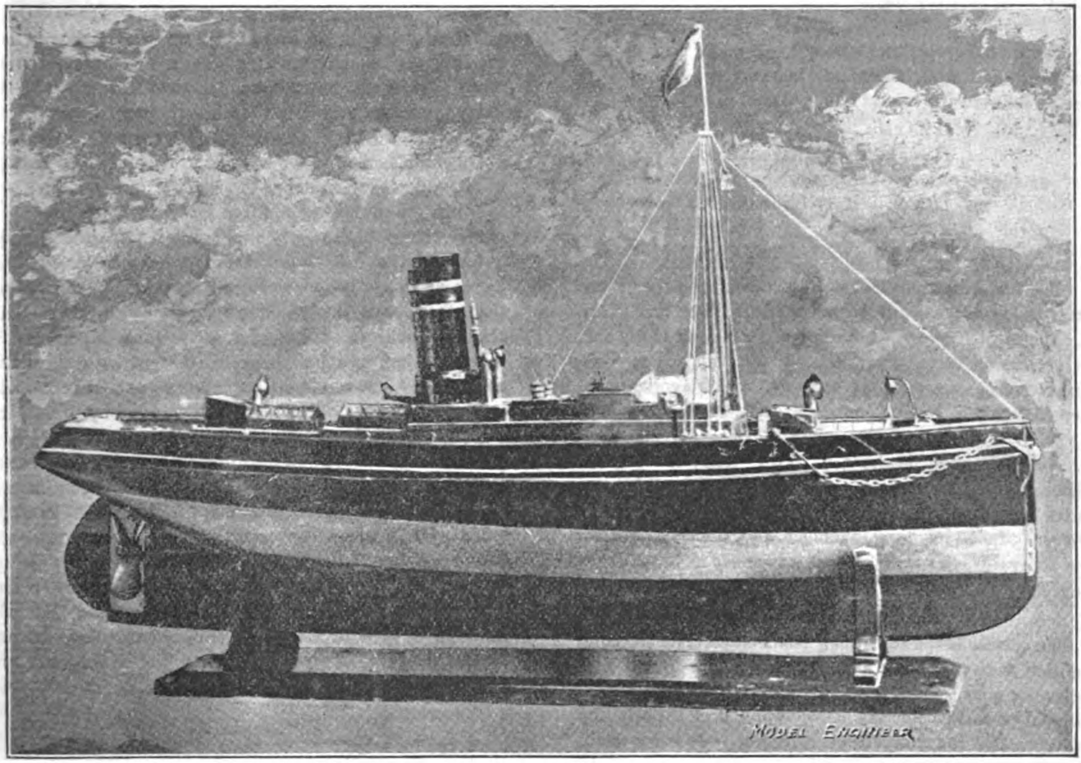
THE model steam tug shown in the photograph here reproduced is my first attempt at model steamer construction, and my experience with her has, at least, shown me what to avoid in any similar work, and may also prove useful to other readers.

The model, which I have named the *Trojan* is 2 ft. 6 ins. long, 7 ins. beam amidships, and 8 ins. total depth. She is carved from a block formed of three boards glued together vertically, so shown by dotted lines on the diagram. The forward portion is lined with thin zinc, which extends aft as far as the engines. This not only makes the hull neater inside, but prevents bits of red-hot charcoal from the furnace burning the wood.

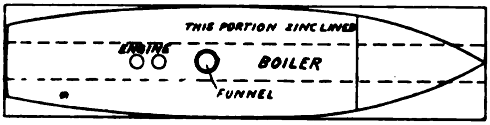
The lines of a tug have been followed closely, except that at the bows the model is a little finer than is quite correct. The stem is protected by a strip of ¼ in. square brass, which runs down and under the forefoot; a strake of ⅛ in. brass is also fitted.

The engines for the model were supplied by Messrs. Whitney, and are double-cylinder, double-acting slide valve type, ⅜ in. bore, 1 in. stroke. They are fitted with link reversing motion, and have given every satisfaction. The engines drive a three-bladed propeller, 1¾ in. diameter, which is not quite satisfactory. It is of copper, riveted, having water all round firebox, which is 6 ins. long. It is fired with charcoal, and the trouble I find is that the fuel burns away quickly, and when cold water is pumped into the boiler, the pressure, of course, falls, and so renders the blower useless just when it is most required. Once the blower gets into action, a good pressure of steam is soon obtained, the charcoal making a very hot fire. The deck forward of the mast is removable for stoking purposes. The boiler holds about half a gallon of water. The funnel was made by an ironmonger to my design, and has an inside liner.

The boiler is filled by means of a hand pump, which is hidden beneath the aft companion way. The rudder is worked from the wheel on bridge, having ⅛ in. diameter to let the string run easily round the various corners. The model is painted black and salmon, with the bottom or dark green, and the stern is realistically finished by having the draught in feet marked off (really showing how much water she draws in half-inches). The boat was built without working drawings.



Mr. Bucknall's Model Steam Tug.



Method of Building Hull.

I have tested the capabilities of the model by allowing her to tow a 9-ft. dinghy with myself sitting in it (10 stone), and this she was able to do at a sufficient rate to make steerage way for the dinghy, being proof that the model is fairly powerful.

The Editor's Page.

WE must confess to some disappointment at the results of our speed competition for model steamers (No. 23) which recently closed. Only nine entries were received, and of these eight came from Wirral, where, we believe, considerable interest is taken in model steamer racing. The remaining entry hails from Guernsey, and as all the competitors appear to have complied strictly with our conditions, the result should prove interesting in many ways.

* * *

The three competitors whose boats come first in point of speed, and who, therefore, secure the prizes offered, are as follows, the names being placed in order:

1. Mr. J. THARME,
   11, Huison Street, Birkenhead.
2. Mr. HERBERT THARME,
   11, Huison Street, Birkenhead.
3. Mr. SIDNEY KEAY,
   7, Martin's Lane, Liscard, Cheshire.

The following particulars of the winning boats and their performances will be of interest. The first is Mr. J. Tharme's *Express*, which covered a measured distance of 100 yards three times in 40½, 42, and 40½ seconds, respectively, averaging 41 seconds, which works out at five miles per hour almost exactly. This model is 5 ft. 6 ins. long. The second boat, Mr. Herbert Tharme's *Darling*, is also 5 ft. 6 ins. long, covered the distance in an average of 43½ seconds, equal to 4·70 miles per hour; and the third, Mr. Sidney Keay's *Fidget*, 5 ft. 10 ins. long, averaged 44 5·6ths seconds for the 100 yards, this representing a speed of 4·56 miles per hour.

* * *

The speeds of the remaining boats entered for the competition average 4·50, 4·46, 4·26, 4·23, 4·10, and 3·16 miles per hour, respectively. The prizes offered were conditional on full particulars being supplied of the winning boats, so that the competition will not only have established a useful record in model steamer speeds, but will also afford an opportunity of showing how the successful vessels attained their pre-eminence, and will, no doubt, prove a starting point, from which still speedier models may be designed.

* * *

"J. C. C." (Muswell Hill), a correspondent who is well known to many of our readers as an enterprising and successful model locomotive enthusiast, sends us the following expression of opinion on electric *versus* steam model locomotives:—"With regard to your suggestion to readers of THE MODEL ENGINEER who have so far only touched steam models to turn their attention to the recent articles in THE MODEL ENGINEER on model electrical traction, I should like to ask your reason for such advice. I think it must be obvious to all that to design and build an electric railway with locomotives, cars, &c., is simplicity itself, as the motive power is derived outside the railway, whereas on a railway which employs steam as its motive power you have a superior machine which creates its own power, and is independent of any power outside of itself. I venture to think that all will agree that to design and build a model steam locomotive which will work satisfactorily reflects far more credit upon its builder, and creates more outside interest than an electric engine would. Therefore, in my opinion, the model locomotive designer and constructor will find steam models vastly more interesting and instructive than the construction and working of electric models."

* * *

We need hardly say that in making the suggestion that the subject of electric traction would prove interesting to many of our mechanical readers, we had no wish to decry the importance and the attractions of steam-driven locos, and we fully agree with our correspondent that every credit is due to the successful designer and builder of a good steam model. We must, however, venture to differ from his contention that the building of a model electric railway is simplicity itself, and we are quite sure that all those readers who have tried their hands at this class of work will support us in saying that there are many difficulties in connection with electric traction, calling for skill and ingenuity in their solution, and for congratulation when successfully overcome. The whole matter is largely one for individual taste, and just as one man will make a hobby of gardening, or cycling, or photography, to the exclusion of every other hobby, so it is quite within reason that one model engineer should find all his pleasure in steam-driven models, while another will attempt nothing but electrical work. There are, however, many people whose interests in the one direction or the other are not sufficiently strong to cause them to confine their efforts to the one special branch, and it is more particularly to these that our remarks were addressed. Possibly some others of our readers may like to give their views.

Answer to Correspondent.

B. BALDWIN.—We have received a query and some stamps for back issues, *but no address*. Please communicate with us.

Prize Competition.

Competition No. 22.—Two prizes, value £2 2s. and £1 1s. respectively, are offered for the best and second-best designs (to include full description and working drawings) for a working model flying machine. The size, type, and propelling power of the model are left entirely to the choice of the competitor, the main stipulation being that it shall be capable of successful working. The model must have been actually made, and the prize winners will be required to send in their models for inspection and trial by the judges before the actual awarding of the prizes takes place. The last day for receiving entries is October 31st, and the usual general conditions apply in this Competition.

The general conditions for the above Competition were given in the previous issue (page 141).

Is "The Model Engineer" to be Published Weekly?

AN IMPORTANT QUESTION FOR OUR READERS.

FOR a long time past we have been receiving letters from our readers urging us to publish THE MODEL ENGINEER every week, instead of twice a month as at present, and the more our circulation has extended, the more numerous have been the communications on this subject. Indeed, so frequently and so strongly has this change been urged upon us that we feel the time has now arrived when we should endeavour to ascertain the feelings of our readers in general. For this purpose we have inserted in every copy of this issue a post-card asking for an expression of opinion, and we trust that every reader will make a point of voting one way or the other. It is somewhat unusual for the supporters of a journal to be consulted in this way, but in view of the friendly relations existing between our readers and ourselves we feel that our motives in giving our readers a voice in the decision of this question will be duly appreciated. We have no wish to force a weekly issue upon our readers; but if their opinion is favourable to a such change, we, on our part, are quite prepared to undertake the increased work and responsibility which would necessarily be involved. We, at least, can safely promise that the high standard of our contents would in no way suffer, and as some indication that there is no lack of good matter for our pages, we may say that the pressure on our space has for some time past been such that many excellent contributions have had to wait several months before a suitable opportunity for using them has occurred. Should the decision of our readers be in favour of a weekly issue, the increased space at our disposal would enable us to deal more promptly with the articles we receive, and moreover, it would especially facilitate the publication of serial and continued articles, so that readers would not be compelled to wait so long for the completion of a subject in which they were particularly interested. Already we give more than enough in the way of working drawings and descriptions of models to keep an energetic reader of the paper going through all his spare time, and we fully appreciate the fact that to use the extra space merely for giving still further descriptions of models would be very much like putting a number of extra dishes in front of a man who was already making a very good dinner. But we do feel that more articles on workshop practice, and additional articles of an instructional character which would enable our readers to more fully grasp the principles of mechanical and electrical matters, would be generally acceptable, as also would regular notes on the latest developments in engineering science and invention. There are, in fact, many things of interest which we should like to put before our readers did space permit, and the question whether this alteration is desirable or not is now submitted for decision. It will be remembered by some that we issued a similar post-card when changing from publishing once a month to twice a month, and so willingly did our readers respond to our invitation on that occasion that we feel sure they will be equally ready to record their vote once again. What the result will be we will not venture to forecast; but we make the request that every reader will be good enough to reply, and, further, that he will do so by the earliest possible post, so that whatever the general feeling may prove to be, it may be made known without undue delay.

A Magnificent Run on the Midland Railway.

THERE has recently been turned out, from the Derby Works of the Midland Railway, one of the largest locomotives in Great Britain. It is a compound, and weighs 112 tons in working order.

The record to hand of its fine unbeaten performance is as follows: The 1.30 p.m. from St. Pancras on 5th September, with 13½ vehicles on the train for St. Enoch, Glasgow, and Waverley, Edinburgh, reached Hellifield, the stop prior to Carlisle, 17 minutes late, that is at 6.41 p.m., instead of 6.24. The 25½ miles from Hellifield to Hawes Junction was covered in 36 minutes, giving a speed of 42½ miles an hour on the ascent.

Then came the sensational part of the journey. The descent of 20½ miles from Hawes Junction to Appelby was negotiated in 16 minutes, that is an average speed of 76·8 miles per hour. The last section of the journey from Appelby to Carlisle, 30⅝ miles, took 27 minutes, making an average speed of 68⅓ miles. When the train stopped at the Citadel Station, Carlisle, she was just 5 minutes late, 12 minutes arrears having been knocked off during the journey from Hellifield.

The details of the record of this night's run are given below, and rank as the record "one engine, platform to platform" performances of the world, considering the weight of the train, and the height of the summit and the average speed:

Hellifield to Hawes, 25½ miles in 36 minutes —42½ miles per hour.
Hawes to Appleby, 20½ miles in 16 minutes —77 miles per hour.
Appelby to Carlisle, 30¾ miles in 27 minutes —68 miles per hour.
Hellifield to Carlisle, 76¾ miles in 79 minutes —58⅓ miles per hour.

MESSRS. WHITTAKER & CO. will shortly publish a work on "Galvanic Batteries," by that well-known writer on electrical subjects, Mr. S. R. Bottone. This book will treat fully upon the theory, construction and use of electric batteries, comprising primary, single and double fluid cells, secondary and gas batteries, and will contain numerous illustrations.

THE laying of new gas mains in Finsbury Pavement has been (says the *Times*) the cause of an interesting discovery about 4 ft. below the road surface, in the shape of old trunks of trees, which were in old times laid as water conduits. The trunks of trees, as they were raised from their bed, proved to be in a wonderful state of preservation. They had been hollowed out to a bore of 6 ins. or 8 ins., the trees in some cases being from 4 ft. to 6 ft. in girth. One end of each length had been pointed to fit into the hollow of the next, some of the trees being 20 ft. or more in length. There is an opinion that they must have been 150 years in the ground.

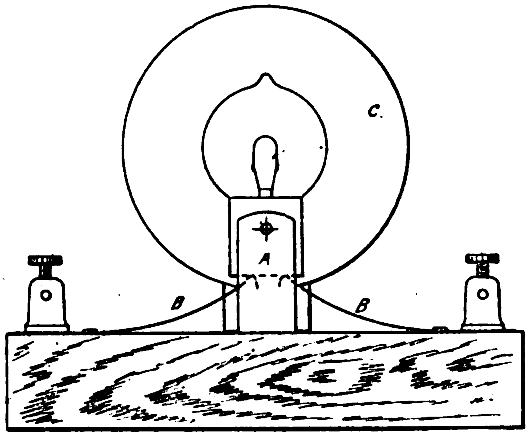
Practical Letters from Our Readers.

[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.]*

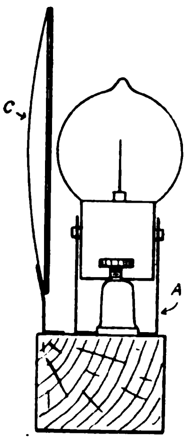
A Simple Electric Lamp Holder.

TO THE EDITOR OF *The Model Engineer*.

DEAR SIR,—I enclose a sketch of a simple electric



SIDE VIEW OF LAMP HOLDER.



END VIEW.

lamp holder, which is suitable for placing in front of a watch stand. It is mounted on a wood base about 4 ins. long by 1 in. wide by ¼ in. thick.

The lamp is supported by a piece of sheet brass, bent into a [_] shape, and takes the projecting pins on lamp holder.

Contact is made from the terminals to the lamp by means of two pieces of spring brass (B), the ends of which are rounded over, as shown, and serve to keep the lamp in a vertical position as well as make contact.

At the back of the lamp I have a reflector (C), which was made out of an old watch case, and is held in position by being riveted to a piece of tin plate, which in turn is screwed down to the wood base.—Yours truly,

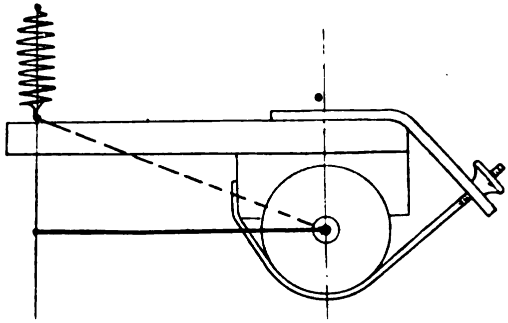
L. A. WHITEHEAD.

Brockley, S.E.

Testing Small Engines.

TO THE EDITOR OF *The Model Engineer*.

SIR,—There is a serious slip by "B.S.K." in the description of the dynamometer in "Testing Small Engines" in your issue of September 1st. The *virtual radius* of the instrument is the shortest distance between the line of action of the spring balance and the shaft axis —*i.e.*, the full line in sketch below instead of the dotted



MEASUREMENT OF VIRTUAL RADIUS OF DYNAMOMETER ARM.

one. The error would lead to an excess of apparent b.h.p. over real.—Yours truly, A.M.I.M.E.

London, E.C.

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, *37 & 38, Temple House, Tallis Street, London, E.C.]*

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

[6833] **Bearings for Dynamo.** F. S. writes: I am thinking of making a Manchester type dynamo (output, 500 watts 100 volts 5 amps.) as per Fig. 13 in your "Small Dynamos and Motors." (1) Could you give me a scale diagram showing the position, size, etc., of the bearings, commutator, and armature, *i.e.*, a cross section along armature spindle? (2) In your table of outputs on page 51, what gauge of wire is meant and where can I get the wire?

(1) It is hardly worth while preparing a set of scale drawings for bearings, etc., when so many good designs are in print. We should recommend you to get Avery's book, "The A.B.C. of Dynamo Design," which can be had from Messrs. Dawbarn and Ward, Ltd., 6, Farringdon Avenue, E.C., for 1s. 2d., post free. You would find it extremely useful. In chapter iv, "Small Dynamos and Motors," a plain design is shown for commutator. In "A.B.C. of Dynamos and Designs," chapter iv. the construction of ring armatures and the method of driving them is described. (2) Standard wire gauge is used. Wire may be had from any electrical apparatus manufacturer or agent, or from the advertisers in either of the books above referred to.

[6735] **Use of Air Pump; Strength of Aluminium.** W. A. H. (New York) writes: Would you kindly tell me what the air pump is used for on the engine for a fast steam launch illustrated in the issue of March 15th, 1902; also give the modulus of elasticity, elastic limit, and ultimate tensile strength, pounds per square inch of aluminium.

An air pump is used in a condenser to get rid of the air which finds its way into the condenser, and which would materially affect the quality of the vacuum. It also removes the water and vapour. Elastic limit in tons per square inch of aluminium rolled-bar and aluminium bronze (33 aluminium, 67 copper, &c.), is about 7 tons and 31 tons respectively; maximum stress about 10 tons and 36 tons per square inch, respectively. We regret we cannot answer remaining part of your query, having no further information upon the subject.

[7031] **Diaphragm for Gramaphone.** J. M. (London, S.W.) writes: I am constructing a gramaphone to drawings and particulars in the last numbers of THE MODEL ENGINEER. I have tried several store chemists but cannot obtain the isinglass for diaphragm. Would you kindly let me know where I could get the same, or tell me what I could use as a substitute? Would thin ferrotype iron plate, such as used in telephones, do?

Isinglass is, of course, much the same as gelatine, and the latter is quite suitable. The best thickness is a matter of experiment. We do not know where exactly the right thing can be obtained, but you might be able to make a suitable diaphragm from a portion of a photographic film, such as is used in Kodak cameras. Possibly a small scrap of celluloid would be suitable, and, indeed, the field for experiment is fairly wide. We hardly think the ferrotype will do, but you should try it.

[6999] **Acetylene Generator; Accumulator Charging.** P. M. (Beckenham) writes: Would you be kind enough to answer the following questions? (1) What volume of acetylene gas can be generated from 1 lb. of calcium carbide? (2) What is the chemical formula of acetylene gas? (3) How is calcium carbide manufactured? (4) Why is a dynamo with a two-pole armature insufficient for accumulator charging? (5) Is it absolutely impossible to charge an accumulator with a two-pole armature dynamo?

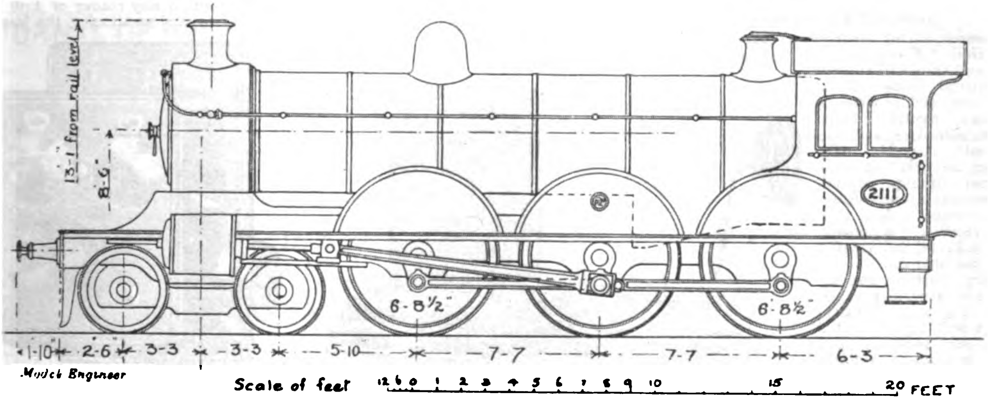
(1) 1 lb. of carbide will make 5 cubic ft. (2) Chemical formula for acetylene gas is C_2H_2. (3) An intimate mixture of finely divided carbon and lime, heated to a very high temperature in a furnace by means of an electric current. (4) Because the two halves of the windings are short circuited at each revolution by the brushes bearing momentarily on both segments at once; thus the cells which are being charged are short circuited through the coils of the armature and this, of course, effectively stops all charging. (5) It is not absolutely impossible; the above difficulty may be overcome by making the slot in the commutator wide enough to prevent any possibility of the brushes ever bearing on both segments at once. This causes destructive sparking.

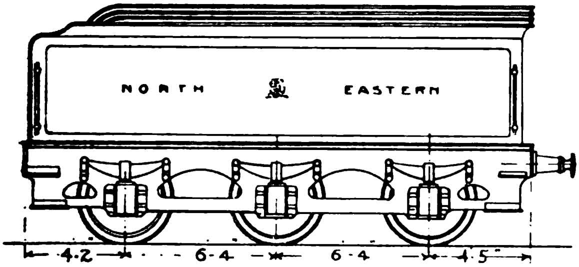
[6553] **Marine Engine Governors.** T. B. (Workington) writes: Do up-to-date marine engines carry any governor or other addition to them, to prevent them from racing when at sea, when their propeller is lifted out of the water? If so, what principle do they depend upon, and have they been a success?

There are several well-known governors used for controlling marine engines. Aspinall's Patent Governor is attached to the pump lever, and actuates a throttle valve. The Westinghouse governor controls the reversing gear. Both are illustrated in Wannan & Southern's "Marine Engineer's Questions and Answers for Board of Trade Examinations," price 3/9, post free, from our Book Department. They are used to prevent racing when the propeller is lifted out of the water, and Aspinall's has a special part which will, in emergencies, such as when a shaft breaks or a propeller comes off, entirely shut off the steam.

[6564] **Measuring Capacities.** W. M. (Ayr) writes: Would you kindly let me know the following: Water engine, cylinder 6 ins. diameter; stroke 8 ins.; water pressure from 28 to 30 lbs. per square inch; feed pipe, 2 ins.; exhaust pipe, 2¼ ins. Kindly say how many gallons of water it will consume per revolution.

Cubic capacity of the cylinder = area of 6-in. diameter cylinder × 8-inch stroke = 28¼ × 8 = 226 cubic inches. One imperial gallon of water = in capacity 277¼ cubic inches. You do not say whether the engine is double or single action, and therefore we cannot give the consumption in gallons per revolution; this, however, can easily be calculated from the data above. Water is practically incompressible, and, therefore, the volume of water consumed may be calculated regardless of the pressure.





N.E.R. SIX-COUPLED EXPRESS LOCOMOTIVE.
Driving Wheels, 6 ft. 8½ in. Diameter.
Scale: ⅛ in. to the foot.

[6989] **N.E.R. Large Six-coupled Express Loco.** D. A. (Edinburgh) writes: I wish to build a ¾-in. scale model of the *latest* type of six-coupled bogie express engine of the N.E.R. 2111 class, and would be very much obliged if you could give me an outside elevation showing the shape of frames, cab and tender and the diameter of wheel.

We reproduce herewith a drawing of the 6 ft. 8 in. N.E.R. six-coupled bogie express locomotive, 2111 class, and also elevation tender. The drawing is to scale of ⅛ in. to the foot, and so will be ⅙ full size of ¾-in. scale and 1-6th for ¾ in. scale.

[6941] **Petrol Motors.** C. N. T. (Ardingly) writes: Should be much obliged if you would kindly supply me with the information I require, namely:—Would it be practicable to join two petrol motors together if they were both of the same power, purchased from the same firm, and in every way alike? My idea was to buy one set of castings, and, if the engine went well, I could put it to my bicycle, then do another one, and join them together for a small voiturette or quad. I should probably get a large engine to get the power for the quad straight away, only that I find two sets of motor castings do not come to as much money as one large one.

It is practicable, no doubt, but this would be a very inconvenient method of doubling your available power. In the first place, the efficiency of a small motor is low, and the cost of running two small motors would be very much more than the cost of developing their combined power by means of one larger motor. Then, weight and space have to be considered, and, lastly, although the castings of two small sets call for a lesser outlay, will this advantage counterbalance the expense and time expended on the machining of two separate engines?

[6992] **Spirit Burners for Models.** B. B. writes: Some time ago I saw a reference in your paper to wood spirit burners. Could you kindly give me some information about them? (1) Would it be possible to get burners to burn wood spirit without having first to heat them? (Those you referred to had to be made redhot, I believe.) (2) Would the burner have to be made with one single hole for the spirit to come through, or are there several small holes

If the latter, I expect they have to be made small. (3) Do you know if wood spirit can be procured, and, if so, could you kindly mention a firm's name where I could get my supply from?

(1) Wood spirit will vapourise very readily. Lamps have been made to burn this spirit—with neither wick nor pressure—but they are by no means commonly used. (2) This is a matter for experiment. (3) We do not know of any particular firm supplying this, but you might try any good oil and varnish stores: they would be as likely as anyone to supply you.

Amateur's Supplies.

[*The Editor will be pleased to receive for review under this heading, samples and particulars of new tools, apparatus, and materials for amateur use.*

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

New and Up-to-date Telephones.

The accompanying illustrations represent two of the specialities of Mr. Harold E. Parris, of 19, Lullington Road, Anerley, S.E., who is well-known to at least our electrical readers as a manufacturer and exporter of telephones, electric bells, electrical indicators, and like instruments. The table instrument in the first cut is a really neat and useful adjunct to an installation, and consists of a microphone, double pole watch receiver, automatic switch hook, call bell, ringing key, &c., together with a 4-way connecting rosette. The instrument is cased in polished walnut. Fig. 2 is an illustration of a wall station, stated to be a very serviceable and reliable instrument suitable for circuits of long distance. It is fitted with a magneto-call and a D. P. watch receiver. A similar telephone, but with 6-way inter-communication board, may be obtained at a slight increase in cost.

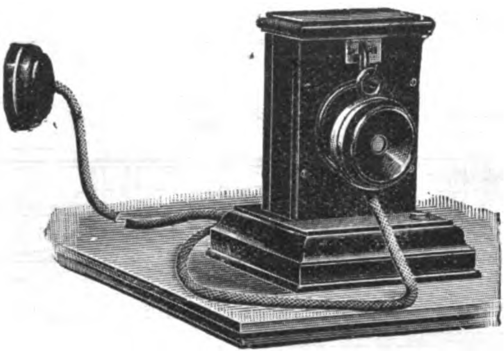


Fig. 1.—Table Telephone.

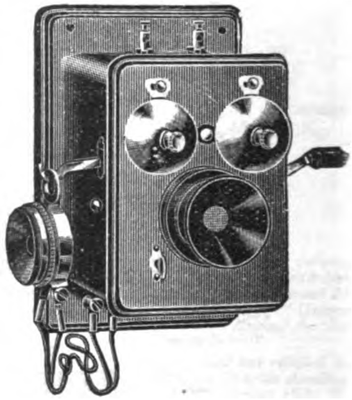


Fig. 2.—Wall Instrument.

Mr. Parris' new catalogue and price list (section T) is full of particulars of the various instruments which he supplies at very cheap rates, and readers on the look out for this class of electrical goods should write him, enclosing a penny stamp and mentioning The Model Engineer.

For Model Locomotives and Steam Engines.

Some time ago Messrs. W. J. Bassett-Lowke & Co., Northampton, informed us that a good oil for model locomotives and other miniature steam engines was very sorely needed. On many occasions they state they have had models returned to them as unworkable, when the sole reason of the engine's indisposition has been due to the employment in the cylinders and other parts of an unsuitable, viscous, vegetable oil, which soon clogs up the moving parts subjected to the heat of the steam, etc. To prevent a recurrence of this trouble, and to provide amateurs with a really good oil in small quantities, Messrs. Bassett-Lowke have had specially prepared for them by Messrs. Price's Patent Candle Company—the well-known manufacturers of engineering oils—a suitable lubricant, which is stated to be a pure hydro-carbon oil. The "Rocket" oil, which may be employed for both cylinders and bearings, is supplied in bottles containing 5 ozs. and tins (of similar pattern to those in which cycle oil may be obtained) containing 7 ozs. at a uniform price of sixpence. Readers sending for this oil should mention The Model Engineer, and also enclose 3d. extra for postage.

A Change of Address.

Messrs. C. A. Vandervell & Co. (late Thorpe Works, North Kensington) have notified us that owing to the continued increase in their business—the manufacture of accumulators of all kinds and other electrical goods—they have been obliged to acquire larger premises, viz., Chapter Works, Chapter Road, Willesden Green, where all communications should be addressed.

Notice to Model Railway Readers.

Messrs. Drake & Co., 4, Balfour Street Bradford, request us to state that they have taken over the business, stock and plant of Messrs. J. & W. Kean, of Solihull, Birmingham, and that they intend to go on with this business in its entirety, supplying model signals, railway track, coaches, and rolling stock of every description, and also parts for same in the rough and finished.

*A Model Horizontal Engine.

Messrs. Arkcoll & Maddock, model brass founders, Porthill, Stoke-on-Trent, send us a sample set of their new production, in the shape of castings for a ¾ by 1¼-in. horizontal engine. The castings, which should make up into a very neat scale model, are all that can be desired as regards cleanness and shape. The bedplate sent is wonderfully flat and true, and as most junior model engineers have no planing machine, this is a desideratum. With a minimum of filing, it is ready for the various parts, such as cylinder and bearings, to be attached. A printed slip is sent with castings, giving a half-size drawing of the complete engine. Enquirers should mention The Model Engineer.

Catalogues Received.

The Central Electrical Co., 186, High Holborn, W.C.—A catalogue of electrical novelties has been received from this firm. It is fully illustrated and comprises particulars and prices of electric bells, indicators, motors, dynamos, and other electrical sundries. H.E. and ordinary lamps are also included in this comprehensive list which will be sent to any reader of The Model Engineer sending a penny stamp, and mentioning the journal.

G. T. Riches & Co., 4, Gray's Inn Road, London, W.C.—Messrs. Riches' speciality is motor car accessories and spare parts, and the comprehensive list we have received includes prices of all mechanical details of De Dion, Panhard, Delahaye, Darracq Cars, both "genuine" and "imitation" fittings, tyres, tubes, rims, and also general accessories, such as lamps, tool bags, lubricators, meters for all purposes, sparking plugs, and accumulators. Those whose hobby is motoring, and those readers making motor cycles, should possess this catalogue, which will be sent upon the receipt of an application, and a reference to The Model Engineer.

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 6s. 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," 37 & 38, Temple House, Tallis Street, London, E.C.

All correspondence relating to advertisements to be addressed to The Advertisement Manager, "The Model Engineer," 37 & 38, Temple House, Tallis Street, London, E.C.

All subscriptions and correspondence relating to sales of the paper to be addressed to the Publishers, Dawbarn & Ward, Limited, 6, Farringdon Avenue, 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.

THE

Model Engineer

AND

Amateur Electrician.

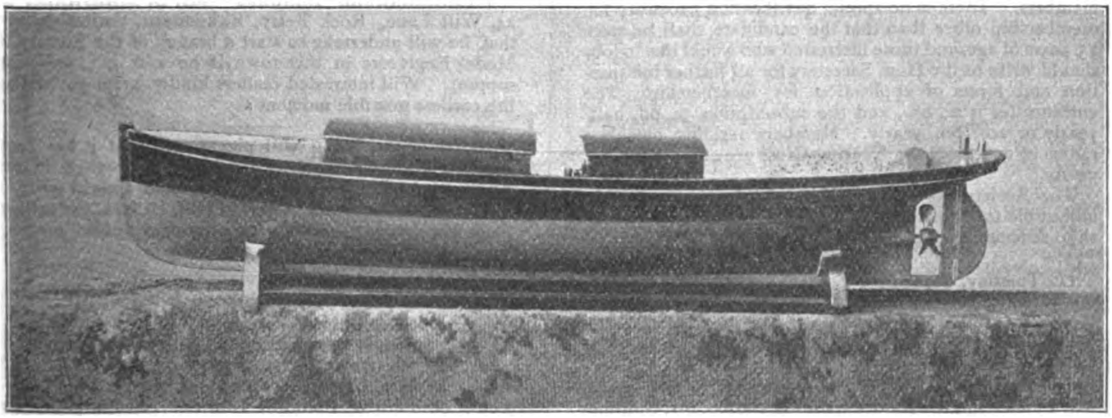
A JOURNAL OF MECHANICS AND ELECTRICITY FOR AMATEURS AND STUDENTS.

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

VOL. VII. No. 83. OCTOBER 15, 1902. PUBLISHED TWICE MONTHLY

A Neat Model Electric Launch.

THE accompanying photograph will give our readers a clear idea of the splendid model electrically-driven river launch, which was made some time ago by a firm of West End electricians. The length of the boat is only 2 ft. 6 ins., the beam 6 ins., and the depth about 4¼ ins.



A SMALL MODEL ELECTRIC RIVER LAUNCH.

The lines of the boat are very good, and a speed of about two miles an hour is possible. The general arrangement is very simple: the raised cabin at the forward end covers the accumulators, and the smaller deckhouse boxes in the motor, which is of the ordinary undertype pattern, with field-magnets of soft cast-iron, and a tripolar armature. Behind the motor is placed the miniature seating accommodation. The bearings of the armature shaft are of brass, the brackets being connected to the field-magnets in the usual way. Between the wooden block, or base, upon which the motor is mounted, and the hull of the boat, a piece of rubber insertion is placed so that the vibration of the motor, when running, is not transmitted to the hull. By this precaution the noise is considerably reduced. The motor is worked at a high speed (about 1000 revolutions per minute), and the propeller shaft is geared down to run at half the speed by a pair of plain two-to-one spur wheels, the motor shaft being directly above that of the propeller. The higher speed of the motor renders it electrically much more efficient than it would be if the propeller were driven direct. A flexible coupling is placed on the propeller shaft, just inside the stuffing-box, the short piece of disconnected shaft running in a plain bearing, with the coupling on one side of it, and the larger spur wheel on the other.

Bristol cells are used, a battery of three in one case measuring only 4⅛ ins. on the plan, by 3$\frac{1}{16}$ ins. high, by $\frac{13}{16}$ in. thick. Two sets are used, in parallel, giving 6 volts, each pair of leads being led separately to the motor. The total weight of the accumulators is only 2 lbs.—1 lb. each set. The boat, in spite of its small size, works splendidly, and has a very good appearance in the water. At a recent trial, with the accumulators fully charged, it ran at full speed for two hours.

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 fortnight before its actual date of publication.*]

London.

THE next indoor meeting of the Society will be held at HOLBORN TOWN HALL, Gray's Inn Road, W.C., on Thursday, October 16th, when Dr. A. C. HOVENDEN will read a paper on "A Year's Experience with a Steam Car." The Locomobile Company will exhibit a steam car boiler, engine, and other essential parts of their vehicles. On Thursday, Nov. 13th, the Annual General Meeting of the Society will be held at the above Hall. At this meeting alterations in rules and the general policy of the Society may be discussed. The officers for the ensuing year will be elected.

NOTICE TO BRANCH SECRETARIES.

In view of the approaching end of the financial year (October 31st) Branch Societies are requested to send in their affiliation fees, a copy of their yearly report and balance-sheet, by November 6th at the very latest, so that they may be embodied in the General Report of the work done by the Society as a whole, which report will be printed, and copies distributed free to all branches. If any of the above reports are not to hand by that date, they must necessarily be omitted.

HOW TO BECOME A MEMBER OF THE S.M.E.

The object of the Society is the bringing together of those interested in the construction and working of model engines, small machines, electrical apparatus, metal working tools, and kindred subjects; the reading and discussion of papers, the exhibition and trial of models, etc., the visiting places of engineering interest, and generally promoting the mutual assistance and intercourse of its members. There is no special qualification necessary for membership other than that the candidate shall be over 15 years of age, and those interested who would like to join should write to the Hon. Secretary for all further information and forms of application for membership. The entrance-fee is 2s. 6d., and the subscription 5s. 6d. half yearly or 10s. 6d. yearly. Members residing outside a radius of 20 miles from Charing Cross are charged 7s. 6d. yearly.

The Society has a splendid model locomotive track, adjustable to all gauges from 2 ins. to 7 ins., and a workshop scheme is being considered.

On Tuesday, September 23rd, the usual monthly meeting of the Society was held at the Holborn Town Hall, Gray's Inn Road, W.C., at 7 p.m., Mr. Percival Marshall presiding. After the formal business, a result of some small boiler tests were given by the Secretary, followed by a discussion. The model track was in full swing, Mr. Flook's single cylinder shunting engine, Mr. Smithies single engine, and a 5 in. gauge model of a G.N.R. 7 ft. 7 in. class inside cylinder single engine, made by Mr. E. Kent, a visitor, being exhibited in working order. Among the exhibits were a model ¾-in. scale signal, and a piece of track by Messrs. George & Co.; a Primus burner with special adapting socket by Melhuish & Co.; a benzoline lamp by the Liverpool Castings Company; parts of model-tank engine by H. Greenly; and Mr. Simkins' electric locomotives.

The proposed additions and improvements to the track were announced by the Track Committee and a special subscription list opened and heartily responded to. Any member specially interested in this part of the work of the Society should communicate with Mr. Henry S. Boorman, the Track Secretary. The members who so kindly helped, and promised co-operation in the scheme, are cordially thanked by the Track Committee. Having spent an enjoyable evening, the meeting terminated at 10 p.m.

Members are especially requested to bring up examples of their work, finished or unfinished, and any models they may possess, and also show them working, if possible. —HENRY GREENLY, Hon. Sec., 2, Upper Chadwell Street, Myddleton Square, E.C.

Provincial Branch.

Tyneside.—About 32 members and friends visited the Newcastle Tramway power station on Saturday, September 6th, where they were met by Mr. Richardson, the Chief Engineer, who showed the party every consideration, and took the greatest trouble in explaining the interesting items of this station. The engine room of this power station is furnished with one triple expansion engine of 2000 i.h.p. built by the Wallsend Slipway and Engineering Company, driving a 1,300 kw. dynamo direct; also two compound 1000 i.h.p. engines by Victor Co., working 630 kilowatt generators. The engines are fed by 6 Lancashire boilers with mechanical stokers, the coal costing only 3s. 6d. a ton. After the visit, the members met at the Society's rooms, having tea, followed at 6 p.m. by a formal meeting, the President, Mr. B. Bamford, in the chair. The rules of the London Society, with the necessary alterations to suit the requirements of the Branch, were adopted. A hearty vote of thanks was passed to Mr. A. E. Le Rossignol and Mr. Richardson, for their kindness in arranging the visit to the tramway power station. Mr. Patterson was unanimously elected as Vice President, and Mr. Turnbull a member of the Committee.—GEO. F. ADDLESHAW, Hon. Sec., 2, Gladstone Street, Newcastle.

TO BIRKENHEAD READERS.—Mr. S. MARSHALL, of 24, Will Lane, Rock Ferry, Birkenhead, writes to say that he will undertake to start a branch of the Society of Model Engineers in this town if he can get sufficient support. Will interested readers kindly write to him at the earliest possible moment?

READERS AT BATH will please note that it has been thought desirable to form a branch Society of Model Engineers in this city, and all interested should write to Mr. R. F. BLACKMORE, Twerton Hill, Bath, at the earliest possible moment, so that a preliminary public meeting may be held and the scheme discussed.

Sending Accumulators for Repair.

THE following useful hints to be observed when sending accumulators for repair appeared in a recent issue of *Motor Cycling*. They are written by Mr. W. Peto, of Peto & Radford, Ltd.: "Accumulators are constantly being sent to us for repairs with the acid solution left in them. The consequence is that by the time they arrive a repair that may have been a simple matter, such as a broken terminal or cracked case, becomes a big job, owing to the acid escaping *en route*, short-circuiting the plates, corroding the terminals, and generally ruining everything on the battery. All batteries returned for any purpose should be carefully emptied after the current in them has been discharged. Discharged plates will not oxidise if sent in a dry state, though charged plates will. Users of accumulators can save themselves much trouble and expense by using a little forethought in this matter, and it is also as well to label them clearly. We receive about 100 daily of every shape and size, some without any name or method of identification."

How to Make a Plumb-bob.

By J. A. B.

A USEFUL plumb-bob can be made by using a penny Menthol case as a pattern. Stick the case together with glue, then cut off the base, and round it up, as Fig. 1, with coarse sandpaper, finishing with fine; carefully find the centres of the top and the base, bore holes with a 3-32nds-in. bradawl, and run through about 4 ins. of 3-32nds-in. iron wire; then give the wood one or two coats of size or thin glue, and when dry, a coat of varnish.

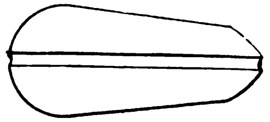


FIG. 1.—THE PATTERN.

To cast the bob, make two frames, 5 ins. by 1¼ ins. by 1 in. deep inside, from wood ½ in. thick, as Fig. 2; drive a wire nail in the edge at each end of one of the frames, cut off its head, and make corresponding holes in the other frame to fit the nails easily; fill in and ram level one of the frames or moulding boxes; then press the pattern horizontally into the sand until it is half buried, also stick a lead pencil into the sand about ⅜ in.

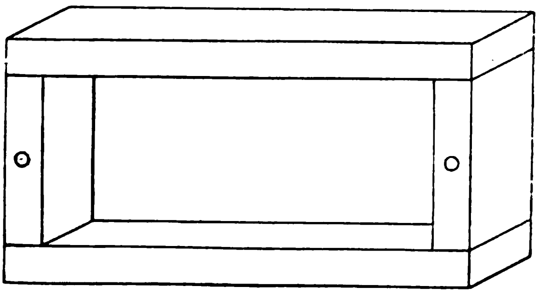


FIG. 2.—ONE OF THE MOULDING BOXES.

from the side of the pattern to form the runner; now put on the other frame, sift on the parting sand (dry sand), and fill in and ram until the box is full. Draw out the lead pencil, and make the entrance to the hole funnel shaped; carefully separate the frames; take out the pattern, and make a small trench, so that the metal can pass from the runner into the mould. Now cut off a 4-in. length of 3-32nds-in. wire; if it is rusty do not clean it up, but rub over it a little blacklead to prevent the molten metal sticking, and lay it carefully in the place made for it by the wire of the pattern in the sand. Put the mould together, and pour in the melted lead; when set, open and take out the bob, file up by hand or when running in the lathe; when finished, knock out the wire and give a coat of black enamel or lacquer.

As we go to press with this issue, a good proportion of the post-cards in connection with the proposed weekly publication of the *M.E.* have been received. Will those readers who have not already voted kindly do so at the earliest possible moment, so that something definite may be announced in our next number?

A Notable Locomotive.

THE average performance of a locomotive in this country is a little over 20,000 miles a year, but an engine of the London and North-Western Railway Company has just completed its second million miles, equal to 100 years' service on the ordinary basis. This is the "Charles Dickens," well known to most travellers who journey between Manchester and London. For years it has taken an early train from Manchester, starting first at 7.45 a.m., then at 8.15 a.m., and since 1889 at 8.30 a.m. from Manchester, and returning from London at 4 p.m. Early this month it completed the 5,312th round trip, in addition to 186 other trips, and during the whole of its career no passenger riding behind it has suffered any accident. It is a wonderful record, and demonstrates the marvellous care with which our great railways are conducted. Its speed has gradually been increased from 40 to 50⅓ miles per hour, while the weight of the train has been augmented by the addition of restaurant saloons, corridor cars, gas reservoirs, electric lighting appliances, &c. The engine is only twenty years old, having been turned out of Crewe on February 6th, 1882; and during its career it has been in but few hands. First, the driver and fireman were David Pennington and Leigh Bowden; David Pennington was succeeded after a few years by Josiah Mills. During its career the engine has consumed 204,771 tons of water, and 27,486 tons of coal, equal to 32 lbs. a mile, including lighting up. During the twenty years the engine has been laid up only 12 per cent. of its time, and the cost of maintenance has been 1·28d. per mile run.—*Engineer.*

The Aeronautical Institute and Club.

THE Monthly Meeting of the Institute was held at St. Bride Foundation on Friday, September 5th, Dr. T. A. Barton being in the chair.

Mr. Carter, Works Manager to Mr. Patrick Alexander, detailed some very interesting experiments which were being conducted at Batheaston, explaining and demonstrating much by means of some of the actual apparatus in use.

Mr. L. S. Anderson produced a model of his proposed twin balloon airship. He claimed many improvements on other designs now before the public. Reference was made during the evening to the two ascents recently made under the auspices of this association—the first when Mr. Gaudron crossed the Channel with Dr. Barton; and the later ascent from Beckenham, when a short trip was undertaken by Messrs. Gaudron, McNair and Field, the landing being made at Rochester, Kent.

SPEED TRIAL OF THE TURBINE DESTROYER "VELOX."—The torpedo-boat destroyer *Velox* has just completed a speed trial, and has proved herself to be the fastest vessel in the world, for she has made a speed of 33·64 knots, which is almost equivalent to 40 miles an hour. The *Velox* was built for the Parsons Marine Steam Turbine Company, and was purchased by the Government a few weeks since. She is the third turbine-engined war vessel to be built, the two previous ones being the *Viper* and the *Cobra*, both of which were lost last year. The *Velox* is a unique vessel, in that she is fitted both with ordinary reciprocating engines and with steam turbines. The latter are only used when the highest speeds are required, and this arrangement makes the *Velox* an exceptionally economical vessel so far as coal consumption is concerned.

Trolley Arm for Model Electric Tramcar.

By Claude C. Close.

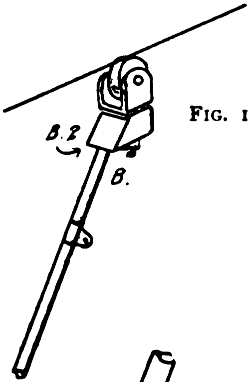


Fig. 1a.

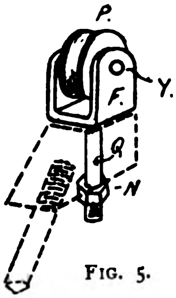


Fig. 5.

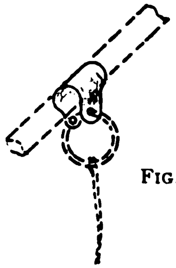


Fig. 6.

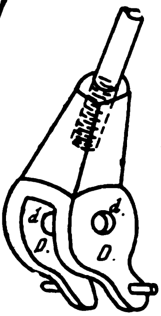


Fig. 4.

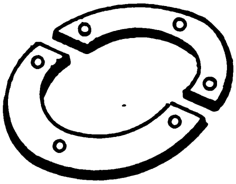


Fig. 3a.

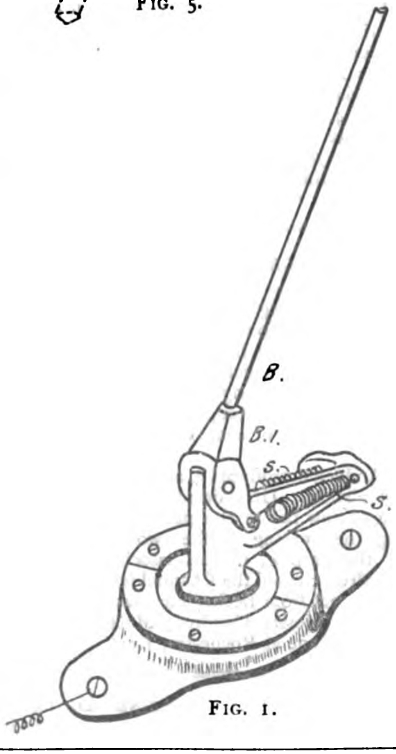


Fig. 1.

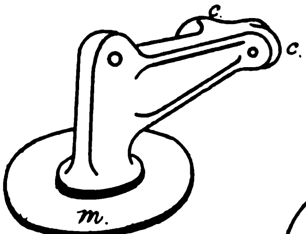


Fig. 2.

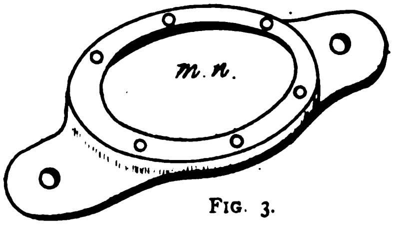


Fig. 3.

Those who are interested in electric traction, and also readers who are constructing a model tramcar on the trolley system, may find the sketches of a trolley I have constructed useful.

The rod B, B (Fig. 1) is a piece of $\frac{1}{8}$ in. brass steam pipe, this being lighter and stiffer than solid rod, and the length, of course, depends on the distance from top of car to the trolley poles. One end is screwed into the block B2 (Fig. 1a), which is also of brass. A $\frac{1}{8}$-in. tapping hole is drilled slantwise in the brass block to enable this to be done, and another $\frac{1}{8}$-in. hole is drilled perpendicular hro ugh the block to admit the shank Q (Fig. 5) of the pulley support F (Fig. 5). This should turn freely in the block, and should have a small nut N to tighten against a shoulder on the shank.

Both pulley and support are made of brass, and the pulley P (Fig. 5) runs freely on the copper spindle Y (Fig. 5), the ends of which are riveted over when the pulley is in position. To avoid breaking contact with the trolley wire, the pulley should have a good deep groove.

The lower end of the rod is screwed into the rocking bracket B1 (Fig. 1). This bracket is also shown enlarged in Fig. 4. It may be made of cast brass, or shaped out of the solid, whichever way may be most convenient.

The arms of this bracket D, D (Fig. 4), should be drilled, and two pieces of brass wire 1-16th diameter and about ⅛ in. long screwed into it. The holes *d*, *d*, are then drilled and countersunk on the outside. It is riveted to the spring support by a copper rivet, and must be able to move freely, therefore care must be taken not to bend the rivet or close up too tightly when putting the bracket upon the spring support.

The trolley and spring support (Fig. 2) is cast in brass, and the lugs C, C are of 1/16th in. brass to take the ends of the two spiral springs S, S (Fig. 1), and should be soldered in the support. The other ends of the springs C, C (Fig. 2) can be fixed by straightening out a short length and passing them through the holes, then bending over neatly on the outside. These springs should be fairly strong, and they can be made very satisfactorily by winding a length of piano wire on a mandrel. If such as piano wire is used in making them, there will be no necessity for tempering.

The round base of the trolley support *m* (Fig. 2) turns in the brass bracket *m*, *n* (Fig. 3), so as to give free play to the arm and to allow for the trolley arm to be reversed for the car to run either way.

A simple device, such as Mr. C. W. Wakelin's, which appeared in the issue of The Model Engineer for August 1st last, might be fitted, so that when the trolley arm is turned it would at the same time reverse the current in the motor.

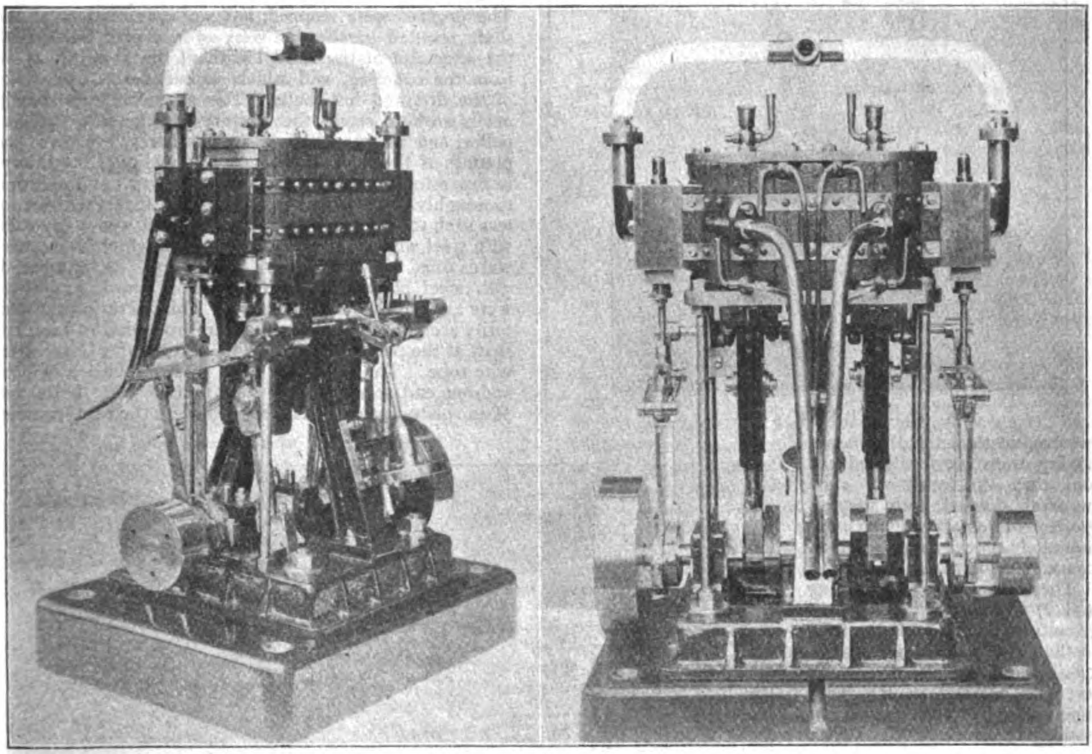
For holding down the trolley support to the base a split ring of brass (Fig. 3A) is provided, this being easier to fix than if it were a solid ring. About six small studs, say ⅛, fixes it to the base and the rings should be adjusted so that the trolley can revolve freely.

Connection should be made to one of the holding-down screws in the lugs of base; but if a reversing switch is fitted, different connections will have to be made.

S.M.E. Medallists and their Work.

J. Chadwick Taylor.

MR. J. CHADWICK TAYLOR, whose model launch engine, shown in the accompanying illustrations, gained a silver medal, is one of the earliest members of the Society. He has two pet hobbies—photography and model engineering, and he is particularly successful in both. The model shown herewith, though not his own design, is an excellent example of good workmanship and finish, and thoroughly deserved the distinction it has gained. The same model recently took the first prize in the amateur class at the Redhill and Reigate Industrial Exhibition.

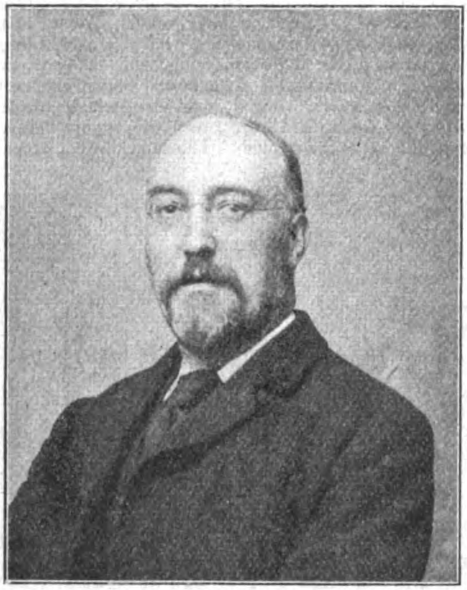


Mr. Chadwick Taylor's Model Launch Engine.

The engine was made to a prize design published in our issue of June, 1898, Mr. Taylor purchasing a set of rough castings, but for the benefit of new readers the following dimensions may be given:

Cylinders (brass) ...	1¼ ins. dia. × 1¼ ins. stroke.
Steam ports	⅛ in. bare × ½ in. ,,
Exhaust ports	6/32 in. full × ½ in. ,,
Crankshaft	⅜ in. dia.; 7/16 in. in centre.
Crankshaft bearings ...	⅝ in. wide × ⅜ in. dia.
Piston-rods	7/32 in. dia.
Crosshead pins	,, ,,
Centre of piston to centre crosshead pin ...	3 1/16 ins.
Length of connecting-rod between centres	2⅝ ins.
Cut-off of valve	¾ in. stroke.

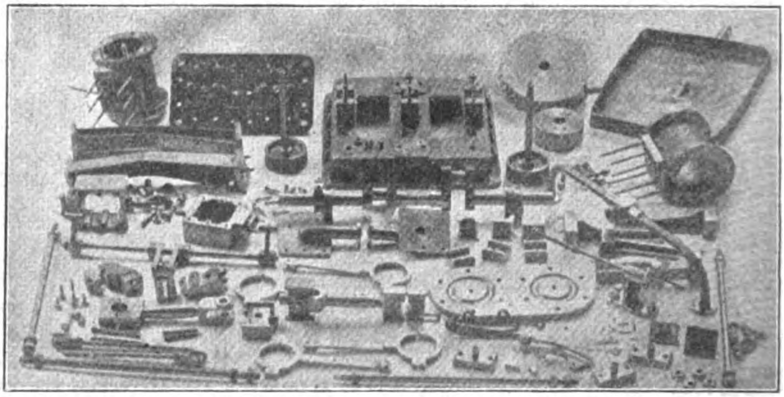
The disc flywheel was arranged to counter-balance the weight of the crank webs and connecting-rods by turning it out of a solid block to a shell, and filling half of the wheel with lead, which was then covered with a steel plate. The coupling block is also hollow and weighted with lead. The steam-chest covers are removable, enabling the valve to be very easily set by sight. The bearing and brasses were drilled *in situ* with a twist drill



MR. J. CHADWICK TAYLOR.

revolved in the lathe, the brasses having been previously halved, and then—to finish—a steel mandrel dressed with varying grades of emery powder was mounted between centres and the bearings made true.

There are 228 separate parts and 279 screws, bolts, and nuts (counting bolt and nut as two) in the model, and every part is numbered. Many of the screws are also marked in this way. The only parts of the engine not entirely the work of Mr. Taylor are about two-thirds of the ordinary screws, bolts, and nuts, and the four drain cocks for the cylinders. The lubricators on the top of the cylinders were made by Mr. Taylor. The engine has not yet, for want of a larger boiler than that at present available, been thoroughly tested; but when the drain cocks are shut, it is difficult to revolve the engine because of the vacuum and compression created in the cylinders. This speaks well for the fitting and the accuracy of the work. The boiler with which the engine has been tried would not keep up any material amount of steam pressure when the model was running, and only raised about 5 to 7 lbs. with stop-cock shut; but, under these circumstances, the engine ran at an average of 490 revolutions per minute continuously for half-an-hour, with a pressure not sufficiently great to show itself on the steam gauge. For the first minute or so the engine worked at from 700 to 575 revolutions per minute.



PHOTOGRAPH OF FINISHED PARTS OF MODEL LAUNCH ENGINE.

Skilful Mending of a Propeller Shaft.

A CLEVER engineering feat was accomplished during a recent voyage of the British steamship *Baroda* from Algoa Bay to Batavia, in connection with the repair of a fractured shaft while at sea. The vessel left Algoa Bay with a light cargo, and was therefore down at the head, which resulted in the propeller racing considerably more than if she were well down in the water, during rough weather. On the eighth day out the vessel ran into a gale, and during the evening the chief engineer, J. G. Shepherd, when entering the shaft tunnel, noticed an eccentric movement, accompanied by a peculiar sound. The engines were stopped, and an examination of the shaft resulted in the discovery of a severe fracture at the after end of the third length of the shafting 2½ ft. from the coupling, and which extended into the holes of the first and fifth bolts. The engineer immediately set to work to repair the fracture and to save the propeller, and as there was no special hurry, cut away the plating of the roof of the shaft tunnel over the injury, in order to obtain light and room to carry out the repair thoroughly. Closer inspection proved that the fracture was such that it could not be closed, so it was made solid with steel wedges, the crevices between which were afterwards filled in with Parson's white brass. A number of 3-ft. steel plates happened to be on board, and these were clothed round the fracture. This operation satisfactorily accomplished, the engineer proceeded to bind the shaft at the point of fracture with 360 ft. of 2¼-in. steel wire rope. The wire rope was passed round a winch, and one end secured to the shaft by two 1-in. bolts and ½-in. plate washer. The engines were then set running slowly ahead, drawing the wire rope from the winch, with steam full against it, by which means the desired tension and strain were secured. The wire was carefully followed and tapped round the shaft as the binding proceeded. The rope was bound round the shaft in two layers, and carried over the couplings. Progress was necessarily slow to ensure the operation being carried out skilfully. So satisfactory, however, was the work performed that the vessel steamed over 1000 miles with this repair, and through exceptionally heavy weather; on one occasion she had to heave to for twenty-four hours until the sea moderated.—*American Shipbuilder*.

The Running of Small Gas Engines.

By P. A. Jackson.

I HAVE written these few lines solely for those amateurs who, having become the proprietors of small engines, do not get the expected results out of them, owing to a deficient knowledge of the general working principles. I shall endeavour in the following, by giving a few hints, to enable the tyro to rectify any mistake he may have made in erecting his engine.

First and foremost, a firm and sound bedding for the engine is indispensable, and for a small engine of, say, under 2 b.h.-p. a strong wooden frame firmly secured to the ground will be found sufficiently strong enough to bolt the bedplate of the engine to.

A common mistake—often made by an amateur—is to fit too small a supply pipe from the meter. The usual rules for calculating the diameter of the supply pipe and the size of the meter are exceedingly simple, and are given below:—

Size of meter (counted in lights) = 3·4 × b.h.-p. + 5.
Bore of supply pipe = size of meter × 0·008 + ·75 = size in inches.

I recently found a case where the owner was running a ⅓-b h.-p. engine with ¼ in. supply pipe, and he was unable to understand why the engine would not run at one-third its normal working speed when the load was off. When the pipe was enlarged to ¾ in. the engine was found to give very good results.*

Another cause of trouble is the overheating of the water jacket, and this generally arises from one of two sources—either that the cooling tanks have not sufficient capacity, or that the circulating pipes are not of sufficient diameter. An engine will require from 20 to 30 gallons per h.-p., and the pipes from the tanks to the jackets should be from 1 in. diameter for small, up to ⅛ b h.-p., increasing by scale up to 3 ins. diameter for engines of 50 b.h.-p.

The return should be from ⅛ in. to ⅞ in. larger than the flow, and the return pipe should have a minimum rise of 3 ins. in the foot for engines under 3 b.h.-p., and 2 ins. to 2½ ins. for those over.

In all cases where it is possible the supply to the tanks should be from the main, and fitted with a ball cock on the inlet to the tank, so that the supply is automatic.

Should the level of the water in the tanks fall below the return pipe, the circulation will cease, the jacket become hot, and the engine will either stop or lose power. It will therefore be seen how important it is to keep the tanks full. The return pipe should be about 3 ins. below the common level of the water.

Valves should command great attention, and should not be allowed to get choked, and care should be taken to ensure a good seating.

If the valves do not seat correctly, they will "blow by," and the engine will loose some of its compression, and misfires will occur, with the result, perhaps, that the unfired charges will explode in the exhaust silencer with a sharp report.

Oil must on no account be permitted to get on the valve seatings.

The grinding in of valves should be performed with great care; they should first be done with flour of emery and paraffin oil, and finished with glass-powder and oil. Whilst grinding the valve, it should be given a reciprocating motion in the seating, and the position of the surfaces should be constantly changed. On no account should the motion be a rotary one, as slight hollows will in all probability result. After grinding, valves should be well washed in paraffin to remove all grit, or the spindles will wear in the guides.

Piston rings will often give trouble by the carbonised oil sticking them in their grooves, allowing the explosion to blow past. It is not always necessary to take out the piston to cleanse them; in nine cases out of ten a drop or two of paraffin or petrol poured into the cylinder will have the desired effect if the flywheel of the engine be pulled round several times sharply. Gumming can usually be put down to overheating, caused by a bad circulation, insufficient lubrication, or, most probably, bad oil.

The matter of lubrication is a very important one indeed, and too much attention cannot be paid to it. It is always necessary to observe that a sufficient supply of oil is on the piston, for if this is not attended to the piston will drag and blow, the engine will slow up, and the piston will tend to seize and score the cylinder, and thus practically ruin the whole engine.

If the engine is not fitted with an automatic lubricator with a positive motion, an ordinary drip-feed lubricator will be found to answer the purpose. Should the engine be one of a type with an enclosed crankpit, a slight difficulty may be experienced, as the piston on moving forward into the crank-chamber causes a compression which often blows the oil back into the lubricator. I have, when this has occurred, fitted a small check valve between the drip-feed and the crank-pit, the suction caused in the pit during the compression or exhaust stroke of the engine taking in the oil and the pressure on the outward stroke of the engine closing the valve. This, so far as my own experience has proved, is entirely satisfactory.

At no time should the oil under the crank be at a higher level than is sufficient to allow the crank to just touch the oil as it revolves, or the crank will lash the oil into the cylinder and cause a dirty exhaust. In engines of the ordinary open type, the oil after passing from the cylinder down to the pit can be collected, and will be found quite serviceable for general shop requirements. The exhaust pipe of any internal combustion engine should never, on any account, be of less diameter than the opening or port of the valve, the best plan being to allow a slight increase in the diameter.

There should be as few bends as possible in the exhaust pipe, as otherwise there will be a tendency to throttle. It has been found, in fact, that an exhaust pipe 20 ft. to 30 ft. long, without any bends, will act as an automatic exhaust, the velocity of the exploded gases in the pipe causing a partial vacuum in the cylinder. With a long length of exhaust pipe there is bound to be a certain amount of condensation, varying with the temperature of the atmosphere. This condensation, starting at the far end of the pipe, works back when the engine has stopped, and water collects in the exhaust box. I have, in cold weather, drawn from an 8 b.h.-p. engine with over 60 ft. of exhaust pipe over a quart a day.

Sometimes this water will work back into the cylinder

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* Although a ½-in. pipe is really large enough for a ⅓ b.h.-p. engine supply, the fluctuation in pressure in the main supply pipe occasioned by the sucking action of the engine, prevented a steady and sufficient heat being given to the ignition tube, thus causing missing fire, and the speed would drop accordingly. In most cases it will be found that the Bunsen burner supply is taken off the engine supply. This is a bad plan, and should be avoided whenever possible. Use the ordinary house or workshop lighting supply for the burner, and let the engine have a meter to itself. Where this is not practicable, other methods to steady the pressure are resorted to.—Ed. *M.E. & A.E.*

and prevent the engine from starting, and will rust the valve seatings. All engines do not accumulate water; but, notwithstanding, I have always found it advisable to fit a ¼-in. composition pipe to the bottom of the exhaust box, and run it into the nearest gully.

The exhaust box should always be fitted as low as possible, within reason, below the cylinder.

How to Make Experimental Electrical Apparatus.

By T. G. J.

The Dip Circle.

(*Continued from page 162.*)

TO fix the needle to its axle, two small cardboard punchings are used. These are ⅛ in. diameter, and 1-32nd in. thick, and are attached to the sides of the dipping needle with Seccotine. Smear a little of the Seccotine over one face of one of the punchings, and then pass the axle through this face until the axle is almost half way through the punching. Next slide the dipping needle over the axle and push it up close to the fixing wad; the other punching is then smeared in like manner as the first and pressed up close upon the dipping needle. The axle should now be finally adjusted until the needle is in the exact middle of the axle. The two fixing wads must then be pressed tight against the sides of the needle with the finger and thumb, and thus held for a short time to enable the adhesive to take effect. To fix the dip needle in position place on end of the axle in the concave end of the fixed stud in the side of upper frame, then bring the other end of the axle opposite the adjustable stud, and screw up the latter until the axle points are delicately supported between the pivots. A careful adjustment of the loose stud will be necessary, for if screwed in too far the dip needle will not swing freely, and if, on the other hand, it be not screwed up far enough the points on the axle will not be supported against the bottom of the concave holes in the ends of studs, but instead will lie on the sides; thereby reducing the sensibility of the needle. When supported between the pivots, the needle should remain balanced in any position; if this is not so, the ends must be filed on their flat faces until the balance is perfect. The final adjustment is made by grinding on an oilstone. The dip needle is magnetised by the method of divided touch (described in article on "Magnets"), and a distinguishing mark made on one side of the needle at its north end. The north pole of the needle should dip downwards when the needle is balanced between its pivots.

As it is frequently necessary to change the polarity of the needle, a clamping table is made use of to clamp the needle while it is being magnetised. This table consists of a baseboard of walnut or mahogany, 4 ins. long, 2½ ins. wide, and 2 ins. thick. At the middle of one of the 4-in. faces a brass plate is fitted. This plate is 1⅛ ins. long, ¾ in. wide, and ⅛ in. thick. A small hole is drilled and countersunk near each end of the plate, to take the screws which fix it to the base. Another hole is drilled in the centre of the plate, and tapped to take a 3 16ths-in. screw. A portion of the surface of the base is cut away to let in the plate, so that the latter, when screwed down, will be flush with the surface of the base. Another plate, 2 ins. long, ¾ in. wide, and ⅛ in. thick, is cut as shown in Fig. 17, and tapped ¾ in. from the rounded end to take a 3 16ths-in. screw. The method of cutting the circular groove is illustrated by the dotted lines in the figure. This latter plate is placed on the top of the one screwed to the base, and a brass thumb-screw provided to keep them both together. A hole must be bored in the base to correspond to that in the brass plate, to admit the shank of the clamping screw. When the plates are fixed in position with the thumb-screw, a ¼-in. hole is bored in the base inside the circular groove in the end of the upper plate. This hole is bored ⅛ in deep, and then continued with a ⅛-in. bit for another 1½ ins. The needle is placed on the clamping table with its pivot resting in the ⅛ in. hole, and the fixing wad in the ¼ in. hole, the ends of the upper or clamping plate resting on the needle. The thumb-screw is then screwed up so as to clamp the needle firmly while it is being polarised. Fig. 16 is a plan of the complete clamping table, and the dotted lines indicate the position of the upper plate and thumb-screw. To assist in levelling the apparatus a spirit-level is used. A

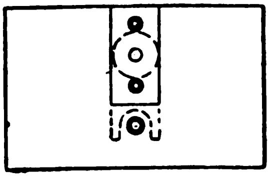


Fig. 16.

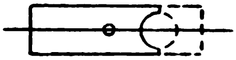


Fig. 17.

DETAILS OF DIP CIRCLE.

tubular brass level is best suited to this purpose, and it should be supported on a small, wooden stand, as shown in Fig. 1.

To level the apparatus proceed as follows:—

(*a*) Place the spirit-level across the horizontal graduated circle (the upper part of the apparatus being temporarily removed), and level the instrument with the levelling screws.

(*b*) Remove the spirit-level, and place it across the sides of the upper frame, this having again been placed in position on the horizontal circle. Test this part for truth in horizontality, and if at all imperfect it must be rectified by filing the underside of the boxwood cross strip where it rests on the horizontal circle. Make final adjustments by sand-papering the strip.

When all these operations have been satisfactorily performed, the spirit-level should be placed on the upper side of the boxwood cross strip, as shown in Fig. 1, and it should be observed whether the drop in the glass tube still remains in the centre. If so, all is well; but, if not, the upper surface must be sand-papered until this end has been attained. When once these points have been put right, it will only be necessary in subsequent levellings to place the spirit-level on the cross piece of upper frame and adjust the screws.

To conduct a dip observation we proceed as follows:—Move the upper frame about until the points of the needle are at the ninety degree marks. The needle is then vertical, and swinging in the plane which lies magnetic east and west, and at right-angles to the magnetic meridian. In this plane no horizontal force can act on the needle, which comes to rest under the influence of the vertical components only of the earth's force, and therefore stands vertical. With the needle in this position the index of the horizontal circle is read, and the box being then turned ninety degrees round the needle will come into the plane of the magnetic meridian, which is the required position. To eliminate instrumental errors both ends of the needle are read, estimating to one tenth of a degree, and the needle then taken out and reversed face for face and the readings repeated, finally the upper portion of the apparatus is turned round through 180 degrees, and all the readings repeated; so that in all eight observations are made, and the mean taken as the most correct result.

Example:—

Suppose N represents one end of needle, and N′ the other end. Also suppose that S and S′ represent the two faces of the needle. Then the eight observations will be as follows:—

Position of instrument.	Side of needle nearest vertical circle.	Reading of N.	Reading of N′.
1st position	... S ...	A ...	A′
"	... S′ ...	B ...	B′
Turned through 180°	... S ...	C ...	C′
"	... S′ ...	D ...	D′

The polarity of the needle must now be reversed by the method of "divided touch," so as to make the other end dip. The axles must then be cleaned with cork, and the needle again fixed between its pivots and eight further observations taken. This second series is precisely analogous to the first, the only difference being that the reverse end of the needle is dipping.

The observation is now complete; but in order to ascertain the true dip, the mean of the sixteen readings must be taken.

Example:—

Pole N dipping.			*Pole N′ dipping.*		
A.	A′.	Mean.	A.	A′.	Mean.
67·2	67·3	67°·25	67·35	67·4	67°·375
B.	B′.		B.	B′.	
67·5	67·5	67°·50	67·8	67·6	67°·700
C.	C′.		C.	C′.	
68·0	67·7	67°·85	68·0	68·25	68°·125
D.	D′.		D.	D′.	
67·15	67·25	67°·20	67·1	67·15	67°·125
Mean of means 67°·45			Mean of means 67°·58		

Mean of all the observations 67°·52.

The 90° marks should be at the top and bottom of the vertical scale or graduated circle, and not at the sides as shown in the figures.

The inclination as observed at London in the year 1880 was 67° 36′, in 1891 it was 67° 31′, and in 1900, 67° 11′·8.

It is of the highest importance that the bearings of this apparatus be kept clean and free from dust.

THE *Locomotive*, an American paper published by the Hartford Boiler Insurance Company, records the following:—A toy boiler operated by the son of William Sawyer, manager of the gas works at Charlotte, U.S.A., exploded with serious results on December 31st. Several boys had arranged a boiler about 4 ft. long and 12 ins. diam., over an arch. Filling it partially with water, they closed all its vents and kindled a fire beneath it, expecting to have all kinds of fun blowing a whistle that they had attached. The resulting explosion threw chunks of iron in all directions, and the lad Sawyer was injured so badly that his left leg had to be amputated.

THREE Scotch boilers of the type used on ocean liners, but probably the smallest ever built perfect in every detail, are being constructed for three open launches of the Coast and Geodetic Survey by the James Clark Company, at Baltimore. The boilers have a length of 5 ft. 5 ins., and an inside diameter of 53½ ins. The diameter of the furnaces is 24 ins. The fireboxes have a heating surface of 163 ft. The boilers are to carry 125 lbs. of steam, and are of 25 horse-power each. As the launches for which the boilers are intended cannot always get fresh water, the Scotch boilers, which use either fresh or salt water, will be installed.—*Nautical Gazette, U.S.A.*

Model Yachting Notes.

MR. ALFRED HILEY, of the Barrow-in-Furness Model Yacht Club, has been good enough to go into the subject of the Y.R.A. rating in connection with $\frac{\text{"L.W.L.} \times \text{S.A."}}{6000}$ boats, and has furnished us with the tabulated results of the application of the newer rule to the vessels in his own club. In addition to this, Mr. Hiley has detailed his own views on the rule, which does not find favour in his eyes. To quote his own words:—

"The opinion of our members is that the present Y.R.A. Rule is too much complicated to adopt. The models are only faired on paper, and are not made the subject of thorough calculation and measurement, and the rating would be very uncertain until the model was finished. I regret to say the rule will not be accepted here, as the advantages obtained by its adoption are very uncertain, and being all fin-keel boats, the factor in the rule of four times the difference in girth is very considerable and variable.

"In my opinion, a fin keel is absolutely indispensable in a model yacht for good steering and keeping its course in such a big dock as we race in. If a model yacht were to be built with a keel such as is common in real yachts, she would make a very unsteady boat, the keel not producing much but lateral resistance when placed in the middle; but if the same area were put well forward and aft, it offers great moment of resistance to turning as well—an essential condition in a model.

"In conclusion, I should like an opinion of a rating rule which I have devised, and which could be universally applied to all sailing craft.

"The rule would admit the several type of boats built under the different rating rules, and would measure the capability of the yacht without regard to anything but the sailing qualities. It would not involve any *dodging measurements* as is so common nowadays.

I arrived at the rule in the following steps:—

(1) A yacht's capability for speed depends on—

$$\frac{\text{PROPELLING FORCE}}{\text{RETARDING FORCE}} \times \sqrt{\text{LENGTH}}$$

(2) Propelling force is proportional to sail area. Resistance is proportional to Stability.

$$\frac{\text{SAIL AREA}}{\text{STABILITY}} \times \sqrt{\text{LENGTH.}}$$

$$\text{RATING (3)} \; \frac{\text{SAIL AREA SQ. FT.} \times \sqrt{\text{LENGTH of L.W.L.}}}{\text{*WEIGHT (only) to Heel } 4^\circ}$$

(Sail area in square feet, weight in lbs., length in ins.)

* *Weight* is placed at a distance of ⅛ L.W.L. from centre line amidships.

Weight is put on sufficient to heel yacht 4°, and the amount of weight noted.

The rating should give a figure which is a multiple of speed obtainable.

"The reason I wish this rule were in vogue is—that it would give designers the chance of producing a fine boat without *dodging measurements* so much, and would produce a wealthy and capable boat. The object would be to get good stability together with least resistance and suitable sail area. In closing such a rule it would be discreet to limit length and overhang. On reviewing present and past rules, it is no wonder that it is stated that it is very debatable whether much advance has been made in yacht-designing for the last twenty years."

The following notes on Mr. Hiley's communication are from the pen of Mr. W. H. Wilson Theobald, whose experience enables him to speak with confidence on the subject. The first paragraph has referred to the tables submitted by Mr. Hiley, but which we do not reproduce, since everybody knows that the $\frac{\text{L.W.L.} \times \text{S.A.}}{6000}$ Rule has produced the shallow-bodied fin-keeler.

"As regards the column on the first page, I find he has, in adding up the elements of the new Y.R.A. Rule, taken ¼ of skin girth instead of ¼ of chain girth. His column of fractions is, therefore, wrong. All the boats are obviously fin-keelers, as is shown by the enormous difference between the chain and skin girth.

"Mr. Hiley says that under the new Y.R.A. 'the rating would be very uncertain until the model was finished.' This would apply even more so to models built under the rule suggested by him on the second page. The weight necessary could only be found by working out the heeling moments of the boat, and this can only be discovered when the design is complete and the calculations are of a most intricate nature. I grant when the boat is made the measurement would be simple; but from a designing point of view, the difficulties which would arise would make the rule quite impracticable.

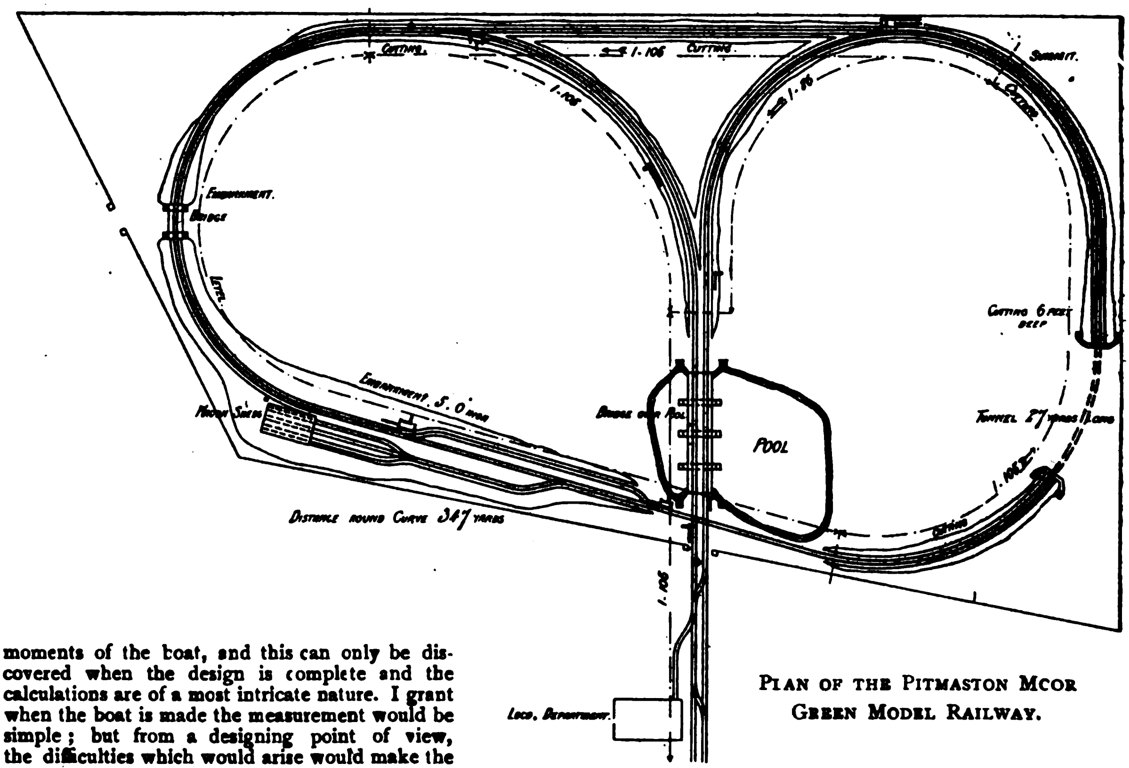
"I join issue with Mr. Hiley when he says that a fin keel is absolutely indispensable in a model yacht. In my opinion a keel boat is (or, rather, should be with properly balanced centres) quite as steady a sailer as the fin keeler. At the same time, I grant a model is not satisfactory with the fore foot very much cut away as in a real yacht.

"Mr. Hiley's rule would, I should imagine, foster an exaggerated skimming dish. The reason for so thinking is, because the object would be to give the boat as much *initial* stability as possible, and this is gained by giving enormous beam. A plank floating on the water would take more weight to tilt it through the 4° than would be necessary to move a weighted body through the same angle; although the ormer would, of course, be absolutely crank when heeled to, say, 45° or 50°; whilst the latter, although easily heeled to the 4°, would be very difficult to upset entirely."

A Visit to the Pitmaston Moor Green Model Railway.

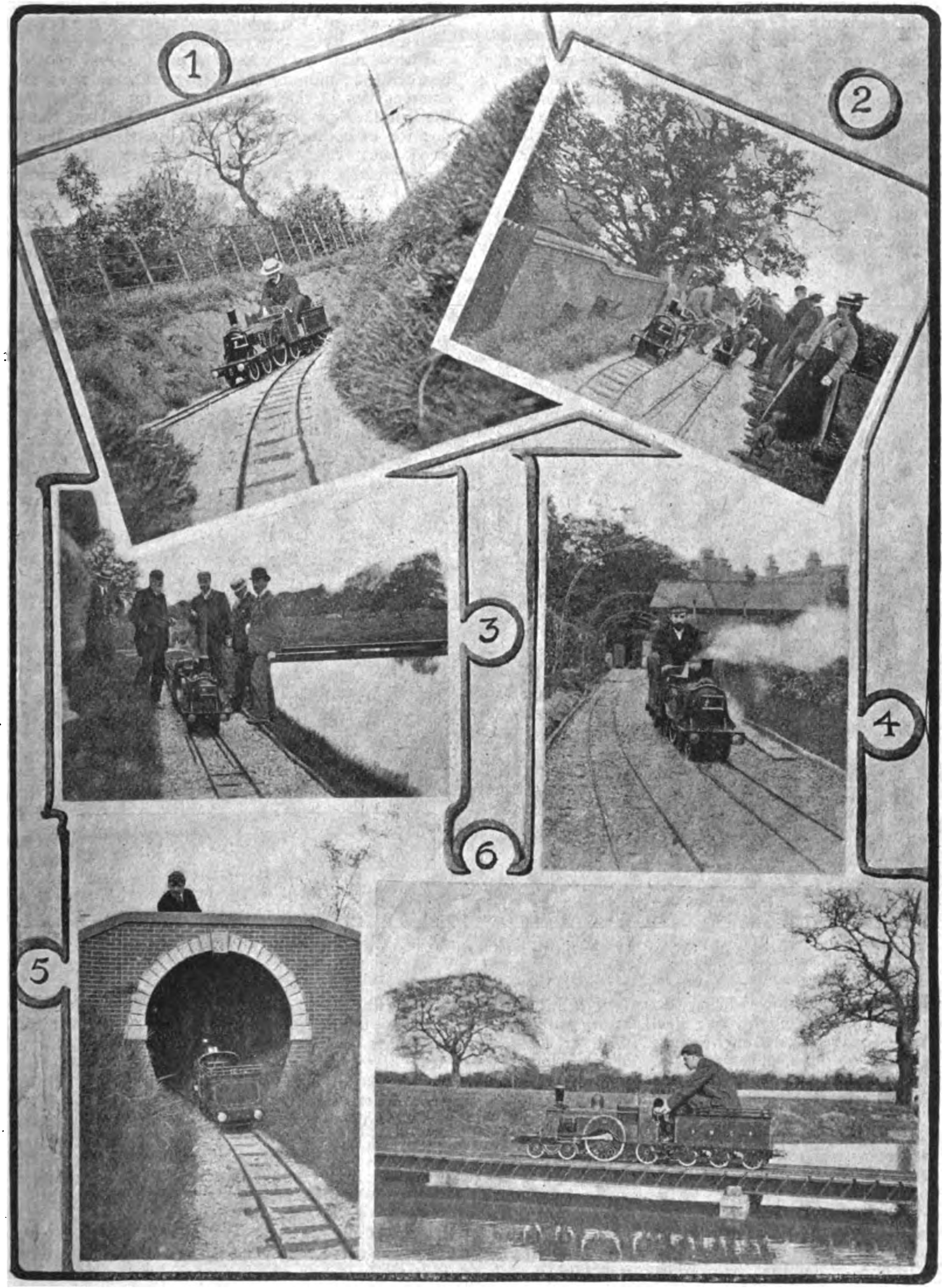
By "ATLAS."

ONE fine morning in June last, I forsook the beaten path which leads to the editorial offices of THE MODEL ENGINEER in the heart of London's city, and struck a bee-line (or as near this as an Inner Circle train could get) for Paddington *en route* for Birmingham and the home of the Pitmaston Moor Green Model Railway. Much as I admire the running on the L.N.W. Ry., the alternative route to Birmingham per the Great Western has a scenic charm which I am seldom able to resist, and least of all when in "leafy June" the upper reaches of the Thames are looking at their best. However, this is somewhat beside the point, for many of my readers probably know the land of the G.W.R. a great deal better than I do.



PLAN OF THE PITMASTON MOOR GREEN MODEL RAILWAY.

Arriving at the Snow Hill station only two minutes behind time, I made my way to the offices of Mr. Henry Lea, where, by appointment, I was to meet my hosts, Messrs. H. C. and J. A. Holder. They beat the G.W.R., for they were not even two minutes late, and were waiting with Mr. Lea to run me over to their house at Moor Green in a Lanchester car, which forms one of their motor "stud." Half-an-hour's run, comfortably within the legal speed limit, sufficed to land us at our destination. Short as this run was, it served to amply demonstrate Mr. Holder's skill as a motorist, and this will be readily appreciated by those who are familiar with the traffic conditions of the Metropolis of the Midlands, where steam trams seem to be flying round every other



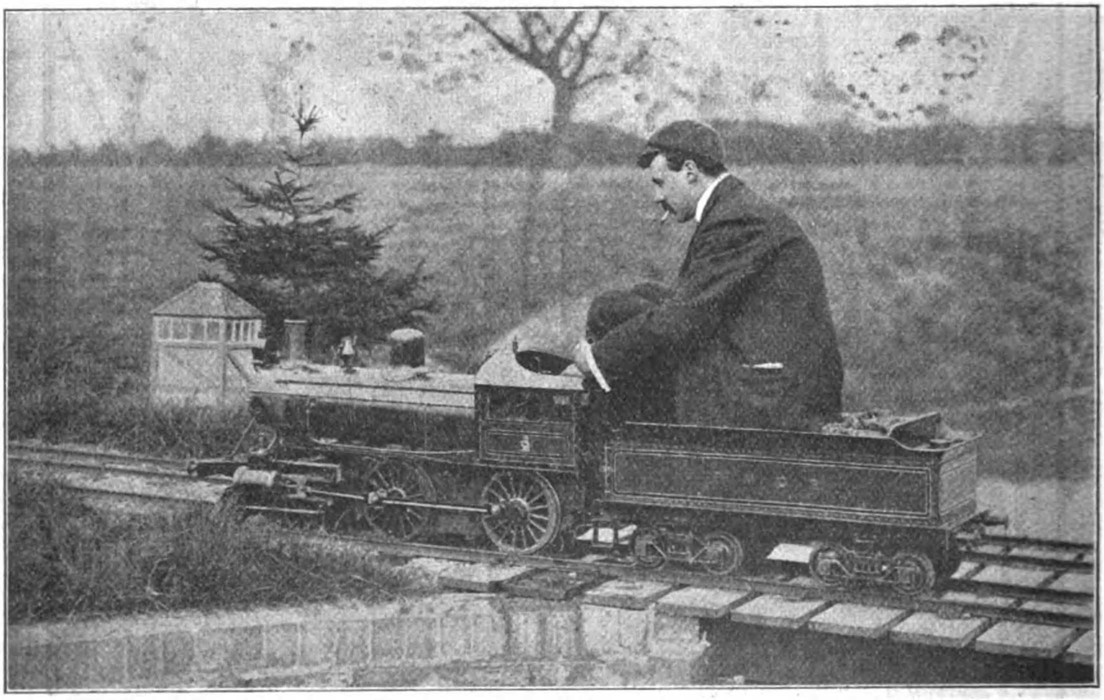
(1) Mr. H. C. Holder and G.N. Loco in the Cutting. (2) "A Consultation.") (3) "Waiting for Steam." (4) "Atlas" on the G.N. Footplate. (5) Entrance to the Tunnel. (6) Mr. J. A. Holder and G.N. Locomotive on the Bridge.

corner of the street, stopping and starting when everybody but the driver least expects it.

At Pitmaston, engineering, prominent as it is, gives precedence to hospitality, and the officials of the P.M.G. Ry. gravely informed me that I could not be permitted to inspect their line until "after lunch." Previous experience of the futility of arguing with railway powers that be convinced me that objections would be of no avail, and I protested not; wherein, gentle reader, you will doubtless agree I showed much wisdom.

This agreeable adjournment concluded, we made our way to the wagon sheds, where we found a G.N.R. loco getting up steam under the supervision of Grimshaw, the worthy foreman mechanic of the line. A temporary sheds again, with another warning whistle, the shutting off of steam, and the gentle application of the brakes, we pulled up in style exactly at the point of starting.

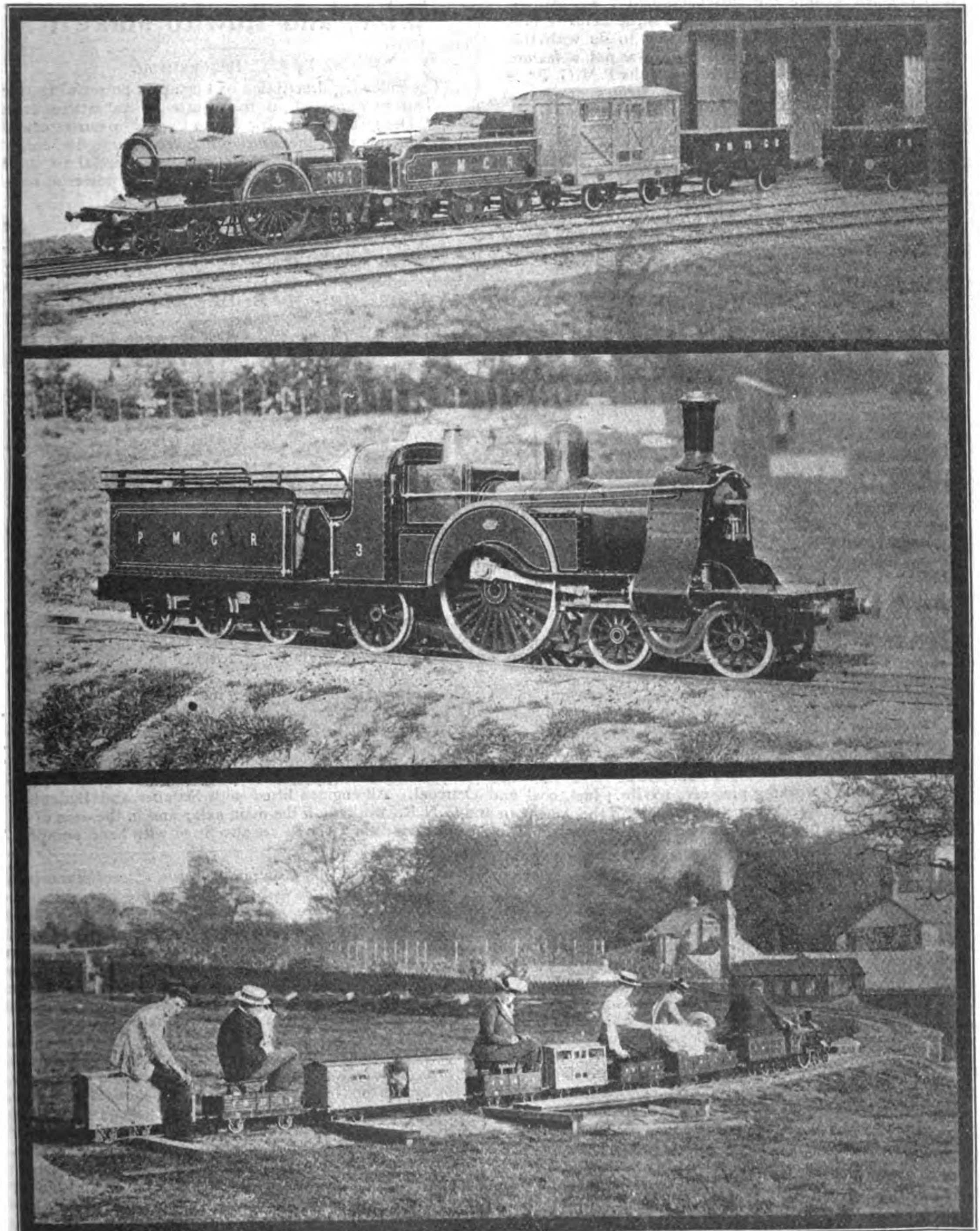
I needs must try my hand at driving, and accordingly boarded the tender of the loco, which, so far as the accommodation of the driver is concerned, corresponds to the footplate proper. I have not yet reached the proud position of controlling the regulator of a full-sized iron steed, but its fascination must be immense if its exciting thrills are at all in proportion to those experienced when driving a fair-sized model. To feel the engine respond to the least touch of the regulator handle; to pick up speed, or to slacken; to watch it "snort" up a gradient with a heavy load behind, and to scoot round a downhill



Mr. J. A. Holder on the "Yankee" Model.

chimney placed over the ordinary funnel of the loco materially aided the draught, and a satisfactory running pressure was soon registered on the gauge. With Mr. J. A. Holder on the footplate, and a passenger load consisting of Mr. H. C. Holder, Mr. Henry Lea, and myself, we started on our initial trip to survey the line. The first portion of the run was up a steady gradient, which was taken in fine style, the beat of the engine as she got her load under way being of a very professional character. Then a blast on the whistle announced our entry of the tunnel, twenty-five yards of darkness quite as impressive in its way as any mile-long run through the real thing. Emerging into daylight once again, we found ourselves in a cutting, banks and bushes on either side, enabling nothing to be seen but the sky overhead and the track ahead. A signal showed the road all clear and on we went, past an opening where the home line across the water ran down to the loco shops, and out of the cutting into the open again. The gradient now in our favour, we sped along until, on the curve approaching the wagon curve with a clear road ahead and the gear notched up—these are the delights of model loco driving, which must be felt to be fully realised. I need not detail the incidents of my trip, for nothing startling happened, although I did hear rumours of "awful disasters" which had occurred when a strange hand had been put on duty.

By the time the G.N. model had been fully tested, the "Yankee" had been brought out of the sheds to show its paces. Here friend Grimshaw looked somewhat anxious, for this was a model of his own creation, and she was about to undergo a critical examination. His anxiety soon gave way to a happier expression, for I could not but admire so excellent a piece of workmanship, and, as a trial subsequently proved, so efficient and powerful a design. Indeed, the "Yankee" is the crack model of the line, having broken all records for both speed and power. It once held the record, too, for a non-stop run, doing fifteen laps of 303 yards each, pulling two people besides the driver. This performance has, however, now been beaten by the G.N. model, which lately ran twenty-



THE GREAT WESTERN MODEL.—THE G.N. MODEL WITH BELPAIRE FIREBOX.—A P.M.G. "MIXED" TRAFFIC TRAIN.

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four laps with a six-passenger load. Even then it was only stopped because the passengers said it was getting monotonous! By the way, I wonder if the Belpaire fire-box on the G.N. model had anything to do with this splendid performance. The Belpaire was not a feature of the original model, but was added in the P.M.G. Ry.'s own shops. A Belpaire G.N. loco strikes one as a novelty; but even novelties are sometimes successful, as the P.M.G. experiment has proved.

After the trials on the track, I peeped into the workshops, where I found a similarly satisfactory state of things prevailing. With an abundance of tools, well arranged and ably used, the mechanical requirements of the line can be promptly dealt with on the spot. I found a Great Western model undergoing some repairs and also several items of rolling-stock more or less completed.

LEADING DIMENSIONS OF THE PITMASTON MOOR GREEN MODEL LOCOMOTIVES.

	American Locomotive.	Gt. Western Locomotive.	G. Northern Locomotive.
Diameter of Cylinders	2 ins.	2 ins.	2 ins.
Stroke	3½ ins.	2¾ ins.	5 ins.
Diameter of driving wheels... ...	9 ins. (4-coupled)	12 ins. (single)	16 ins. (single).
Diameter of bogie wheels... ...	4 ins.	4 ins.	7½ ins.
Diameter of trailing wheels ...	—	6 ins.	9 ins.
Boiler: barrel length, without smokebox ...	2 ft. 4 ins.	2 ft. 3¾ ins.	3 ft. 0½ ins.
Boiler: barrel diameter ...	7½ ins.	7½ ins.	8¾ ins.
Firebox, outside..	11¼ ins. × 7¾ ins. } 9ins. deep.	8 ins. × 9½ ins. } 11¼ ins. deep.	
„ inside ...	10 ins. × 6½ ins. }	6½ ins. × 5 ins. }	7 ins. × 11½ ins.; 9ins. deep.
Nos. of tubes (⅝in.)	12	16, and 2 cross tubes in firebox.	20 ins.
Tender: diameter of wheels ..	3¾ ins. bogies, 7½ ins. centres.	5 ins.	7 ins.
Length of engine and tender over all	7 ft. 6 ins.	7 ft. 5 ins.	9 ft.

Gauge, 10¼ ins.; working pressure, 100 lbs.; fuel, coal and charcoal. All engines fitted with Schaffer and Budenberg injectors and force pumps in the cases of the American and G.N.R., worked off the main axle; and in the case of the G.W.R. two pumps, worked off the cross heads. The American and the G.N.R. are also fitted with hand pumps.

Next an inspection of the photographic history of the P.M.G. Ry. in the Directors' private album—and a cup of tea. Of course, my editorial instinct prompted me to annex some of the photographs for the benefit of my readers, and I very nearly succumbed to the temptation. But prudence prevailed and virtue was duly rewarded, when Mr. Holder very kindly promised to send me a special batch for reproduction in The Model Engineer. Here they are, as also a sketch plan of the line which is a copy of the Surveyor's original plan. To the official photographs have been added some snapshots of the events on the afternoon of my inspection, and for these I am indebted to the courtesy and the photographic skill of some of the Company's fair season-ticket holders who graced the occasion with their presence.

A brief chat with Sir John Holder on the charms of model engineering, followed by the intimation "The motor is waiting, Sir," brought a most delightful and interesting afternoon to a close.

The *Oceanic* arrived at Queenstown recently, having made the passage from New York in 5 days 18 hours, which is record time for vessels of the White Star fleet.

A 40-Ampere-Hour Accumulator, and How to Make It.

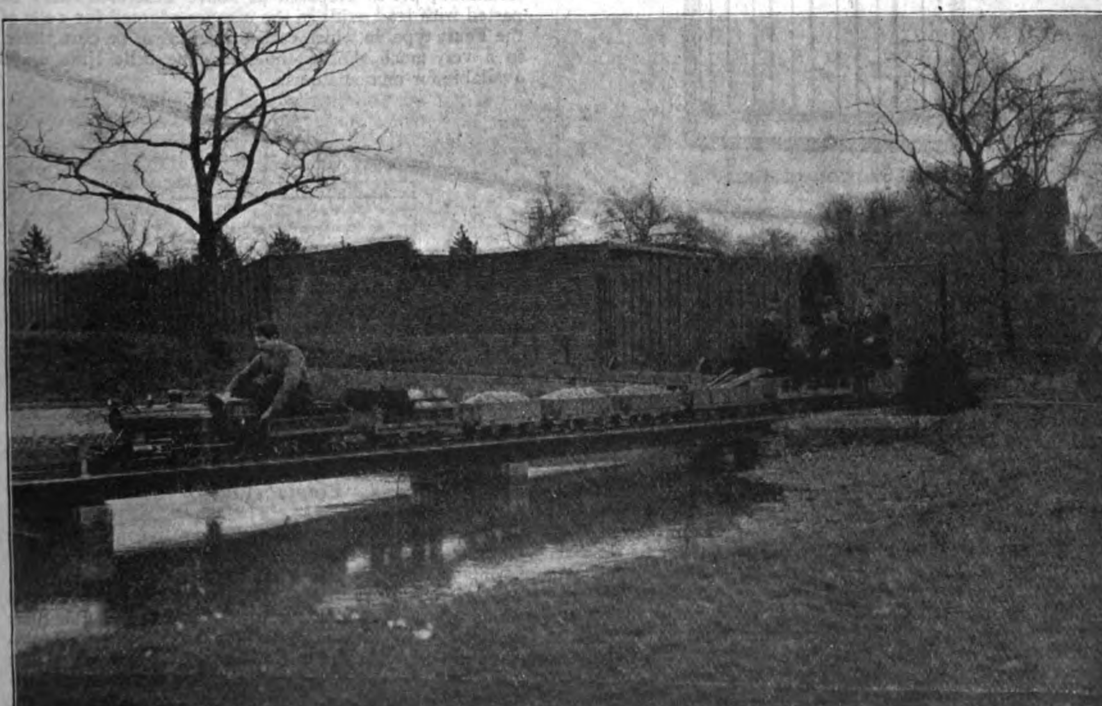
By J. C. Brocksmith.

(The following description of a compact powerful storage battery appeared in the course of an article on a "Design for an Electric Motor Cycle," in our esteemed contemporary, the *American Electrician*. As here reproduced, we are sure it will prove useful to those readers who desire to construct a fairly powerful accumulator for any purpose.)

A STORAGE battery which may be used with good results in connection with an electric motor cycle, or for other purposes where a strong battery, not easily damaged, is required, consists of ten seven-plate elements of the "sawed plate" or Planté type of foundation. The plates are separated by means of perforated and corrugated sheets of hard rubber, and are sealed in hard rubber jars. Figs. 1 and 2 show the details of the rubber cell, element and plates. The cells are to be 3¼ ins. by 4½ ins. by 7 ins. outside measurement, and are to be made of stock ⅛ in. to 5-32nds in. thick. At the bottom of the cell there are some ribs, preferably vulcanized in, which support the elements free from the bottom of the jar. The builder is advised to procure his jars or cells first, if the same can be obtained ready made of the size, or nearly the size, specified. He can then, if necessary, slightly modify the elements to fit his jars. The best plan is to have cells made to order to just the required dimensions, though this will be somewhat more expensive.

The plates are to be cut from pure sheet lead 5-16ths in. thick in case of the positives, and ¼ in. and ⅛ in. in the case of negatives. All plates are to be 4⅛ ins. wide and 5½ ins. in height, and are to have connecting lugs or tails provided at their tops ⅝ in. wide and ½ in. high, said lugs to be cut out in one piece with the plate proper. It would appear at first sight that this latter process will

THE WAGON SHEDS AND SIDINGS



A P.M.G. BALLAST TRAIN CONVEYING PLATELAYERS TO WORK.

result in some waste of material; but this is not the case. By cutting the plates in such manner that the lugs of adjacent plates are toward each other, the material cut away in making two plates is only a small strip ½ in. by 2⅞ ins. long. Moreover, these pieces can be re-melted and used in casting the terminals of the cell, which are shown in the upper portion of the figure. In no case should the lugs be burned or soldered to the edge of the plate, as a joint so made will be constantly exposed to electrolytic action, and is sure to give trouble sooner or later. One joint between a plate and the terminal of the cell is unavoidable, of course; but in the arrangement shown this is made outside the solution, where it can, if

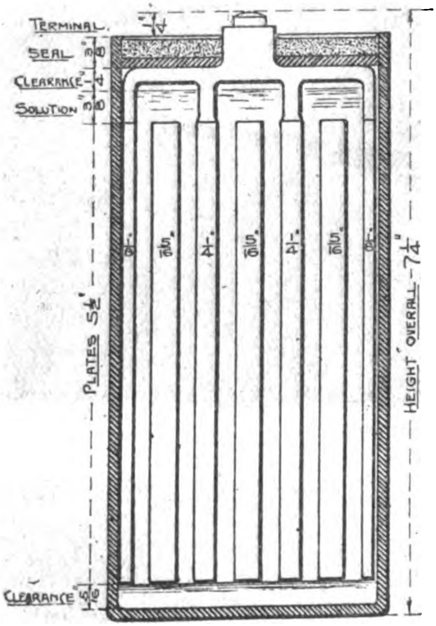


Fig. 1.—Section of Cell.

desired, be still more fully protected from corrosion by coating with acid-proof paint or some similar substance.

When the plates have been cut to size they are to have a number of slots cut in each face by means of metal cutting saws. The two end negatives of each element being active on one face only, are to be only one-half the thickness of the other negatives, and sawed on one side only. Inasmuch as there are some seventy plates to prepare in this manner for a ten-cell battery, it will be advisable for the builder to make considerable preparation in the way of special attachments which will enable him to do the work rapidly and accurately.

A series of cutters may be mounted on a mandrel, spaced at proper intervals, and driven between centres in the lathe. The plate may be fastened upon a small table attached to the slide-rest of the lathe, and adjusted for height so that the cutters will cut to the proper depth. The cutters may then be started and run across the plate by turning the feed screw. Several cuts may be necessary to complete the plate, depending on the number of cutters used. It is not necessary to use an expensive form of milling cutter for this purpose; an ordinary stamped steel cutter, known as a screw slotting cutter, will answer the purpose equally well. In the positives the cutters should be spaced ⅛ in. between centres, the width of the slot should be 5-64ths in. and its depth ⅛ in. In the negatives the cutters are to be spaced ⅛ in. between centres, the width of the cut is 3-32nds in. and the depth of the same 3-32nds in.

Ordinarily, plates so prepared are formed by the Planté process or some modification of same, whereby the active material is formed out of the plate itself; and when formation is complete, all the narrow slots in the face of the plate are filled with active material, consisting

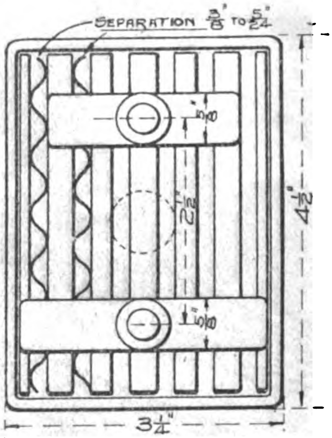


Fig. 2.—Plan of Cell.

of lead peroxide on the positives, and finely-divided metallic lead on the negatives. Where, for any reason, it is not desired to spend the time necessary for the Planté formation, plates prepared as above described may be pasted with lead oxide in the manner adopted for cells of the Faure type, in which case formation can be completed in a very much shorter time, and the cells thus made available for immediate use.

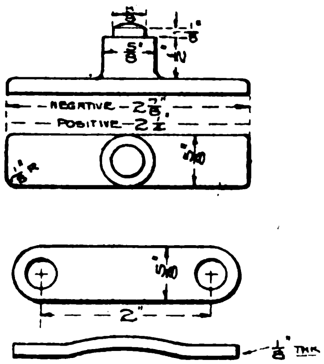


Fig. 3.—Connections of Cells.

The plates are assembled with positive and negative plates alternating, three positives and four negatives composing an element. The connecting lugs are then soldered or burned to the cell terminals, the four negatives connecting with a crossbar on one side, and the three positives with a similar bar on the other side; while this is being done, the plates should be spaced at proper intervals by means of some pieces of board or slate of the proper thickness, and, finally, these can be slipped out and the regular perforated separator substituted therefor.

The complete element is now placed in the jar, and a hard rubber cover fitted into the top of the jar and provided with a pair of holes 2½ ins. between centres large enough to allow the round cell terminals to pass through, and provided in the centre with an opening, through which the electrolyte can be renewed, and for the escape of gases, is placed in position. Sealing compound is heated and poured in on top of the cover, rendering the cell watertight. This compound is indicated in the section of the cell (Fig. 1) as a layer about ½ in. thick, filling the space between the cover and the top of the jar. It will be understood, of course, that the screw plug of hard rubber, or some similar device, must be provided in the centre of the cover for the renewal of the electrolyte and the escape of any gases which may be evolved during charge. Such a plug is indicated in the plan view of the cell (Fig. 2) by the dotted circle ¾ in. in diameter, midway between the terminals of the cell.

For connecting cells of the battery in series some links are to be made of sheet lead, ⅛ in. thick, with holes at their extremities to engage projections on the terminals

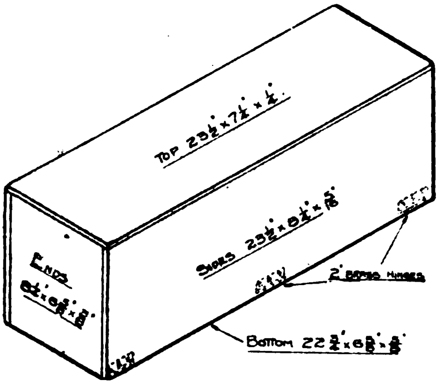


FIG. 4.—BATTERY BOX.

of the cells. When the cells constituting the battery are finally assembled these links are to be soldered on, thus connecting the cells permanently in series. The principal data in regard to the cell here shown are as follows:—

SAWED PLATE ELEMENT.

3 positives, 4⅛ × 5⅛ × 5-16 thick.
4 negatives 4⅛ × 5⅛ × ¼ and ⅛ thick.
Surface, one side one plate, 22·75 sq. ins.
Total positive surface, 136 sq. ins., ·94 sq. ft.
Space for positives, 3 × 5-16 = 15-16 in.
Space for negatives, 3 × ¼ = ¾ ins.
Space for separators, 6 × 5-24 = 1¼ in.
Note: Make separators 3-16 to 5-24 in.

Weight of positives, $\dfrac{3 \times 22{\cdot}75 \times 1{\cdot}22}{16} = 5{\cdot}2$ lbs.

" negatives, $\dfrac{5{\cdot}2 \times 12}{15} = 4{\cdot}15$ "

" electrolyte, 1¼ × 4 3-16 × 6⅛ × ·045 = 1·5 "

" jar, estim. 1·15 "

" cell, complete, 12· lbs.

Capacity of cell, 40 ampère-hours at 15 ampère discharge rate.

The electrolyte for use in this cell is a mixture of sulphuric acid and water, both preferably pure, and having a specific gravity, when the cell is fully charged, of 1·250 to 1·275.

Fig. 4 shows the details and dimensions of the battery box. It will be understood, of course, that this size of box is suitable for containing ten cells of the size specified above. If any other size of cell be used, these dimensions will require to be modified. This box is intended to be made of some good, substantial hard wood, such as ash, walnut, or cherry. The inside of the box is to be thoroughly treated with acid proof paint, and the outside may be finished in any manner the builder wishes. All edges should be rounded to ¼-in. radius.

As shown in the drawing, the sides of the box are hinged to the bottom of same, and arranged to swing down, thus exposing the cells for inspection. This arrangement is not absolutely necessary, however, and the box can be fastened throughout with some blued round-head wood screws. It is intended that the bottom of the box be covered with sheet felt, ⅜ in. to ½ in. thick, placing the jars directly upon this. In this manner the jars rest upon a yielding substance, and are consequently protected from vibrations of small amplitude, which are particularly injurious to the plates. The felt for this purpose should be of the looser and cheaper variety; a very dense felt is of no value for this work. It should be ⅜ in. thick in its natural state, without compression, this thickness having been allowed for in figuring the height of the battery compartment.

Why Old Lathes Bore Taper Holes.

A CORRESPONDENT of *Railway Machinery* discusses the question why most old lathes bore taper holes when an ordinary hook tool is used. Although the fact is well known, many machinists, he remarks, fail to understand that they have within easy

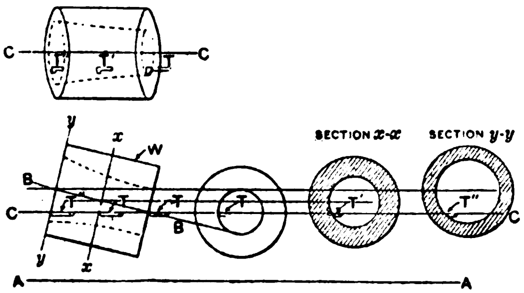


FIG. 1.—LATHE BORING LARGE AT BACK.

reach a method of controlling the defect, so that very often difficulties can be overcome that would otherwise be very troublesome, even if not such as to spoil the work. The cause of a lathe boring taper is usually due mainly to the great wear on the chuck end of the live spindle, the weight of chuck and work wearing this end low. In Fig. 1 the top of the lathe bed is represented by the line AA, the centre line of spindle by BB, showing the face-plate end very much lower than it ever would be, of course. The exaggeration is necessary to make the drawing clear. It represents the work, and the tool is shown at T, which is supposed to be an ordinary hook tool. No other parts need be shown; the work may be regarded as held in a chuck or in any convenient way. The tool T travels on line CC parallel to the bed AA, but not parallel to the centre line BB of the spindle in the horizontal plane. It is, however, parallel to BB in the vertical plane, as shown in the plan view above. Let us suppose that the tool enters the hole at the same height above the bed as the centre of the front end of the hole. As it moves along the line CC it will reach such points as T′ and T″, and though its distance sideways from the centre line BB remains the same, the real distance increases as the distance between the point of the tool and line BB increases. The diameter of the hole bored therefore increases. This is shown in section *xx* and *yy* taken half-way through the hole, and just before the tool runs out.

Now, taking the distances from the centre of the hole to T, T′, and T″ in the end view and cross sections of W and laying them off each side of BB, as shown in the side view, at the distances through the hole at which these views are taken, we get points in the piece W through which the tool has passed, and if we draw lines connecting these points we get the true shape of the hole, which we find to be bell-shaped and largest on the back end and smallest on the front end.

Now let us take the tool as shewn in Fig. 2, in which it enters the work at such a height that when it reaches the back end of the hole it will be on a level with the centre line BB. We now find conditions just reversed, and a bell-shaped hole large on the front end is the result. The same reference letters apply to Fig. 2 as to Fig. 1.

If the tool were made to come to the level of the centre line as it reached the middle of the hole the result would be a combination of Fig. 1 and Fig. 2, or a hole bell-mouthed at both ends.

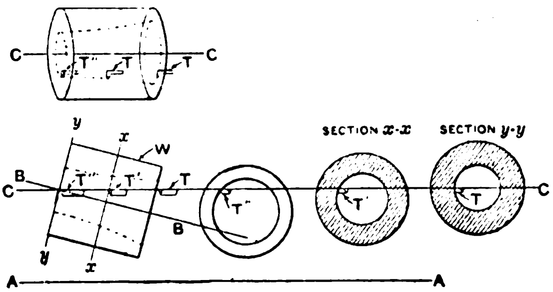


FIG. 2.—LATHE BORING LARGE AT FRONT.

Enough has been said to show that when the faceplate end of the spindle is low it is only necessary to raise the tool above the centre to bore large on the front end when the work is held by chuck or faceplate. But it must be borne in mind that this does not apply to work which is steady-rested, for the work must be raised above or depressed below the centre line of the lathe at the steady-rest end, and effects produced opposite to or the same as here shown, according to whether the work is high or low.

THE Ilford Model Yacht Club sailed a series of races last Saturday afternoon in favourable weather. Mr. Bennett's *Kittie* proved to be a fast boat on a beat to windward, and Mr. Wakeman's *Dorothy* was a very good second. Mr. Carr's *Vixen* won two of the beats, but fouled another yacht in the third. There were several other competitors, and the races were a great attraction to a number of spectators. The Club is increasing in membership rapidly and several members are building new 10-rater yachts for next season. The subscription is merely a nominal one and the Secretary, Mr. P. BENNETT, 60, Balfour Road, hopes that any who are interested and have not yet sent their names in will do so early.

The Late Mr. F. J. Tansley.

WE deeply regret to have to record the death, from heart disease, of Mr. F. J. Tansley, of Lowestoft, one of the most enthusiastic model yachtsmen round our shores, and an occasional contributor to these columns. Mr. Tansley was, for some thirty years past, a North Channel Trinity Pilot, and was an authority on lifeboats, beach yawls, and all matters pertaining to North Sea navigation. He was a prime mover in the

THE LATE MR. F. J. TANSLEY.

establishing of a model yacht pond at Lowestoft, and was a frequent and successful competitor in the races held thereon under the auspices of the Lowestoft M.Y.C. His loss will be keenly felt in model yachting circles.

Hard Alloy for Silver Metal.

THE *Aluminium World* gives the constituents of a hard alloy, which has been found useful for the operating levers of certain machines, and for other purposes:

Copper	57
Nickel	20
Zinc	20
Aluminium	3
	100

This alloy is nickel-plated for the sake of the first appearance, but so far as corrosion is concerned nickeling is unnecessary. In regard to its other qualities they are of a character that recommends the alloy for many purposes. It is stiff and strong, and cannot be bent to any extent without breaking, especially if the percentage of aluminium is increased 3.5 per cent.; it casts free from pinholes and blowholes; the liquid metal completely fills the mould, giving sharp clean castings. true to pattern; its cost is not greater than brass; its colour is silver white; and its hardness makes it susceptible of a high polish.

The Editor's Page.

SOME little time ago we published a note from a South Coast reader, relating how his model yacht had outsailed the rowing boat in which he accompanied it, and had got clean away to sea. We now learn, through the columns of the *Yachting World*, of a model yacht which has run ashore on the French coast, and, so far, is without an owner. We are doubtful whether this is the boat which our correspondent lost; but we think the news is worth inserting in the interests of the rightful owner, whoever he may be. The actual letter to our contemporary, in which the recently found model is described, reads as follows:—

"A yacht model came ashore on Saturday last, in Wissant, which bears the English flag. The model is a built model, fin keel, painted red and black top-sides, bearing no name nor indication whatever. Length over all, 46 ins.; extreme breadth, 10½ ins.; depth moulded, keel to gutter, 5 ins.; depth moulded from under bulb, 12 ins.; girth, including beam and 2 ins. under bulb, 37½ ins.; height of mast, 33½ ins.; length of boom, 35 ins.; length of bowsprit, 17 ins. Main sheet automatically geared from tiller, which moves in a semi-circular rail with two rows of holes and two brass pins. Lead disc on top of deck behind the rudder. This model, which appears to belong to some model yacht club, is in the hands of the French marine authorities, who will hand it over to its proprietor on application and payment of the salvage expenses.—F. MAGNIER, Calais, September 3rd, 1902."

If the model is claimed, we should be pleased to have from the owner an account of the adventures of his wandering craft.

* * *

"E. W. F." (Clapham) sends us a few notes on the subject of economical model-making. He says: "As we shall soon be having winter upon us, and the model making season is about to begin, I would point out to your readers that the cheapest way of making a model is to make your own patterns and take them to a foundry to be cast. I am writing from practical experience, as I have before me as I write a small steam punt, the castings for which would have cost me from 10s. to 12s. to buy in the ordinary way. By making my own patterns and sending them to a foundry, the bill for the castings, both iron and gunmetal, came only to 4s. 3d. Plain brass castings should be got in London for about 10d. per lb. I have had really good stuff at 9½d., and gunmetal at 1s. to 1s. 3d. per lb. Of course, these figures are for ordinary straightforward work, as one cannot expect to get, say, a small cylinder casting with the ports cast in at that price. Tube, copper and brass, should be bought generally by weight, and not by the foot, the price being about 10d. per lb. for brass, and a little more for copper. Sheet metals, and iron or steel, either plate or bar, may also be bought more economically by weight than by measurement. I trust these hints may be of use to those readers who have to study the question of expense in connection with their hobby."

* * *

The foregoing hints draw attention to the fact that many amateur mechanics who would like to make their own patterns, but are prevented from so doing by a lack of knowledge of the principles of pattern-making. We have had this matter before us for some little time past, and have been waiting a suitable opportunity to publish some practical articles on the subject. We are glad to say that, having completed arrangements with an expert contributor, we shall, as soon as our space permits, commence what we trust will prove to be a generally acceptable series on this important subject.

Answers to Correspondents.

"CALCIUM CARBIDE" (Penistone).—We cannot advise you to attempt it. Calcium carbide can only be made successfully—from the commercial point of view—when ample power at the cheapest possible rate is available; consequently you will find it advisable to purchase what you want, especially as you require only small quantities. The cost of plant alone (to say nothing of your time) would pay for a good supply of first class carbide.

"C. E. H." (Poole).—The sail plan for Mr. Paxton's 10 rater model yacht appeared in the March issue of THE MODEL ENGINEER for 1900, vol. iii.

W. D. (Catford).—Please refer to our issue of March, 1898. We do not supply working drawings.

W. S. (Portsea).—You do not enclose your full address. Articles on the construction of a lathe appeared in our second volume—January and April issues of 1899.

T. A. (Preston).—As far as we know there is no such journal now.

Prize Competition.

Competition No. 22.—Two prizes, value £2 2s. and £1 1s. respectively, are offered for the best and second-best designs (to include full description and working drawings) for a working model flying machine. The size, type, and propelling power of the model are left entirely to the choice of the competitor, the main stipulation being that it shall be capable of successful working. The model must have been actually made, and the prize winners will be required to send in their models for inspection and trial by the judges before the actual awarding of the prizes takes place. The last day for receiving entries is October 31st, and the usual general conditions apply in this Competition.

GENERAL CONDITIONS FOR ABOVE COMPETITION.

1. All articles should be written in ink on one side of the paper only.
2. Any drawings which may be necessary should be in good black ink on white Bristol board. No coloured lines or washes should be used. The drawings should be about one-third larger than they are intended to appear if published.
3. The copyright of the prize articles to be the property of the proprietor of THE MODEL ENGINEER, and the decision of the Editor to be accepted as final.
4. The Editor reserves the right to print the whole or any portion of an unsuccessful article which he may think worthy of publication, unless the competitor distinctly expresses a wish to the contrary.
5. All competitions should be addressed to The Editor, THE MODEL ENGINEER, 37 & 38, Temple House, Tallis Street, London, E.C., and should be marked outside with the number of the competition for which they are intended. A stamped addressed envelope should accompany all competitions for their return in the event of being unsuccessful. All MSS. and drawings should bear the sender's full name and address on the back.

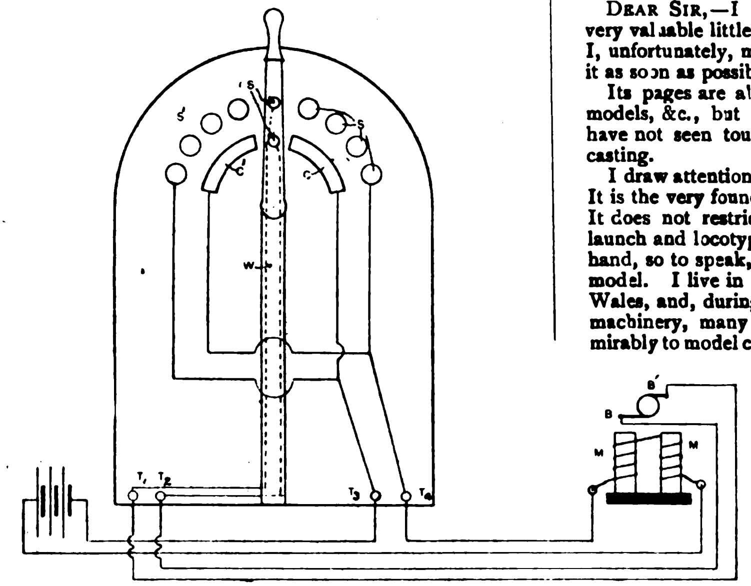
Practical Letters from Our Readers.

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 Simple Combined Rheostat and Reverser for an Electric Motor.

To the Editor of *The Model Engineer.*

Dear Sir,—I enclose a drawing of a rheostat combined with a reverser, which I have just made for an electric motor used to work a model crane. As will be seen, there are two sets of buttons on the board, S and S′, each set being a separate resistance. There are also two brass sectors, C and C′, concentric with the row of buttons. Contact is made on the lever being moved to the right or left by the two studs IS (which are insulated from one another), pressed down against a spring, and which are joined respectively to two brushes B and B′. The right



A Combined Rheostat and Reverser for Electro Motors.

hand row of buttons, S, is joined to the left hand sector, C′, and *vice versâ.* The resistance wire is not shown in the diagram, as it is underneath the board. The wires which join terminals T_1, T_2 respectively to the two studs on lever are led up a hollow piece of wood W, and thence along the lever to the studs. MM are the field-magnets, the motor being wound in series.

The method of working is as follows :—Pull the lever over to the left. Current then flows from battery through T_3 and along to S′, there being no outlet at C. From S′ to top stud IS, down to T_1, along to B′ and through armature to B, back to T_2, to lower stud IS and on to sector C′, then through T_4 and magnet coils MM, and so back to battery. When the lever is over to the right, the current flow is similar but in the opposite direction.—Yours truly,

Liscard. J. F. Satow.

Brakes for Model Electric Railway Vehicles.

To the Editor of *The Model Engineer.*

Dear Sir,—Referring to Mr. Harry Haughan's letter in your issue of the 15th inst., I should like to know whether the idea therein described is based upon theory or practical results. I have found in my experimenting that a motor suitable for a locomotive will rarely act as a dynamo, and if it does it will only do so at a certain speed. At this certain speed, of course, it would reduce the speed of the vehicle ; but when the speed of the motor is reduced it ceases to act as a dynamo, and the vehicle still continues to run.

I may say that I have tried this and abandoned it. With my system, viz., using the main power, I am able to pull up a locomotive weighing about 35 lbs., travelling about four miles per hour, in its own length This can be done to a nicety with the aid of a resistance-coil, as described in my article.—Yours faithfully,

Harringay, N. F. J. Burnham.

Castings for Model Work.

To the Editor of *The Model Engineer.*

Dear Sir,—I have been a constant reader of your very valuable little paper ever since the advent of Vol. ii. I, unfortunately, missed Vol. i., but I purpose procuring it as soon as possible.

Its pages are always full of interesting matter anent models, &c., but there is one subject which, so far, I have not seen touched upon, viz , pattern making and casting.

I draw attention to the matter for more than one reason. It is the very foundation of model machine construction. It does not restrict the model engineer to the eternal launch and locotypes of engine, but allows him a free hand, so to speak, in the selection of a prototype for his model. I live in an extensive mining district of South Wales, and, during my rambles, I come across all sorts of machinery, many of the types lending themselves admirably to model construction; but, unfortunately, through the difficulty of obtaining castings of this or that particular type of engine or piece of machinery, the amateur engineer is reluctantly compelled to abandon all thoughts of models of this class. The subject has also an important bearing upon models for competitive purposes, as the amateur who designs his own model, makes his castings, and ultimately turns out the finished machine, has certainly a prior claim to the prize, when competing against those who simply build up their models from bought castings or finished parts, added to which it would greatly enhance the value of the model, when one would be in a position to say, "I constructed it entirely myself, even to the castings."

What I would, therefore, suggest is—that a series of articles appear in the pages of The Model Engineer, dealing with pattern making, cone binding, and casting in brass, iron, &c.; or, failing this, perhaps it would be possible to issue a little book on the subject similar to that admirable little work, "Model Boiler Construction." I am sure it would be welcomed by all your readers who, like myself, are interested in models of machinery. Of course, the amateur would find many difficulties at the commencement; but I think that once the inevitable initial failures were mastered his labours would be well repaid, and he would find the making of his own castings both interesting and instructive, to say nothing of the saving to his pocket, and the ofttimes vexatious "working drawing" question. It would, at the same time, open up to the amateur a wide field for the exercise of his ingenuity and skill.

Trusting that I have not trespassed too m ch on the Editorial time,—I remain, yours truly,

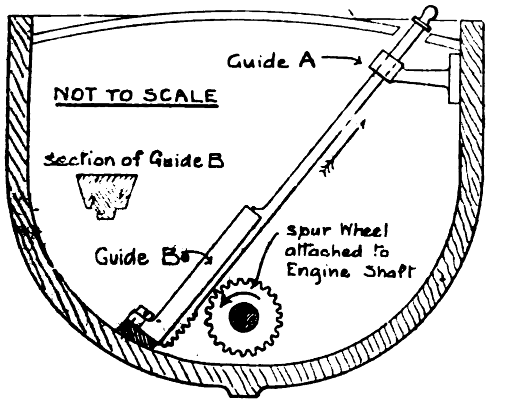
South Wales. E. B. M. A.

Starting Device for a Model Boat Engine.

To the Editor of *The Model Engineer*.

I enclose a sketch of an idea for a starting device for model steamers having an engine (such as the usual single cylinder type) which is not self-starting. The rod shown has a few cog teeth projecting towards its lower end, and when it is pulled upwards these engage with a small spur wheel attached to engine shaft. To start engine the rod is first pulled up till teeth or rod are above cogwheel. Then, when steam is turned on and steamer is ready to start, the rod is pressed down sharply, giving the engine about a quarter of a turn on its way down. The end of the rod above the deck has a small knob or dummy fitting attached to it, which is flush with deck when rod is pushed down. The guide B should have a stop to prevent its being drawn out too far. In some cases, perhaps, the guide could be more conveniently affixed to the engine. G. H. M.

London.



Starting Device for a Model Boat Engine.

Utilisation of Dock Water.

To the Editor of *The Model Engineer*.

Sir,—The article on "Wave Power," by the *Engineer*, in your last issue, led me to investigate the latent power of dock water available for lighting up quays and loading and unloading vessels. If my calculations are correct, this power might with advantage be utilised.

The Alexandra Dock at Hull is, roughly, 2000 ft. by 1000 ft., and if every tide, or twice every twenty-four hours, this were lowered 2 ft. by a pipe 37 ins. in diameter communicating with a low-pressure turbine 4,000,000 cubic ft., would, with an average head of 10 ft., run out in 6¼ hours, and, at a rate of 1,523 ft. per minute, develop 202 theoretical h.-p. For the area of a 37-in. pipe, being 7 sq. ft., we have:

$$7 \times 10 = 70 \text{ cubic ft.} \times 62{\cdot}4 \text{ lbs.} = \frac{4{,}368 \text{ lbs.} \times 1{,}523}{33{,}000} = 202.$$

This in round numbers would give, say, 150 effective h. p. and light for 6¼ hours, and twice in 24 hours; 1,800 16 c.-p. electric lamps, or fully 150 arc lights. The saving effected by turbine (not reckoning the saving in initial cost of turbine over engine and boiler) would be, reckoning 2 lbs. of coal per h.-p. per hour, as follows:—

$$\frac{2 \text{ lbs.} \times 150 \times 6\tfrac{1}{4}}{112} = 17 \text{ cwt. } i.e., \text{ about 16s.}$$

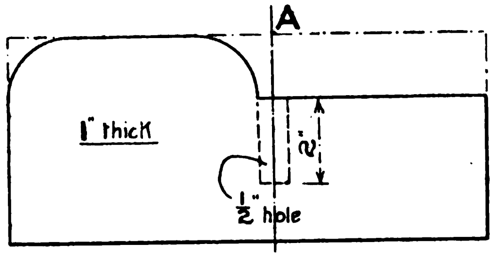
This in two tides would amount to 32s., *i.e.*, £11 per week, or £572 per year. The engine and boiler would require a man to look after them, and cost about £78 per year, so that the total saving would be £650 per year. The turbine would be erected at the dock entrance, and be in charge of the usual dock gate men, who could easily give it the little attention required. The question to be decided seems to be this. Would the gradual ebbing and flowing of the water in the basin incommode to any great extent the loading and unloading of vessels?—Yours truly,

Hull. H. P. Slade.

Bending Steam Pipes.

To the Editor of *The Model Engineer*.

Dear Sir,—I fitted an ½-in. seamless copper tube between high and low pressure cylinders, and after several



Block for Bending Steam Pipes.

attempts I adopted this plan, and hope a description of it will be appreciated by your readers.

I used a piece of wood about 1 in. thick, squared one side with the grain, and drew a centre line (A); drilled this down about 2 ins. beyond the bend, the same diameter as the tube, and on the half not used reduced to the level of the bottom of the bend, shaped the corners to the desired radius, and, having annealed and filled the tube (I used resin), put one end in the hole, and found no trouble in getting two perfect bends.—Yours faithfully,

Wandsworth, S.W. A.F.M.

For the Book-shelf.

[*Any book reviewed under this heading can be obtained from* The Model Engineer *Book Department, 6, Farringdon Avenue, London, E.C., by remitting the published price and cost of postage.*]

Modern Iron Foundry Practice. By G. R. Bale, A.M.I.C.E. Manchester: Technical Publishing Company, Ltd., 31, Whitworth Street. Price 5s. nett. Postage 4d. extra.

To those readers whose knowledge of the foundryman's craft is but slight, this book should provide a means whereby it may be rendered, as far as is possible, complete. To the engineering student, draughtsman, young moulder and pattern-maker, the volume would appear to be of inestimable worth. It is not within the bounds of possibility to give a complete idea of the scope and contents of Mr. Bale's work, but it will suffice to say that it embraces all branches of the subject dealing, amongst many other processes, with moulding, moulding sands, the cupola and its charge, core drying, malleable and chilled casting. The aim of the writer is to further scientific methods in the foundry, and, as he remarks, there are few branches of the engineering trade which offer such a wide scope for the exercise of the perceptive faculties as in the production of a perfect casting. That the other branches involved should work harmoniously with the moulder is also urged. The book is closely printed, with nearly 400 pages and 200 illustrations, and intrinsically is also very good value.

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, *37 & 38, Temple House, Tallis Street, London, E.C.]*

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

[7019] **1½ Scale Model Locomotive.** L. C. P. (Eltham, N.Z.) writes: I intend building the model locomotive in Query No. 3,852, July 1st, 1901, and would be pleased if you would answer the following questions: (1) How are cylinders fixed to main frames? (2) What would be the most suitable guidebar to use with this engine, and how should they be fixed? (3) What diameter should axle-boxes be? (4) How much lap and travel should valve have, also size of steam ports? (5) Would this engine be suitable for coal fuel?

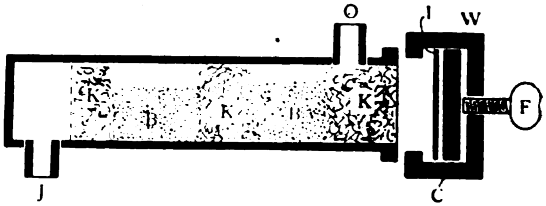
(1) The cylinders, if the valve chest is between, may be attached to the frames in exactly the same way as those of the ¾-in. scale "Dunalastair" described in our pages—see issues of April 1st, May 1st, and June 1st, 1901. The cylinders may be attached to the frames by a strong transverse frame, as shown on page 44, July 15th, 1901, if the system of placing the valves outside the cylinders is adopted. This design of cylinders is more suitable than the ordinary, because of the ease with which the valves may be set, and also another advantage is gained by the fact that no splitting of eccentrics is necessary. (2) On the page adjoining that containing the design of model you have chosen, you will find the design of a suitable cross-head and slide-bar. The slide-bar may be 9-16ths or ⅝ by 5-32nds thick, supported by the motion plate at one end. (3) Make all details, such as axle-boxes, etc., about twice the size of those of the ¾-in. scale "Dunalastair." (4) Steam ports, ¾ in. by 3-16ths in.; exhaust, ¾ in. by 5-16ths in.; lap of valve, 1-16th in.; travel of valve in full gear, 7-16ths in. (5) With a few alterations, the engine would be very suitable for coal fire. To get a deeper firebox, the throat-plate will have to be placed farther back, so that it may clear the cranks and big ends. The firebox should be—to get the best results—8 ins. long inside. The above alterations will necessitate the overhang behind trailing wheel being increased to about 7¼ ins. At the front, to balance this, the overhang should be about 8 ins. instead of 7 ins. Lift the lower cross tube about ¼ in. The level of the grate should be at least 8 ins. below centre line of boiler You ought to obtain a speed of ten to twelve miles per hour it such an engine, the load being one or two person

[6706 **Resistances of Copper Wires.** W. T. (North Shields) writes: In designing electrical apparatus, I am very much handicapped by the want of a knowledge of the resistances, diameters, etc., of the different gauges of wire. I have bought pocket-books and books of tables; but in all I could get the finer wires are omitted. Now, I would be very much obliged if you could give me the resistance per yard, and approximated number of turns per inch when silk covered, of the wires from 25 to 30 S.W.G.?

It is true that it is difficult to obtain exactly the information you require. However, it is not difficult to work out the values provided you have, at any rate, the figures for one size and know the diameters of the gauges in question. The difficulty is this, that only resistances for *pure* wire can be quoted, commercial copper having, of course, various impurities which are indeterminate in quantity, and cause unknown alterations in the resistances. We gave a table embodying the details, as far as approximate estimates can do it, in our January 1st issue, 1901. We give below the short table you require, with approximate values for resistances per yard from No. 25 to No. 30 S.W.G. copper wire. As a matter of fact, these are deduced easily enough from any known figure, remembering that resistances of wire vary inversely as the squares of the diameters. The number of turns per inch is an exceedingly variable quantity, depending on the insulation. If you have a sample of wire, the simplest method is to wind it yourself on a small rod and count the turns.

No. of wire, S.W.G.	Diameter (inches).	Resist. per yard (ohms).	Turns per yd. (silk covered) about.
25	·020	·075	41
26	·018	·096	45
27	·016	·120	50
28	·014	·140	55
29	·013	·180	58
30	·012	·200	62

[7020] **Acetylene Generator and Purifier.** R. E. P. (Cape Town) writes: In your July issue of MODEL ENGINEER AND AMATEUR ELECTRICIAN there is an article on an "Automatic Acetylene Generator," by Mr. Turner. I would like to know how the air is kept from mixing with the gas, and also how to make the purifier air-tight, and yet be able to place fresh bleaching-powder in at certain periods? I have made the generator, but find that the



A RECHARGABLE ACETYLENE GAS PURIFIER.

gas given off is mixed with air and is explosive. I have taken your paper in for a considerable time, and find it very useful.

We communicated with Mr. Turner on this matter, and now append his reply:—"One of the disadvantages of this type of generator is that air necessarily gets in the gasometer when recharged with carbide, and to remove it a slight waste of gas is inevitable, as the air passes off with it the first few minutes. The following is a rough sketch of a rechargable purifier. The flange may be made of ¼-in. square iron, in a ring slipped over the end of the tube and soldered thereon. If there is anything else that your querist does not understand, I shall be pleased to try and explain."

K, cotton wool or waste, loosely packed; B, bleaching-powder; C, clamp; W, iron plate; I, rubber washer; F, thumb-screw; J, inlet; O, outlet.

[6978] **Magneto Machine.** A. E. (Wainfleet) writes: I have an electric motor in course of construction, and I should like to know (1) How much wire should I put on field-magnets, and what size? I have 1 lb. of No. 24 S.W.G. single cotton-covered, which I should like to use. (2) What output in volts, ampères, and candle-power would it give as a dynamo, and what horse-power will it take to drive? (3) What horse-power would it develop as a motor, and how many bichromate cells will it require? (4) I have a few bichromate cells (six in all) with zinc rods, 3 ins. by ⅜ in., and carbons 5 ins. by 1 in. by ½ in. (5) Are zinc rods of these dimensions better than plates 5 ins. by 1 in. by ⅛ in.? (6) Would six such cells give 4 c.-p. with an 8-volt lamp? (7) Please give me the correct method, size of wire and length to wind a 1 to 10-volt voltmeter, similar to one described in *M.E.*, December 1st, 1901.

The motor of which you send a sketch is not of a type from which you can expect to get any appreciable power. (1) Your best plan is to wind the armature cores with about 26 yards of No. 24, *i.e.*, 13 yards on each pole-piece. We have assumed that the cores are circular in section, as you have only given us two dimensions. For field-magnets, use 140 yards of No. 24. Magnet coils will be in series. (2 and 3) This will be found by experiment only. Two or three. (5) The advantage of using zinc plates is that they may be placed nearer to the carbon, thus reducing the internal resistance of the cell. (6) If you used six bichromate cells for an 8-volt lamp, three cells would have to be single and the remaining three in parallel with each other; but still taken on the whole, in series with the single cells, otherwise an 8-volt lamp would not last long. (7) An instrument such as you refer to is, we think, more elaborate than need be for a 10-volt circuit, and a more suitable instrument for your requirements is given on page 149 of April 1st, 1901 issue.

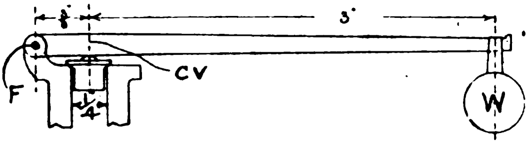
[6911] **Charging Cells; Switchboard Arrangements.** A. B. M. (Douglas) writes: (1) I have a dynamo, 50 volts 5½ amps., driven by ¾ h.-p. gas engine, and wish to know how many 8 c.-p. lamps it ought to light. (2) I am having some storage batteries made. How many should I require to light seven 8 c.-p. lamps?

(3) Would you please inform me the best way to connect the cells to the dynamo in charging? I have a voltmeter and ammeter. (4) Would you enclose sketch of switchboard for switching in cells, and also for lighting? (5) My conductor wire is 1-16th, and flexible wire 35-40ths. What size fuse required for main, and also for ceiling roses?

(1) Eight or nine. (2) Your lamp being 50-volt ones, you would need 26 cells in series. Their size would be a matter of choice, and would be determined by the length of time you wish to run the lamps. (3) Connect up the positive of dynamo to positive of cells for charging, and insert the ammeter on the positive wire. The voltmeter would be connected across the mains. (4) A well-arranged switchboard is given on page 164 of April 1st, 1902, issue, and if you think it necessary, any detail could be altered to suit your own requirements. (5) No. 20 S.W.G. for main fuses, and No. 26 for ceiling roses, both of tin lead alloy.

[6773] **Safety Valve Proportions.** F. W. B. (Bow) writes: Please will you kindly answer the following query? I have a safety valve made as the sketch below. What weight would it require on end of lever to allow the valve to blow off at 20 lbs. pressure?

The distance from the fulcrum (which we have marked F on your sketch) to the centre of valve (C V), and the distance from the fulcrum (F) to the centre of the weight (W), is in the proportion of



LEVER SAFETY VALVE PROPORTIONS.

⅜ to 3⅜ = 1 to 9. Therefore, the weight will require to be 1-9th of the pressure acting on the valve, which, at 20 lbs. per square inch, would be equal to the area of ¼ in. circle × by 20 lbs. = ·049 × 20 = ·98 lb. The weight required is 1-9th of ·98 lb. = ·11 lb.

[6884] **Gas Engine to Drive Dynamo.** P. W. F. (Windsor, Victoria, Australia) writes: I wish to get a motor to drive a 30-watt dynamo; and as I may subsequently obtain a larger one—say up to 200 watts—I should like to get, if possible, in order to avoid expense of importing another, a motor that will not only drive the 30-watt, but also the prospective 200-watt dynamo. Steam being excluded, the choice lies between (coal) gas engine, (ordinary burning-petroleum) oil engine, and gasolene motor. Now, as the 30-watt dynamo will only require 1-12th b.h.-p., while a 200-watt will only absorb ⅓ to ½ b.h.-p., what I want to know is, can the supply of gas, oil, or vapour be so regulated as to enable one of above types of motors to run efficiently and without jerkiness or irregularity, at considerably under the full power for which it was designed? My impression is that it will not work smoothly except at (or nearly at) its full load. In the case of a gasolene motor which runs at 1,200—1,500 revs., will the gearing necessary to obtain the requisite dynamo speed (say 2,500—3000 revs.), cause much loss of power, and will the cylinder get seriously overheated? Any information on above will be greatly appreciated.

Provided you can get coal gas at a reasonable price, you will find a gas engine more satisfactory in every way. You need not anticipate trouble through the engine running on a light load. An engine well up to its work, runs well, and wears well, provided it is a good one to start with. For electric lighting, it is advisable to have two flywheels, or one very heavy one. Cut the gas supply down as much as ever possible (not at the gas bag, but by means of the proper gas check on the engine, which all first-class makers use now) so that you get a low explosion almost every cycle when the usual load is on. By this means, you will ensure perfect steadiness in running. Small oil engines are not nearly so satisfactory to run. A slipping belt has the same effect on the lights as an engine which is governing badly, therefore a belt doing high-speed work needs careful attention. We may add that a 30-watt dynamo will probably need considerably more than 1-12th b.h.-p. Probably 1-9th or ⅙ will be nearer the mark.

[6585] **Firing Model Boiler.** P. V. H. (Wimbledon) writes: I shall be very pleased if you will answer me the following questions. I have three No. 5 Primus burners, and a round tank, 12 ins. by 5 ins.; what air pressure is necessary to work burners? Will they be large enough to fire a vertical boiler, 20 ins. by 10 ins.; firebox, 10 ins. high, 8 ins. diam.; twelve 1-in. tubes? The boiler is of copper, with copper firebox, and is new. At what pressure shall I be able to work boiler, which is strong, but not stayed?

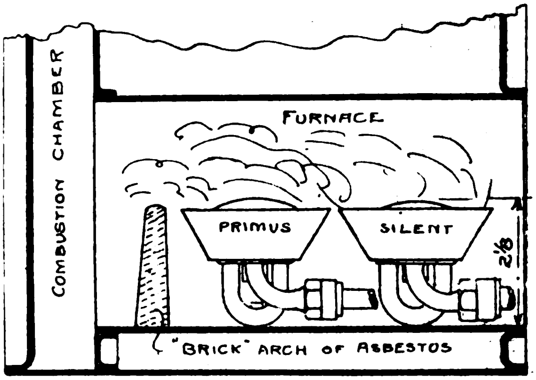
You will require a release valve and filler, and a pump upon the tank. The air pressure should be varied, with increase or decrease in the required output of the boiler. You will soon be able upon to judge the best pressure to use. At about 10 lbs. per square inch you will find that the burners are working quite hard enough for ordinary purposes. One burner should be used for every 200 sq. ins. of heating surface provided, and for your boiler three burners is about the right thing. We cannot say, from the particulars given, what is the maximum pressure at which you can safely work the boiler. A vertical multitubular boiler (if the tubes are properly affixed) would require very little staying. See our Handbook, "Model Boiler Making," price 7½d., post free, for method of arriving at working pressure of a given boiler.

[6932] **Harmonograph.** J. A. (Bristol) writes: Can the editor or any of the numerous scientific readers of the *M.E.* give constructional details of a harmonograph or compound vibration pendulum, or name books in which such information could be found?

We do not know of any book giving constructional details of harmonograph, but perhaps some of our readers may be able to assist you.

[6568] **Oil Fuel for Model Marine Boiler.** E. W. (Stockton) writes: I shall esteem it a great favour if you will give me some information on the above subject. I want a burner for my model steamboat; at present I am using charcoal, but I think an oil burner will be much less trouble. The boiler diameter is 9 ins the furnace tube is 4 ins. diam, and 21 return tubes ⅜ in. inside diameter. The engine is 2-cylinder, 1⅛ ins. by 1¼ ins., and makes about 600 revs. a minute in the water. What are the "Primus" burners like, and where is the best place to get full particulars from? Any information you can supply will be greatly esteemed.

In reply to your query, you may use two "Vesuvius" or "Hekla" burners (Swedish patent, by the same makers as the "Primus"? These burners are non-silent and project the flame some distance. They can be obtained from Messrs. Bassett-Lowke & Co., Messrs. Melhuish & Sons, Nurse & Co., and other advertisers. For the arrangement and use of oil burners, please see the "Dunalastair" articles in August 1st and October 1st issues of last year, and also the issue for June 1st last (pp. 245 and 246). The necessity for forced draught will be judged from a perusal of this article. The 2½-in. silent "Primus" is the most efficient burner and besides being noiseless is well suited for your purpose. It may be arranged



OIL FUEL FOR MODEL MARINE BOILER.

to take up only 2¼ ins. of the vertical height available. To prevent the cold air passing under the burners and doing no useful work—rather the other way, a wall or "brick arch" of asbestos or other suitable material should be placed at the end of the furnace reaching as high as the top of the lip of the burner as shown below. The burners are in this case best lighted out of the furnace. Don't flood the burners with oil at any time and you will have very little trouble in the matter of pricking or the nozzles. To prevent this have a screwdown valve on the supply pipe from the oil tank, and never leave this open when the burner is not hot. Secure the caps of the burners by two setscrews.

[7040] **Model Boat Engines.** A. R. (Sunderland) writes: Would you kindly let me know what size double-action oscillating cylinder and boiler it would take to drive a launch 3 ft. long, 7 ins. deep, 6 ins. beam, at a good speed?

About ⅜ in. by 1 in. stroke. Boiler on page 216, Nov. 1, 1901, modified with a down-comer as shown in March 1st issue, would suit your purpose well.

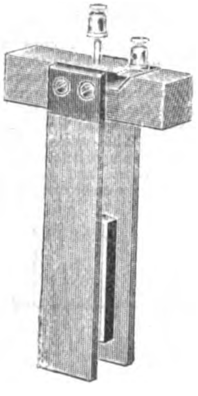
TEMPERING SCREWDRIVERS.—The third blue is said to be the best temper for screwdrivers. Heat a medium size screwdriver for a length of 2 or 3 ins. from the end to a nice red, then immerse it in water to a depth of about 1 in.; take it out, scour it bright, and when the first blue comes brighten it again. Do the same the second time the blue makes its appearance, and when the blue shows itself the third time immerse it in water. Care should be taken to have sufficient heat to run the colour down; but it should run as slowly as possible.

Amateur's Supplies.

[*The Editor will be pleased to receive for review under this heading, samples and particulars of new tools, apparatus, and materials for amateur use.*
**Reviews distinguished by the asterisk have been based on actual editorial inspection of the goods noticed.*]

* Bichromate Batteries—a Cheap Line.

The Electrical Sundries Co., 152, Grey Mare Lane, Manchester, send us a bichromate battery set, consisting of two carbons, having a sliding zinc between, properly mounted on an insulated support, with terminals complete, which they are open to supply for the very small cost of 9d. The set is very cheap, and perhaps a material degree of refinement in the construction is not possible for the price. The only weak point—one which the merest tyro can overcome by the exercise of the memory or the provision of a simple contrivance—is the want of a something to prevent the zinc revolving in the support and short circuiting with the carbons. Readers in need of a small battery for a minimum outlay should send at once to the Electrical Sundries Company.



THE ELECTRICAL SUNDRIES CO.'S BICHROMATE BATTERY SET.

* Castings for Model Four-Pole otors.

Sets of castings for the model four-pole electro motor recently described in our pages have been prepared by Mr. James Webb, of Church Street, Bloxwich, who has sent us a set of size "B" (armature 1⅜ ins. diameter 1½ ins. long) for inspection. We are very pleased indeed with their appearance, all the castings being very smooth, free from burrs or holes, and exact to sizes. Our impression is that just enough metal has been employed to enable the parts to be turned properly without fear of taking off too much. The field-magnet—in one piece—is of soft malleable iron, which is superior to ordinary cast iron for this work, and the bearings, rocker, brush holders, and commutators are in brass in the set to hand, but can be had in aluminium it desired. The set includes also the right number of quadripolar armature stampings. The brush holders have the flat hole cored out to obviate the necessity for drilling and chipping. We are assured that the samples are the same as those sent to customers, and that the maker is prepared to supply all necessary screws, wire, or insulation, to do part machining on the castings, or supply complete finished motors He will be glad to send particulars and prices for either size or type on receipt of stamp, THE MODEL ENGINEER being mentioned.

* "The Amateur Mechanic."

Under the above title, a new journal for model makers being issued by the Liverpool Castings Supply Co., 5, Church Lane, Liverpool. In the opening number it is stated that the primary object of the new publication is to further the business of this firm, and to place before the amateur new appliances, tools, and models in a thoroughly practical manner. As a change from the usual type of catalogue, this little publication is decidedly enterprising, and its neat get-up, combined with the varied nature of its contents, should make it very readable. It is proposed to issue the journal quarterly, and a remittance of twelve half-panny stamps to the Liverpool Castings Company will ensure the receipt of the first four numbers as published.

* A Scale Model Compound Surface-Condensing Marine Engine.

There must be among our readers a large proportion who are very much interested in marine engineering, and to these the latest production of the Model Manufacturing Company more especially appeals. This firm are now open to supply sets of castings for a scale model marine engine, with cylinders, 1⅛ ins. and 2 ins. by 1½ ins. The engine is a well designed example, with the cylinders supported upon the condenser at the one side, and columns in the front. The air, circulating, and force pumps are worked by links and levers from the crosshead pin, in the usual manner, the pumps being situate behind the condenser. The castings are good in quality and cleanness; the cylinders (with ports cast in), standard bedplates, condenser, etc., are in iron; the rods, crankshaft, and other moving parts (subject to tensile strains) are in cast steel. The gunmetal parts are heavy and clean. One feature worth noticing is that the connecting steam pipe for H.-P. and L.-P. cylinders is cast in one piece, with flanges, and a clear way is cored through the pipe; this method saves bending of pipe and brazing-on of connecting flanges. The Model Manufacturing Company, whose address is 52, Addison Road North, Shepherd's Bush, W., state that they will, to those who prefer the method, supply these castings on the instalment plan. Three sheets of well-made drawings—two measuring 24 × 26 inches, are sent out with the castings.

Catalogues Received.

Amateur Castings Supply Co., 2, Colliery Road, Nottingham.—We have received this firm's list of castings, which include complete sets for bench lathes from 2⅜ to 4 in. centres, single speed or back-geared, and also angle and face-plates, slide-rests, driving wheels, hand-planers, and many other tools and workshop appliances. The Amateur Castings Company also list castings of steam engines and dynamos, and state that they are open to make castings in cast or malleable iron, brass, bronze, steel alloy, and aluminium from customer's own patterns. The price of the list is 3d., which will be deducted from the first order of five shillings. Discounts of 5 per cent. on orders up to 20s., and 10 per cent. over, are offered to readers of THE MODEL ENGINEER, who, therefore, should mention the journal when writing for goods from this firm.

T. W. Thompson & Co., 73, Trafalgar Road, Greenwich, S.E.—Readers in search of particulars and prices of motor engine ignition specialities, should send to Messrs. T. W. Thompson & Co. for their illustrated list E, wherein they will find all information required. This firm supply all kinds of suitable accumulators, induction coils, volt and ammeters, and sparking plugs for motor bicycles or cars, and gas and oil engines.

Messrs. J. Christopher & Sons, 35 and 35B, Clerkenwell Road, E.C.—Messrs. Christopher's catalogue, which we have just received, is one which should be in the hands of all small professional and amateur engineers. The speciality of the firm is pulleys, shafting, and all kinds of bearings, wall brackets and hangers for same, lathes, leather belts, files, hacksaws, emery wheels and vices, which latter are obtainable at very low prices. Readers in want of any kind of workshop appliances or engineer's stores should write at once for this list, enclosing a penny stamp to cover postage.

James Murchie, 39, Mains Street, Glasgow.—It is very useful to know where good bicycle balls can be obtained cheaply, and we can recommend our readers who are in need of such to write to Mr. Murchie for his price lists. Steel balls catalogued in all sizes from ⅛ in. to 1 in., and they are stated to be of the best material, strong, uniform to size and for sphericity practically perfect. Balls are also supplied in gunmetal, brass, aluminium, and cast iron. Another speciality of Mr. Murchie is stamped steel lathe carriers and drop forged engineers' spanners finished or unfinished.

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 6s. 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," 37 & 38, Temple House, Tallis Street, London, E.C.

All correspondence relating to advertisements to be addressed to THE ADVERTISEMENT MANAGER, "The Model Engineer," 37 & 38, Temple House, Tallis Street, London, E.C.

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THE

Model Engineer

AND

Amateur Electrician.

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

VOL. VII. No. 84. NOVEMBER 1, 1902. PUBLISHED TWICE MONTHLY

The Motor Bicycle: Its Design, Construction and Use.

By T. H. HAWLEY.

VI.—ON DESIGNING AND BUILDING THE FRAME—

(*continued from page 151.*)

THE front portion of the frame being brazed up, the next thing will be to apply very careful tests for alignment. Of course, if the work has been properly done, and each tube tested and set, if necessary, as the work has proceeded, there will be no further alteration required; but it is imperative that this should be assured before the rear frame tubes are brazed on.

There are several methods of testing the alignment of frames, according to the appliances at hand; but the result to be aimed at is simply that the *bore* of the bottom bracket shall be at a true right angle with the centre line through the length of the frame. I say bore of bracket because if the alignment is taken from the end face of the bracket it is liable to be misleading, as the bracket ends are not always turned up true to the bore; but if these end faces are known to be true the ob is simplified.

The most simple test is to place a couple of straight-edges, one each side the bracket, and if the frame is true the tube will lie parallel to them, though not exactly in the centre, as the bracket shell overhangs more one side than the other. The test should be applied to both bottom tube and seat pillar, and if these are found correct it remains only to see that the steering socket or head tube is in the same vertical line as the seat post, this being easily and accurately ascertained by "sighting" the two tubes, one being dressed with chalk and the other left black.

Once these two tubes are set accurately in line it is an easy matter to test and ensure the alignment of the back forks; for the long straightedge laid alongside the lower portion of the head tube, and at a point on the seat post which will bring its rear end in contact with the back fork ends, will show any discrepancy in the distance of either fork end from the centre line of the machine. A good plan being to cut a recess in the end of the straightedge at the requisite depth to bring it just into contact with the inner surface of the fork ends when they are correctly in position.

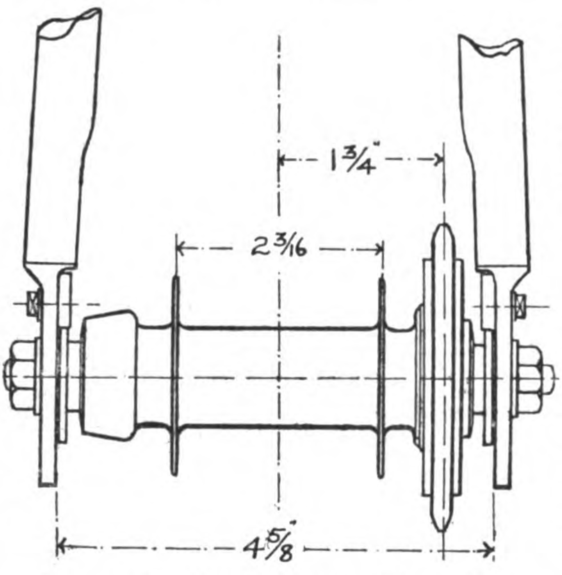


FIG. 31.—TOP VIEW OF DRIVING WHEEL HUB.

A certain method should be adopted in brazing up the back carriage, where no regular jigs exist for controlling the positions during the operation of brazing, as it is essential that not only should the fork ends be the proper distance apart and equi-distant from the centre line; but they must "sit" perfectly square to the hub spindle which they carry; otherwise, when the lock-nuts are tightened up there will be an amount of distortion tending to tilt the bearing cones over, and so setting up unequal wear and added friction in the bearings.

As our back forks and stays are D section there will be less likelihood of trouble in this direction than where oval or round tubing is employed, but it sometimes happens that D tube, which is rolled from a round tube, has a slight twist in it, so that the fork ends do not sit square with the lugs of the bridge piece, in which case the error must be corrected either by heating and slightly twisting the tube or the fork end itself, the former method being the more mechanical.

The back fork tubes should first be cut equal lengths, measured from the point of the bend, *i.e.*, the bend shown in the back forks in Fig. 28 must be made to coincide in the two tubes, and the total length made to correspond to the dimensions given in the drawing. The fork ends are then brazed in, and any setting required may be done at this stage so that the fork blades may be brazed up to the bridge piece with a dummy spindle corresponding in length to the proper hub spindle in position in the rear fork ends.

When this dummy spindle (which should be turned up with large shoulders) is held in position by nuts in between the two fork ends (*a*, Fig. 28) any twisting in the back forks will then be plainly disclosed at the further extremity of the tubes, which must be set square so that the bridge piece (*b*, Fig. 28) sits perfectly true and free from distortion.

It is absolutely necessary to good work and appearance that this bridge piece should stand exactly parallel to the back axle and at a right angle to the vertical plane of the frame, and it must also be centrally placed so that when a *true* wheel is placed in position in the forks the space between fork sides and wheel shall be equal on either side.

It is rather unlikely that these back forks will be purchasable ready bent, but will be bought in straight lengths and will have to be curved by the maker.

D-tubes are rather tricky to bend, because the flat side on the hollow of the curve is liable to buckle in, and the outer section to lose its rounded form, unless the tube is well packed with some resisting medium, the usual packing being fine, *dry* Calais sand rammed hard, and plugged perfectly tight at each end of the tube; the tube is then heated at the exact point at which the bend is to be made. When the bend is sharp the heat must be confined as much as possible to the required position; but if the bend is to be gradual the heat may be diffused over a correspondingly greater length, always ensuring that the greatest heat is at the point where the greatest curve is required, for the tube will naturally bend most where hottest.

When the back fork tubes in Fig. 28 have been fitted with fork ends so that the bends coincide, one side fork should be brazed to the bridge-piece *b*, and the other one finally cut or filed up to exact length to bring all square, a trammel being the handiest method of getting the lengths equal.

At the same time, as the second joint in the bridge-piece is brazed up, the two short lengths of tube should be pinned and brazed ready to connect the whole back fork to the bottom bracket, when these joints may be filed up and polished prior to the final brazing, the idea being to completely finish the entire back fork shown in Fig. 28, and prove it true before proceeding with the job of brazing it up to the frame front.

Perhaps the nice point in the whole frame construction is to be found in adding the back forks (Fig. 28), because the slightest variation in length here, or any inequality in the back forks will be made manifest when the wheel is placed in position, and it is a great advantage to the amateur worker to have a true wheel at hand with which the frame may be tried at each step. Thus, after the back forks are brazed up to the frame front, the latter may be held by the bottom bracket in the vice, the wheel placed in position, and note taken in the first place whether the wheel sits truly in line with the seat post, and, secondly, whether the action of tightening up the hub spindle nuts has any tendency to deflect the wheel from the position it occupied before the nuts were tightened.

Whatever may be wrong in this direction must be righted before the work of fitting the back stays is commenced, otherwise the resulting frame will be out of truth at some point or another; but assuming that the fork end distances have already been proved, it remains only to see that the wheel is perfectly vertical and sits midway between the forks at the periphery or tyre.

The back stays (Fig. 29) are built up in similar manner to the back forks, the bends being made first; then the lower ends brazed in, at which stage the two stays may be bolted in position on the back fork lugs, when any variation in angle at the stay ends will be magnified at the top ends, and the tubes must be set over if required until they occupy the proper position each side the seat clip, being 2¼ ins. apart at the upper ends, as shown in the drawing.

When this stage is reached the upper end pieces may be added one at a time, the wheel being again tried on the frame after fitting, but before brazing the final lug, this lug (C) being brought into correct position by trimming up the tube end to the exact requisite length to retain the wheel centrally.

The small bridge piece at *d* is a rather difficult but very necessary job in the case of a motor bicycle, for it vastly increases the strength of the pair of back-stays; but it is worse than useless unless well brazed to the stays at both ends, the chief difficulty with the amateur in brazing a joint of this kind being that through the expansion of the bridge piece *d* one or other of the stay tubes may be deflected from the proper position.

I think the best makeshift method of fixing this bridge piece is to fit it in position with the back fork spindle screwed up, and the seat bolt in, thus keeping both back forks and stays in position; fit the bridge piece with as much "lip" or bearing surface as possible, but do not wedge it up at all tight—simply make it fit; then well wrap both joints with fine iron wire, and first apply the heat to the centre of the bridge piece, maintaining as nearly as possible one uniform heat over the two joints until both are securely brazed; then quickly cool off the joints, when the resulting contraction of the bridge tube will be insufficient to break the joint.

This completes the brazing up of the frame itself, but unless the front forks have been purchased ready made, there is another job requiring some thought and care, the character of the work being similar to that in the back forks and stays, the object being to get the forks of exactly equal length, so that the wheel rim sits centrally between the forks, the wheel at the same time being in the same vertical line as the rear wheel and the frame itself.

There are two simple tests for this after the forks have once been brazed up. First, with the front wheel in position and the nuts screwed up, see that it sits exactly in the centre of front forks; then with nuts slacked off, note if position of rim alters; if so, the fork ends are out of square, or there is lost motion in the fork end slots, and either fault must be corrected until the reading is the same with nuts either on or off.

Then proceed to ascertain whether the path of the front wheel is the same as the driver, this being done by applying the long straightedges to each side the driving wheel rim as near the centre as the spokes will admit to give the straightedge a double bearing on the rim; then note whether the two straightedges touch both sides of the front rim (always supposing the two rims are of equal width); if not, the difference will be the amount that one wheel is "out of track" with the other, this, of course, being the front wheel if the other work has been correct.

Another method of making this test is to have an assistant hold one long straightedge *vertically* on the rim of the rear wheel, whilst the constructor holds the other straightedge in similar position on the front wheel, when the parallelism of the two straightedges, viewed lengthwise of the machine, will prove the correct alignment of the two wheels.

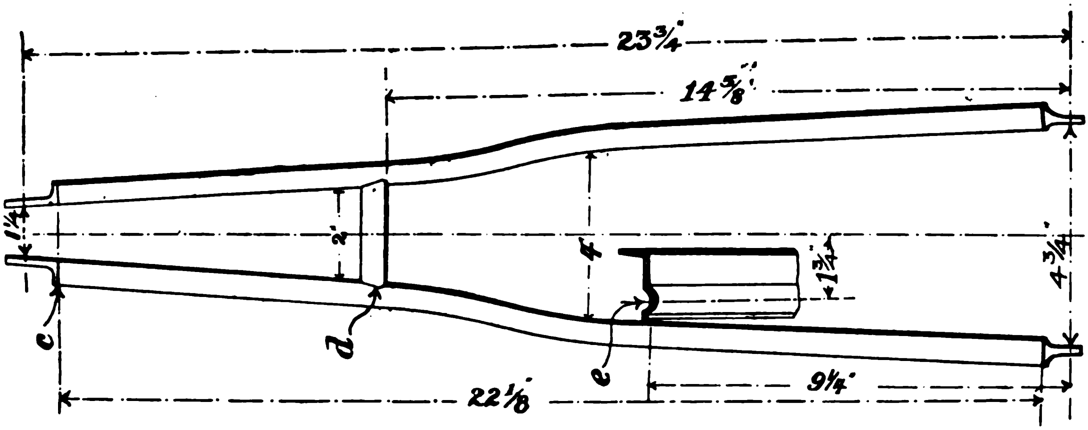


FIG. 29.

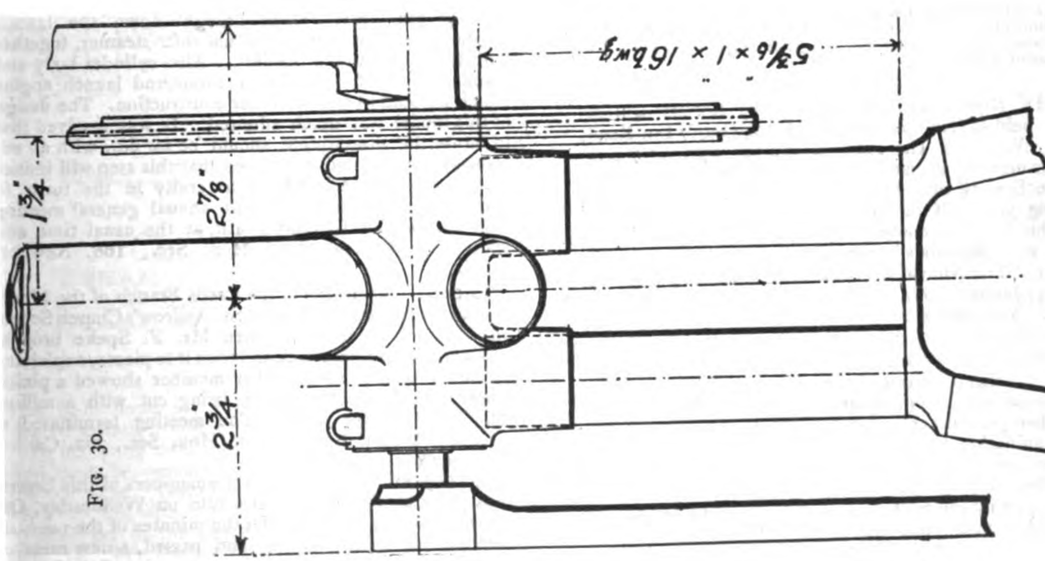


FIG. 30.

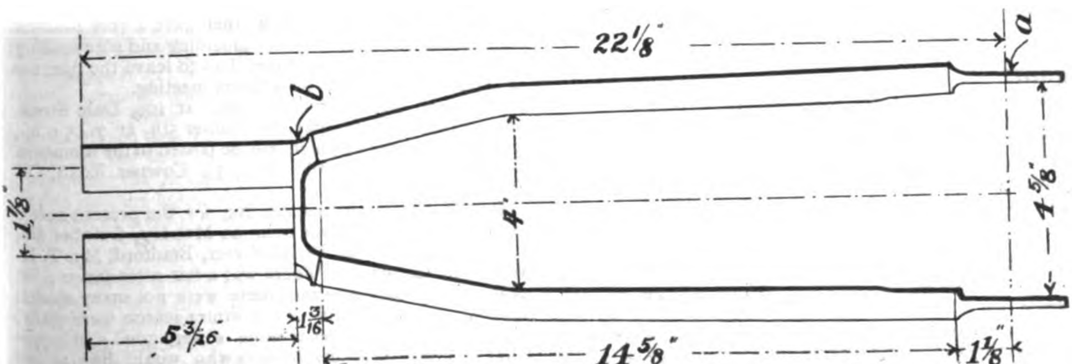


FIG. 28.

DETAILS OF MOTOR BICYCLE.

(For description see pages 193 to 196.)

If it is found necessary to make any adjustment of the front forks after they are brazed up in the direction of varying the length, it may be done by very slightly altering the curve of the fork blade, increasing the curve having the effect of *shortening* the length, and decreasing the curve causing the total length to be greater; but it should be noted that whereas the forks may thus be brought to equal length, the fork ends will no longer be in position to show the wheel in line with the driving-wheel, and at the same time show the front fork crown square, or at right angles to the front wheel, when viewed from the top side.

So, in order to put this final matter right, one fork must be heated quite close to the fork crown, and pulled either backward or forward, as the case may be, to bring the fork crown square with the wheel.

Fig. 30 (page 195) gives the principal dimensions of the bottom bracket, extended rearward to the back fork bridge. Fig. 31 (page 193) is a top view, giving dimensions of driving wheel hub, and showing chain line, etc.

(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 eighteen days before its actual date of publication.]*

London.

THE next indoor meeting of the Society will be held at HOLBORN TOWN HALL, Gray's Inn Road, W.C., on Thursday, November 13th, at 7 p.m. At this meeting alterations in rules and the general policy of the Society may be discussed. The officers for the ensuing year will be elected. The December meeting will be held in above hall on Monday 15th, when a paper on "Materials" will be delivered by Mr. E. W. Fraser. The Annual Conversazione has been fixed for Friday, January 16th, 1903, instead of in November, as usual. Members are requested to get their models ready for this important event as the best exhibition possible is this session especially desired.

NOTICE TO BRANCH SECRETARIES.

In view of the approaching end of the financial year (October 31st) Branch Societies are requested to send in their affiliation fees, a copy of their yearly report and balance-sheet, by November 6th at the very latest, so that they may be embodied in the General Report of the work done by the Society as a whole, which report will be printed, and copies distributed free to all branches. If any of the above reports are not to hand by that date, they must necessarily be omitted.—HENRY GREENLY, Hon. Sec., 2, Upper Chadwell Street, Myddleton Square, E.C.

Provincial Branch.

Cardiff.—By the courtesy of Mr. Arthur Ellis, the Borough Electrical Engineer, the members of the Cardiff Branch of the Society of Model Engineers visited the Power Station, at Roath, on Saturday, September 27th. The first object to which attention was directed was the switchboard, which is situated at one end of the engine-room, covering a space 42 ft. by 12 ft. This is fitted with the latest type of meters and switches, and is so arranged as to give perfect control over the whole of the lighting and tramway systems, including sub-stations. The floor space is taken up by four sets of 500 h.-p. engines and generators, while two 1,600 h.-p. sets are in course of erection. The engines are of Messrs. Musgrave & Sons' make, and are of the vertical cross-compound condensing type with Corliss valves, and run at 100 revs. with 140 lbs. of steam, the condensers being driven by side levers from the cross-heads. The two larger engines are practically similar in type to the foregoing, and their flywheels weigh 75 tons each. The four smaller engines drive British Westinghouse generators of 300 kilowatt output of the multipolar type, the armature being placed between the high and low-pressure cylinders direct on the shafts. These generators work at 500 volts as compound machines on the tramway loads, and as shunt at 400 volts on the lighting. The two large generators to be supplied by Messrs. Dick Kerr & Co. will have an output of 900 kilowatts each. In one corner of the engine-room is situated an 80-kilowatt motor generator, receiving current from the main buss-bars at 500 volts, and giving out 100 volts for charging cells and the local lighting of the station. It can be worked in reverse order from the batteries at 100 volts, and gives out 500 volts, which is used for shunting in the car-sheds, driving various motors and working the automatic stokers for the seven boilers during steam raising. The battery room contains fifty-six cells of thirty-one plates each, with an output of 2,100 ampère-hours. The thanks of the members are due to Mr. Hosgood, who conducted them over the installation and spared no pains to explain its operation.

The opening meeting of the session took place at the Society's rooms, 7 and 8, Working Street, at 8 p.m., on October 7th. Mr. Ferrier brought down the launch engine he is constructing for his 6-ft. steamer, together with the shafts and propellers. Also cylinder body and crankshaft of a Stuart-Turner compound launch engine which a friend of his has under construction. The design of this model was much admired. It was resolved that in future the subscription should be 2s. 6d., with an entrance-fee of 1s., and it is hoped that this step will induce more of the model-making fraternity in the town to become regular members. The annual general meeting will be held on November 4th, at the usual time and place.—R. T. HANCOCK, Hon. Sec., 168, Newport Road.

Leeds.—A meeting of the Leeds Branch of the Model Engineers' Society was held in St. Andrew's Church School on Tuesday, Sept. 23rd, when Mr. F. Speke brought a four-jaw Universal chuck and took it to pieces, explaining its construction; and another member showed a pinion wheel and cutter, the pinion being cut with a milling attachment in the lathe. The meeting terminated at 10 p.m.—W. H. BROUGHTON, Hon. Sec., 262, Carlton Terrace, York Road, Leeds.

Liverpool.—A meeting of the members of this branch took place at the Balfour Institute on Wednesday, October 1st, at 7.45 p.m. After the minutes of the previous meeting had been read over and passed, a new member was elected, and it was decided to accept the offer of a more central meeting room at the same charge as that at the Balfour Institute. Mr. Meadows then gave a very practical demonstration of the method of moulding and core making; but, owing to the limited time, had to leave the question of pattern making over for a future meeting.

The next meeting will be held at 100, Dale Street, Liverpool, on Wednesday, November 5th, at 7.45 p.m., further particulars of which will be posted to the members. —F. T. STEWART, Hon. Sec., 33, Cowper Road, Old Swan, Liverpool.

Bradford.—The first meeting for the present season of the above Society was held on Monday, October 6th, at the Coffee Tavern. Tyrrell Street, Bradford, Mr. T. H. Wilson in the chair. There was a fair attendance; but as it was the first meeting, there were not many models shown. Arrangements for the winter season were made, and the committee hope to have a very good and enjoyable session. Will any readers who would like to become members, kindly write to J. H. LAMB, Hon. Secretary, 109, Rushton Road, Thornbury, Bradford?

How to Make a Spring Chuck.

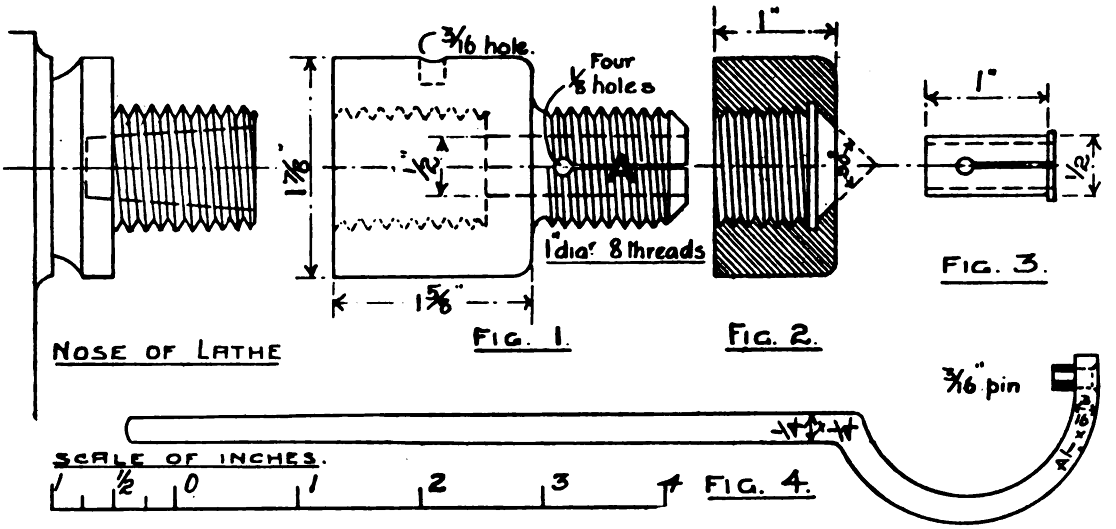
By E. Ronald C.

THE advantages of the spring chuck are numerous, and even the amateur with a goodly array of chucks — self centring and independent — would find it a useful addition to his lathe appliances. In the first place, it requires very little metal to make it, and the use only of the tools that the possessor of a lathe is sure to have. It may be employed with advantage for holding drills when drilling in the lathe, as it holds them securely and true, and they are easily and quickly set. The chuck I am about to describe is suitable for the 5-in. screw-cutting lathe described in an earlier number of The Model Engineer, and will take drills or metal ranging from ⅛ in. down to ⅛ in. Of course, the dimensions may be altered to suit any lathe.

To make the chuck, a piece of round wrought iron or steel must be procured, measuring 2 ins. diameter and 3⅛ ins. long. This should be chucked, bored, recessed, screw-cut and faced to suit the nose of the lathe, and then screwed on to the spindle and turned to the drawing (Fig. 1). The smaller part is screwed 1 in. Whitworth and bored out ½ in. The nose is turned to a taper of 45 degs., as shown. The nut should then be taken in hand and screwed a good fit to the chuck. The taper should be bored out to fit exactly the chuck, taking care to arrange it so that they bear on each other before the nut is screwed right up, so as to leave room for tightening. The chuck must then be saw-cut. Mark off the screwed part into four equal parts, and an inch from the end drill the ⅛ in. holes toward the centre into the bore. Following the lines, make the four saw-cuts A straight down into the holes.

If the amateur is not very skilled in the use of the hack-saw, and is fortunate enough to possess a saddle lathe, he may place a thin parting tool in the rest, laying it on its side, with its cutting edge facing the chuck, and cut the slots by moving the saddle along the lines. Put the back-gear in to keep the job from moving, taking small cuts, and using soapy water as slurry. If the saw is used the slot should be opened out a little afterwards with a thinly-ground file. The main part of the chuck and nut is now finished, except that it would be best to screw the nut on so as to spring the chuck in a little and then skim the bore out true.

A number of bushes, as Fig. 3, can now be turned, drilled and saw-cut. Then place them in the bore, and bore them out to standard sizes. In using small drills it would be advisable to use two bushes, the smallest one fitting in the large one. Be careful after boring them out true in the chuck to mark their position, so as to ensure their running dead true when used again. Fig. 4 is a key for tightening the chuck up, and for screwing it on and off the lathe. It is a piece of ¼-in. by ¼-in. steel, ben to suit the chuck, and a 3-16ths in. pin riveted in the end A 3-16ths in. hole is drilled in the chuck and cut to fit the pin. If this is too much trouble, flats may be [illegible] suit one of the spanners belonging to the lathe.



The Construction of a Spring Lathe Chuck.

A Turbine Dynamo.

OUR contemporary, the *Automotor Journal*, describes briefly a new combined water turbine and dynamo, which it states has been put on the market by Messrs. Roth and Benninghoven for the purpose of charging small accumulators. The turbine is arranged in a glass case above a horizontal magneto-generator, which it rotates by a vertical shaft. The armature is ring wound, and the field is formed by two permanent steel magnets of "C" shape, giving a pair of consequent poles by soft iron pole-pieces which unite similar polar ends of the magnets. The moving part of the turbine consists of a revolving cylinder, mounted under a glass case. It is driven by two jets of water issuing from the ends of two fixed horizontal pipes, which project close to the inner edge of the cylinder, the latter presumably having blades fixed vertically all round, and the water issuing from the fixed pipes tangentially to the cylinder. The water after entering the supply pipe passes upwards to a cylindrical cavity into which the two horizontal arms project. The waste water drops into a trough at the bottom of the glass case, and is led away by a pipe. Our contemporary does not give details of speed, etc., but it is stated that the turbine consumes about 40 gallons of water per hour with a head of 30 ft.

Model Steam Travelling Crane.*

By D. Shannon.

In the design submitted no attempt is made at a scale reproduction of any large crane, beyond retaining the gauge to suit a ¾-in. scale track, that is, it will be 3 17-32nds in. between the rails. It is also a scale model in the fact that it will raise the load, travel, and slew all at the one time—a fairly large scale of operations for a model of this size. It is meant to lift 4 lbs., and the working pressure of the boiler is 40 lbs. per square inch, which, together with the size of cylinders given, will give a purchase far in excess of that required to lift 4 lbs.; but for various reasons it is not desirable to put a much smaller engine on. In any case it will be a matter of trial to find the proper working pressure.

Commencing with the carriage, this calls for no special remark beyond noting that the wheels are inside the framing to allow the locomotion engine to be bolted on to the outside. The carriage wheels are 2½ ins. diameter, and the motion is transmitted from the engine to the axle through gearing wheels, the pinion on the engine shaft being 1-in. pitch diameter, and having twenty teeth, and the one on the axle being 2¾-in. pitch diameter, with fifty-five teeth. This gives a pitch of 5-32nds in. for the teeth. These wheels are shown drawn to the one side in Fig. 3; but the proper position will be in the centre. The engine cylinders are ½ in. diam., and having a stroke of ¾ in. The guides are cast on to the front cylinder cover, and the bolting-up lugs are cast on to the cylinder body. It is proposed to reverse this engine by means of link motion, the lever for reversing being shown at E (Fig. 1). There is one on either side of the crane, so that it can be reversed from either side, as the case may be. This engine is almost the same as the hoisting engine, except that it is made longer from the centre of the crankshaft to the cylinder to allow good long valve-rods to be used.

Fig. 3 shows the method adopted for supplying this engine with steam. It will be noticed that the boiler swings with the crane, and that the carriage engine does not. Hence the simple device shown was adopted to meet this difficulty, and consists of the following:—A steam pipe is taken from the boiler receiver, and passes through a stuffing-box down a hole bored exactly in the centre of the crane post. At the bottom of this hole other two holes are bored to take the steam to the cylinders.

I think this method of fixing the engine direct to the carriage instead of on the crane baseplate, is much simpler than fixing it on the baseplate and driving it through worm and bevel wheels.

The centre post (Fig. 3) is firmly screwed to the carriage with countersunk screws by means of the large flange, which serves also to keep the ball bearings in place. These lower ball bearings are on a 3½-in. diameter circle, and are held in position by the flange on the crane post, and an annular ring screwed to the underside of the crane baseplate with countersunk screws. The upper ball bearings are on a 2-in. diameter circle, and are held in position by another annular ring fixed to the top side of the baseplate, and by a circular nut which is screwed firmly to the crane post, as shown. The crane post at this part is 1 in. diameter, and the lever C (Fig. 1) is for admitting steam to the crane post, and thence to the engines, which exhaust into the atmosphere.

The jib is built of thin sheet metal, and is made a plain box section, as shown in Fig. 8, and to the dimensions in Fig. 1. The chain is first fastened to the top of the jib, then down round the snatch-block pulley, then back to top of jib and over the guide pulley and down the inside of the jib over the guide pulleys to the crane drum. The snatch-block pulley is 1¼ ins. diameter, and the guide pulleys 1 in. diameter, all grooved to take the chain.

The drum is 2½ ins. diameter by 1½ ins. broad, with the gear wheels on one side and a plain smooth projection on the other, this projection being for the band brake. The arrangement of the hoisting gear is clearly indicated in Figs. 1, 2, and 4. The band brake is shown in Fig. 6, and consists of the lever A with two projections, to the lower one of which the band is fixed (which may be a piece of clock spring), and is then carried round the projection on the drum, and back to the top of the lever. The lever is depressed to put on the brake. This lever swings on the top right-hand stay, four of which are used to keep the standards apart, two at the top and two at the bottom, as shown in Fig. 1. The two top ones are shown in plan in Fig. 4, which also shows the band brake lever A, and the lever B. This lever B swings horizontally round a vertical pin fixed on the same stay as the brake lever, and is for throwing the pinion in and out of gear. This lever is shown over the pinion in Fig. 2. When it is desired to lower the load, the pinion is thrown out of gear by the lever B, and the load is gradually lowered by means of the brake lever A.

The hoisting engine is the same as the carriage engine, but does not reverse. The valve rods are bent to clear the drum spindle, or the drum spindle could be placed out of centre of the standards clear of the valve rods. The motion is transmitted from the engine to the drum through gear wheels, the pinion on the engine shaft being ½ in. pitch diameter, with ten teeth, and that on the drum 3 ins. pitch diameter with sixty teeth, which gives a pitch of 5-32nds in.

The method adopted for turning the crane is similar to that used on hydraulic cranes, and consists of a steam cylinder 1½ in. diameter, with a stroke of 1 in., shown on Figs. 1, 3, and 4. The chain is fixed to one of the cylinder cover studs, as clearly indicated in plan in Fig. 4, and then passes round the little pulley on the end of the piston rod, and then round the crane post at the reduced part. This part is ⅝ in. diameter, which, together with a stroke of 1 in. in the cylinder, will enable the crane to make a complete revolution in either direction. The four-way valve is shown enlarged in Fig. 7, and the lever D in Figs. 1 and 3. The cylinder is bolted to the boiler, as in this position it takes up less room.

The boiler is shown in section in Fig. 5. On either side of it there is a tank, one for the feed water, and the other carrying the oil supply for the fire. The burner is carried up under the boiler so that no fire door will be required. It would be advisable to fit a steam receiver (as shown in elevation in Fig. 1), from which the steam could be drawn to the various cylinders. This would avoid perforating the boiler with holes. A steam dome might be fitted for this purpose, but the space on the top is small, and it is not so easily fitted as the one shown. Although the working pressure of the boiler may be 40 lbs. per square inch, the safety valve should be set to blow off at about 45 lbs., since the draw on the boiler will be intermittent, and it is better to allow a little to come and go on. Also, the water capacity of a crane boiler should be large, what is now termed the flywheel of the boiler. A force pump ¼ in. diam. by 1¼ ins. stroke is shown mounted over the water tank in Fig. 1. This, together with the usual mountings on a boiler, should complete this part of the crane.

* This article gained a prize in our Competition No. 17. Editorial comments may be seen in our issue of February 15th last, page 88.

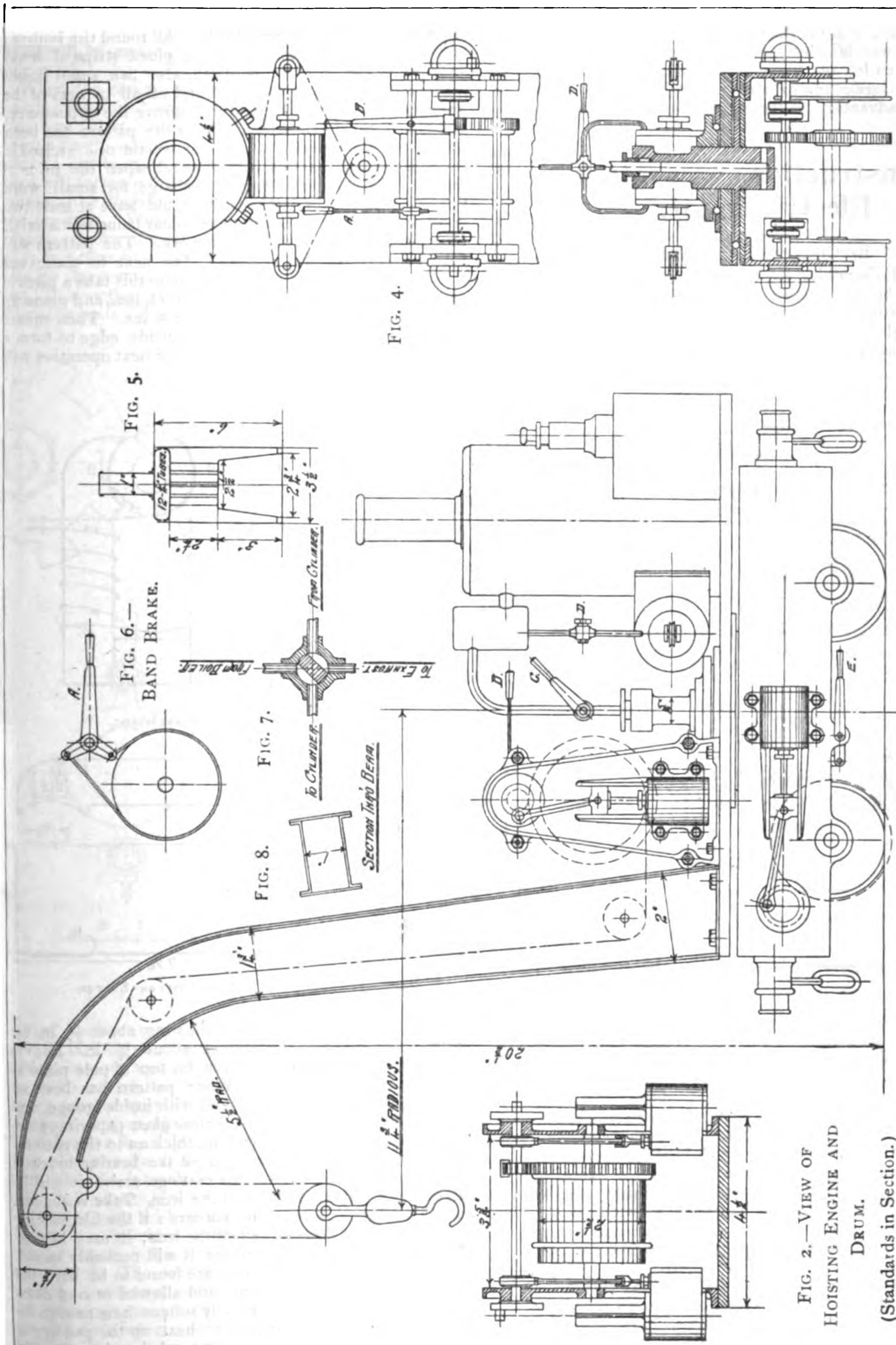


Fig. 2.—View of Hoisting Engine and Drum. (Standards in Section.)

Fig. 3.—Section through Crane Post. *Scale:* ¼ **Full Size.**

Fig. 1.—Side Elevation.

A MODEL STEAM TRAVELLING CRANE.

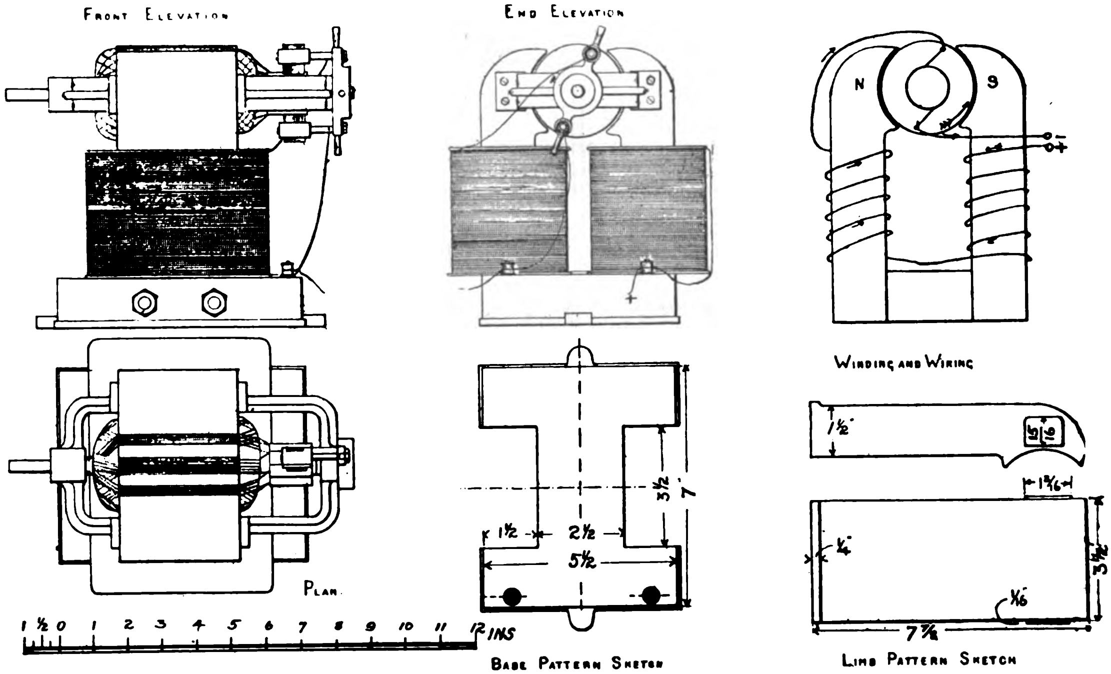
For description, see page 198.

A careful study of the drawings should make the various parts of the machine clear, and, although some minor details have been left out to avoid complicating the drawings, such as steam and exhaust pipes, these can be put in to better advantage on the actual machine than on the drawings.

The Construction of a 1-10th h.-p. Electric Motor.*

By Charles E. Savage.

BEFORE describing the construction of this motor it may be not out of place to warn the amateur motor-maker that he cannot be too careful in securing high insulation efficiency. As a motor of the class here described is designed to work from public or allow for fitting the magnet limbs. All round the bottom, except the gap spaces, should be glued strips of wood ¼ in. by ⅛ in. to form a plinth, also two small bosses for holding down purposes. Round off all corners of the base (except those of the gap) to improve the appearance, and also assist the moulder. After the pattern has been carefully glass-papered (special care should be exercised in the finishing off, as this will often cheapen the price of casting, as a number of founders charge for small work according to the time taken), it should have at least two good coats of shellac varnish—the colour being immaterial, except that black hides inferior work. The pattern will then be ready for the foundry. The next to claim our attention is the magnet limb pattern; for this take a piece of yellow pine, 8 ins. long by 3¾ ins. by 1¾ ins., and plane up to a rectangular shape, 3½ ins. by 1½ ins. Then square the bottom end, putting plinth on outside edge to form a continuation of the plinth of base. The next operation will



other supply companies mains (*i.e.*, 60 volts to 220 volts), the insulation resistance ought to be able to come up to the usual standard.

The motor about to be described is of the overtype pattern, with series winding, and drum armature. Patterns for the cast-iron field-magnets will be required at an early stage of the construction of the motor, and commencing with the base of motor which is also the yoke for the two limbs, we shall have to obtain a piece of wood, preferably yellow pine, which will finish 7 ins. by 5½ by 1½ ins. When this has been reduced to the above sizes, the gaps to receive the magnet limbs must be set out from dimensions given on general arrangement.

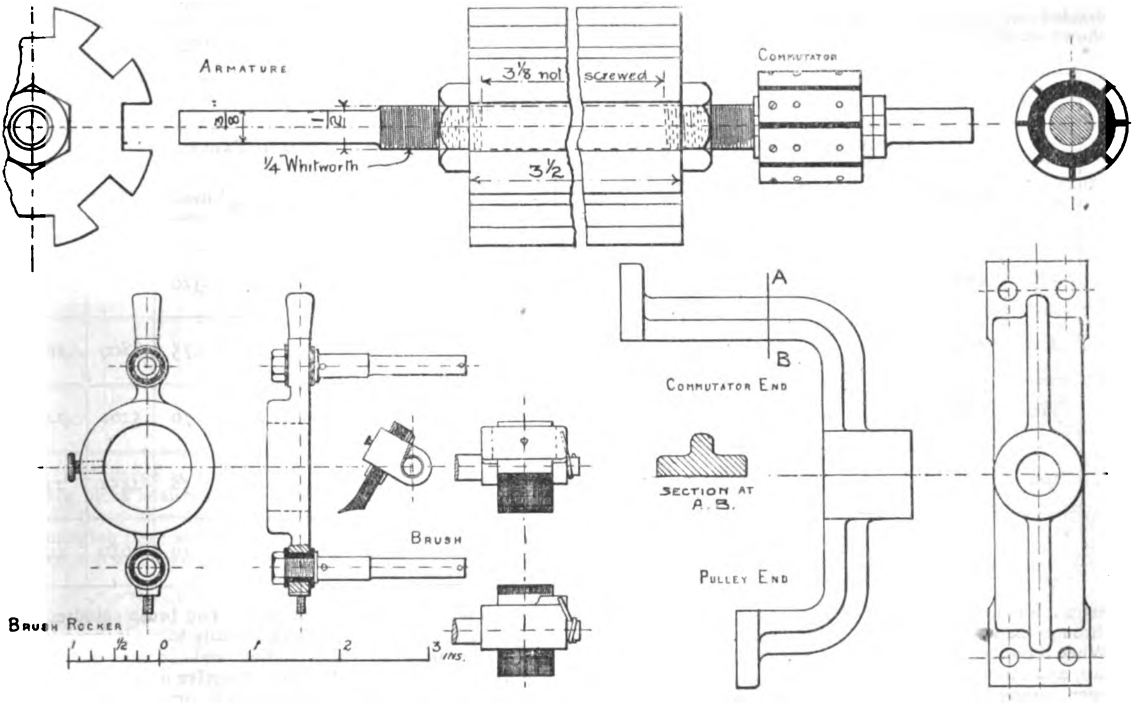
These gaps are each 3½ ins. by 1½ ins., and in the pattern they should be left 1-32nd smaller all round to

*This article gained the prize offered in connection with Competition No. 21.

be to set out armature tunnel, allowing about ⅛ in. for boring out, making the tunnel about ¼ in. less in diameter; then strike out curve for top of pole piece as indicated on the drawing. When pattern has been set out thus, then pare out the tunnel with inside gouge, and the outside curve with a chisel. Before glass papering, glue, two small facings about 1-16th in. thick on to the pattern. These are to enable the bedding of the bearing brackets to be done easily. When the castings arrive it will be advisable to test the softness of the iron. Take a file, and rub lightly across one of the corners: if the file passing over the casting does not effect the iron, it may be concluded that it is hard; otherwise it will probably be soft enough. Supposing that they are found to be hard the castings may be placed in a fire and allowed to cool down as the fire dies out. This generally softens them enough for the purpose. Another way is to heat up the castings in a kitchen fire to a bright red heat, and then bury them in sawdust or lime. If buried in sawdust a nasty smoke and smell will be created; but I have always found this way successful.

When the castings have been cleared up, and all the rough places filed off, they may be prepared for fitting together. First, fire up the lower end of the limbs, giving them a bright and even surface. Then fit them into the gaps in the base, as perfectly as possible, as a bad joint here will increase the magnetic reluctance. The distance between the limb faces should be the same as shown on the drawing. When fitted in, and marked to their places, remove them and set out position of bolts—drill a ⅜-in. clear hole through one of the limbs, and put it into its place, and mark the position of the holes and drilling. This method should bring the fields into proper line. Place the bolts in the holes and screw the nuts up tightly, so that the faces may be in immediate contact. The next process is that of boring out the armature tunnel. A boring bar, with a cutter wedged in, is placed between the lathe centres, the arrangement being the same as the boring bar for cylinder boring. Proceed by rounding off all corners, upon which the wire is coiled; and file up the faces for the bearing brackets. These may be squared from the armature tunnel, and levelled with a straight edge, the distance between the faces being 3½ ins. Also drill three ½-in. holes, ¼-in. deep, as shown for terminals, plug with ebonite, and tap to suit thread on terminals. Before screwing the terminals into place, interpose ebonite washers between the base and the bottom of terminals. The next patterns required are those for the bearing brackets; these should be made according to the drawings, one side of each bracket being shown, the end view being common to both. The boss should be left solid, and an extra 1-16th in. should be allowed on the feet for facing. In the case of the bracket for the commutator ends the ½ in. of boss standing beyond the rib, should be made larger for turning as the brush rocket bracket fits on to this.

The armature spindle should be made of steel to the drawing on detail sheet. The spindle in bearings is ⅝ in. diam. and ½ in. through armature. When the shaft has been turned and screw-cut or chased, the armature may be built up, using plates or laminations, which can be obtained from small dynamo and motor manufacturers. We shall require about 230 of these laminations, if they are, as usual, about ·015 in. thick. In building up the armature core, one nut should be screwed into its proper place on the shaft, and slip a number of laminations over the shaft. Then take two strips of wood, which will fit into the slots, and place them in diametrically opposite slots, and slip the other laminations on these strips of wood, which will guide the laminations over the shaft, and also keep the slots in line. When all the laminations have been put on, screw up the other nut, and if in correct position, slightly burr the thread, so as to check the nut from slacking back; and this done, glue strips of wood in all the slots, allowing them to stand up 3-16ths in. When the glue is set, put into lathe, and tap the strips, till they fit tightly into the armature tunnel bore. Next take the two bearing brackets, shown on detail sheet, which have been previously bored and rimered, until they are a good running fit on shaft; and after the armature has been placed in the tunnel, put the brackets on the shaft and bed them on the fields in their correct position, securing with four 3-16ths in. cheese-headed screws in each. Take off the brackets and mark them for positions; also remove the armature from the tunnel, and unfasten the wooden strips by applying warm water, placing the armature over a flame to thoroughly dry it. Then file out the slots smooth, and if necessary turn the laminations level.



Details of 1-10th H.-P. Electric Motor.

Almost the next item is the commutator. This is usually some trouble to amateurs; but the one about to be described is not beyond any amateur. Obtain a copper tube a little bigger than the finished size given on drawing, and about the same internal diameter. Cut the tube off about 2 ins. longer than the required size, for holding in vice. Make ebonite plug, which need not go down much further than the finished length of commutator, to drive into the tube. Find the centre with a pair of compasses, and drill a full 7-16ths in. hole, and tap out with ¼-in. gas taps. This hole should be concentric with the outside. Before this hole is drilled and tapped, the copper tube should be divided (not cut) into eight segments, and have lines scribed lengthways at divisions. Then set out the positions of the screws — these will come in the centre of the divided segments; their position longitudinally being shown on detail sheet. The two outer screws are ⅛-in. diam., for these will want ⅛ in. tapping holes drilling through the copper tube and 3-16ths in. into the ebonite. When these holes have been drilled, tap them with ⅛-in. tap, and screw up the studding. After the studding has been screwed up, cut off with hack-saw, and file level with commutator face. Then drill holes near the inner end of commutator with ⅛-in. tapping holes, and tap them out to receive cheese-headed screws ⅛-in. diam. These screws will have beads on to secure armature winding, and need not go deeper than thickness of copper. The commutator should be cut off to the length given on detail drawing, then cut into eight segments, with a hack-saw, the saw cuts being made to the scribed lines. The copper dust should be cleaned out of the slots, and cut a little into the ebonite; then again clean out the slots and try with a battery to see if there is any contact between the segments. After this has been done, thin strips of ebonite and mica may be driven into the slots, well varnished with good shellac varnish, and levelled off to face commutator. Make three thin nuts, according to detail drawing, from ⅛-in. sheet brass, and chase ¼-in. gas thread through the centre of the round nuts, two flats diametrically opposite being filed for screwing up. Place one nut on shaft, and screw on the commutator, and also the two nuts locking the whole. Tap the commutator in lathe, using a fine V-pointed tool, and finish off with a fine file, and emery cloth.

A pattern made to allow for machining will be required for the brush rocker, but is so simple as not to need any particular description. The two spindles carrying the brush holders being turned from stick brass, and tapped for 3-16ths-in. brass nut, the hole that the spindle passes through in the rocket should be lined with ebonite and have a washer of ebonite on each face for the shoulder on the spindle to bear against, and the other for the nut. A hole is drilled through the spindle near the rocket bar. Through this the flexible leads are brought and soldered. The brush holders are designed very simply, and may be filed from rod brass, or worked up from castings. The brush is of copper gauze, and beat at end to give larger arc of contact. The spring to hold brush up to commutator is made from steel wire and made as shown in detail drawing, being secured by passing through hole in spindle, thus keeping brush holder in position, and holding spring fast, so as to allow it to press against the holder. The brush spindles and rocker bars may be tested electrically to see if there is any contact between the spindles and rocker bar. The terminals screwed into base to receive mains were partly dealt with earlier. They are to be screwed into place, when field winding is fixed.

TABLES OF WINDINGS.

Armature Winding Table.

Volts.	Armat. Cond.	Layers in width of Slot.	Depth of Layers.	Approximate Res. Ohms.	Gauge of Wire.	Length of Wire in feet.
220	2200	22	13	13	28	1100
2:0	2000	18	14	8	26	1000
110	1100	14	10	3	24	550
100	.000	14	9	25	24	500
60	600	11	7	1	22	300

Field-Magnet Table.

Volts.	No. of Turns of Wire	Length of Limb covered with Wire.	Turns in Length.	No. of Layers deep.	Resistance.	Length of Wire in feet.	Gauge of Wire.
220	8644	3·¾ in	134	33	320	10170	26
200	8000	3½in	125	32	275	8800	26
110	4784	3½ in.	92	26	70	5262	22
100	4048	3½in.	92	22	58	4452	22
60	2400	3½in.	75	16	19	2640	20
Half per Limb.							

The winding of these motors are given in tabular form, headed according to the voltages. The methods of connecting up are shown in diagram, also direction of rotation. The amateur, if not familiar with drum armature winding, better consult some electrical work — for instance, Hawkins and Wallis, on "Dynamo Design"; but with a fair knowledge of armature winding, the amateur will see his way clear by the aid of the diagram here given. As two separate windings will come in each shot, these should be separated by a strip of thin fibre, placed up middle of slot, to divide the two. The reason that two different windings come in one slot, is that the wire has to pass opposite from the starting side, so as to complete the rectangle and circuit. The fibre strip is placed between the maximum E.M.F. which may exist between two such windings. In winding the armature frequent electric testings should be carried out with battery and galvanometer, to see if the insulation is perfect. The wire before winding might be soaked in paraffin wax, to preserve the insulation efficiency, and a good coat of varnish applied to every layer, when it has been tested for leakage. This applies both to the armature winding and field winding.

The rheostat is a simple thing—three lamps are employed first in series, then two in parallel. The lamps

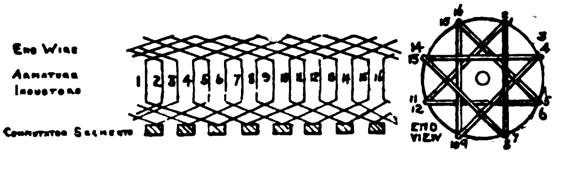


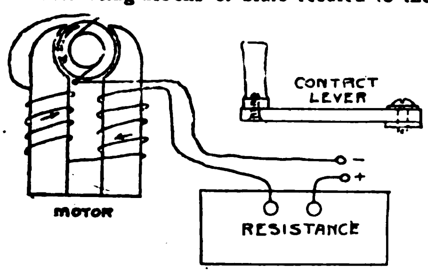
DIAGRAM OF ARMATURE WINDING.

are fixed on the board as shown with holders, similar to those sold for the Coronation illuminations. These have

RESISTANCE IN OHMS OF RHEOSTAT.

	C.-P. of Lamp.	Res. 1	Res. 2	Res. 3	Res. 4	Gauge of Fuse Tin
220	32	500	250	166	All out.	36
200	—	450	225	150	—	36
110	—	120	60	40	—	30
100	—	110	55	36	—	30
60	—	30	15	10	—	26

a small flange at the bottom for securing to board. A face block is also used, and an ordinary tumbler switch All these have to be purchased. The arrangement fo changing the resistance is the only part requiring making the contacts being blocks of brass secured to the base



CONNECTIONS OF MOTOR AND RESISTANCE.
CONTACT LEVER OF SWITCHBOARD.

board, separated as shown where necessary, with ebonite handle screwed on. The winding is plainly shown in dotted lines. A number 16 wire being used, or its equivalent in flexible wire. The terminals bring and take away the current, the whole arrangement being shown on the drawing. This resistance is very simple, and cheaper than a wire resistance, which would have to be exceedingly long. Now, when all is completed, and the motor connections properly made, according to drawing, we may close the switch, which will insert the high resistance. Then move the lever to block two, then three, and then out, when the motor will run at full power, its own back E.M.F. checking the current.

A Water-Regulating Resistance for a 1-in. to 2-in. Spark Coil.

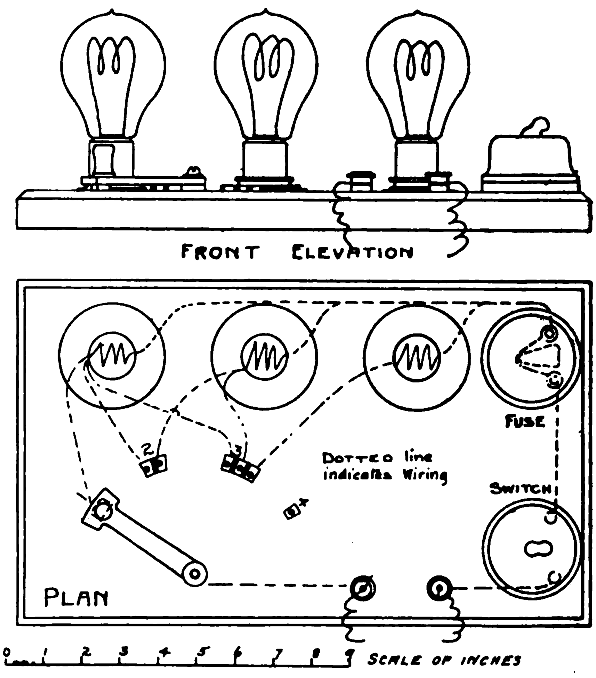
By H. R. EADE.

IN putting the above article before the notice of the readers of THE MODEL ENGINEER, I feel a certain fear and trepidation on account of the number of times this little piece of apparatus has been previously described. It is hoped, however, that the advantages of this design, compared with the indifferent makeshifts that occasionally appear, will recommend it to the practical amateur who possesses the few tools (including a lathe of about 3-in. centre) with which it can be constructed.

Before proceeding with the actual construction, I will just enumerate a few of its specially advantageous points:—

1. Portability without fear of leakages.
2. Fine adjustment of resistance.
3. No sparking across or between terminals.
4. Very little evaporation of water.
5. Facilities for refilling.
6. Superior appearance, etc.

The first piece of work in connection with the above is



SWITCHBOARD AND RESISTANCES.

the turning up of the base. For this a piece of ebonite, teak, mahogany, or maple, will do admirably. Whichever is chosen, a slab, 3 ins. by 3 ins. by ½, should be taken and turned to dimensions (K, Fig. 1), and then nicely finished off with coarse and fine emery cloth, and finally French polished; or in the case of ebonite, finished off with rottenstone and oil. Before completing this, however, three No. 4 B.A. clearance holes should be drilled as shown in the plan (Fig. 1, page 204).

Notice should here be taken of the fact that ebonite blunts all turning tools, so that if the amateur has an odd graver he should re-harden it and temper it to a light straw colour, and henceforth keep it solely for use when turning ebonite or fibre.

The next point to consider will be the machinery and fixing of the collars E, E, Fig. 1. These are made of brass tube about 1⅛ in. internal diameter, and turned down to 1-16th. in. thick, one edge of each being chamfered off for appearance sake. After turning up to correct size and length, clean up with fine emery inside and out, and then proceed to cut out a bottom and top disc for them. The top one should be roughly cut out of

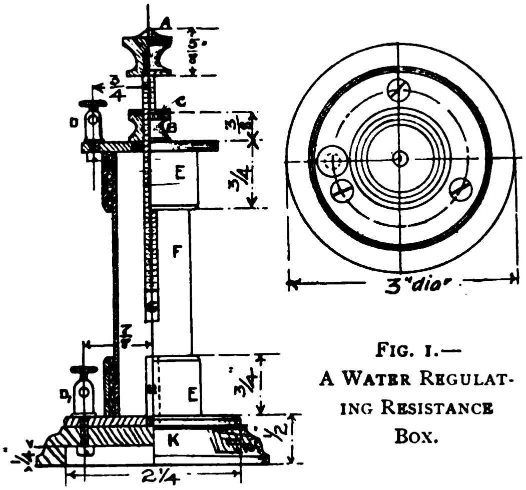


Fig. 1.—A Water Regulating Resistance Box.

⅛-in. thick brass sheet, after having struck a circle thereon with a scriber. Now drill it in the centre with a ⅜-in. Whitworth tapping hole. It can now be attached to a mandrel, held in the lathe chuck, and nicely turned up to the right diameter. A hole for the terminal D, Fig. 1, 4 B.A. clearance size, might as well be drilled at this juncture, after which the centre hole can be tapped out with a ⅜-in. Whitworth tap. The bottom disc may now be operated upon, and, as it cannot be mounted in the chuck similar to the proceeding one—the centre hole only being 4 B.A. tapping—it must be sweated on to a boss, and then turned, the boss being inserted in the chuck. When turned, melt it off and drill in five places, as shown in plan, Fig. 1, all holes being subsequently tapped 4 B.A., and, finally, finish off in a similar manner to the above.

The collars and discs should now be sweated on to each other concentrically, care being taken to avoid using too much solder, and thereby causing an untidy joint. Having satisfactorily completed the soldering, they should both in turn be mounted in the lathe, and any surplus solder cut off, after which they might be polished with coarse and fine emery cloth, Oakey's No. 00 being a good brand.

A piece of brass wire, 3-16ths in. diameter by ⅜ in. long (H, Fig. 1), should now be screwed into the centre 4 B.A. tapped hole in the bottom plate E, so as to serve as a bottom contact.

The terminals D, D (which are cheaper to buy than to make, as the size we require can usually be procured at 2d. each at any optician's or Model Supply Stores), ought now to be screwed into place.

The next consideration is the turning and fitting of a brass plug or stopper, as at B, Fig. 1. This consists of a piece of yellow brass rod, ½ in. diameter, turned down, as shown, and having a ⅜-in. Wh. thread chased on one end, so as to fit easily, not loosely, in the tapped centre hole of E.

The rod is also drilled and tapped 2 B.A. size, so as to accommodate the movable contact G. When the drilling, etc., is complete, clean up and lacquer as usual, and then proceed with G, the movable contact piece. This is a piece of brass wire, 3⅛ ins. long, screwed 2 B.A. for a distance of 2⅝ ins. long, after which one end is reduced to ⅛ in. diameter for the distance of ¼ in., and screwed 4 B.A.

The only remaining piece of brass work now is the milled screw A (Fig. 1), which might preferably be turned from ⅝ in. diameter rod, and finished by milling the edges, as shown, with a knurl, if the latter tool be handy. It is, of course, drilled and tapped 4 B.A., so as to screw on to the reduced end of the contact G (Fig. 1).

We have now only to prepare our glass tube. This is 1 in. external diameter (a lamp chimney will do excellently), and should be 3⅛ ins. long.

At first sight it will probably puzzle the amateur how to cut it off, but the two methods detailed hereafter show how easily this can be done.

Take the glass tube and round the place it requires to be cut tie one turn of thin string; now soak the string in turpentine and set a light to it, plunging it into cold water immediately the flame burns low. It will be found that the glass drops in halves quite smartly, and only requires the sharp edges taking off on the grindstone.

Another way is to plug up the ends of the tube with wood plugs, mount truly between the lathe centres, and then revolve slowly whilst pressing a glass cutter against the required place of severance.

The glass tube is now placed concentrically in the collars E, E, and fixed by filling up the 1-16th-in. gap all round with a thin paste of plaster-of-Paris and water, care

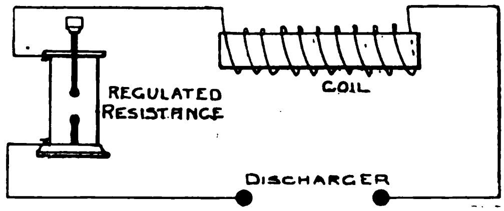


Fig. 2.—Diagram of Connections.

being taken to do this quickly, as the plaster sets so rapidly that, unless expertly done, the joints look very untidy. The only remaining job to be done is the fixing of the tube to the base by means of three 4 B.A. screws, as in Fig. 1. Finally, to make the apparatus watertight, a rubber washer (C, Fig. 1) is cut out of thin sheet and placed in the position shown, so that when the movable contact is screwed down on to it, there is no chance whatever of any water leaking out during transport.

As many of the readers of The Model Engineer, who, no doubt, will eventually construct the foregoing, are more skilful mechanicians than electricians, a few words about the practical use of this apparatus will be helpful. The coil, having been got ready for starting, its secondary terminal should be connected to one terminal of the regulator, its two contacts being at their maximum distance apart. The other terminal of the regulator should now be connected to the piece of apparatus to be experimented upon, as Fig. 2 above.

The usefulness of this resistance for coil workers will now be evident, as a wide range of working, from a small shock to full spark length, can easily be got by screwing down the movable contact.

A little explanation as to why water is used as the medium might be interesting. As the voltage of the secondary of coils runs up to close on 50,000 for 1-in. sparks, it is obvious that a low-resisting material cannot be used, on account of the quantity that would be required, therefore iron and other metals are out of the question. Consequently water has been employed, being about the only cheap material midway between a conductor and an insulator.

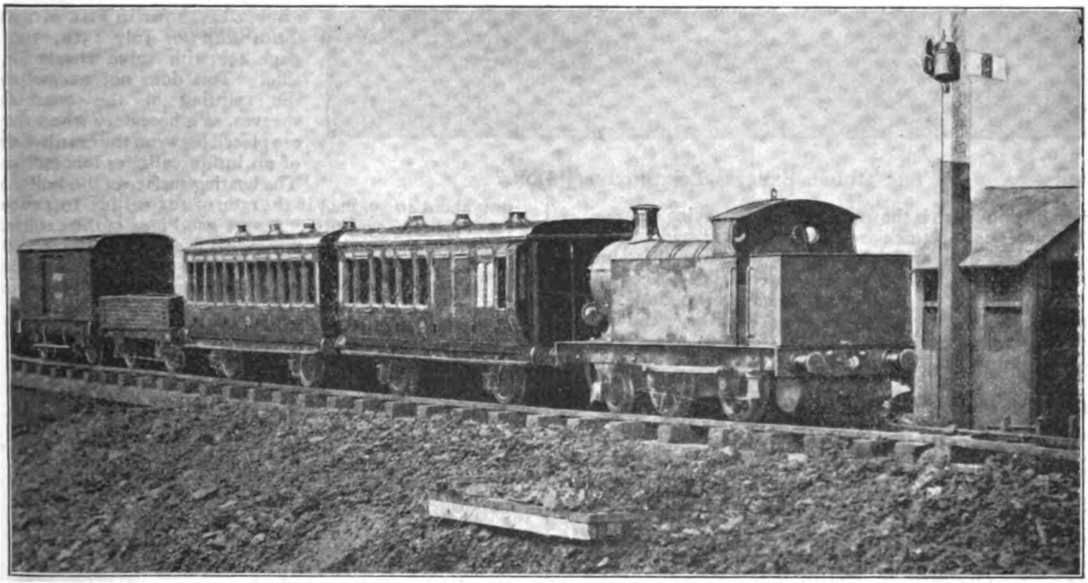
By adding various chemicals—for instance, salt, potash, sulphuric acid, &c.—in small quantities to the water, the resistance is decreased very much, and therefore the working range of this instrument is vastly increased.

Again, a spark coil with an accessory similar to this can be used as a shocking coil at will by connecting up in the method detailed at Fig. 2, and substituting a pair of handles for the discharger, the shock borne by the various persons being registered very nicely by graduating the glass tube, or by several other little devices which are evident to the thoughtful model engineer.

S.M.E. Medallists and Their Work.

F. Smithies.

MR. SMITHIES is nothing if not enthusiastic in his especial hobby of model locomotive engineering. His two models gained a bronze medal at the recent competition of the Society of Model Engineers. Mr. Smithies' chief aim in making model locomotives is to get his miniature engines to run, and to do so in exactly the same way as a real one, and it cannot be gainsaid that he has produced the most successful locomotives the London Society has had the privilege of seeing at work. At the same time, the construction of the models are of the simplest character, made out of scrap material with, in the past, the rudest of tools. Mr. Smithies has never had the opportunity of any instruction in the science and art of engineering, or any handwork, being in business in no way connected with the manufacture of any thing. The total mileage of these two locomotives is now well over 2000 miles, and there is seldom a day upon which his models are not worked for an hour or so. In general proportions, appearance, and capabilities, Mr. Smithies' models of locomotives have improved from time to time during the last twelve years of spare time he has devoted to model-making.



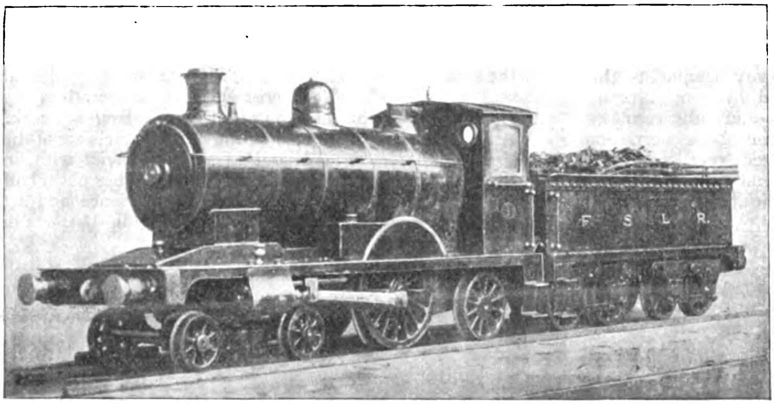
MR. F. SMITHIES MODEL TANK LOCOMOTIVE AND TRAIN.

Forgetting the maker for a short time, we will now consider the construction of the two locomotives which were exhibited at the competition. The tank engine and the express engine are built both to the same gauge and scale. The railway is laid to 3½ in. gauge, and the engines stand well up, having high pitched boilers of ample dimensions, which gives them a massive appearance. The scale of the models is ⅝ in. to the foot.

The tank engine was made over three years ago, and, in its original state, had only one cylinder, ⅝ in by 1¼ ins. The driving wheels are 2⅜ ins., and the boiler is 3 ins. in diameter by 8 ins. long. The engine was illustrated in the pages of THE MODEL ENGINEER for April 15th,

TO PREVENT IRON FROM RUSTING, put 4 ozs. of essence of turpentine or benzol into half gallon of boiled linseed oil, and mix with this a solution of ferro-cyanide, so as to make a homogeneous emulsion. Clean the iron from rust and apply the mixture, when the evaporation of the spirit will leave the surface of the iron protected from further rusting. Another recipe is as follows:—Melt a small lump of camphor in some lard, and colour the mixture with black lead till it resembles the colour of iron. Clean away all rust that is causing difficulty, or clean up the iron parts that it is desired to treat, and then rub on this mixture. After it has remained for a day the parts should be cleaned up again with a cloth, and there will be no more trouble from rust. To make the mixture, use a pound of lard to an ounce of camphor. A mixture of common resin with pure olive oil and spirits of turpentine forms another material which will act very well towards preserving iron from the formation of rust. It is always better and easier to keep the iron parts clean and clear from rust formation than it is to remove the rust once it has got a start.

1901, and was the fifth locomotive Mr. Smithies had made, and also, at the time of construction, the best model for running and steaming, the reason of which will be dealt with later. In June of last year it was tested by the Secretary of the Society and another member upon a continuous track which Mr. Smithies had just completed, the main line of which is shown in the accompanying diagram. The curves on this track are very sharp—5 ft. radius—and the engines, even with the very flexible wheelbase provided and a super-elevation of the outer rail of ½ in., would run off when the speed attained five miles per hour. However, the test in every way proved satisfactory; the tank engine accomplished a distance of 1·039 miles in twenty-five minutes, which equals an average speed of 2·49 miles per hour. One carriage, weighing as nearly as possible 10 lbs., was attached to the engine for the first forty-six laps (a full ½ mile) when it was "slipped" whilst running, and pushed into a siding out of the way of the engine. The highest average speed was registered between the 46th and 62nd laps—viz., 3·21 miles per hour. The track, measured in the centre, was 57 ft. 9 ins. long, making about 94 laps to the mile. The steam pressure did not fall during the test, but was greater at the finish than when the model commenced running; and upon feeding with fuel and lubricating the cylinders, the model was off again for another ½ mile or so. The water lasts about an hour and a-half, the amount evaporated during the mile run being about 9½ cubic ins., a surprisingly small quantity, considering the distance covered, and the driving wheels made some 9,300 revolutions—about six per second.



THE MODEL EXPRESS LOCOMOTIVE "DON."

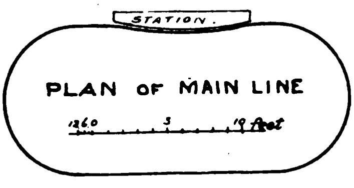


FIG. 1.—THE MODEL RAILWAY.

With the two engines coupled together and the carriage attached, fifty laps of the track (·546 mile) in 11½ minutes, or a speed of 2·85 miles per hour. The steam pressure at start and finish was 35 lbs., and in the middle of the run went up to 45 lbs. With the coach detached, the models were tested at highest possible speed, and attained an average of 3¼ miles; but on this being increased, the engines, after gathering speed at the straight portion of the line, ran off at the curve, the speed at the time being about 5 miles per hour.

There is nothing remarkable in these tests, as they have since been eclipsed by better records; but they serve to illustrate the perfect running of the models, and also their ability to do a great amount of work with a minimum expenditure of steam. The cylinders of both models are small, and the proportion between the total capacity of the cylinders (or cylinder, in the case of the single cylindered engine), and the heating surface is as it should be.

When rebuilding the model tank loco at the beginning of this year, Mr. Smithies decided to have two cylinders, and adopted 7-16ths in. by 1 in., which were rather less in cubical capacity than one ⅝ in. by 1¼ ins. The cylinders are arranged as shown in THE MODEL ENGINEER for July 15th, 1901, page 44, with valve chests outside. This does not necessitate the splitting of the eccentric sheaves, as is necessary when they are placed between the crank webs of an inside cylinder locomotive. The heating surface of the boiler is now about 40 sq. ins., in the ratio of 125 sq. ins. to 1 cubic in. of cylinder capacity. A very good idea of the external improvements made in the model is given by the photograph of tank engine with Mr. Smithies' model train, standing at the station of a fellow member's railway at Watford. The carriages are very realistic, and the bodies were made to instructions by a friendly cabinet maker, and the underframes by Mr. Smithies, the wheels being cast in a lead alloy, and have axle-boxes fitted with suitable tempered spiral bearing springs.

MR. F. SMITHIES.

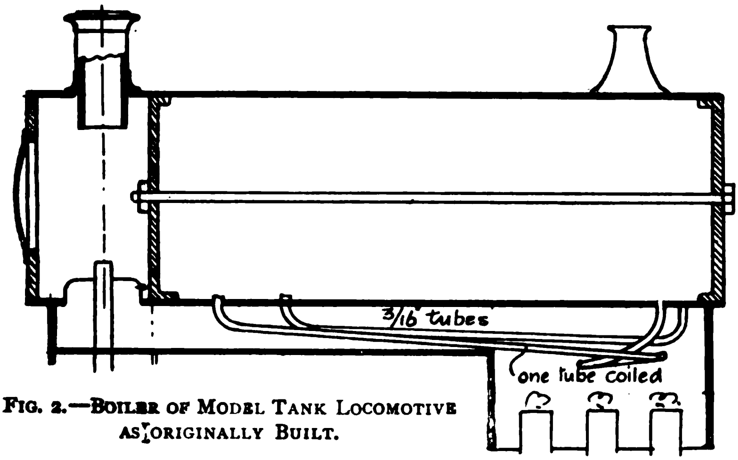


FIG. 2.—BOILER OF MODEL TANK LOCOMOTIVE AS ORIGINALLY BUILT.

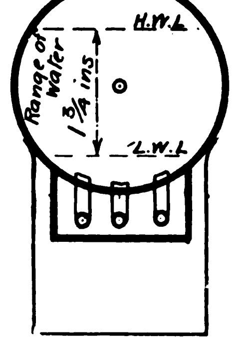


FIG. 2A.—CROSS SECTION AT FLUE.

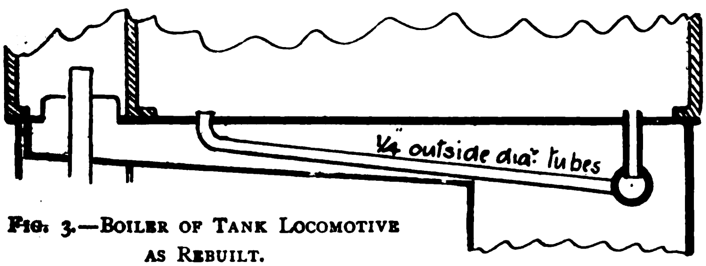


FIG. 3.—BOILER OF TANK LOCOMOTIVE AS REBUILT.

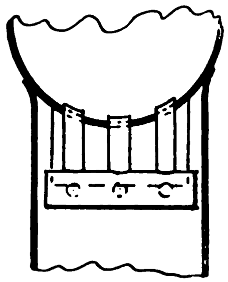


FIG. 3A.—CROSS SECTION AT FIREBOX.

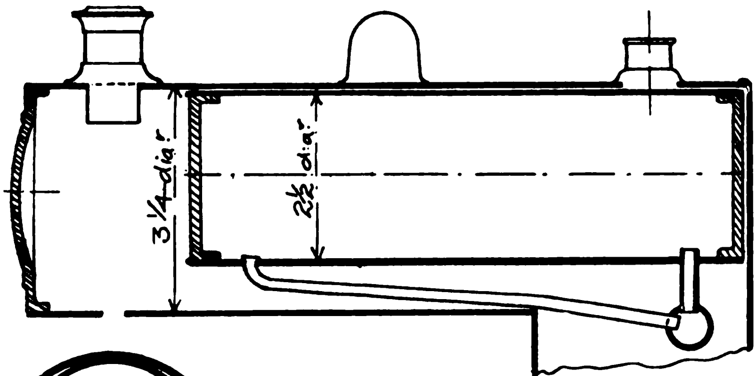


FIG. 4.—
BOILER OF MODEL EXPRESS "DON."

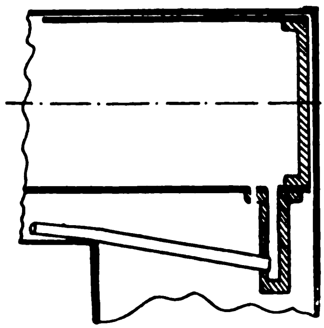


FIG. 5.—"DON" BOILER AS AT PRESENT, WITH CAST DOWNCOMER.

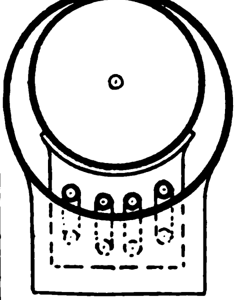


FIG. 5A.—CROSS SECTION OF "DON" BOILER AS AT PRESENT (showing Four Water Tubes).

MR. F. SMITHIES' LOCOMOTIVES.
DIAGRAMS SHOWING IMPROVEMENTS MADE WITH THE BOILERS.

Not to Scale.

(*For description, see page 208.*)

The next locomotive attempted was a marked improvement on any of the others turned out from Mr. Smithies' shop. This engine was built with what material and parts that could be collected, and is better described by the photograph and the outline drawing (Fig. 6) reproduced herewith. The cylinders (two) are ½ in. by 1 in., having a total capacity of about 2-5ths of a cubic in., and the driving wheels are 3⅝ ins. diameter. The only parts for which castings were used were the cylinders and the wheels, all the rest being made from scrap material. The tender body and under-framing is of wood, and is fitted with double bogies. The driving wheels were made in an interesting way from an old pair, with the treads worn right through. The old tyre was cut off entirely, and a new one made from straight rectangular brass rod, bent round in a circle, sweated on to the spokes, and turned up in the usual way. The bogie of the engine is slung on a turned rod, which works in a swivelling pin on the engine, which has a hole through it fitting the rod, making practically a universal joint. The rod is fitted with a light-coiled spring on either side to control the lateral play of the bogie. The bogie wheels are necessarily of small diameter to enable the rear wheels to pass freely under the piston crosshead when the loco is on a sharp curve.

The chief feature of the engine is the boiler, which is certainly a very clever idea, and seems to solve the difficulty of providing a good boiler for the small model locomotive. The barrel seen externally is not the boiler proper, but simply a casing which contains the generator. The outer shell is 3½ ins. diameter, and the boiler proper 2½ ins. diameter. Now we are dealing with the boiler question it will be as well to record graphically the improvements made from time to time in Mr. Smithies' model locomotives (see page 207).

The earliest attempts at boiler work was the provision of a plain cylindrical boiler without water tubes, and coupled to large cylinders, as may be judged, it did not prove a success. Mr. Smithies' endeavour was, and is, to obtain a model which would in every way run as a real locomotive—go slow or fast and always have ample steam for all conditions of working, and the next improvement, to box the flame in entirely and augment the heating surface by the addition of water tubes as shown in Fig. 2, gave every satisfaction.

On rebuilding the tank engine, the water tubes were provided with a downcomer made of pieces of tubes as shown on Fig. 3, and a conical casing underneath to conduct the heated gases to the smokebox. The boiler of the express loco "Don" was first provided with tubes as in Figs. 2 and 3, but the whole of the boiler proper has just been rebuilt with a cast brass downcomer similar to the one illustrated in the article starting in our issue of March 1st. This type of downcomer does away with a number of possibly leaking soldered joints. Three ¼-in. outside diameter water tubes are used in the latest arrangements, and the cylinders are amply supplied with steam for the hardest conditions of working. Great care is taken with all the boilers to make them steamtight and not have the slightest leak.

Another point with the engines under consideration is good fitting of valves and perfect packing of pistons. The valves are ground on to the faces as accurately as possible at frequent intervals. This is necessary when it is considered how many miles in a year these models cover, as the valve and cylinder faces get quite deeply scored, and loss of steam ensues.

The eccentrics are slip eccentrics with an arrangement for adjusting the angle of advance. The use of slip eccentrics enables the steam distribution to be as perfect as can possibly be imagined—there is very little lost motion between the eccentric sheaves and the valves due to joints. In small link-motion models this multiplication of joints, combined with other things, makes the valve very irregular in its movements, and the "beat" of the engine suffers accordingly. The blast-pipes are placed low down, and materially aid the ventilation of the flame when the engines are at work. When standing a blower is used, but this fitting is only a later addition, and is not absolutely essential; one of the chief advantages of the boilers used being a freedom of draught.

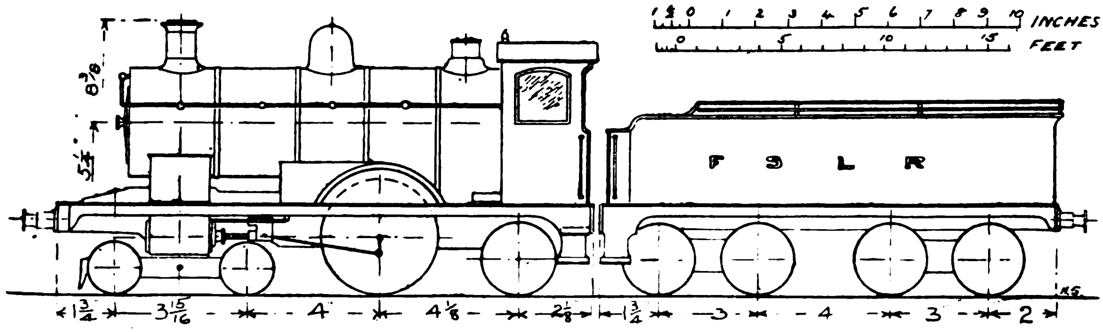


Fig. 6.—Mr. F. Smithies' Model Locomotive "Don."

The good circulation of the water due to the water tubes is, in a measure, one of the best features of the boilers, and the fact that the whole of the steam generator proper is encased from the outer air in the model "Don," has a great deal to do with its success, and the very dry quality of the steam it produces. To dry the steam more thoroughly, Mr. Smithies allows the steam pipe to pass through the flame and hot gases, and thereby the water consumption of the engine for a given amount of work is comparatively very small indeed. On the whole, Mr. Smithies' locomotives are creditable pieces of work—although they may not be considered as highly finished examples of the model engineer's craft, they evidence much forethought and the result of a well-digested experience.

Solder for Aluminium.—In a paper read before the the Society of Arts, Prof. E. Wilson recommends the following composition as a successful solder for aluminium. The constituents are 28 lbs. of block tin, 3·5 lbs. lead, 7 lbs. spelter, and 14 lbs. phosphor tin. The phosphor tin should contain 10 per cent. phosphorus. Clean off all dirt and grease from the surface of the metal with benzine, apply the solder with a copper bit, and when the molten solder covers the metal, scratch through the solder with a wire brush.—*American Electrician.*

A Carbon Electrolytic Interruptor.

By A. H. Taylor.

A WEHNELT interruptor using a platinum point in a solution of sulphuric acid has the great disadvantage that when carrying large currents the platinum wears away. This suggested the substitution of a cheaper metal for the anode.

An interruptor can be made by using a lead plate as cathode in a solution of sulphuric acid, and as anode a heavily-insulated copper wire. The tip of the wire is laid bare for about 1·0 to 1·5 mm. However, this interruptor works poorly and requires constant adjustment on account of the wearing away of the copper and the tearing of the insulation. Other experiments were tried with indifferent

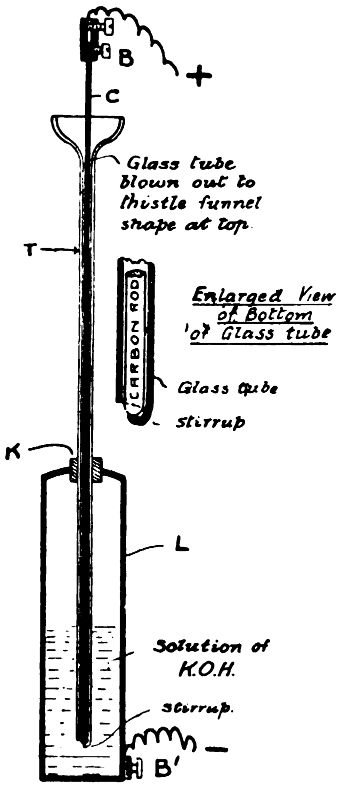


Diagram showing Construction of Interruptor.

success. Under suitable conditions lead, iron, copper, brass, or carbon may be used as anodes, and, as has been pointed out by others, many different solutions may be used as electrolytes. An acid seems to give a little the best results, but is open to the objection that obnoxious fumes are then emitted by the interruptor.

The critical voltage below which an interruptor fails to work satisfactorily seems to vary with different metals.

Although the critical voltage for carbon is rather high, it gave by far the most satisfactory results. The first form of carbon anode used was a 3 mm. carbon rod in a close-fitting hard rubber jacket, covering it to within a few millimetres of the tip. However, this over-heated with a current of four to six ampères, and fused the rubber jacket. The type shown in the accompanying illustration was then devised. C is a carbon rod 3 mm. in diameter, and copper plated to within a few millimetres of the tip. This rod fits loosely in a well annealed glass thistle tube (T) which, in turn, fits the cork K of the lead jar L, and dips into the electrolyte, in this case a solution of KOH (potassium hydrate).

The end of the tube T has a little stirrup drawn out on one side of it. Upon the point of this stirrup rests the carbon rod C. The rod has a binding post at B and the jar one at B′. The copper plating, by increasing the conductivity of the rod, prevents excessive development of heat in it. As the rod wears away, it slides down the tube and the copper wears off. The cork K has a small opening to allow the escape of any gases generated.

Such a size of interruptor as this one, where the rod is 3 mm. in diameter and projects below the tube T 1·5 mm., is adapted for use with a 6-in. spark coil directly on a 100 to 110 volt direct or alternating current circuit without the use of a resistance in series. The size of the lead jar and the quantity of solution vary with the facilities for disposing of the heat developed in the interruptor. If some simple cooling device is used, such as immersing the jar in cold water, it may be of the dimensions shown in the sketch—*e.g.*, about 2·7 cm. in diameter, and 8 cm. high.

To allow automatic adjustment, the carbon rod fits the tube T rather loosely, and during operation the liquid is forced up into the bulb of the thistle tube until equilibrium is attained. The period of the interruptor may be varied as with other interruptors, by varying the depth of the solution. The concentration of the solution affects the current strength only by a limited amount after a certain point is reached, beyond which the current strength may be regulated by the length of the projecting stirrup and the size of the carbon rod. With a solution of one part concentrated KOH to four of water, the above dimensions give a current of about 5 to 6 ampères on 100 volts with a 6-in. spark coil intended for use on an 8-volt circuit. This easily gives the required spark length and shows some peculiarities in the spark, which will be spoken of later.

By adjusting the stirrup or varying the size of the rod, an interruptor may be made to give almost any spark length up to the maximum spark length which the secondary of the coil will stand. Similarly, interruptors may be adjusted for different coils.

For use with *x*-ray tubes the direct current is preferable; but for many other purposes, as for wireless telegraphy, &c., the alternating current is preferable, because with it the interruptor works more evenly. This interruptor requires a minimum D.C. voltage of about 65 to 70 volts to give satisfactory results, and works best between 85 and 110 volts. With the alternating current the minimum voltage is lower, just how much has not been determined.

For any given interruptor on a constant voltage there seems to be a critical spark length at which the interruptor works best.

When this spark length is attained the ordinary ragged, bright discharge is accompanied by a smooth, curved, red or violet discharge, which rapidly oscillates from point to point of the discharge knobs. This part of the discharge is more easily deflected by a blast of air than the bright ragged part. By shortening the spark gap and introducing a capacity, such as a Leyden jar into the secondary circuit, an intensely bright and noisy spark of great energy is produced, while the Leyden jar, if suddenly disconnected, is found to be charged so as to give a spark of 2 to 5 millimetres.

Most of these peculiarities of the spark are characteristic of electrolytic interruptors, and are only mentioned here to show that this interruptor, which is cheap and simple in construction, can be used in almost any case where the platinum interruptor can.

One striking peculiarity is noticed when the interruptor is used on an alternating current circuit, with an alternate and a direct current ammeter in series. On several occasions when the A.C. ammeter read from 5 to 7 ampères the D.C. ammeter read 0·3 to 0·4 ampère.

This was not accidental, but could be repeated, not with exactly the same current readings, but the D.C. instrument invariably gave a reading showing a slight excess of current from the carbon to the lead. A copper voltmeter in the circuit gave a result corresponding to 0·38 ampère while the total current as measured by an electro dynamometer was about 4·0 ampères. This voltmeter also showed the excess current to be from carbon to lead.

These results suggested that possibly there might be a rather high E.M.F. of polarisation, and a D.C. or A.C. voltmeter was used giving on a 100 volt circuit, 108 volts fall across the interruptor, and 55 volts across the coil. To determine whether these results were altogether due to phase differences a D.C. voltmeter was used. This showed about 0·1 volt on the whole circuit, about 0·2 across the coil, and about 0·7 to 0·8 across the interruptor.

These results are necessarily only approximate, since the action of the interruptor is, to a slight degree, intermittent, and causes unavoidable quivering and oscillating in the voltmeter needle. Such as they are, however, they do not justify the assumption of any very large E.M.F. of polarisation in the interruptor. The readings of the D.C. voltmeter are only what would be expected on account of the 0·3 or 0·4 ampère excess current from the carbon to the lead.

This excess current is probably due to the fact that the current is interrupted a less number of times in passing from carbon to lead than when passing from lead to carbon. For in the first case the break is probably caused mostly by the accumulation of oxygen on the anode, and in the second case, mostly by the accumulation of hydrogen, although analysis shows that both gases appear at the anode when a direct current is used. But since the hydrogen accumulates the faster, it is not unfair to assume that the interruptions would be more frequent in one direction than in the other with the alternating current.

A wattmeter indicated a consumption of 62·5 watts for a 6-in. spark; but the spark was plainly of much greater continuity and energy than that produced by any mechanical interruptor.

In conclusion, this interruptor may be recommended as a cheap, simple, self-adjusting instrument, well suited for continuous service.—*Physical Review.*

A Device for Winding Springs.

By R. T. Otis.

EVERY machinist realises the more or less trouble incidental to winding a spring in a lathe. The job is often one requiring the services of two men, and as a great deal of force has to be applied to the wire to hold it back, a bend is made in the wire which causes a defect in the spring. Much of this trouble can be avoided and a better spring produced by using the little device shown in Fig. 1.

This device consists simply of a flat board about 18 inches long and 2 inches wide, on which is fastened a strip of leather. In the leather are punched three or four holes through which the wire is threaded before winding. In winding a spring with this device the leather furnishes sufficient tension to hold the wire back properly, and all that is necessary is to start up the lathe and guide the board, as shown in Fig. 2.

When a spring is being wound by the usual method it is generally necessary to have the arbor run on centres, as the pull on the wire would bend an arbor that was held in a chuck. When winding a spring by this method the wire draws the board up against the arbor and thus relieves the pull that would otherwise tend to bend it.

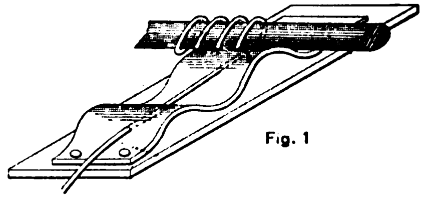


Fig. 1

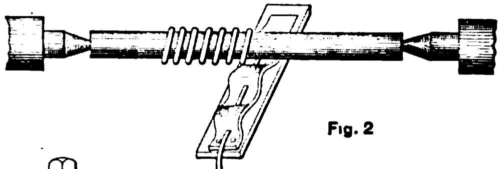


Fig. 2

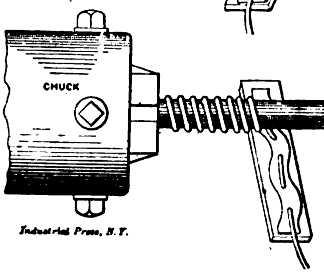


Fig. 3

This enables one to use any rod or arbor in a chuck, and thus saves the time which would be wasted if it were necessary to stop and centre an arbor especially for the job. Fig. 3 shows a spring being wound on a rod held in a chuck.—*Railway Machinery.*

THE Great Northern Railway Company has recently made provision at the locomotive works at Doncaster for a new locomotive erecting shop 580 ft. long, and equipped throughout with electrically-driven machinery. The overhead electric cranes are capable of lifting a weight of 35 tons.

EDGE-TOOLS THAT ARE BRITTLE AND HARD can be made to keep an edge by putting in boiling fat for two hours. Treated in this way they will retain their hardness without being brittle. Another simple remedy for tools that are too hard is to light a piece of paper and run it across the edge after grinding.

FRENCH ELECTRIC FIRE PUMP.—The novel fire pump of Robert Lefebre, of Rouen, carries an electric motor, which is connected to a supply of energy by throwing a hooked pole over a street car or electric light wire. The apparatus is so small that it can be drawn by one horse on a two-wheeled cart, and in a test made a jet was being forced to a height of more than 100 ft. within three minutes. To get an equal stream a steam pump required fourteen minutes.

The Editor's Page.

WE have recently been taken to task by one of our advertisers for giving an undue number of "puffs," as our correspondent was pleased to term them, to the goods of a competing firm. Unfortunately for himself, this complainant disclosed the real nature of his grievance by adding: "The notices must have been worth at least £20 to ——. I only wish they had been given to me." The whole incident, of course, was merely an instance of trade jealousy, with the details of which we do not propose to trouble our readers; but we should like to use it as a peg on which to hang a few remarks with regard to the notices of various goods which are inserted in our journal.

* * *

In the first place, we wish it to be clearly understood that the only space we have to sell is in our advertising pages. We have never accepted a penny piece for any notice of goods or mention of a firm's name in our literary pages, and no editor who had the slightest respect for his own reputation, or that of his journal, would dream of so doing. We believe, however, that it is in the interests of our readers that we should keep them posted up in the various new tools, appliances, and materials, which are in any way connected with model engineering or electrical work, and for that reason we invite the trade to send us for review samples and particulars of any novelties they may introduce. Such goods are noticed in our "Amateurs' Supplies" column, or elsewhere if more suitable, entirely on their merits, and are given such praise or criticism as we think they deserve. As far as possible we make a point of personally inspecting all goods before we notice them in our paper, and we are careful to indicate whether the notices are based on a personal knowledge of the goods or not. Although we regard our judgment as by no means infallible, we are pleased to be able to say that ever since the starting of this journal we have received only one complaint from a reader stating that our recommendation had led him into buying something which he considered was not as represented. This, when investigated, proved to be without any real foundation, so we may claim to have a clear conscience on this score. On the other hand, we have frequently been told by readers that they have bought goods on the strength of our notices in THE MODEL ENGINEER, and that they have been very well pleased with their purchases. Of course, it must not be forgotten that different people form different standards of quality, and that one reader might be quite satisfied with a certain article where another would regret the bargain. We cannot be expected to guarantee that any article we may favourably review will give universal satisfaction; but we must usually content ourselves with pointing out what we consider to be the points in its favour, or the reverse, and with expressing our opinion as to whether it is fair value for the money. Sometimes an article is so good of its kind that we feel we can recommend it without any reservation whatever, and we accordingly do so.

The necessity for our honesty in this matter will readily be apparent if the reader considers what the effect of a wilfully misleading notice would be. If, in order to please an advertiser, we highly praised an undeserving article, there would naturally be a keen demand for it, and the seller would undoubtedly profit by the first rush of orders. The disappointment of the customers when they received their goods, however, would do him an infinitely greater amount of harm in the long run, for the customers would be chary of coming to him again, and each would caution his friends against buying the particular article in question. From our point of view the result would be equally disastrous, for no reader who had been deceived on this occasion would put any faith in our recommendation again, and the character of our paper would soon be gone. The reputation for fair play which we have already gained is far too valuable a thing for us to fritter it away by trifling with our readers in this fashion.

* * *

One or two words more in conclusion. It sometimes happens that a new article is placed on the market and the sale is taken up by several of the firms catering for our readers. We, obviously, cannot be expected to review the same article for half a-dozen people, and we therefore make it a rule to give the notice on behalf of the firm which is the first to send us a sample for inspection. If one firm scores off its competitors in this way more often than the others, it is simply due to smarter business methods, which we think all will agree should have their due reward. It has also been suggested to us that we are doing harm by reviewing, as we are occasionally asked to do, goods which are made abroad. Our reply is that while we should be only too delighted to see the manufacturing in the particular class of goods we have in mind undertaken by English firms, we are not narrow-minded enough to exclude good things from our paper simply because they happen to be produced abroad. We trust that we have spoken plainly on these matters, and that our remarks will be appreciated by those whom they most concern. May we add an apology to our readers for taking up so much space with these remarks on "policy," although we feel that probably they will not be altogether unwelcome to those who, after all, are the ones mainly concerned in the *bonâ fide* nature of our "Amateurs' Supplies" column.

* * *

The following extracts from letters on the subject of steam *versus* electric models will doubtless be of interest:—"A. R. M. S." (West Ealing) writes: "Having made both steam and electric models, including locomotives, I think it is a question of the quality of work you put into them, so that to draw a line in favour of either is impossible. A well-made electric loco is necessarily more interesting than a badly made steam loco, and *vice versa*, and the brain power and skill called for in either is, I should say, about the same. The best steam model I have ever seen was made by Dr. J. B. Winter, and it is a marvel of workmanship; but no doubt if that gentleman made an electric loco it would be equally as marvellous.

The advantage of electrical models is that you can use them at any time, and they do not get disfigured and discoloured by heat, steam, and oil. No matter what pains you have taken with your model, it is always a pleasure to work it; but with steam it is quite different. The better your model is the more loth you are to use it, and as a rule it becomes an ornament to be looked at, but not used. Certainly an electric railway is much more difficult to make than one intended for steam only."

* * *

"A. H. M." (Broad Oak) also writes:—"With regard to the letter from 'J. C. C.' (Muswell Hill) in THE MODEL ENGINEER for October 1st, I should like to say that I have had a great deal of experience with both steam and electric models, and I find electric traction is far before steam. I think 'J. C. C.' makes a serious error in saying that building a model electric railway is simplicity itself, for I find that it calls for as much skill to build and design a good electric model as it does a good steam one. In my opinion electric models create far more outside interest, and are much better to handle. I would like to add that I think great credit is due to the writer of the recent articles on model electric traction for the clear way in which he described the third rail system and the electric brakes."

* * *

Most of our readers are doubtless anxious to know the result of the voting on the question of a weekly issue of THE MODEL ENGINEER. Although we shall probably continue to receive post-cards for some time after these lines are written, we may say that so far the votes show a majority of more than ten to one in favour of publishing weekly. This proportion seems decisive enough, and if maintained in the later votes will leave no doubt in our mind as to the desirability of the proposed change. We shall, however, deal with the matter more fully in our next issue, when we hope to be able to find space for some interesting quotations from the opinions which our readers have been good enough to express. If there are any readers who have not yet voted but who still wish to do so, we should be glad if they will send in their cards by the earliest possible post.

* * *

What shall we say to the perpetrator of the following conundrum, which recently reached us on a post-card:—"Why is THE MODEL ENGINEER (engine here)? Because we WOODWORKER (would work-her)" ! ! ! He certainly ought to have his name and address published, so that his friends might deal out summary justice when next they meet him; but—prudent man—he omitted to send it. Anyhow, we know these conundrums; they come from Sheffield. Really, Sheffield model engineers, we thought better of you.

Answers to Correspondents.

F. O. MOSLEY (Huddersfield).—Please send your full address. We cannot trace your original query, and cannot write to you.

R. (Dublin).—To what model do you refer? Look up the back numbers of engineering journals for descriptions of submarine boats.

New Prize Competitions.

The winter season having fairly started, we think it an appropriate time for announcing a new series of prize competitions. The list is an extensive one, and while the subjects are very varied in character, we have carefully borne in mind the fact that one of the main objects of these competitions is to induce readers to contribute to our pages something that will be of benefit to their fellow-workers. As in past competitions, we have found that several of the unsuccessful entries have contained some good wrinkles, we may say that, in future, should we decide to use the whole or any portion of an article or design not gaining a prize, we will pay for the matter we use in proportion to its merits and its length. We therefore trust that with this extra inducement in view a good number of entries for all the competitions will be received.

Competition No. 24.—A Prize of £2 2s. is offered for the best article on "THE POINTS OF A GOOD LATHE, AND HOW TO TEST THEM." We do not require a specification of a perfect lathe, but simply a practical description of the constructional features which are required to give satisfactory results in working, and a simple explanation of the tests which a well-made lathe should stand. In short, we require an article such as would enable an intending purchaser to form an opinion as to the suitability of any lathe he might contemplate buying, either new or second hand. The closing date for this Competition is December 1st, 1902.

Competition No. 25.—A Prize of £2 2s. is offered for the best article on "THE MATERIALS OF MODEL ENGINEERING." This should explain the nature and properties of materials such as cast iron, wrought iron, cast steel, mild steel, silver steel, copper, brass, gun-metal, German silver, solder, tube, &c, and should indicate the various purposes for which each material is most suitable. Hints should also be given as to the basis on which the materials are usually sold, such as by measurement, or by weight, in rod, sheet, or bar, etc., and the most economical method of buying. The closing date for this Competition is December 1st, 1902.

Competition No. 26.—A Prize of £2 2s. is offered for the best article entitled "THE AMATEUR ELECTRICIAN—WHAT SHOULD HE MAKE?" This should be written on the assumption that the reader is about to take up electrical work for the first time, and is desirous of having a progressive course in electrical apparatus and model-making mapped out for him. The work suggested should be progressive, both in point of knowledge and tools and materials required, and the subsequent uses of the various pieces of apparatus for experimenting or testing should be borne in mind. The closing date for this Competition is December 15th, 1902.

Competition No. 27.—A Prize of £2 2s. is offered for the best article on "MY EXPERIENCES IN MODEL LOCOMOTIVE BUILDING." This should describe briefly the various model locomotives built by the competitor, and should deal as fully with his difficulties and failures and their causes, as with his successes. If possible, it should be illustrated by photographs or dimensioned drawings, showing the principal features of each engine described. The article should deal with steam models only. The closing date for this Competition is December 15th, 1902.

Competition No. 28.—A Prize of £2 2s. is offered for the best article on "WORKSHOP FITMENTS." This should describe useful home-made workshop fittings, such as shelves, tool-racks, nests of drawers, and other devices for the convenient arranging or storing of tools, parts, and materials. It should be illustrated, if possible, by photographs or dimensioned drawings of the various fittings described. The closing date for this Competition is December 15th, 1902.

Competition No. 29.—A Prize of £2 2s. is offered for the best article on "SCREWS AND SCREWING TACKLE FOR MODEL ENGINEERS." This should describe the characteristics of the threads in general use for small work, such as the Whitworth thread, the B.A. thread, pipe threads, &c., and should point out the advantages or disadvantages of each from the model-maker's point of view. Suggestions should be made as to the best class of thread to be used for various purposes, and hints on the most suitable screwing tackle—home-made or otherwise—should be given. The closing date for this Competition is January 1st, 1903.

Competition No. 30.—A Prize of £2 2s. is offered for the best article on "SOME TOOLS I HAVE MADE." This should deal with the various bench or lathe tools the competitor has made either for general or special use, and should describe clearly how each tool was made. Dimensioned sketches of each should be given. The closing date for this Competition is January 1st, 1903.

Competition No. 31.—A Prize of £2 2s. is offered for the best article on "EXPERIMENTS WITH INDUCTION COILS." This should be written on the assumption that the reader possesses an induction coil of moderate power, and desires to know to what uses it can be put. Sketches or diagrams should be given where necessary. The closing date for this Competition in January 15th, 1903.

Competition No. 32.—A Prize of £2 2s. is offered for the best design for "A MODEL STEAM TURBINE." In setting this subject we realise that we are setting a problem of some difficulty, but we believe many of our readers are equal to getting out a design for a workable model. The model should be reasonably simple in construction, and should be capable of being turned to some useful purpose, such as propelling a model steamer or driving a small dynamo. Full working drawings, with dimensions, should be given, and a written description sufficient to clearly explain same should accompany each design. The closing date for this Competition is January 15th, 1903.

GENERAL CONDITIONS FOR ABOVE COMPETITIONS.

1. All articles should be written in ink on one side of the paper only.

2. Any drawings which may be necessary should be in good black ink on white Bristol board. No coloured lines or washes should be used. The drawings should be about one-third larger than they are intended to appear if published.

3. The copyright of the prize articles to be the property of the proprietor of THE MODEL ENGINEER, and the decision of the Editor to be accepted as final.

4. The Editor reserves the right to print the whole or any portion of an unsuccessful article which he may think worthy of publication, upon the understanding that remuneration is given at the Editor's discretion in proportion to the length and merit of the matter used.

5. All competitions should be addressed to The Editor, THE MODEL ENGINEER, 37 & 38, Temple House, Tallis Street, London, E.C., and should be marked outside with the number of the competition for which they are intended. A stamped addressed envelope should accompany all competitions for their return in the event of being unsuccessful. All MSS. and drawings should bear the sender's full name and address on the back.

THE LIVERPOOL-MANCHESTER MONO-RAIL LINE.—Considerable progress has, it is said, been made of late in the matter of providing capital for the Liverpool and Manchester Electric Express Railway, and that before long an official announcement will be made as to when the construction of the new railway will be commenced.

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, *37 & 38, Temple House, Tallis Street, London, E.C.]*

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

[6969] **Model Yacht.** D. J. M. (South Shields) writes: Please could you tell me the best form of body plan for model 10-tonner, 48 ins. L.W.L., 6 ins. beam, fin keel, 1,500 sq. ins. sail area. I would like to build a racer but have no experience. She is to sail under the 1730 Rule.

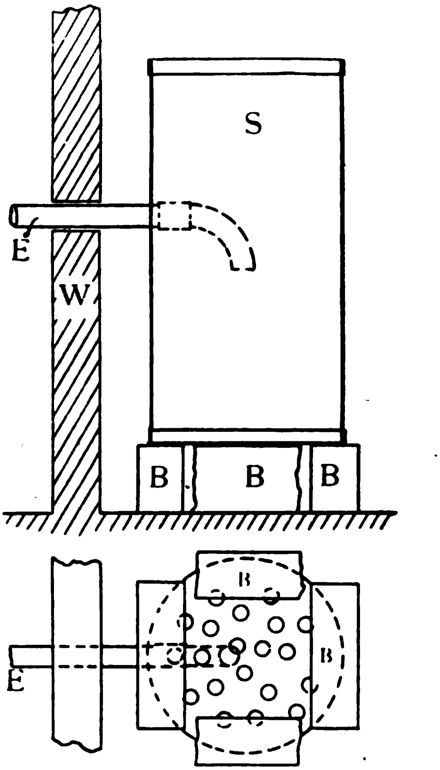
Replying to your enquiry, we should not recommend such extreme dimensions for your proposed tonner under the $\frac{(L + B)^2 \times B}{1730}$ Rule There being no tax on sail under this rule, the object is to get as large a boat as possible and a fine spread of canvas. With only 6 ins. beam as suggested, and a fin keel, she would doubtless carry the 1,500 sq. ins. of sail area, but a far more powerful boat would result if the length were reduced and the beam increased. The following table shows the possibilities under the rule:

	1	2	3
L	40·5	41·5	42·7
B	7·5	7·25	7

We think you would find the last, viz., 42·7 L.W.L. and 7 ins. beam more successful than 48 ins. L.W.L. and 6 ins. beam. You will see, roughly speaking, that for every inch of water line reduced it is possible to give ¼ in. extra beam, and the latter means stability and power to carry sail. Then again, you suggest a fin keel. This will not do with very small beam. The fin keel was the outcome of the $\frac{L.W.L. \times S.A.}{6000}$ Rule, due to the fact that beam was not taxed, and, in consequence, spread. The body was made more shallow and to avoid heavy displacement, the fin was introduced. Without beam stability must be obtained by displacement, and this necessarily means a deep bodied boat of the keel type. In conclusion, we should say that a boat 40·5 L.W.L., 7·5 beam, 10 ins. draught, of say 22 to 24 lbs. displacement, with 1,800 sq. ins. of sail area would be more successful than 48 ins. L.W.L. 6 ins. beam and 1,500 sq. ins. of sail.

[6815] **Launch Petrol Motor.** R. E. M. (Tylorstown) writes: I have a petrol motor 5 ins. bore 5 ins. stroke, speed given as 900 revolutions per minute, taken out of a launch. I intended connecting it direct to a dynamo whose armature measures 7 ins. diam., 7 ins. long over all. I find, when engine is worked 900 revs., dynamo does not magnetise, and also engine combustion chamber and exhaust pipe become abnormally hot, so much so that after running about six minutes the butt of exhaust pipe and adjoining part of combustion chamber become red hot. Also, although I have inserted two layers of wire gauze in inlet pipe, engine has still a tendency to fire back into tank. Cylinder is water-jacketed, combustion chamber being cooled by surrounding vanes, as in the air-cooled motor. Also, the exhaust makes a very great noise, which I wish to stop. Advice as to method of making an efficient silencer, together with suggestions for overcoming the other difficulties, I should be very glad to have.

We are sorry we cannot do more than offer a few suggestions as to the cause of your trouble; you give us so little data to go upon. If the dynamo does not begin to pick up at 900 revs., it is most probable some of the connections are wrong. Try reversing the field connections and see that the brushes are on the right diameter. The fact that the exhaust pipe gets very hot need not trouble you; it is only natural that it should. Provided the motor is of good design, the water jacket clear, allowing the cooling water to circulate freely, we can only infer that you must be overloading it. Does it take a charge every time, or does it become overheated when running comparatively light? Some motors are inclined to fire back when a weak mixture is taken in; but if this is put right and the vapour inlet valve closes at the right time you should have no trouble of this sort. We give a sketch of exhaust silencer which may be of use to you. A tin box of any kind may be converted into an efficient silencer; a small dust bin makes a suitable one, as shown in Fig. 1. The exhaust pipe E is led through the wall and inside the silencer S, with the bend pointing downwards. The box is nearly filled with broken coke, and the bottom is perforated with



A SILENCER FOR INTERNAL COMBUSTION ENGINES.

a good number of holes to prevent water accumulating there. The whole is set up on a few bricks which may be held in place by cement. Fig. 2 is an inverted plan, and, as will be seen, openings are left in the brick work for drainage, otherwise t would be useless to perforate the bottom of the silencer.

[6983] **Steam Gauge Fixing.** C. W. P. (Rotherham) writes: Could you tell me why on a boiler the pipe to pressure gauge from boiler is dipped down or is coiled round gauge?

The dip in the pipe from the boiler to pressure gauge is to prevent the very hot steam from coming in direct contact with the working parts of the steam gauge. A material degree of heat seriously affects these instruments, and would render them inaccurate in a very short time. You will understand that steam will condense in the pipe at first, and the dip would prevent this water from running back into the boiler when steam is run down. Upon steam raising after the first time, this water will be pushed in front of the steam going to the gauge, and will form a non-conducting cushion between the delicate parts of the steam gauge and the highly heated steam of the boiler.

[6985] **Steam Engine for Launch.** H. K. (Bath) writes: I want to build a boiler, 14 ft. long and 4 ft. beam. Will you kindly tell me whether a launch engine, with single cylinder, 1¾ ins. by 2¾ ins., or 2 ins. by 3 ins., would be best? Would Cornish boiler, described on page 40 of "Model Boiler-Making," do if size were just double, and metal ⅛ thick, instead of 1-16th? Also, would ⅛ metal require as many stays? Working pressure and size of pump?

2 ins. by 2 ins., or 2 ins. by 2½ ins., single-cylindered engine would suit your boat very well if, however, very high speed is not required. The boiler you name is entirely out of the question for the purpose; one with about 850 to 1000 sq. ins. of heating surface is necessary, and a steel boiler, similar to that on page 35 of "Model Boiler-Making" (price 7d., post free, from our Book Department, 6, Farringdon Avenue), would be found the best and cheapest generator, if solid fuel is to be used. A working pressure of 50 lbs. is advisable. T. Goodhand, of New Brompton, Kent, will supply you with complete boiler, or flanged plates and parts for such a generator. The pump must be of sufficient size to throw about 15 cubic ins. of water per minute, and we should say that one with a ram about ½ in. diam., and a stroke of ⅝ in., running at about 200 revs. per minute (geared down from engine) ought to do well. To regulate the feed you should place a cock on the delivery pipe before it reaches the boiler, and by opening this the feed may be adjusted to a nicety. Working pressure, 40 to 50 lbs., is a very good pressure for small steam engines.

[7102] **Induction Coil Failure.** J. H. (Preston) writes: Enclosed you will find simple shocking coil as described in THE MODEL ENGINEER. I have followed instructions laid down by you as near as possible, but I find I cannot get it to work. I used three No. 2 Leclanché cells. I should be very much obliged if you will put me straight.

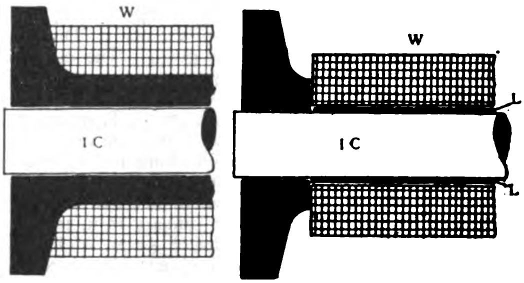


FIG. 1.—THE WRONG METHOD. FIG. 2.—THE PROPER METHOD.

INDUCTION COIL FAILURE.

We have found it necessary to take the coil to pieces to discover the fault. It would appear to lie in the great distance you have allowed between the iron core and the wire, which appears to be wound on the wooden bobbin. The section would be as in Fig. 1 in your coil, whereas it ought to be as in Fig. 2, in which you will note only the bobbin *ends* are used, and a layer or two of paper is wrapped round the iron. The wire appears to be all right, but one of your connections was wrong. We think if you alter the coil as above, the results will be quite satisfactory with two or three Leclanché cells. I.C. Iron core. L., Layer of paper. W., Wire.

[7013] **Sack Leclanche Cells.** T. W. (Barnsley) writes: Is it possible to completely seal sack Leclanché cells, and so make them portable? I have often tried to accomplish this, but have not succeeded, as the sal ammoniac always forces its way out sooner or later. I have charged the cell, screwed in the lead plug, and left cell standing untouched, and in a few hours the liquid is oozing out round the plug, this taking place whether the cell is standing up or laid down. If you can give me a reason for this, and suggest a remedy, I should be greatly obliged. I want cells to be as portable as dry cells, to be used in any position, and stand shaking. Will they do this without leaking? Will three of them light a small H.E. lamp for 3 to 5 minutes at long intervals?

No, it is not possible to completely seal these cells; had this been practicable it is probable the dry battery would never have been in such demand as it is at the present day. Sal ammoniac will almost creep through anything, especially when it is shaken about. Again, in the sack Leclanché, gas is generated when working, and this fact alone shows it is not practicable to hermetically seal the cell. Three cells will light a 4-volt amp but only for a minute or two at time.

[7163] **Bichromate atteries for Lighting and Charging.** G. L. (Manchester) writes: I am making a 12-cell bichromate battery, the cells being joined in series. The size of each of the elements is 5 ins. by 1¾ ins., the jars are 3½ ins. by 4½ ins. Could you oblige me by answering the following queries:—(1) How many lamps would this battery light? Please state candle-power of each lamp. (2) What size motor would it drive? (3) Could I charge an accumulator with it? If so, of what size? (4) How long would the lights last? (5) What candle-power dynamo would it take to light a room equal to two gas jets; also size of engine to drive the same?

(1) You could run six 4-volt lamps of about 2 c.-p. each, or three 8-volt of about 3 or 4 c.-p. (2) Any size you please up to, say, 80-watts. (3) Three 6-volt accumulators of the pocket size could be readily charged. (4) Provided your lamps do not take (all together) more than 2 or 2¾ amps., the cell should hold out for several hours —say two or three—with the lamps going continuously. If only used intermittently they will be good for weeks. (5) 28 c.-p. if you refer to the ordinary fishtail burner. About ⅛ or 1-6th h.-p.

[7108] **Model Boiler Queries.** F. F. S. (Barnet) writes: (1) What pressure would the boiler described on p. 124 of THE MODEL ENGINEER stand, if all the tubes were fitted with nuts and sweated, also the screws sweated? (2) Should the rivets be copper, and what size? (3) What would be the cheapest method of heating it? I don't want to go to the expense of a "Primus" burner. (4) Could the method of heating boilers by means of oil atomised by a steam jet be adapted to a brazing lamp? If so, please will you send me a sketch of the apparatus?

(1) We should say that, given good construction, this design of boiler is safe up to a working pressure of 45 or 50 lbs. per square inch. (2) 3-32nds in. diameter. (3) Methylated spirit lamp with about six wicks. Keep the wicks as far as possible from the bottom of the boiler so that the combustion may be rendered as perfect as possible; if the boiler is placed too close to the lamp, the flames will be choked and will not burn properly, and unburnt spirit vapour will be given off from the top of the chimney. (4) We do not think such a lamp is possible; you would expend more money on materials for experiments—and then perhaps not succeed—than would buy a first-class new paraffin brazing lamp.

[7094] **Model Auxiliary Yacht.** W. B. S. (Battersea) writes: I have a model yacht 4 ft. 3 ins. long, and I am desirous of making it into an auxiliary schooner yacht. I have an ½-in. bore, 1-in. stroke reversible engine, which I should like to use, if possible, to drive it. Has it enough power to drive it at a good speed, and, if so, what size propeller (three blades) should be used?

You will find that ½-in. by 1-in. cylinder will do all that you require if fitted with a satisfactory boiler. 2½-in. propeller may be used with success. Boiler should have at least 50 to 60 sq. ins. of heating surface.

[7113] **Model Boiler Queries.** W. A. W. (Birmingham) writes: (1) Would you kindly inform me whether a horizontal copper boiler, measuring 3 ins. in diameter and 9½ ins. in length, would be large enough to produce a sufficient quantity of steam to drive a horizontal slide-valve cylinder engine, whose cylinder is ¾ in. bore and 1½ ins. stroke? (2) Is the steam-tap on a boiler that tap through which steam from the boiler is admitted into the pipe which conducts it to the cylinder?

(1) The boiler referred to in your query will not supply a large amount of steam, and it is doubtful, even, with the greatest number of wicks you can place under the boiler, if you will obtain enough to run the engine continuously at a reasonable pressure of, say 15 or 20 lbs. You would do well to improve the boiler by fitting a downcomer and water-tubes, as shown in the drawings of the locomotive in our issue of March 1st last. Yes! in a real engine this fitting would be called the "main stop valve"; "steam tap" is only an old-fashioned model maker's term.

Amateur's Supplies.

[The Editor will be pleased to receive for review under this heading, samples and particulars of new tools, apparatus, and materials for amateur use.

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

To Model Brass Founders.

Mr. Geo. Wells, General Brass Worker, Needham Market, Suffolk, sends us his list of amateurs brass founders' tools and appliances. We have received from time to time many enquiries as to the supply of the necessary materials for brass casting, and model engineers who are anxious to try their hand at making their own castings, should write for this list, which includes sizes and prices of crucibles and crucible tongs, furnaces, and also quotations for small quantities of moulding sand. A special cheap line for experimental purposes, consisting of a crucible to hold one pound and a canister of sand, is offered to readers for 1s. 6d. post free. A pamphlet, which should prove of some service to those who invest in it, entitled "Hints on Brass Casting," may be obtained from Mr. Wells, price one penny.

A New Foot Driving Gear.

The Typewriting Telegraph Corporation, Limited, 303, 304, and 305, Dashwood House, New Broad Street, London, E.C., has recently designed and patented a new treadle stand which is worked by one foot, on the basis of a free-wheel combined with a flywheel, thereby giving uniform and continuous revolution. This treadle will shortly be introduced for the purposes of sewing machines, small printing machines, lathes, bicycles, and for similar light machinery.

Training for Amateurs.

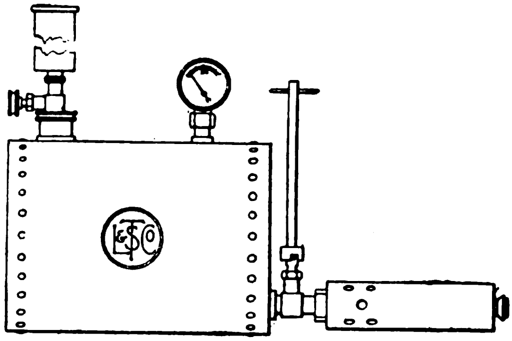
We feel sure that there must be many amateurs in London and district who would be only too willing to avail themselves of an opportunity of obtaining instruction in the use of metal working and other tools. Mr. T. J. Syer's "Finsbury" School of Mechanics, unlike our endowed technical colleges, is open to any amateur, and the prospectus which lies before us announces the re-opening of the classes for the winter session. Besides the instruction in the evening classes, private lessons are given, the times of attendance being by arrangement. Those unconnected with the various trades who wish for instruction in metal working, engineering, and woodworking, should send one stamp at once to Mr. J. T. Syer, 45, Wilson Street, Finsbury Square, E.C., for the prospectus and syllabus and entry form.

*For Galvanometers.

Many amateur electricians have no doubt found themselves in difficulties when, in making a galvanometer, they have arrived at the point of producing a satisfactory graduated scale. Mr. T. M. F. Tamblyn-Watts, a maker of scientific apparatus, whose address is Goldielands, Settle, Yorks, has just brought out for the small cost of 2d. each, post free, a 1½-in. graduated card scale which should prove invaluable to galvanometer makers. A dozen of these cards will be sent for 1s., post free, and if there appears to be a demand for such an accessory, Mr. Tamblyn-Watts will arrange for various other sizes.

*A New Benzoline Lamp for Model Boilers.

Model steam engineers will welcome anything new in the way of a handy means of effectually firing their boilers, and the new lamp which we have received from the Liverpool Castings Co., 5, Church Lane, Liverpool, is as good an appliance as we have had the privilege of testing. The burner, which is well made and designed in a scientific manner, is more suitable for use in model steamboats, and for boilers where a long flame, projecting in a horizontal direction, is required. The flame can be varied quite easily by a screw-down or "pin-" valve on the supply pipe from a length of two or three inches to nine or ten inches without reducing the air pressure. Only about 5 lbs. of air is required to obtain the largest amount of flame, and the tank may be placed any distance away from the fire if it is so wished. The lamp we have tested consists of a burner, which measures about 4 ins. long by 1 in. in diameter, a 4-in. by 6-in. cylindrical tank of copper about 1-25th in. in thickness with riveted and sweated seams, flanged and riveted ends, a pressure gauge, and a combined filler release valve and attachment for a removal pump, which is also supplied with the lamp. Between the burner and the tank, the outlet pin-valve intervenes, and with a key this valve may be actuated some 8 ins. above the level of the burner. Careful instructions were sent with the lamp, and with these no trouble was occasioned in manipulat-



ing it very successfully. The heat obtained from such a fire as provided by this new burner should be amply sufficient for even a large model steamer. There is also no reason why such a lamp should not be used for various workshop purposes, such as sweating up boilers and annealing, brazing and silver-soldering small articles.

*New Designs of Model Locomotives.

Messrs. Bassett-Lowke & Co., Northampton, have sent us a sample of their new 2½ inch gauge locomotive—L.S.W.R. outside cylinder design—which we have tested, and can recommend as a very good working model. Although it arrived badly damaged—the connecting and piston rods on one side having received a bad knock by uncoupling of the former part and the jamming of the piston-rod to prevent its movement in and out of the cylinder—we were enabled to give it a thorough trial. In spite of having only one cylinder at work, it showed its capabilities by running at an average rate of over two miles an hour for some thousand feet upon a continuous track, with curves of only 26 ins. radius, laid upon the Editorial floor. When in perfect order we have no doubt it would double or treble this record, and pull heavier loads. The painting of the locomotive is splendidly done, the bright parts being nickled. It must not be forgotten, however, that with externally fired boilers such as are fitted to models of this class the paint is liable to become soiled after a few runs. It reverses from the cab with absolute reliability, and runs just as well in fore or back gear. Everything that we said of the "Black Prince" model first produced by this firm some eighteen months ago applies to this model, and the two engines are much the same in their general proportions. As to these features, we must say we were looking for better things this season, but, of course, much cannot be done in the way of improvement of the outline until amateurs do not demand such small radius curves. A bogie carriage of the same gauge and scale came with the locomotive, and with reference to this, we think that it leaves nothing to be desired for painting, lining, and lettering. The doors are made to open and the inside is properly fitted up with seats and racks just the same as the carriages illustrated in our issues of November last year. The body is splendidly proportioned.

* To Solve Valve-gear Difficulties.

The mysteries of the "Meyer" valve-gear very often prove too much for the engineering amateur and the student, but with such a model as Mr. W. H. Bedford, of Hardybutts, Wigan, Lancs., supplies, and the handbook accompanying it, the action of this should be grasped quite easily. With this model it is possible to find the cut-off for any given size of valve, and determining the proportions for given cut-offs, and to study the many other properties of the gear also. Many model engineers would find such a model very instructive, and a study of its arrangement would enable them to make similar models, say, several sizes larger than the actual engine they were making, when fixing the proper amounts lap and lead, the angles of advance, and other important details. The booklet contains working drawings and an excellent frontispiece of a pair of 14½ in. cylinder vertical engines, with "Meyer" valve-gear, by a well-known firm of steam engineers. A sheet of Zeuner valve diagrams for the Meyer valve accompanies the model under consideration. Mr. Bedford also supplies a working cardboard model of a plain D slide-valve, and several other types are being prepared. We can heartily and unreservedly recommend these models to all engineers and model makers.

Catalogues Received.

Sam Middleton, 65, Southampton Street, Camberwell, S.E., sends us his catalogue of new and second-hand telegraph and telephone apparatus, galvanometers, lightning protectors, coils, wire, terminals, and other electrical apparatus. Readers on the look-out for good instruments should obtain this list, and, if possible, call and see Mr. Middleton's stock. Apparatus may be hired from Mr. Middleton, and he is open to do any light mechanical work, turning, boring, and screw-cutting.

Arthur Cort and Co., 277, Camberwell New Road, London, S.E., make a speciality of insulating, hard or flexible fibre in sheets, tubes, rods, washers, valves, etc., for electrical mechanical, railway, and tramway engineers and other purposes. Readers in need of such material should send a stamp for Messrs. Cort's catalogue and mention THE MODEL ENGINEER.

W. Lawson & Co., Engineers, Newton-le-Willows, Lancashire.—No steam generator of any size is really complete without an injector, and amongst the very best, if not *the* best, small injectors may be mentioned the Eaton "Vic" injectors. Messrs. W. Lawson and Co.'s list includes prices and illustrations of the various sizes and kinds made; "Vic" automatic injectors for models and very small boilers, Eaton's improved Giffard non-lifting injectors for boilers from ¼ to 5 h.-p., automatic jet pumps for deliveries of from 150 to 2000 gallons per hour, and the Eaton patent "Wide Range" injector, which will work from 30 to 180 lbs. pressure (and 240 lbs. in special cases), by a one-movement lever. These latter fittings are supplied for 7 nominal h.-p. to 160 nominal h.-p. boilers, and should prove very useful for steam cars. Tubing and fittings to suit injectors are also listed in this catalogue, which may be obtained by any reader for a penny stamp.

A. G. Thornton, St. Mary Street, Manchester.—As there must be a great many draughtsmen, amateur and professional, amongst our numerous readers, these lists of drawing-office requisites should be in demand. Messrs. Thornton, who also supply instruments of good quality, in the leaflets now to hand catalogue new designs for copper stencil-plates for lettering drawings and tracings, the "Nerite" adjustable drawing board and square, tracing cloths and papers, of which samples are included in the list, and also some new specialities, such as a new celluloid slide-rule, scale-graded curves, boxwood and paper scales—the two latter designed by leading engineers—a booklet on the theory and practice of the slide-rule, and several new sets of drawing instruments, tee-squares, and waterproof liquid colours.

C. Nurse & Co., 182 and 184, Walworth Road, London, S.E. —No model engineer should be without such a comprehensive catalogue as Messrs. Nurse & Co. have produced in their "Invicta" illustrated price list of engineers' tools, &c. To describe its contents would be impossible within the scope of this notice, and it will suffice to say that it includes prices and particulars of practically all tools in ordinary use by model makers and woodworkers, and many special appliances and small machine tools besides. A fine assortment of several makes of lathes are catalogued, together with lathe tools, slide-rests and chucks, and "Primus" burners and stoves, paraffin, methylated spirit and benzoline blow-lamps. The smaller necessaries of an amateur's equipment, such as hammers, rules, squares, calipers, drills, taps, stocks, and dies, are very completely provided for in the catalogue, which may be obtained from Messrs. Nurse & Co., post free for 1s. to any reader of THE MODEL ENGINEER, and gratis to purchasers of the amount of £1 and over. The book is well indexed, contains 336 pages, and about eight times that number of illustrations.

S. Bottone & Sons, Wallington, Surrey.—We have received this firm's 1902 list of dynamos and motors, primary batteries and materials for same, induction coils, resistance sets. Messrs. Bottone are well known to most amateurs for all electrical apparatus and parts, and they now make a speciality of wireless telegraphy installations and special Wimshurst sets for Röntgen ray work. A separate leaflet deals with automobilist's requirements, such as the supply of motor accumulator charging dynamos, coils, cells, and sparking plugs.

W. Macmillan & Co., Mar Street, Alloa, N.B.—This firm's "Coronation" edition catalogue is a large well-filled book of about 120 pages, with several hundreds of woodcuts, comprising particulars and prices of all kinds of model engineering supplies, from "toy" models to quite large steam, gas, and petrol engines, and electrical machines. Cycle motors are listed, also motor launches, model railway goods—locomotives, rails, rolling-stock, etc. In addition to the very good things therein we find a number of small model locomotives, ships, and stationary engines, which, although low in price, are poor in design and do not tend to enhance the character of the catalogue, and in these cases we think our editorial remarks of some twenty months ago ought to apply. Castings for the model locomotive "Dunalastair," which was completely described in our 1901 issues, are quoted, and also Messrs. Macmillan are open to do any of the machining which is beyond the builder or supply a complete model. A very neat launch engine in several sizes for boats 14 to 30 ft. long, is illustrated and priced, either castings, rough, partly finished, or complete engines are supplied. We cannot give our readers an idea of the whole of the contents, but can recommend this catalogue as one which should be in the hands of every model engineer. Messrs. Macmillan will send it, post free, on receipt of six stamps. A supplementary list is also to be had for 2½d., post free.

The Electrical Sundries Manufacturing Co., 152, Grey Mare Lane, Manchester.—The third edition of this firm's list contains prices and particulars of all kind of electrical apparatus, bells (complete or in separate parts), pushes and switches, battery sets, terminals, medical and sparking coils, electrical indicators, voltmeters and ammeters, standard resistance coils, galvanometers, dynamos, motors, telephones, and hundreds of other electrical instruments and materials. It is worth any reader's while to obtain a copy of this catalogue, which will be sent, post free, on the receipt of two penny stamps.

TO READERS IN HALIFAX.—The formation of a branch of the Society of Model Engineers in Halifax is proposed, and readers of the *M.E.* residing in this district are invited to correspond with Mr. C. A. OATES, 38, Emscote Avenue, Halifax, with a view to holding a preliminary meeting. We think there is plenty of scope for a strong and enthusiastic Society in this part of Yorkshire.

TO READERS IN THE MAIDSTONE DISTRICT.—A preliminary meeting will be held in the Maidstone Church Institute, on Wednesday, November 5th, at 8.30 p.m., to discuss the formation of a local Society of Model Engineers. Will intending members who cannot be present please write or call upon Mr. F. SILLS, 25, Hardy Street, Maidstone?

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 6s. 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," 37 & 38, Temple House, Tallis Street, London, E.C.

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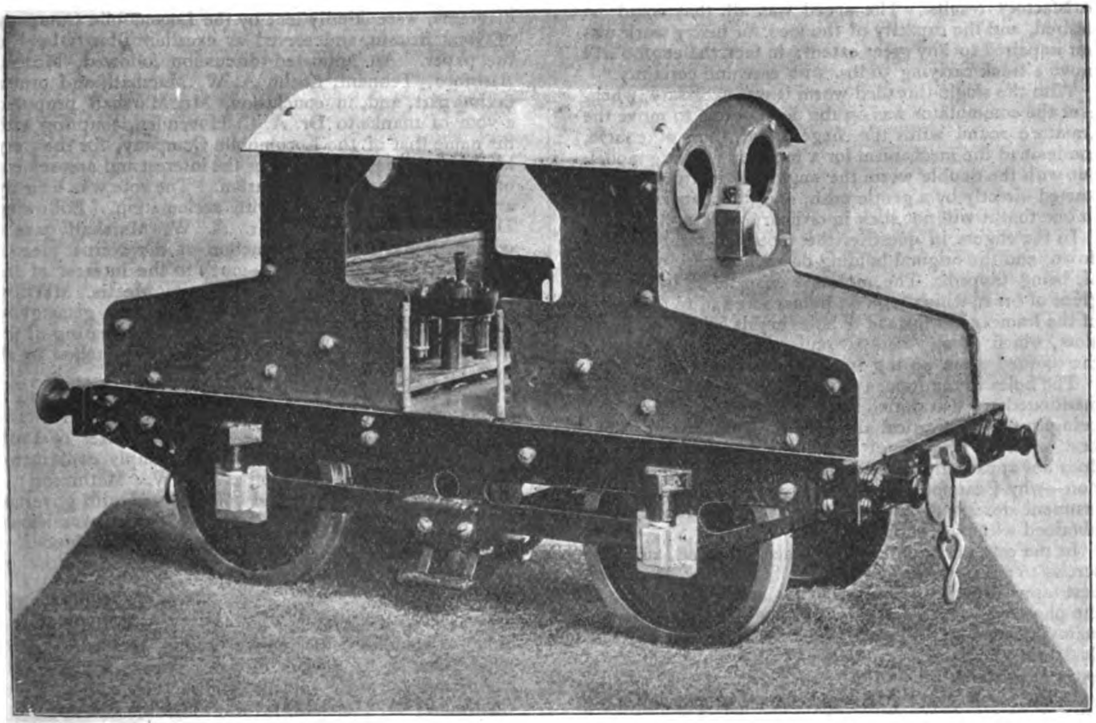
Some Notes on the Construction of a Model Electric Locomotive.

By A. R. M. S.



MR. A. R. M. SIMKIN'S LATEST MODEL ELECTRIC LOCOMOTIVE.

HAVING carried out some experiments with a very small motor by the "Crypto" Company (I believe it is the smallest they make, price 10s. 6d.), I came to the conclusion that by modifying it to some extent, and using it in conjunction with a worm gearing, I could get sufficient power to propel a 3¼-in. gauge loco weighing 10 lbs.

The modification apparently most necessary was the elimination of all possible friction in the motor itself. The parallel bearings and shoulder thrust were evidently inadmissible, so I substituted these with hardened steel-pointed screws, carefully turned in the lathe and polished after hardening and letting down. One screw was provided with a lock-nut, so that adjustment could be carried out at any time. In order to secure the armature remaining central between the poles of the field-magnet, I was careful to fix the necessary bridges, which carry the pointed screws, to the crossbars of the motor before dispensing with the parallel bearings, and I did not widen these bearing holes until I had got the bridges and screws truly central. This accomplished, I ran a drill through the crossbars, and removed sufficient metal to ensure the axle of the armature running quite free of the bars.

This alteration made a great difference in the working of the motor, but I found it necessary to put in long flexible brushes. These are mounted on a small ebonite block fixed to a right-angled cock by a screw and thumb nut, so as to allow of adjustment. The springs—about 2½ ins. long and ¼ in. wide, slightly tapering to 3-16ths in. at the ends, bearing on the commutator, and split for a short distance at these ends—are secured to the block by the terminals originally supplied with the motor, short headless screws being screwed into the ebonite for this purpose; care, of course, being taken that they do not touch the central screw, which secures the ebonite to the brass cock. The brass cock is fixed to one of the original crossbars of the motor.

Having roughly shaped out the loco I tried the motor, and found I had plenty of power; but, using a single-threaded worm, the speed was not satisfactory.

I then tried a double-threaded worm, with the most satisfactory results. The speed was all that could be desired, and the capacity of the loco for heavy work was not impaired to any great extent; in fact, the engine will move a truck carrying 50 lbs. with ease and certainty.

With the single-threaded worm it was necessary, whenever the commutator was on the dead point, to move the armature round with the finger, and this, of course, condemned the mechanism for a properly working model; but with the double worm the engine, if it sticks, can be started directly by a gentle push, and the chances are ten to one that it will not stick in ordinary working.

In the engine in question the motor is turned upside down, and the original holding-down holes are made use of, being tapped. The motor is suspended by a stout piece of brass, which rests on pillars screwed to the inside of the frames, and instead of holes in this bridge, there are slots, which greatly facilitate adjustment of the worm in the toothed wheel on the driving axle.

The holes in the frames provided for the pillars above mentioned are also slotted to a slight extent, the object being to provide vertical adjustment for the worm. The best working position of the worm and toothed wheel does not apparently depend upon its true theoretical position—why I cannot say—but, with the two means of adjustment described, the best working position can be obtained without trouble.

In the case of the pillars this once obtained, auxiliary screws to act as steady pins should be used. These are best tapped right through the frame into the pillars. In the photo one of these screws is shown with a head, but to maintain symmetry they are in reality headless screws and flush with the outside of the frame. The object of these extra screws is to prevent the motor rocking.

In this model the collecting contact for central rail is hinged, and drops on the rail by its own weight. I find this much more satisfactory than any spring arrangement —a small chain is provided to prevent it falling too far— as when picking the model up.

The photo gives a good general idea of the model, which is slightly larger than the one described in THE MODEL ENGINEER for the 1st October. The wheels are ¼ larger in diameter. The engine is 1 in. longer and the cab ½ in. higher, but the wheelbase is maintained, viz., 7 ins.

The best results are obtained with 9 volts and 3 ampères, when 50 lbs. can be moved, and, light, the engine runs about 7 miles an hour.

All my experiments have been carried out with Silvertown 6-block agglomerate cells, which give each 1·50 volts and 1·50 ampères. They are very durable, but must be kept in a cool place, and evaporation looked to, water being added as required.

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 eighteen days before its actual date of publication.]*

London.

ON Thursday, October 16th, the usual monthly meeting was held at Holborn Town Hall, Mr. Percival Marshall presiding. Several members were enrolled, and at the close of the formal business, the Chairman called upon Dr. Arthur C. Hovenden to read his paper on—"A Year's Experience with a Steam Car." The paper proved extremely interesting, Dr. Hovenden giving the actual facts and figures of the year's run, and spoke well of the Locomobile steam car for his especial purpose. A boiler, engine, petrol-burner, and other important parts of a typical car, together with some diagrams, were kindly lent by the Locomobile Company of Great Britain, and served as excellent illustrations to the paper. An animated discussion followed, Messrs. Bashford, Tennant, Loebl, A. W. Marshall, and others taking part, and, in conclusion, Mr. Marshall proposed a vote of thanks to Dr. A. C. Hovenden, coupling with his name that of the Locomobile Company, for the very kind way he had provided for the interest and amusement of the members on this occasion. The vote was heartily and unanimously carried with acclamation. Following Dr. Hovenden's paper, Mr. A. W. Marshall gave a demonstration of the construction of the Nernst electric lamp, and showed working—much to the interest of the members—two of these lamps lent by Messrs. Marshall and Woods. The lamps were lit up with the glass globe removed, and by this means the gradual heating of the filament by the resistance coil was easily watched by all present.

The exhibits were very good in quality and quantity, and among them may be mentioned a finished Stuart compound engine and castings for various sizes of small Smithies' boilers by Stuart Turner; a simply constructed six-coupled model locomotive by W. Mathieson; a model horizontal engine and boiler, fitted with governor and feed-pump, by P. Blankenburg, which was shown working through the whole evening continuously; small electro-motors and parts and accumulators by Messrs. Marshall & Woods.

Mr. Mathieson's engine ran on the track during the first part of the evening, and Mr. Bashford's splendid model Caledonian locomotive during the latter part. After showing its powers by pulling heavy weights, this engine, amidst much applause, finished by conveying the Chairman (Mr. Marshall) several times up and down the Society's railway.—HENRY GREENLY, Hon. Sec., 2, Upper Chadwell Street, E.C.

Provincial Branches.

Bolton.—The monthly meeting of the above branch took place on Tuesday, October 21st. Mr. Booth occupied the chair, there being fifteen members present. Business details being over, a discussion on models in general took place. Mr. Thompstone (member) had on view a fine piece of brazing work, in the shape of a copper firebox and flue, fitted with cross tubes, for a ⅝ in. scale loco. Another member brought down the principal castings for a petrol bicycle motor, the design of which was very severely criticised. A very pleasant meeting closed at ten o'clock. As the next meeting will be the first of a new year, will members and intending members kindly take note?—ERNEST MALLETT, Hon. Sec., 83, Manchester Road, Bolton.

Glasgow.—The October meeting of this branch was held in the Society's Room, 309, Shields Road, on Wednesday, October 8th, at 7.30 p.m., there being a good attendance of members, and Mr. Rogers occupying the chair. The Secretary reported the finding of the Committee at the meeting arranged on September 24th; but as several members were absent, it was decided to convene an extraordinary meeting so as to have the consent of all to any alteration in the working of the branch. Mr. Hall exhibited an exceptionally neat and well finished three-throw crankshaft for a 2 h.-p. triple expansion marine engine which he is constructing; the shaft is in three parts, and the eccentric sheaves are in one with the shaft. All the turning in connection with same was done in the Society's workshop. Mr. Hall was much complimented on the appearance and finish of the job.

On Saturday, October 11th, the members of the above branch and their friends visited the Pinkston Power Station of the Glasgow tramway service. This is the main station, where the supply of electricity for the tramcars is generated. An inspection was made of the engine room, where two of the five engines were working, of the boiler room, and the pump room, and altogether the visit was much enjoyed by the members.

As the meetings are held every second Wednesday at 7.30 p.m., any intending members, who wish to see the workshop, might arrange to be present on one of these evenings. The present is an opportune time to join, as the Society's small power vertical engine is now under way, and members will have an opportunity of seeing and assisting in the making of this engine, apart from the benefits to be derived from the use of the workshop for their own model-making, and for which latter purpose special evenings are set aside for each member, during which he can have the entire use of the lathe.

Intending members might either be present at one of the meetings, or communicate with the undersigned, when all particulars will be furnished.—JAMES R. BEITH, Secretary (*pro tem.*), 39, Hope Street, Glasgow.

Leeds.—A meeting of the Leeds Branch of Model Engineers was held in St. Andrew's Church School on Tuesday evening, October 21st, when Mr. F. Speke showed a very neat and well finished 1½ h.-p petrol motor for a bicycle, and Mr. W. Harrington brought a well-finished built-up crankshaft for an horizontal engine; and Mr. Baurley, a new member, brought a pair of miniature callipers, which needed a magnifying glass to examine, also a scribing block, a small polishing head, and set of stocks and dies made by himself, which, for workmanship and finish, were highly admired by all the members present. Afterwards it was arranged that the annual general meeting be held on Tuesday evening, November 18th.—W. H. BROUGHTON, Hon. Sec., 262, Carlton Terrace, York Road, Leeds.

Norwich.—On October 17th the usual monthly meeting of the Norwich Branch was held at the Co-operative Institute, Col. J. R. Harvey in the chair. Seven new members were elected, and after other formal business a most interesting paper was given by Mr. Hines on "Chucks and Chucking." Another feature of the evening was an exhibition of models (about thirty), which were greatly admired by all present. A vote of thanks to those who had provided for the interest and instruction of the meeting brought a very pleasant evening to a close.—R. W. WRIGHT, Hon. Sec., 5, Ella Road, Thorpe.

Tyneside.—The members of this branch on Saturday, September 20th, by kind permission of Mr. Le Rossignol, visited the Newcastle Tramway Company's car sheds at Byker. The Manager, Mr. Porter, conducted the party, taking every trouble to instruct the visitors in the various details of the work of the shed, and in the construction of the cars and motors. The best thanks of the branch are due to the officials of the company for the courteous treatment received.

On August 4th the usual monthly meeting was held at Pillar's Café, thirteen members being present, and Mr. Bamford in the chair. The Chairman showed a small marine engine, made by himself, under steam.—GEO. T. ADDLESHAW, Hon. Sec., 2, Gladstone Street, Newcastle.

Useful Hints about Gasoline.

MR. E. W. ROBERTS, the well-known gas engineer, recently set forth in the *Rudder* some interesting particulars in regard to gasoline. It is also called naphtha, and is a by-product in the manufacture of kerosene oil from crude petroleum. Gasoline has a specific gravity between that of kerosene, which is heavier, and benzine, which is lighter. It is classified in the petroleum trade as A naphtha, B naphtha, and C naphtha, A naphtha being the lightest of the three. Startling as it may sound, a stream of gasoline can be poured from an ordinary oil-can into a fire, or a lighted match thrown into an open can of gasoline with impunity. The top can be removed from a can of gasoline, a lighted match held to the opening, and, unless the can has been quite recently filled, no explosion will occur, for the reason that there is not sufficient air mixed with the gasoline to form an explosive mixture. Gasoline evaporates rapidly in ordinary temperatures, and soon after the can has been filled the vapour is driven into the air through the top of the can. Gasoline cans will explode after they have been filled for some time under the following conditions only: a gasoline can which has no vent and is exposed to a temperature considerably higher than that at which the gasoline will evaporate will explode from rise of pressure due to the transformation of the liquid into vapour. It is a fact that there is less danger of a reservoir of gasoline exploding from the application of a flame at an opening than if the reservoir contained kerosene. To avoid an explosion from expansion due to over-heating every gasoline reservoir should have a vent or be provided with a safety valve. If gasoline by any chance should take fire, water should not be used to put it out. Some porous non-combustible should be spread over the burning oil. If the body of gasoline is not deep, sand will answer the purpose, and, if damp, will be most effectual.

THE INTERNATIONAL ENGINEERING AND HARDWARE EXHIBITION, 1903, AT CRYSTAL PALACE.—We have to hand the prospectus of this exhibition, which will be held in the spring of next year—from March 2nd to March 31st—and notice that amongst the patrons are Lord Kelvin and many other leading engineers and business men. The exhibition, which will comprise examples of engineering, machinery, hardware, and allied trades, should prove a success. The building is a large one, and all that is needed is a hearty response to the invitation to exhibit goods. Mr. Henry Gillman, the general manager, who may be addressed at the Crystal Palace, will be pleased to forward the prospectus of the exhibition to any firm interested.

The Motor Bicycle: Its Design, Construction and Use.

By T. H. Hawley.

VI.—On Designing and Building the Frame—
(*continued from page 196.*)

In handling the frame during the various processes every care should be taken to prevent marking or indenting the tubing, or forming flats on it by gripping in an ordinary vice, as nothing so surely mars the appearance of a machine, or discloses the hand of the amateur worker.

If, however, small indentations should be made, they must be filled by brazing in some grain spelter, the surface being afterwards filed up; but soft solder must not be used as a filling, because it would most likely run in the enamelling process. Flats in tubing may be dealt with in two ways—if the tube end is open a mandrel or drift may be passed down to expand it; but if the tube is a closed one the best method is to hold it between a pair of lead or hardwood jaws shaped as nearly as possible to the section and size of the tube to be dealt with, and then work the tube to and fro in a rotary direction under constantly increasing pressure until the circular shape is restored.

Immediately the frame is completely finished as regards brazing, filing up, and setting, it should be well polished with emery cloth, and every particle of rust removed; then, if it is inconvenient to stove enamel it straight away, it should be thoroughly rubbed over with vaseline or some other grease for protection against rust, as it is absolutely necessary that no rust shall be on the tubing at the time the enamel is applied; for if there is, then, no matter how well the enamelling may be done, the rust will spread and gradually lift off the enamel in flakes.

As I previously mentioned, the process of brazing will not be dealt with in detail, as there are numerous handbooks on the subject; or my former articles may be referred to, in which the matter was fully dealt with.

I will, therefore, merely give a few hints:—1, The work must *fit* well, and the surfaces to be joined must be *clean* and bright; 2, The two parts to be brazed must be pinned or otherwise held together during the process if the joint is of such a nature that there is any tendency to shift position under the influence of heat; 3, The work must be so disposed on the brazing hearth to ensure an easy flow of the spelter in the required direction, and, at the same time, it should be supported at its extremities so that the tubes have no tendency to bend when heated to redness at the joint; 4, The brazing material may take the form of either grain spelter, wire, or brass rod (termed filling wire) according to the nature of the joint; the "flux" most commonly used being borax, though boric acid is much easier to work with, and leaves the work cleaner with the scale more easily removed; 5, The heat must commence gently on the heaviest portion of the joint to be brazed, and after once the heat is commenced, it must be applied *continuously* until the job is completed; 6, The brazing should be done at the *lowest* heat possible to ensure a sound joint, in order to reduce the danger of burning the tubes.

Enamelling is another subject which I need not enlarge on, as I have frequently described the process, and probably few amateurs would care to take the trouble, even if the appliances were at hand; in any case, it will be far cheaper to send the entire frame to some enamelling firm making a speciality of bicycle business.

Very briefly described, the process termed enamelling, but which, correctly speaking, is japanning, consists of first thoroughly cleansing the work from all rust or grease, and then applying the enamel very carefully and evenly with a camel-hair brush, so that an even flow, free from tendency to drip, is secured, when the work is placed in the oven or stove, and subjected to a temperature of from 250 to 300 degs. F., over a period of from three to eight hours, according to the enamel used and the heat which is required, the best results being attained at lower temperatures extending over a greater length of time.

The great feature in securing a smooth highly-finished final coat (three being usually required) is perfect cleanliness and exclusion of dust, this being no easy matter, except in specially prepared premises.

To those who wish for fuller information on the subject of enamelling, I can recommend "Japanning and Enamelling," by W. W. Brown, published by Scott, Greenwood & Co., 19, Ludgate Hill, E.C.

Wheel-building is another subject on which, for full details, I would refer readers to the former series on "Motor Cycle Construction," which appeared during 1901.

The tools for wheel-building are simple in the extreme—a screw plate for threading the spokes, a nipple key for pulling up the tension, and a piece of chalk being the only absolute necessities, though the operation is facilitated if a wheel trueing stand is at hand.

The chief point is finding the exact length of spoke, and screwing the threaded portions all of equal length. In a rough and ready way the length may be got by measuring from the hub centre to the inner surface of the rim, though this will not come right with every make of rim and hub.

The front wheel will have thirty-two spokes, and the driving wheel forty. Full particulars of the spoke gauges were given in an earlier article but; it may be said that if plain spokes are used instead of the butted variety, such spokes must not be less than 12 B.W.G.

In trueing up the wheel it is simply necessary to mount it by its spindle on any convenient stand or projection on the bench so that the wheel may be spun and a chalk mark made on the sides and periphery, wherever the chalk marks show, the spokes require tightening; but this must be done little by little, the amount of rotation given to any nipple being decreased as the wheel assumes something like truth, until in the final touching up, a half or quarter turn at a time is sufficient.

If the frame is known to be true, it is well to finish off the wheel in its own frame, so that it may sit perfectly central between the forks.

The first process should be securing the *true circle*, after which attention is paid to the sideway truth of the wheel, and care must be taken that the wheel is not made up to run true, only to find later that it is "dished," a term denoting that the hub is not equally spread out each side the rim, or in other words, the rim does not stand central with the hub. When the wheel is free from dishing, a silk thread stretched tight from centre to centre of inside of rim should intersect the exact centre between hub flanges, which may in general be taken to be where the lubricator is screwed in.

A motor bicycle must be fitted with extra strong and wide mudguards, and all the connecting bolts must be strong to withstand the vibration; otherwise, the fitting of mudguards calls for no further notice, excepting that they should correctly follow the wheel outline, as shown in Fig. 27 (Article V).

In my next contribution I shall deal with the motor itself, and I have selected for this simplified machine a motor for which castings are easily procurable, and which any amateur of average capacity will be able to make up into an efficient engine.

(To be continued.)

Mr. Bennett's Model Railway.

By H. G.

READERS will remember that a few months ago the Society of Model Engineers paid a visit to the workshop and model railway of Mr. H. A. Bennett, one of the members, at his residence in Ashford, Middlesex. Full particulars of the engine and railway were not given in the report of the meeting, and therefore I think that a photograph or two and a description of the model will not come amiss.

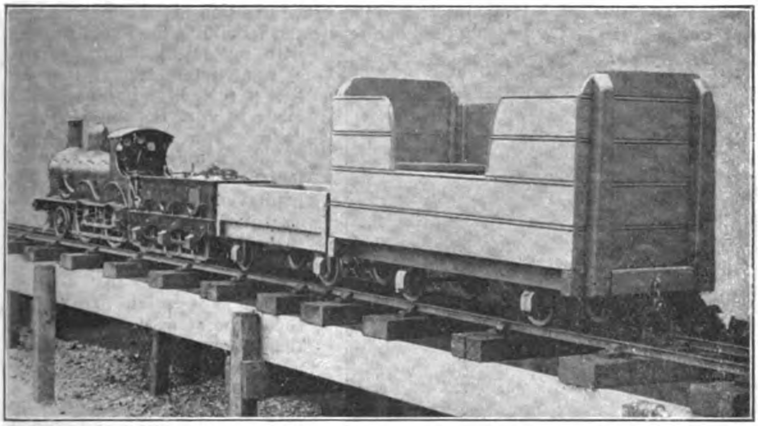


FIG. 1.—THE COMPLETE TRAIN.

Mr. Bennett's keenness for the hobby of model engineering is patent to all who know him. His workshop is especially well equipped. The railway, which is laid along one side of the garden, is 6¼ in. gauge, and about 250 ft. long, and upon this length of railway it is possible to get an average start-to-stop speed of 7½ miles an hour, and the rate of about ten miles per hour at the middle of the journey. To deal with the line first, the rails are of the ordinary bull-headed type, laid about 2 ft. above ground level in chairs upon cross sleepers, which in turn are fastened to heavy 7-in. by 3-in. longitudinal balks supported upon posts driven into the ground. The only enemy of the line—as usually experienced — is rust, but a coating of tar over the whole construction before the approaching winter prevents very serious damage. At the end of the line nearest the house the railway is simply provided with a pair of buffer stops into which the amateur driver is cautioned not to collide, because with a total weight of about a quarter of a ton, the results of charging the dead end at only a slight speed are likely to be disastrous to the front of the model. At the other end of the line is situate the workshop of the "Chelston Light Railway," and adjoining it is an outbuilding forming the running shed, through which the line extends. This shed contains the water tank, coal stack, and other implements necessary when working the engine, and also houses the other rolling stock of the C.L.R.

In the accompanying illustrations, Fig. 1 will give the reader a good idea of the train. The driver seats himself, or rather kneels, in the first truck behind the locomotive, and leaning over the tender takes charge of the running of the engine. The trailing vehicle shown on the illustration is provided with seats for two persons and recently for the amusement of a number of children Mr. Bennett has made a further vehicle. The engine, however, does very well with a passenger load of three persons, and at one time pulled very comfortably two adults and four lads.

From the above particulars the power of comparatively small cylinders may be gathered. The model (Fig. 2) which is about 1¼ in. scale, somewhat represents a rather old-fashioned type of G.E.R. locomotive, viz.: the rebuilt state of Mr. Johnson's small four-coupled express engines, a few of which are still to be seen on this railway.

The engine burns charcoal and coal, half-burnt embers from the domestic grate doing as well as anything else. Charcoal does not last very long, but considerably lightens the coal and prevents an undue amount of smoke which sometimes gets rather unpleasantly in the eyes of the driver when the engine is standing still, and the wind blowing towards him.

The leading dimensions of the model are as follows :—

Cylinders (inside, valves between) ...	1⅝ ins. by 2¾ ins.
Driving wheels }	8 ins. diam. on tread
Carrying wheels	5 ins. diam. on tread
Distance between tyres	6⅜ ins.
Rails laid	6¼ to 6$\frac{5}{16}$ths in. gauge
Coupled wheelbase	10⅜ ins.

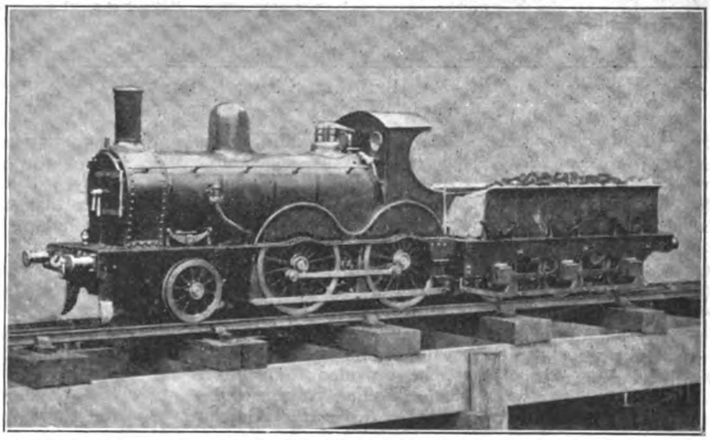


FIG. 2.—THE LOCOMOTIVE.

Leading and driving wheelbase	9¼ ins.
Overhang of frames at leading end... ...	8¾ ,,
Overhang of frames at trailing end... ...	5 ,,
Distance between frames	5⅝ ,,
Thickness of frames (steel)	$\frac{5}{32}$ in.
From rail level to top of footplate	5⅞ ins.

From rail level to centre of boiler	$9\frac{15}{16}$ ins.
Diameter of boiler barrel	6 ,,
Diameter outside lagging	$6\frac{3}{8}$,,
Length of boiler and firebox	$20\frac{1}{2}$,,
Length of smokebox	$3\frac{3}{8}$,,
Grate	5 ins. by $4\frac{1}{2}$ ins. wide
Firebox (outside)	6 ins. by $5\frac{1}{2}$ ins. wide
Heating surface	430 sq. ins.
Depth of throat-plate in centre	$3\frac{1}{4}$,,
Height of firebox	$7\frac{1}{4}$,,
Top of funnel to rail level	18 ,,

The engine is fitted with a steam blower and the exhaust nozzle is contracted in the usual manner, the orifice being $\frac{1}{4}$ in. diam. This gives a splendid sharp exhaust, creating a good vacuum in the smokebox, and therefore a good fire. As readers will understand, but for the exhaust the evaporation of a locomotive tubular boiler would fall to a very small amount per unit of heating surface were it not for the blast, which, besides urging the fire, brings the surfaces of the flue tubes in contact with the highly heated products of combustion, making all parts of the heating surface of the boiler do their share in the work of evaporation.

Of course, before the steam blower and blast are available some means must be provided to create a draught, whilst the water is below boiling point, and the photograph herewith (Fig. 3) shows the method adopted by Mr. Bennett, and Mr. Bennett himself in the act of steam raising. A handful of wood and shavings are put into the firebox, together with some charcoal and a spoonful of methylated spirit. A match ignites this, and then having shut the fire-door and made sure that the smokebox door is tightly fastened the working of the foot bellows may commence, and continue for about fifteen to twenty minutes, when indicator finger of the steam gauge will begin to move, the steam blower made available.

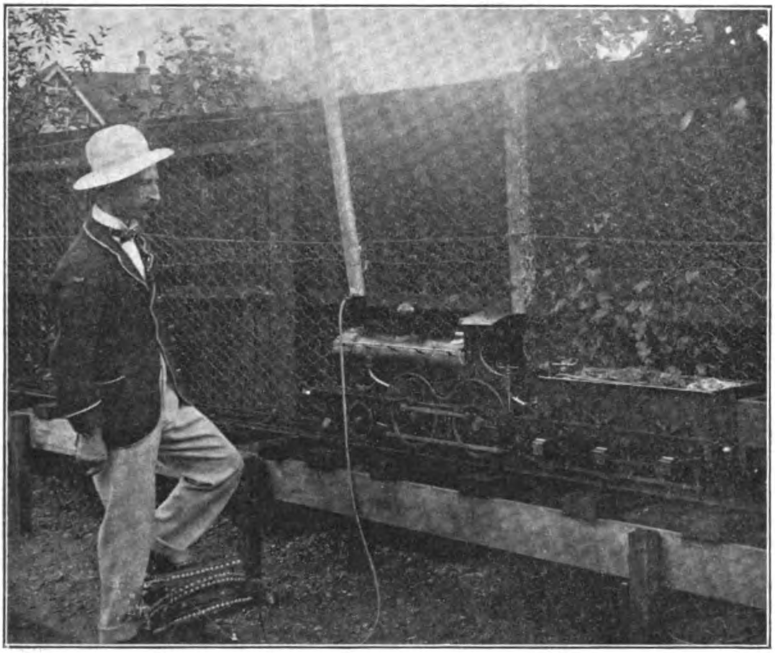


FIG. 3.—MR. BENNETT STEAM RAISING.

The boiler is fed by a crosshead pump, and a smallest size "Vic." injector. The injector works very well, and is in practice invariably used.

Mr. Bennett's workshop contains a partly-finished second engine of the same gauge and scale, but this will be of larger dimensions and provided with a bogie. The engine now running was not made by Mr. Bennett, but he has during the time it has been in his possession effected many little alterations and improvements, and as the engine has been running for several years Mr. Bennett will this winter give it a thorough repair if not "rebuild" it. The vexed question of the difference between a thorough repair and rebuilding I will not discuss with my readers, but perhaps at some future time I may be able to record the improvements made by Mr. Bennett in these pages. The old-fashioned type of the engine does not allow an increase in the grate area, but readers who are building this size of model should remember that this part of the boiler should be made as large as possible, and also that a deep firebox is essential. The grate should be at least 3 ins. below the bottom tube of the boiler—a greater depth may be allowed if practicable. Rumours of a water-tube boiler pitched very high on the framing, and oil fuel being employed, are afloat; but whatever shape the improvements take I can now only say that we shall see what we shall see. In conclusion I have to thank Mr. Bennett for the several enjoyable afternoons spent in running his locomotive, and for the facilities in allowing me to take the interesting photographs reproduced herewith. Readers who have sufficient room at their disposal, and are about to lay down model railways which will involve the expenditure of any considerable amount of time and money, should not hesitate to adopt a gauge which will enable the provision of a locomotive which will pull them. The pleasures of the hobby will be immensely increased, in a geometrical rather than an arithmetical ratio to the scale of the model adopted.

PETROL-DRIVEN BROUGHAMS FOR TOWNS.—The Motor Power Company are about to bring out a new type of vehicle specially intended for town use. It will take the form of a petrol-driven brougham, and is expected to be as silent as the electrical vehicles that steal about the West End. Quietness is being secured by the use of a somewhat lower degree of compression in the cylinders of the 10 horse power motor driving it, and by the employment of an extra silent design of exhaust box. Not more than three, and possible only two, speeds will be provided, and the vehicle is expected to have all the advantages above indicated, besides being able to run unlimited distances, whether in town or country, and on hilly or flat roads. Its weight being less than that of an electric vehicle of the same kind, smaller, and therefore cheaper, pneumatic tyres can be used.

A Lathe from "Scrap."

By "HADDON."

SOME time ago one of your readers propounded the question—"How to obtain a lathe for next to nothing," which both amused and interested me greatly. The idea of possessing "the King of Tools" at an outlay of "next to nothing" will always remain a fascinating problem to the rising young amateur, whose enthusiasm for model-making is in an inverse ratio to the length of his pocket. After reading the way in which the questioner so ingeniously solved the problem, I was fired with the desire to go one better, and, if possible, construct a lathe which actually cost nothing. I don't know whether our high-class engineering friends will allow me to designate the result of my efforts by the name of "lathe"; still, I can show some really creditable work from such a home-made contrivance, both in wood and metal. This is how I went about it.

Armed with the determination to purchase nothing, and further handicapped by not having access to a lathe for the necessary turning, I sought diligently amongst that wonderful collection of rubbish which accumulates in an amateur's sanctum in a suprising manner. A short time previous a friend leaving this part of the country

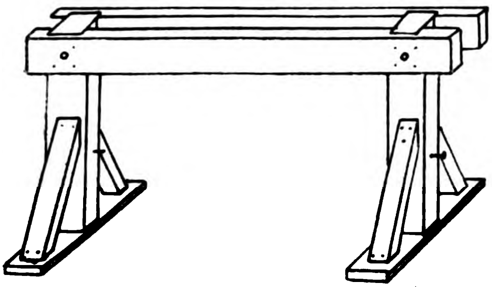


FIG. 1.—BED AND STANDARDS OF LATHE.

had bequeathed to me a certain amount of firewood in the shape of an old-fashioned bedstead, of the wooden four-poster type. Here was the bed, thought I (there is no joke intended), the material being quite smooth, strong, and perfectly straight. In the end of the side pieces were nuts let into the wood, into which screwed coach screws. I cut off two of these ends, two of which were to be converted into the loose and fast headstocks, as will be seen later.

From the rest I constructed the bed and standards, each joint being carefully mortised, glued, and screwed together. (Fig. 1 shows the appearance.) The feet are simply pieces of inch board, planed up smooth and true to give a good foot-hold. Through the standards I screwed two stout coach screws with points hardened for bearings. Now came the problem of obtaining the crankshaft, and here I must own I was particularly fortunate. A few months previous I had done our village blacksmith a small favour, which he had often wished to repay. I therefore sought him, and obtained his willing services for the asking. From a sketch of mine he constructed out of 1 in. square iron a two-throw crank, with throws nicely rounded and ends drilled and countersunk. It will be noticed the two throws are 180 degs. apart. By this means I use two treadles, and can sit down to the work —a convenience one can only properly appreciate after once trying. I have often wondered why English lathes are not sometimes fitted thus; it gives so much more comfort, greater control over the speed, and increased steadiness of the hand, in wood-turning especially. I can also easily unhitch one treadle, and, standing up, use the other whenever I have an extra heavy job, as, of course, more purchase can then be obtained; still, for ordinary work, I always prefer the sitting position.

My next job was to make the flywheel, which, for obvious reasons, is of wood. I cut six pieces of 9-in. by 1-in. plank each 27 ins. long, and placed them crosswise as in Fig. 2. These I firmly screwed together, and, first drawing on them a 2 ft. circle, I cut it to this as near as possible by aid of saw, chisel, and rasp. A second circle

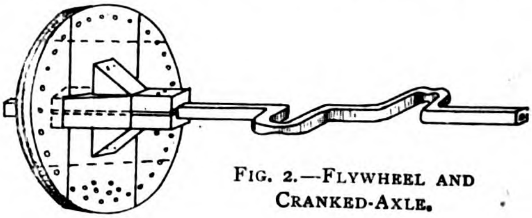


FIG. 2.—FLYWHEEL AND CRANKED-AXLE.

4 ins. less in diameter was now drawn, and on this, at a distance of 2 ins. from each other, were bored 1-in. holes 1½ ins. deep with a centre bit. Into these I poured lead obtained from melting up an old lead pump which I found lying about the premises. I also bored and filled similarly a few extra holes at one point to form a counter-balance. By this means the treadle is always ready for starting.

To fasten a 2-ft. wooden wheel on a 1-in. crankshaft securely is not so simple a matter as it would appear. This is how I managed it:—After cutting a piece of wood 12 ins. by 4 ins. square, and planing it slightly taper towards one end, I sawed it very carefully in two halves, endwise. Down each half was cut a 1-in. by ½-in. (nearly) rectangular channel, so that when the halves were placed together it would enclose and secure tightly

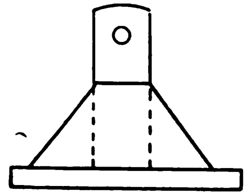


FIG. 3.—PLAN OF FLYWHEEL SHOWING CLEATS.

the crankshaft. Four bolts held it tightly in position, as seen in Fig. 3. Four triangular cleats screwed and glued on form a butt for the wheel to close up against. In the centre of the flywheel a 4-in. slightly tapering hole was made, and then by aid of long bolts it was fastened in position most rigidly. The two treadles are merely pieces of 1-in. board, 6 ins. wide and 3 ft. in length. The hinges are fastened to the floor, being beneath the stool on which I am seated when at work. The advantage here is that it is not necessary to lift up the leg so high when working, an important fact when one is seated—in other words, what I lose in power I gain in comfort. Two triangular pieces of wood fastened to centre of treadles give additional support to the foot. Now to finish the wheel. I improvised a tool rest by means of a box screwed to the floor, and reaching half-way up the wheel, and then by having an obliging friend on the treadle, I succeeded in turning the edge true in its place. This was a long and tough job; but at last I succeeded, though I must say I don't want another—nor does the obliging friend!

For the headstocks I used two pulleys, or bosses, from a Wimshurst machine, a relic of former days, which I had consigned to the scrap heap, owing to the unfortunate tendency that glass plates have to crack and ebonite ones to warp. Fig. 4 shews one of them in section. It will be seen that the hole is bushed at each end with a brass bush, the hole itself being lined with a brass tube—thus leaving a space to act as a reservoir for oil. The lower half of this pulley I cut off and fastened to a block of wood (see Fig. 5). I further made it secure by pieces of copper sheet (remnants of a Daniell's cell—another relic of bygone days), one at each end and also over the top. This unique headstock I fastened to the bed temporarily by a couple of screws. I now took the ⅜-in. spindle of the aforesaid never-completed Wimshurst and cut it into two parts. The longer portion I used for the mandrel, and run on a ¼-in. gas thread for ½ in. at one end. Next to this I soldered a brass collar, to butt up close to

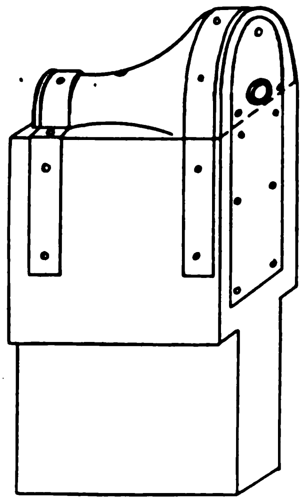


Fig 5.—Headstocks.

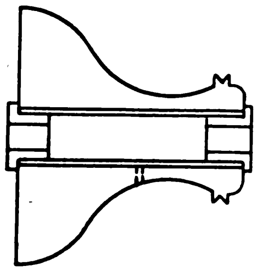


Fig. 4.—Section of Bearing of Headstocks.

the brass bush in the headstock. By using a gas thread, odds and ends of old gas fittings can be made into chucks, as I will show later on.

Now I wanted the pulleys to fix on the mandrel, so again resorted to my poor discarded wreck of a Wimshurst and took off the driving wheels, which were fixed to a wooden spindle. I took out the steel rod on which it turned, cut the wooden spindle in two and drove one half, with driving wheel attached, on to other end of mandrel, having placed it in its bearings first, of course. This was a good tight fit, but I made more secure by boring a hole right through wooden spindle and mandrel, and putting in a French nail. Though this wheel was not a flat one, yet it run true enough to carry a flat belt from it to the fly-wheel. I now had a one-speed mandrel complete. The tailstock was made from one of the ends I cut off when making the bed, and cut it to make a sliding fit between the shears. Two pieces of wood, screwed on, gave an increased bearing surface, as seen in Fig. 6. An old sewing machine wheel pinned to a coach screw and a piece of ¼-in. iron plate supplied the means of clamping it to the bed. To the top of this block of wood I fastened the necessary part of the other Wimshurst pulley, as I did that of the fast headstock.

For the back centre I took the other half of the spindle, and ran a gas thread on one end and filed a point on the other. This point now required turning up true, which I did by reversing the tailstock spindle and connecting it to mandrel with a gas socket. When this was done, and the centre hardened, I fastened a short piece of brass tube to the screwed end and cut in it a slot. This was to take the feed lever, which I made from an old broken backsaw working in a pulley block with pulley removed. The spindle is clamped in place by means of a T-shaped screw, as shown at H. For the live centre I screwed a piece of steel in a T gas-socket, and turned up the centre. A short piece of bent gas-tubing converted it into a catch-plate, as seen in Fig. 7.

I was now in a position to turn up my permanent driving pulleys. I determined, in order to get a change in

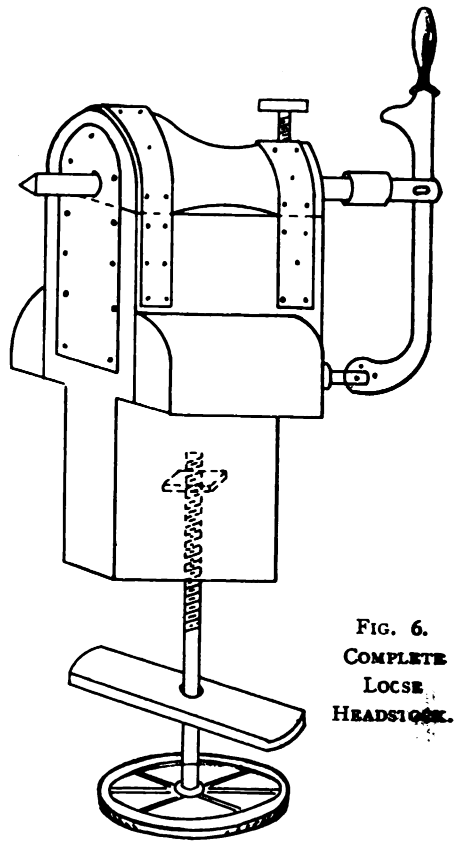


Fig. 6. Complete Loose Headstock.

speeds, to run the lathe from a countershaft fixed to a beam in the ceiling. For this countershaft I took the other driving wheel with half the wooden spindle attached, screwed in two coach screws for the pulleys to turn upon, and turned them up true. The rest of the countershaft was easy, and is so apparent from Fig. 8 as to need no remarks, except, perhaps, to say that the bearings are bushed with brass tubing. I now turned my attention to the fast headstock again, reversed it, and placed on two more pulleys of such a size as to take the same cord as the others. All these pulleys are of mahogany 1 in. thick, except the flat one, which is 2 ins., being made from two pieces glued and screwed together crosswise. I now put headstock back in position and fastened in securely and permanently with screws and strong glue.

The rest was also made of wood in the shape as shown in Fig. 9. A piece of sheet steel forms a strong support to the tool. I had to place another on the end for surfacing purposes, as I could not get the first one near enough to the work, owing to its thick base. The clamping arrangement is simply an iron wheel (once belonged to a child's wheelbarrow) pinned to a bolt. The nut in which this works is fastened to a strip of sheet-iron. There is a similar piece for it to screw up against, as in the loose headstock. For the prong chuck, I screwed a short length of ½-in. steel into a gas socket, and hammered out the end by aid of the kitchen fire and the domestic coal-hammer, then filed it up to shape, and hardened. For faceplate the back plate of a gas bracket did admirably, being already tapped to fit. A wooden disc screwed

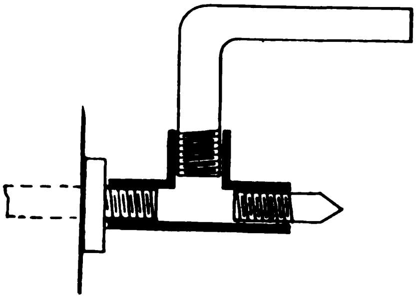


FIG. 7. DRIVER CHUCK.

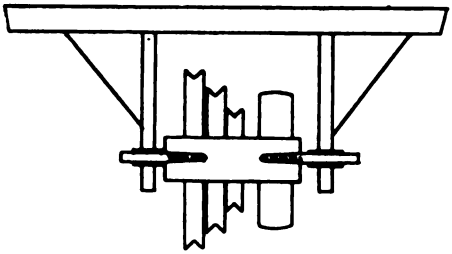


FIG. 8. OVERHEAD GEAR.

tightly to this gave me a faceplate of sufficient size for large work. A very handy arrangement for holding work, having a centre hole, may be obtained by imbedding a nut in the underside of the disc, and having a bolt to fit, the nut being placed quite central, of course.

I am afraid the constant reference in this article to glue, screws, and nails will cause many to doubt the rigidity or lasting property of this home-made lathe. But no fear may be entertained on this score, for I have done much heavy work these last nine months, and find it as strong and rigid as ever. As for its capabilities, I have turned up on it the legs of a dressing-table 2¼ ins. by 30 ins. (the material being the last remnants of that memorable bedstead). I have also turned all my tool handles and the necessary work on an electric motor to run a model electric tramcar—the second car I have constructed. In addition, I have constructed all the science apparatus necessary to give thirty lessons on magnetism and electricity, and many other jobs. I cannot call it a handsome structure, for it has called forth many a smile from my candid friends; but then, no one makes lathes—or buys them for matter of that—in order to have something to ook at. It certainly is a serviceable tool, and, in one way, stands unique—*i.e.*, it did not cost me a single penny.

WE understand that a Royal Motor Parcel Mail Service will shortly be running between Manchester and Liverpool, and that the vehicles are being designed to work with petrol.

Construction of a Demagnetiser.

By S. M. KINTNER.

THIS article is intended chiefly for the handy central station man of the small city, who goes by the various titles of electrician, lineman, wireman, etc. It is for the man who looks after everything of an electrical nature in his town, from the alternators at the station to the door bells of the citizens. There is no objection, however, to others who may be interested in such a device reading what follows.

All jewellers should include in their stock of tools a demagnetising device. At present the majority of those who have any such device are provided with a permanent magnet in the form of a horseshoe, and to demagnetise a watch, it is suspended by a twisted string between the

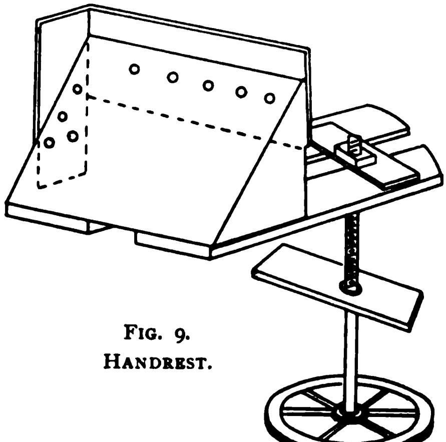


FIG. 9. HANDREST.

poles of the magnet, and as the watch revolves rapidly it is slowly withdrawn from the magnetic field. The whirling motion, of course, changes the direction of magnetisation, and by drawing the watch farther from the magnet, the strength of field is gradually reduced, and the intensity of magnetisation oscillates between values first in one direction, then in another, but continually decreasing in intensity, so that when the watch is entirely removed from the field of the permanent magnet it should have no magnetisation.

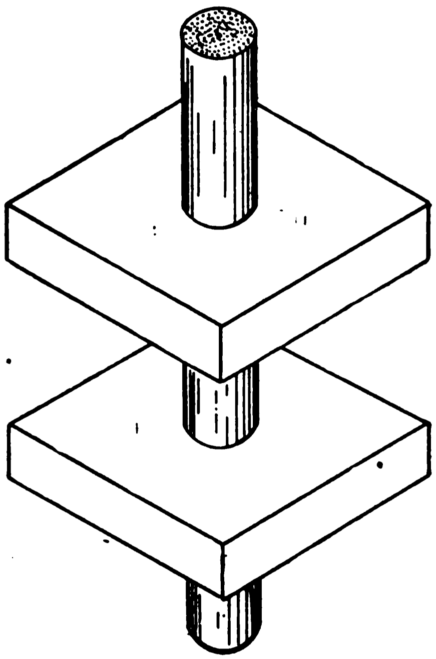
This device would be all right, aside from the inconvenience of manipulation, were it not for the weakness of its field; a watch badly magnetised may be so strong as to resist the demagnetising efforts of this form of instrument. The remedy for such a trouble is almost self-evident; a stronger field must be found in which to spin the suffering watch. As a matter of fact, it is immaterial whether the watch changes direction with regard to the field, or the field changes its direction, the watch remaining stationary.

The demagnetiser described in this article is dependent upon the latter principle, and is designed for use on an alternating current circuit. The demagnetiser consists of a bundle of iron wires, around which a coil of insulated copper magnet wire is wound. The terminals of the copper wire are attached to a lamp socket by an ordinary attachment plug, and the alternating current going through the coil magnetises the bundle of iron wires first in one direction and then in the reverse direction, so that to demagnetise any small article like a watch it is only necessary to hold it near one end of the iron core for an instant, and then slowly draw it away, as the magnetic field from the iron core is rapidly changing in direction, and that is equivalent to the whirling motion given the watch in the other method.

In order that it shall be possible to attach this coil to the lighting circuit without blowing the fuses in the cut-outs, it will be necessary to so design the coil and core that the current that will pass on connecting it will not be greater than the regular lamp current. The current that passes will depend on the voltage of the circuit, the number of alternations of the current, the size of the iron core, the number of turns of copper wire and slightly upon the size of that wire. The formula that gives the approximate relations between these quantities is the following:—

$$\frac{100{,}000 \times V}{0{\cdot}7 \times S \times A} = T,$$

where T is the number of turns of copper wire; V is the voltage of the circuit to which the coil is attached; S



THE DEMAGNETISER.

is the apparent cross-section of the core in square inches, and A is the frequency of the current in alternations per minute. As the round iron wire, when clamped in a bundle, fills about 70 per cent. of the cross-sectional space occupied by the core, the constant 0·7 is included in the denominator. The number of alternations per minute, represented by A, can be determined by multiplying the number of revolutions of the alternator supplying the power by the number of its field-magnet poles. It will be noticed that the formula contains two quantities that are unknown, the number of turns of wire and the cross-sectional area of the core. The other factors will be determined by the conditions existing at each particular place, where the voltage will be a fixed quantity, and the same is true of the alternations, within very close limits. The two unknowns are determined by assuming a particular value for one, and solving for the other. Generally it will be found best to assume the value of S and solve for T.

Assume, for example, a 50-volt circuit and 16,000 alternations per minute as the two quantities fixed by the existing system. For S, assume ·7854 sq. in., which is the gross cross-section of a bundle of iron wires 1 in. in diameter. On substituting these values in the above formula, we get:—

$$T = \frac{50 \times 100{,}000}{{\cdot}7 \times {\cdot}7854 \times 16{,}000} = 589{\cdot}6$$

This shows that 590 turns of wire are needed to magnetise the core properly, and to keep down the current in the coil, under the assumed conditions. As the resistance of the coil is so small, compared with the reactance, any convenient size magnet wire larger than No. 23 S.W.G. gauge will be found suitable.

The iron core should be from 6 to 8 ins. in length and built up of pieces of soft iron wire, about No. 19 S.W.G., which have been either varnished or thoroughly rusted. Varnishing is preferable when possible; otherwise the wires may be rusted by dipping them in salt water, or a sal ammoniac solution, and then allowing them to dry in the air.

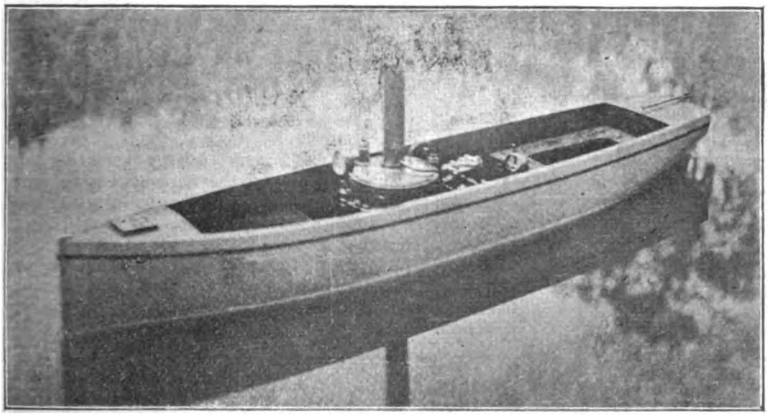
A simple and effective way of constructing the device is illustrated in the accompanying sketch. The core is shown threaded through holes in two wooden blocks (B B), which are spaced apart the proper distance to allow for the winding between them. This distance will generally be found to be about 2 ins. That part of the core between the blocks should be carefully covered with tape, so as to thoroughly insulate the coil from the core. The coil is wound on over this taped surface, the inner connection being made through a small hole in one of the blocks, shown in the sketch at H, where a wire terminal is brought out. The required number of turns having been put on, a variation of ten or fifteen turns will not make much difference, and the outer layer of wire can be made complete; the end of the wire may be fastened by a staple tacked in the block, or may be held under a wrapping of tape. Some provision should be made for keeping the two blocks at the proper distance apart after the windings have been put in place; one convenient way is to nail two stips of wood from one to the other. The rest of the construction can be made as seems best, but care should be taken not to include any large pieces of metal in the enclosing case; the case should be made of wood. This device will be found inexpensive and easy of construction, yet very effective, and with it the worst cases of magnetised watches are readily remedied.—*American Electrician* (N. Y.)

A LARGE CRANE.—What is said to be the largest crane in the world has recently been built for the Kaiser Dock at Bremerhaven. The total weight of the crane, including counter-balance, is 474½ tons, and it consists of a four-legged tower, supporting a revolving centre post, to which is attached a horizontal jib, one arm of which carries a counter-balance at the extreme end, and the other arm a crab capable of travelling from its extreme to the edge of the tower. It is capable of carrying a test load of 200 tons. The maximum pressure on the foundation imported through the centre pillar is about 520 tons, and the maximum horizontal force on top of the tower about 98 tons. The total length of the jib is 164 ft., the height of the gantry rails from the ground being 114 ft. 10 ins. The crab contains the whole of the mechanism for lifting and traversing, the speed of the traverse being about 26 ft. per minute. The travelling mechanism is driven by a series motor, and the lifting mechanism by two motors.—*Mechanical Engineer.*

S.M.E. Medallists and Their Work.

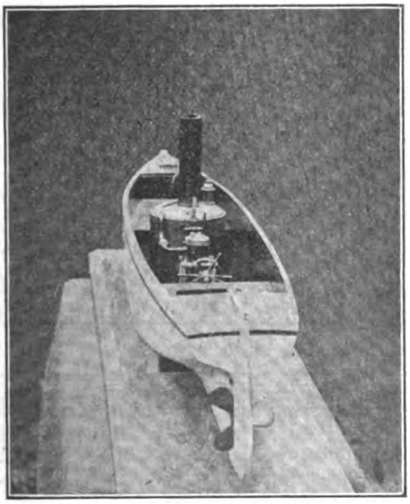
H. C. Willis.

THE model steam launch made by Mr. H. C. Willis, which gained the highest award—a silver medal—in the model boat class of the Society's competition, is altogether a splendid production, and serves to illustrate what can be done by a pure amateur if he really perseveres and strives for excellence in his work.



Mr. H. C. Willis' Model Steam Launch in the Water.

Mr. Willis holds a clerkship in a city bank, and has never in any way received instruction in the use of metal working tools. Although only twenty-one years of age, his work takes a high place amongst that of other members, and has in character been very varied. At the earlier stages of his model making career he took to plate working, and can now flange a copper plate with the skill of a professional. The number of boilers he has made is almost legion, and he is at present engaged in the construction of a model locomotive, which bids fair to prove a great success. With regard to the model steam launch, the description of its construction, in the words of the maker, is as follows:—



Mr. Willis' Steam Launch.—Another View.

This model represents an open steam launch to the scale of an inch to the foot, and was designed more for correctness of appearance than for speed, although it works very well for so small a boat. The hull was made from a piece of white American pine, 2 ft. 6 ins. by 6 ins. by 6 ins., obtained from Messrs. Syer's, of Finsbury. Lines were drawn along the middle of the wood right round, and from these lines the position and sizes of the keel, cutwater and stern post were taken; the deck plan was drawn in by hand, cross lines being ruled to facilitate this; the dead wood was then cut away with saw and chisel, the keel made ¼-in. thick, and the boat shaped up underneath, the stern post being a separate piece of mahogany mortised in, after the hole for the propeller was made. After being trued up the hull was finally finished with sandpaper. A short piece of lead, about 9 ins. long, is cast in the keel, by cutting the latter away, driving in nails about ½ in. apart, placing laths on either side of the keel, and then pouring the lead round the nail heads, which hold it firmly in position.

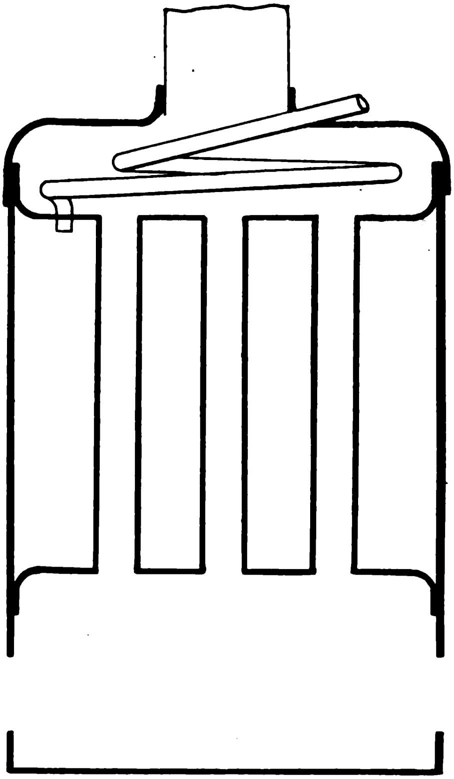
Two lockers are fitted, one forward, the other aft, the former holding the spirit tank, which is connected with the lamp by means of a 3-16ths copper tube, placed under the flooring, which, however, is omitted amidships for convenience in handling the engine and boiler.

Mr. H. C. Willis.

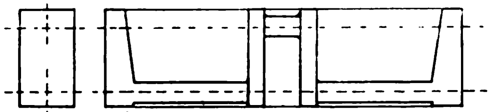
Steering is effected by means of a wheel placed just abaft the engine; cords being brought from the tiller underneath the seat. This wheel was made from a piece off a length of 1½ ins. brass tubing, with the spokes of ⅛-in. brass wire soldered through it and into the hub, which is of ¼-in. brass tube.

The seats are made from ¼ mahogany, and are covered with red velvet to imitate cushions.

As in most launches of this type the boiler is of the multitubular vertical pattern, being made from 3½ ins. solid drawn copper tube, with thirteen ⅜-in. brass tubes, 1-64th in. thick, soldered in; steam is conveyed to the engine through a tube coiled in the smokebox to avoid cylinder condensation. The construction can easily be seen from the sketch, which is *not* to scale, and the photo-



Boiler of Mr. Willis' Steam Launch.



Method of Constructing the Crankshaft.

graph. Castings for the engine were supplied by Messrs. Whitney, and with the guide and cylinder bored. These make up into very serviceable engines with a minimum of fitting, as the cross-head guide is bored, and fits exactly over the stuffing-box. The size of cylinder is ⅝ in. by ⅝ in. The crankshaft was cut from the solid, and took nearly a week to make, working two hours a night at it. This was perhaps the most difficult part of the whole engine to make; it was, however, when completed, a most satisfactory job.

The propeller is 2½ ins. in diameter, and has three blades mounted on an ⅛ in. shaft running in a tube ¼ outside diameter, fitted with a stuffing-box on the forward end.

For a *model* the engine works with very little friction, with no leakage from glands, &c., and steam at a pressure of 5 lbs. per square inch is sufficient to drive it at a fair speed, the boat going about two miles an hour. The boiler tubes, however, appear to be somewhat too large as the smokebox gets very hot, and I should recommend double the number of ⅜ in. tubes, or even 5 16ths internal diameter, when a larger number still could be used. This would greatly add to the steaming power of the boiler.

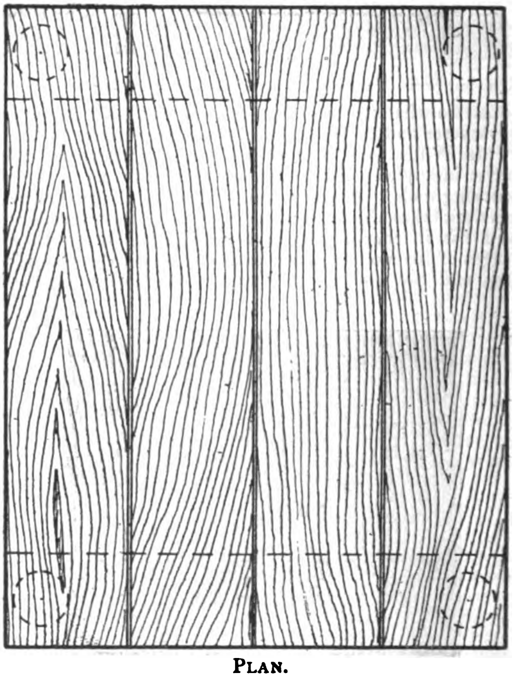
All the turning for the above was done on a 3-in. single geared lathe without slide-rest, mounted on an old Wheeler and Wilson sewing machine stand, the flywheel of which was weighted with lead.

How to Make an Insulating Stool.

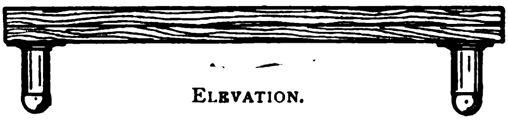
By D. W. Gawn.

In many electrical experiments, a large insulating stool is an essential portion of the apparatus to be used; and, necessarily, it must be mechanically strong and, as an insulator, unquestionably efficient, or it will fail to give satisfaction.

A stool which will be found to fulfil all requirements, and which can be constructed very easily and inexpensively, is here briefly described. It is shown in plan and elevation.



Plan.



Elevation.

With ¾-in. tongued and grooved boards, make the top of the stool, letting it measure, when finished, 28 ins. by 22 ins. Strengthen it across the grain at both ends with a batten, 22 ins. by 4 ins. by ¾ in., fastening each board of the top thereto with two 1¼-in. screws.

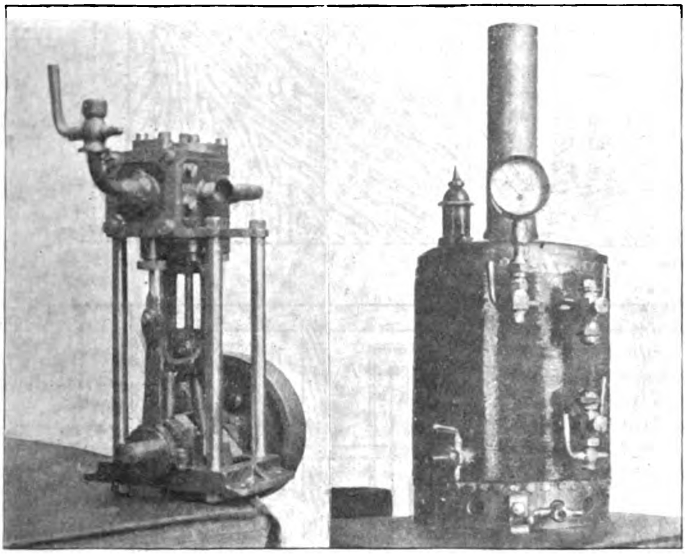
Upon the battens, near their extremities, secure four iron ceiling plates, such as gasfitters would use for 1-in. diameter pipe. The plates are, of course, attached to each underside corner of the steel, legwise, as represented in the illustration. When screwed firmly into position, fill them—the stool being inverted—with a fresh slack mixture of plaster-of-Paris and alum water; take four glass spheres, slightly larger than 1 in. in diameter, and press one into each open end of the plates, so that the plaster will hold the balls securely.

Paint or enamel the ceiling-plates, and finish the stool by staining and varnishing.

Instead of employing glass spheres for the legs, short lengths of stout glass rod may be used, provided due care is observed to cut each piece of equal size, so that the stool shall stand true and steadily.

In making a very small stool, ceiling-plates may be dispensed with, glass balls being simply cemented with Chatterton's compound into shallow counter-sinks cut at each corner of the board used for the stool top.

When finishing the insulating stool, take care to remove all sharp edges and corners whatsoever, and to varnish thoroughly every portion—the glass of the legs included—otherwise the insulation will be rather imperfect.



ENGINE AND BOILER OF MR. WILLIS' MODEL LAUNCH.

"PICK-UP" WATER TROUGHS ON G.N.R.—We learn that the Great Northern Railway Company, in order to facilitate the working of the Scotch express traffic, are about to establish on the main line at Bawtry—about nine miles south of Doncaster—the "pick-up" water troughs. The establishment of the "pick-up" water troughs at Bawtry will, it is stated, render quite practicable the running, when necessary, of the Scotch express traffic between York and King's Cross and the West Riding trains between London and Leeds without a stop.

A CORRECTION.—E. W. F. writes to say that the words "steam punt" in line 2 of the second paragraph on page 187 of our issue of October 15th should read "steam pump."

For the Book-shelf.

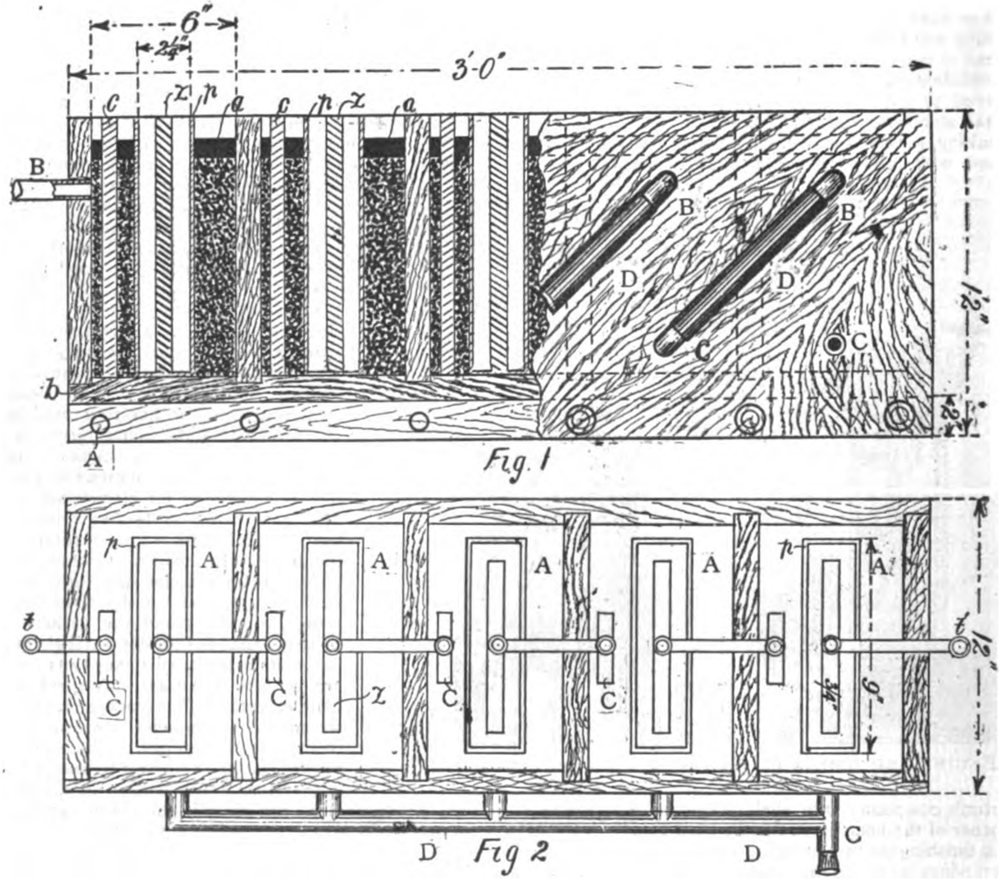
[*Any book reviewed under this heading can be obtained from* THE MODEL ENGINEER *Book Department, 6, Farringdon Avenue, London, E.C., by remitting the published price and cost of postage.*]

THE AUTOMOBILE: ITS CONSTRUCTION AND MANAGEMENT. By Gérard Lavergne. Revised and edited by Paul N. Hasluck. London: Cassell & Co., La Belle Sauvage, Ludgate Hill, E.C. Price 10s. 6d. Postage 4d.

We have here a really standard work on the automobile, which, although a translation of Gérard Lavergne's Manual, has been so revised and enlarged as to make it practically a new book altogether. The endeavour of Mr. Hasluck has been to provide an up-to-date treatise, and to this end quite a large proportion of the original book has been re-written. A perusal of the volume will be found of absorbing interest to all, more especially to those who take a part in the development and use of motor traction. It is crammed full of useful information, instructive drawings, and woodcuts. The opening chapter gives a short account of the automobile from the earliest records, detailing, in an interesting way, the performances of the comparatively successful steam cars of the early part of the nineteenth century. The next chapter deals with motive agents for horseless vehicles, and the following with such subjects as steam boilers and engines, carburettors and motors for petrol-driven cars, electric motors and accumulators for electric automobiles, all comprehensively treated with few important omissions. The general arrangements of most makes of horseless cars—petrol, steam and electrical—are described, and the chapters on the transmission of power, comparison of the various motive powers, and the tables giving results of automobile trials, efficiency tests and races are no less important. A good index is another feature of the work, and, altogether, we cannot recommend our reader a better treatise of the subject. The book is well printed, contains some 600 pages and 530 illustrations. It is written in a clear style, and all dimensions are given in the metric system with, in practically all cases, English equivalents.

GALVANIC BATTERIES: THEIR THEORY, CONSTRUCTION, AND USE. By S R. Bottone. London: Whittaker & Co., 2, White Hart Street, Paternoster Square. Price 5s. Postage 4d. extra.

Any practical treatise on the subject of galvanic batteries is bound to meet with warm welcome at the hands of the amateur electrician. Definite information with regard to the construction and materials of cells, E.M.F.'s, and internal resistances, are hard to get and often enough unreliable when obtained. In Mr. Bottone's book the amateur can be sure of finding much that may be looked for elsewhere in vain, or that can be found only by prolonged and extensive search. In a long chapter on the tabulation of various classes of cells the author inserts numerous results of his own and other tests of different types, and his exact figures and minute descriptions are sure to be of use to that very large class of our readers who take a practical interest in these details. In his theoretical section a smaller measure of praise must be given, because this part of the subject—well treated as far as it goes—does not bear the impress of thoroughness so legibly as the larger section already noted. Indeed it might have been enlarged to the exclusion of the short section on accumulators, which are very slightly touched upon; the chapter on "dry" cells is also lacking in completeness. A really good, but very short, section is devoted to some practical hints on the construction of ordinary cells, and the preparation of their parts. Altogether, the volume is one to be heartily recommended as a guide to the amateur investigator.



General Arrangement of Gas Battery.

A Gas Battery.

By Fred. Walker.

The primary battery has incurred a certain amount of not undeserved odium among amateurs, who, in carrying out experiments in electric lighting and power on a small scale, find a reliable and constant source of power a necessity. But when it entails re-charging with destructive chemicals, the diffusion of noxious fumes when working, loss by local action when idle, and the never-ending worry of amalgamating irregularly-consumed zinc elements, the necessity becomes a nuisance. Here is described a zinc-carbon sealed battery, in which rough unamalgamated zincs are placed in pure water, and wear away evenly until reaching the thickness of a wafer, and the carbon is not subjected to a fluid at all, the depolarisation being effected by chlorine gas generated in a separate generator shown in section by Fig. 4. This generator has occasionally to be cleaned out and re-charged. At that time there is a distinct smell of chlorine; but at all other times this is not apparent if all the joints are well made and are gas-tight. The electro motive force per cell is 2·1 volts, and in the 5-cell trough described in this article the total E.M.F. is 10·5 volts, and the total internal resistance is ·13, the resistance of one cell × 5, or 0·65 ohm, thus affording a current of 6·5 ampères through one ohm external resistance between the battery terminals. The high internal resistance is rather a disadvantage; but according to the ordinary rule observed in primary battery installations, the best effect is obtained when $R = r$, R being the external resistance, and r the internal. The chemical action may be stated as follows:—

$$1\begin{cases}\text{Porous cell } H_2O + Zn = ZnO + (H) \\ \qquad\qquad\qquad\qquad\qquad\quad + \\ \text{Carbon cell} \qquad\qquad\qquad (Cl) = HCl\end{cases}$$

After working, whilst circuit is closed:

$$2\begin{cases}\text{Porous cell } HCl + Zn = ZnCl + (H) \\ \qquad\qquad\qquad\qquad\qquad\quad + \\ \text{Carbon cell} \qquad\qquad\qquad (Cl)\ HCl\end{cases}$$

resulting in $H_2O + Zn + Cl = ZnCl + H_2O$ which is a good disinfectant. One pound of zinc is equivalent to the consumption of 5 cubic ft. of chlorine, which requires 1 lb. commercial sulphuric acid, ½ lb. rough crude manganese oxide, 1 lb. common salt, 6 ozs. water, in the producer. The result is 750 ampère hours—electrically, the only change to be effected is in the producer, since the battery need not be touched until the zincs are worn out.

In making the trough well-seasoned teak should be used, the two sides being 3 ft. in length, and 1 ft. 2 ins. deep, extending 2 ins. below the bottom to allow of an air current passing. The ends and divisions are mortised together, and 6½-in. bolts are passed through between the sides at *a* and tightly screwed up. A marine glue, composed of one part of indiarubber, shredded into fine shavings, should be melted and incorporated with twelve parts of coal tar naptha, whilst gently heated, then twelve parts of powdered shellac should be added and well mixed. This mixture should be poured into each cell and well worked into the joints. The lead pipes and bends B D should be tightly fitted, and the composition well worked round them.

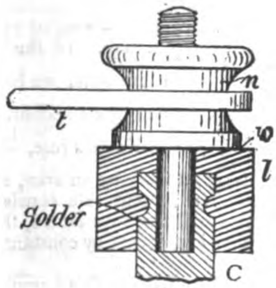


Fig 3

Each cell should be separately tested for leakage by filling with water, and finally the whole trough should be filled and left to stand in order to effectively test the joints of the bottom and sides. Presuming these to be perfect, five porous cells, 11 ins. deep, 5 ins. across, and 2 ins. wide, of the kind known as "biscuit" pottery, are chosen as nearly symmetrical as possible and free from incipient cracks. Then five thick carbon plates, 11 ins. deep, 3 ins. wide, and ½ in. thick, are nicked on each side, as shown by Fig. 3, and slotted by filing to receive the shank of the terminal *w*, and a cement mould having previously been made to receive *w* and the grooved top of the carbon plate, lead is poured in, forming a leaden cap *l* and making a good electrical connection between the terminal *w* with its connecting strip *t* and milled nut *n* and the carbon *c*. The carbons *c* and the porous cells *p* are now placed in position, as indicated by the plan view (Fig. 2) and the spaces all round packed in with broken carbon, such as gas-retort refuse clinker, all dust being eliminated by sifting. This carbon filling is carried to within 2 ins. of the top edge of the trough and partitions, leaving the carbon plates *c* and the porous cells projecting 2 ins., as shown (Fig. 1). Pieces of parchment paper are now cut out, spaced carefully for the porous cells and carbons, and laid upon the levelled surfaces of the broken carbon.

The joining edges should be touched with plaster-of-Paris, to prevent the subsequent treatment by marine glue from percolating downwards. About 50 per cent. of pitch should be added to the glue made up as before mentioned, with sufficient resin (powdered) to flux it, and a coating, 1 in. in thickness, laid evenly on. The projecting carbons, and the outside of the porous cells, should be painted over with the mixture. The zinc plates *z*, 11 ins. by 4 ins. and ¾ in. thick, may be of ordinary rough cast commercial zinc, not amalgamated. The terminal pin is let into a slot, as shown by the carbon fixing (Fig. 3), and well soldered into place. The terminal strips are preferably copper, 6 ins. in length, ⅝ in. wide, and ⅛ in. in thickness, the two finals *t*, *t* being extended for connection with the outer circuit. The elbows of leaden pipe B, C, are connected by tightly fitting indiarubber piping D, without a wire core, the end B being coupled to the gas producer by a similar piece of piping, and C at the opposite end by an ebonite tapered plug. The cells are connected so that the gas, being 2½ times the weight of air, enters from the producer at B, the plug at C being withdrawn; displaces the air in the first compartment, flows from the bottom vent of this through the piping to the top of the next, and so on, until pure chlorine issues from C, its greenish opalescent colour, and most pronounced odour, when the plug should be at once inserted, and the battery may be considered charged, if the porous cells *p* are filled with pure water. In about a quarter of an hour the current will flow until the maximum is reached.

Now, referring to Fig. 4, the producer chamber E is made of lead 3-32nds in. thick, spun or beaten round a wooden pattern, 6 ins. internal diameter, and 10 ins. in length, the joint being soldered with soft solder having about four per cent. of bismuth in its composition. The chamber E should be cut off at 11 ins. to allow for turning the flange over to meet the edge of the leaden cover,

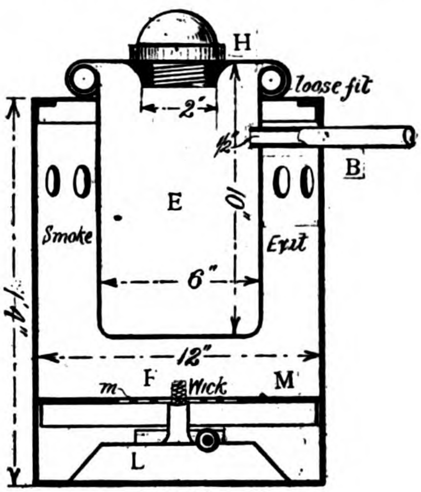


Fig 4

as shown. A collar 3 ins. diameter and 1 in. thick, also of lead, should be thickly soldered and wiped upon the cover, and bored and screwed gas pipe thread, eleven per inch, to receive a thumb-headed lead plug, screwed to make a good fit. A sheet-iron cylinder F, 1 ft. 4 ins. long by 1 ft. diameter, has a hole cut in the cover to allow the chamber E to drop in and rest upon the flange, and smoke exit holes are drilled round, as shown. A screen plate (M) is fitted to the cylinder F 3 ins. above the bottom, and perforated centrally to allow of the ingress of air to the wick of the paraffin lamp L, a slot being formed to allow this to be slid into position. A slip of perforated zinc may be fitted to guard this slot. The pipe B is connected to the battery by means of an indiarubber tube, which should be fitted with a screw clip to close it against the return of the gas while cleaning the producer.

The whole of the gas-producing device is placed upon a shelf above the battery, so that it may be charged by displacement, due to gravitation. The producer is charged by 2 lbs. commercial manganese oxide, 1½ lbs. common salt, 1 lb. water, and 4 lbs. of hydrochloric acid and sulphuric mixed. Commercial "spirits of salts" and "oil of vitriol" will do, but a better quality is preferable. The lamps need not be lit for the first ten hours' work, but will afterwards be necessary, and its cost is negligible. Before lighting it the tube should be clipped, and the leaden plug removed, and the contents of the chamber E stirred by a rod of glass, and a small quantity of acid added.

The outer chamber F may be improvised out of an old paint drum, or large sized provision tin of exceptional stoutness. The producer charge should last out 600 to 700 ampère hours.

It should be remembered that the battery requires *no attention*, save to make up with pure water the loss by percolation and evaporation in the porous cells *p*. No local action takes place when the circuit is switched off. The carbon surface is kept moist by the deliquiescent action of the gas upon the cells *p*, and when the producer is recharged, the indiarubber tubes D are removed from the lower pipes C, and the cells allowed to drain, the liquor being a first-class disinfectant, but mal-odorous.

If the amateur, having set up his battery, does not care for the gas-producing plant, a very tall glass or earthenware funnel should be fitted to the end pipe B, all the other connections remaining, and the carbon cells filled with the following depolariser:—Mix in an earthenware vessel 8 parts of commercial nitrate of soda, 8 parts sulphuric acid (Nordhansen), 1 part of bichromate of soda; stir occasionally till dissolved, but do not fill into the funnel until cold. Charge the porous cells *p* with dilute sulphuric acid (1 to 10) and amalgamate the zincs; this charge will give 10 volts 20 ampères for ten hours; but the resultant re-charging, and irregular zinc plates, and re-amalgamation is a serious disadvantage. Now the gas battery gives but little trouble, and is as near to absolute perfection as it is possible for a primary battery to be—especially for a small, steady output.

The London to Brighton Electric Railway.

A CORRESPONDENT of the *Times*, referring to the proposed electric railway between London and Brighton, states that a preliminary syndicate is being formed to carry out the surveys, to prepare the plans, and to present this Bill to Parliament in the coming session. Mr. Robert Hammond, the electrical engineer-in-chief, in his report to the directors of the syndicate, says: "With reference to the proposed line (London to Brighton) it would, in my opinion, be quite possible, with due regard to safety, to run trains at a speed of 100 miles per hour; but such a rate of speed would involve very heavy working expenses, and, taking into account the question of economy, I recommend that the normal speed should be 75 miles per hour. The time required for construction should not be more than three years." Mr. F. H. Cheesewright, the engineer-in-chief, in his re-report, states that "the whole length of the line will be under 47 miles. The gauge will be standard gauge, with a central rail to transmit the electric current. The curves will be few and of large radii, the gradients not more than 1 in 120. There are no engineering difficulties whatever in the project. It is proposed that the railway shall be in tunnel about 13 miles of the total length, and that such tunnel shall be constructed 27 ft. wide in the clear from side to side; this will allow room for workmen should two trains be in the tunnel at the same time, as well as avoid the train diminishing speed through the resistance [illegible] likewise secure perfect ventilation."

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 should invariably be attached, though not necessarily intended for publication. Communications should be written on one side of the paper only.*]

Model Yacht Rating.

TO THE EDITOR OF *The Model Engineer*.

DEAR SIR,—Surely Mr. Hiley, when he undertakes to propound a new rating rule, should have some regard for the dimensions of his formula. Till recently, yachtsmen have sailed under cubic rules, that is, of three dimensions. Now we are trying a linear or one-dimension rule. It has remained for Mr. Hiley, however, to propose a rule whose dimension is minus a half. In the Thames rule, viz., $\frac{(L-B)\times B\times \frac{1}{2}B}{94}$, for example, we have a product of three linear factors, divided by a constant. This makes three dimensions. In Dixon Kemp's rule, $\frac{L.W.L\times S.A.}{6000}$ a linear quantity is multiplied by an area, again making three dimensions. The present rule consists of several linear measurements added or substracted, there being no multiplication or division, except by constants, the dimension remains unity.

But Mr. Hiley, if I understand his formula at all, proposes to multiply an area by the square root of a linear quantity, and divide by a weight, which, being of the same nature as displacement, is cubic. The dimensions, therefore, work out at

$$2 + \tfrac{1}{2} - 3 = -\tfrac{1}{2}$$

The result is obvious; the bigger the boat, the smaller the rating.

Thus, let A be the rating of any given boat; then, by Mr. Hiley's rule,

$$\frac{S.A. + \sqrt{L.W.L.}}{W} = A,$$

W being the required weight.

Now make another boat on the same lines, and exactly of the same proportions, but to double the scale. Every linear quantity is twice as great, areas are four times as great, displacement is increased eight-fold. The rating will therefore be

$$\frac{4\,S.A. \times \sqrt{2}\,\sqrt{L.W.L.}}{8\,W} = \frac{4\sqrt{2}}{8} \times \frac{S.A. \times \sqrt{L.W.L.}}{W}$$

$$= \frac{1}{\sqrt{2}}A,$$

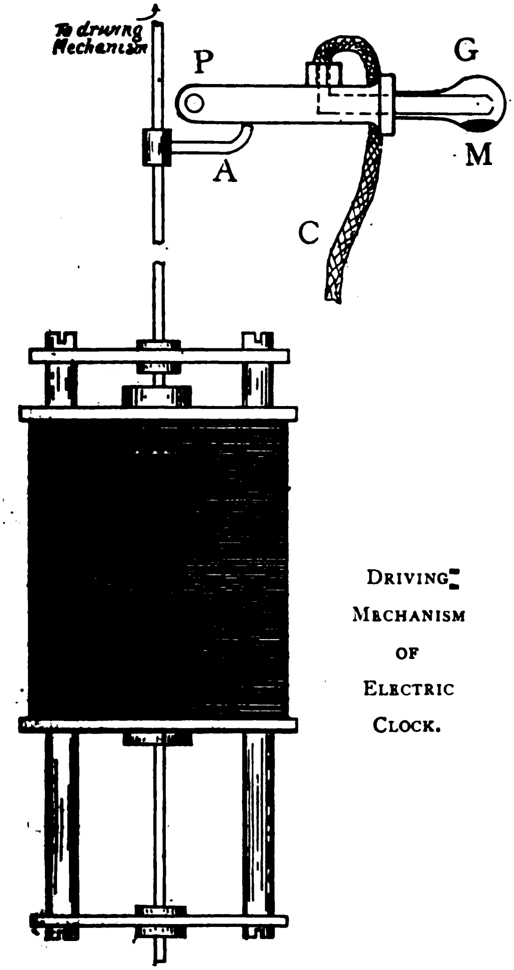
or about ·7 of the rating of the boat half as long. If, therefore, the designer wants to reduce his rating slightly, all he has to do is to increase his dimensions all round. What a grand opportunity for the "artful dodger"!—Yours, etc., A. V. PRIOR.

Harrow.

NO. 5 SUBMARINE (Holland type) has proved herself the fastest British submergible boat. Outside Walney Island, in deep sea water, it was submerged to a depth of 10 ft., and ran for several miles under water with only the periscope visible, and subsequently underwent severe speed trials on the surface. These and the various evolutions were regarded as most satisfactory. When the vessel was fully submerged a speed of eight knots was obtained, and when on the surface it kept up easily a speed of eleven knots. With No. 5 the first order of the Admiralty is completed.

A Novel Electric Clock.

THE En Holm electric clock, invented and patented by Oscar A. En Holm, is a radical departure from any form of clock now on the market. As will be seen by the following description, the application of electricity is in supplying the motive power in place of the usual spring. In the base of the clock, concealed from view, are two sealed batteries, whose capacity is 10 ampère hours. In the place of the spring, and running



Driving Mechanism of Electric Clock.

through the centre of a solenoid is an armature in the form of a rod of soft iron. This core is suspended from a lever, which is connected to the gear train by means of a small ball clutch guided by standards. The clock starts with a core or armature at its highest point, its own weight carries it downward; and, as it descends, it pulls down the lever with it, which has a sliding motion, ensuring uniform driving power, thus giving the driving power to the regular machinery of the clock.

The circuit of the magnetic or solenoid coil is completed by means of a "switch" of the following construction. This "switch" is composed of a glass bulb (G) fixed to a holder which is pivoted at P. In the bulb are two wires of metal not liable to be dissolved by mercury, a little of which (M in the illustration) is also enclosed in the bulb. The two wires nearly meet one another at one point, as shown, and their other ends are joined to the conducting wires in a light flexible twin cable (C) which emerges from the bulb-holder. The "switch" is supported by the arm (A) attached to the guide-rod of the solenoid core, and the motion of this actuates the arrangement; in its ordinary position the wires are at the top, and the mercury at the bottom. When the core reaches the lowest point in its descent, it allows the bulb to fall until the end with the two wires is the lower. The mercury completes the circuit, the electro-magnet raises the core to its original height, and the bulb assumes its upright position again, thus disconnecting the circuit. By another ingenious device the driving power of the core is not stopped while it is being raised. There is nothing to wear in the mechanism, as the friction is reduced to a minimum.

The weight takes five and a fraction minutes to make the descent, and the amount of time necessary for the electricity to lift it is less than one-third of a second. The capacity of the batteries, as stated above, is 10 ampère hours or 36,000,000 millampère seconds. Every five and a half minutes the clock requires for one third of a second 350 milliampère seconds. As the electricity is only in use during the one-third of a second in which the core is being raised, it follows, therefore, that the batteries contain enough electricity to run the clock for more than three thousand days. The makers only guarantee it for three years, however.

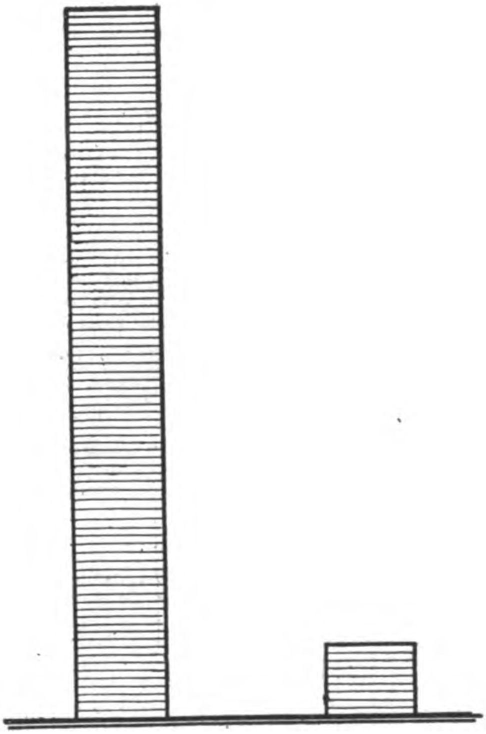
One important point in favour of this clock is that it has no pendulum or spring, it does away with the necessity of a perfectly horizontal base, and helps to assure correct time.

This extraordinary clock, says the *Railroad Telegrapher*, will cost no more than the spring-driven clock in the various styles of cases, for all purposes where accurate time is required.

A New Incandescent Electric Lamp.—Osmium has the highest melting-point of any metal, viz., about 2,600 degs. C., and it can therefore be used at a higher temperature than carbon in an incandescent lamp, making the efficiency correspondingly higher. The lamp was the invention of Dr. Auer von Welsbach, and the Auer Company, who are making it, will shortly be letting out lamps on hire. Owing to the rarity of osmium, it is found worth while to employ the metal remaining in the filaments after they have burned out. The chief difficulty appears to be the low resistivity of osmium. Owing to this, up to the present, lamps of 25, 35 and 50 volts only have been produced, and the smallest candle-power of a 35-volt lamp has so far been 40. The lecturer described experiments made with a 20-volt lamp at different pressures. At 20·5 volts the lamp gave 22 candle-power, and required 1·48 watts per candle. At 25 volts the efficiency rose to 0·99 watt per candle and the candle-power to 46. At 30 volts the figures were 0·654 watt per candle and 99 candle-power; at 35 volts 0·487 watt per candle and 171 candle-power; at 40 volts 0·38 watt per candle and 275 candle-power; and at 50 volts 0·32 watt per candle and 460 candle-power. At this pressure the lamp burned out. A life test was made on another lamp at its normal pressure. This lamp required 1·5 watts per candle at the commencement, dropped gradually to 1·36 and 1·32 watts per candle, and finished at 1·4 watts per candle after 1,100 hours. During this the candle power, which started at 14·7, rose gradually to 16·8 after 250 hours, and then dropped to 15 candle-power after 1,000 hours' use.—*Scientific American.*

The Editor's Page.

THE later voting on the question of a weekly issue, though naturally smaller in volume, has steadily maintained the majority of ten to one, which we indicated in our last issue. In deference, therefore, to this very pronounced opinion on the part of our readers, we have decided to make the change at the commencement of our next volume. In order to give a graphic indication of the proportions of the votes, we have had the following diagram prepared. We think this will show as



For Weekly Issue. Against Weekly Issue.

THE PROPORTIONS OF THE VOTING.

well as anything how decided the feelings of our readers, taken as a whole, really are. We may add that, in addition to cards from nearly every town in the United Kingdom, we have already had votes from France, Holland, Belgium, Switzerland, Spain, Italy, Sicily, Russia, Denmark, Sweden, Greece, Egypt, Canada, and one even from the remote and turbulent Mediterranean island of Crete. Probably the mails from the Colonies will shortly bring us the voting of our readers in more distant lands, and we do not doubt that they will endorse the opinions of those at home. Before passing on to some other interesting features of this subject, we would like to express our thanks to the thousands of readers who have responded to our call, and we need hardly say that we appreciate the trouble taken by those who have voted adversely to the scheme equally as well as that taken by those who have supported it. We asked for candid expressions of opinion, and, whether they have been yea or nay, they have been most helpful to us, and we feel indebted to all who have replied in either way.

* * *

All journals which have a large circulation, such as that of THE MODEL ENGINEER, must necessarily reach people with diverse tastes, and though the scope of our paper is fairly closely restricted, we have always found that our readers are very divided in their preferences for different classes of matter. This has been particularly brought out in the comments which have been made on the voting post-cards, and we quote below some examples of directly opposite opinions, which will serve to indicate the difficulties of an editor who wishes to please all his readers :—

"Please keep model loco work well to the front."

"More loco work and plans."

"I like the locomotive articles especially."

"Give the steam engines first place."

"Should like to see more model railway work."

"Should like to see as much electrical information as possible."

"Would like to see more electrical science."

"I prefer motor articles."

"Would like more about motor bicycles."

"Give prominence to model yachting."

"Could you not reinstate your model yachting supplement? I used to find it very interesting."

"Should like to see, say two pages devoted to advanced amateur work."

"Get on past the toy stage."

"Should prefer more descriptions of models with photos."

"A little less loco detail and more electrics generally."

"For goodness sake cut the locomotives for a bit."

"Not quite so much model loco matter."

"I suggest more space devoted to gas and oil engines."

"Steam matters preferred to electrical."

"Please don't overdo the electrical matter."

"More marine engine articles."

"I hardly think motor cycle construction can be termed model engineering."

"Could do with a little more model steamer matter."

"Why not leave out model yachting matter? It is not engineering."

"I am afraid you are getting too far advanced."

"I think articles are too far advanced for an amateur."

"Should like to see series on the theory of electricity and magnetism."

* * *

Of course, these are only a few out of the very large number of suggestions we have received, and many readers have been good enough to say that the present choice of subjects and space allotted to them is quite satisfactory. However, the suggestions are all being preserved for our future guidance, and we think we shall be able to steer a course such that all readers will find little cause for real complaint as to the nature and variety of the fare we provide. Several suggestions have been made that we should regularly include other subjects, such as photography and lantern work, or astronomy, in our scope; but, as we have stated some months ago, we cannot see our way to do this, as these matters are already fully dealt with in other journals.

We fully appreciate the responsibility which will rest upon us to keep up the standard of the contents, and we shall spare no effort or expense to see that this is done. As an indication of this, and in accordance with many suggestions, we may say that we are completing arrangements for serial articles on the following among other subjects:—"The Electric Lighting of a Private House," "Amateur Pattern-making," "Brass Founding for Amateurs," "Milling in Small Lathes," and "Electrical Workshop Practice." We also have several other interesting subjects under consideration for treatment in the new year, particulars of which we shall announce later on. In fact, so confident do we feel of the scope for really useful and interesting matter, that we can promise that THE MODEL ENGINEER shall be as practical and as readable a paper as a weekly as it is now—and perhaps better.

* * *

Just one word as to the price. This will remain the same as now, 2d. per issue. We have had many suggestions that it should be reduced to 1½d., and even a 1d., if weekly; but if this were done, the paper would no longer be the MODEL ENGINEER that our readers know. We prefer, and we think most of our readers would prefer too, that the thing should be done really well at 2d., than only half-done at 1d. The penny price would mean cheaper paper, fewer pages, and fewer illustrations; in fact, a poorer and less useful paper altogether. Journalistic finance is too complicated a matter to be fully discussed here in all its bearings; but briefly, it may be said that if the *M.E* is to be produced in the style that model engineers are accustomed to and desire, the price cannot be reduced. While we shall still charge the twopence, we shall give twopennyworth of value for it.

Answers to Correspondents.

W. G. T. (Christchurch, N.Z.).—We think it would hardly be feasible to keep all our competitions open sufficiently long to enable Colonial readers to enter; but we do occasionally arrange competitions specially for readers abroad, and shall probably announce another of this kind before long. The subscription rate to the *M.E.* is 6s. for twenty-four issues, post free to any part of the world.

R. B., from whom we received a query asking for names and addresses of electrical firms in New Zealand will oblige by sending us his latest address. The answer to his query has been returned through the post.

New Prize Competitions.

Competition No. 24.—A Prize of £2 2s. is offered for the best article on "THE POINTS OF A GOOD LATHE, AND HOW TO TEST THEM." We do not require a specification of a perfect lathe, but simply a practical description of the constructional features which are required to give satisfactory results in working, and a simple explanation of the tests which a well made lathe should stand. In short, we require an article such as would enable an intending purchaser to form an opinion as to the suitability of any lathe he might contemplate buying, either new or second hand. The closing date for this Competition is December 1st, 1902.

Competition No. 25.—A Prize of £2 2s. is offered for the best article on "THE MATERIALS OF MODEL ENGINEERING." This should explain the nature and properties of materials such as cast iron, wrought iron, cast steel, mild steel, silver steel, copper, brass, gunmetal, German silver, solder, tube, &c., and should indicate the various purposes for which each material is most suitable. Hints should also be given as to the basis on which the materials are usually sold, such as by measurement, or by weight, in rod, sheet, or bar, etc., and the most economical method of buying. The closing date for this Competition is December 1st, 1902.

Competition No. 26.—A Prize of £2 2s. is offered for the best article entitled "THE AMATEUR ELECTRICIAN—WHAT SHOULD HE MAKE?" This should be written on the assumption that the reader is about to take up electrical work for the first time, and is desirous of having a progressive course in electrical apparatus and model-making mapped out for him. The work suggested should be progressive, both in point of knowledge and tools and materials required, and the subsequent uses of the various pieces of apparatus for experimenting or testing should be borne in mind. The closing date for this Competition is December 15th, 1902.

Competition No. 27.—A Prize of £2 2s. is offered for the best article on "MY EXPERIENCES IN MODEL LOCOMOTIVE BUILDING." This should describe briefly the various model locomotives built by the competitor, and should deal as fully with his difficulties and failures and their causes, as with his successes. If possible, it should be illustrated by photographs or dimensioned drawings, showing the principal features of each engine described. The article should deal with steam models only. The closing date for this Competition is December 15th, 1902.

Competition No. 28.—A Prize of £2 2s. is offered for the best article on "WORKSHOP FITMENTS." This should describe useful home-made workshop fittings, such as shelves, tool-racks, nests of drawers, and other devices for the convenient arranging or storing of tools, parts, and materials. It should be illustrated, if possible, by photographs or dimensioned drawings of the various fittings described. The closing date for this Competition is December 15th, 1902.

Competition No. 29.—A Prize of £2 2s. is offered for the best article on "SCREWS AND SCREWING TACKLE FOR MODEL ENGINEERS." This should describe the characteristics of the threads in general use for small work, such as the Whitworth thread, the B.A. thread, pipe threads, &c., and should point out the advantages or disadvantages of each from the model-maker's point of view. Suggestions should be made as to the best class of thread to be used for various purposes, and hints on the most suitable screwing tackle—home-made or otherwise—should be given. The closing date for this Competition is January 1st, 1903.

Competition No. 30.—A Prize of £2 2s. is offered for the best article on "SOME TOOLS I HAVE MADE." This should deal with the various bench or lathe tools the competitor has made either for general or special use, and should describe clearly how each tool was made. Dimensioned sketches of each should be given. The closing date for this Competition is January 1st, 1903.

Competition No. 31.—A Prize of £2 2s. is offered for the best article on "EXPERIMENTS WITH INDUCTION COILS." This should be written on the assumption that the reader possesses an induction coil of moderate power, and desires to know to what uses it can be put. Sketches or diagrams should be given where necessary. The closing date for this Competition in January 15th, 1903.

Competition No. 32.—A Prize of £2 2s. is offered for the best design for "A MODEL STEAM TURBINE." In setting this subject we realise that we are setting a problem of some difficulty, but we believe many of our readers are equal to getting out a design for a workable model. The model should be reasonably simple in construction, and should be capable of being turned to some useful purpose, such as propelling a model steamer or driving a small dynamo. Full working drawings, with dimensions, should be given, and a written description sufficient to clearly explain same should accompany each design. The closing date for this Competition is January 15th, 1903.

GENERAL CONDITIONS FOR ABOVE COMPETITIONS.

1. All articles should be written in ink on one side c i the paper only.

2. Any drawings which may be necessary should be in good black ink on white Bristol board. No coloured lines or washes should be used. The drawings should be about one-third larger than they are intended to appear if published.

3. The copyright of the prize articles to be the property of the proprietor of THE MODEL ENGINEER, and the decision of the Editor to be accepted as final.

4. The Editor reserves the right to print the whole or any portion of an unsuccessful article which he may think worthy of publication, upon the understanding that remuneration is given at the Editor's discretion in proportion to the length and merit of the matter used.

5. All competitions should be addressed to The Editor, THE MODEL ENGINEER, 37 & 38, Temple House, Tallis Street, London, E.C., and should be marked outside with the number of the competition for which they are intended. A stamped addressed envelope should accompany all competitions for their return in the event of being unsuccessful. All MSS. and drawings should bear the sender's full name and address on the back.

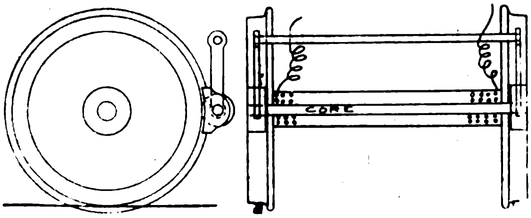
Practical Letters from Our Readers.

[*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.*]

Brakes for Model Electric Railway Vehicles.

TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—Feeling sure that the enclosed sketch of an electric brake will be of benefit to some of my fellow



A NOVEL ELECTRIC BRAKE FOR MODEL RAILWAY VEHICLES.

readers who have iron wheels to their vehicles, I tender this letter as a practical suggestion.

The brake blocks are fixed on the ends of magnet core. The whole is slung, as is usual with brakes.

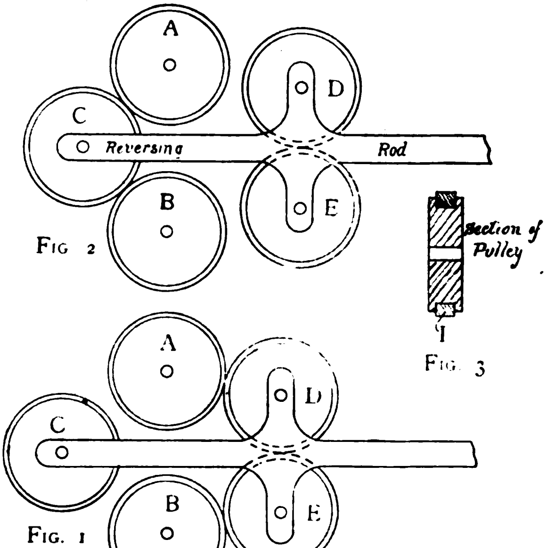
If current is sent through the wire on the bobbin, the core becomes magnetised, likewise the brake blocks, which therefore cling to the tyre of the wheel, and so give a braking effect.—Yours truly,

Brandon. E. BUDD.

Reversing Arrangement for an Electric Locomotive.

TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—I think the following is a very simple form of reversing gear for an electric locomotive not fitted with a reversing motor. It consists of three rubber friction pulleys, C, D, and E, mounted as shown in Figs. 1 and 2. A is the motion pulley of the motor, while B is a wheel mounted on the driving axle. In Fig. 1. it will be seen, by tracing the direction of the rotation that



A MECHANICAL REVERSING ARRANGEMENT FOR MODEL ELECTRIC LOCOMOTIVES.

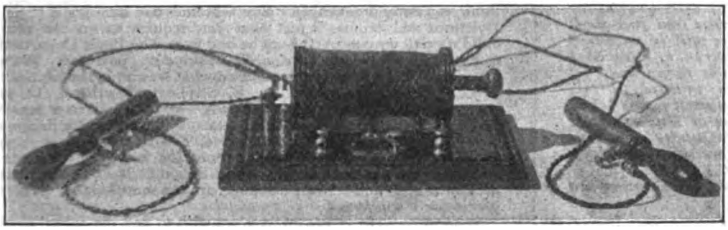
when D and E are thrown in gear B will move in the opposite direction to A; and, conversely, when the reversing lever in cab is pushed over, C will be thrown in gear and D and E thrown out of gear, as in Fig. 2, that B will move the same way as A. Fig. 3 shows a section of one of the pulleys. Hoping this will be of use to some of your readers.—Yours truly,

Tadcaster. BERNARD VAVASOUR.

A Cheap and Simple Shocking Coil.

TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—I enclose a photograph of a shocking coil which I have made very cheaply out of scrap brass and iron which, I think, may be of interest to your readers. The bobbin is turned out of beech, 4¼ ins. long over all, with flanges ¼ in. thick and 2 ins. diameter. The barrel of the bobbin is drilled through its entire length to admit the core and draw tube, which require a ⅝-in. hole, and the bobbin wound with four layers of No. 22 D.C.C wire for the primary and twelve layers of No. 36 S.S.C. wire for the secondary. I used brown paper, well soaked in paraffin wax, to insulate the one winding from the other; I also put a layer of thin brown paper between every layer of wire in the secondary. The core is made of soft iron wire cut in 4¼-in. lengths, bound together with fine wire, and soldered at the ends. It is made small enough for the draw tube to slide over it. The latter is a piece of brass gas tube ⅜ in. outside diameter and 5 ins. long; the armature and contact pillars are turned out of brass rod 5-16ths in. diameter and 1½ ins. high from baseboard; the armature spring being thin brass 2 ins. long and ¼ in. wide; the armature itself is of soft iron ⅜ in. diameter and ⅛ in. thick, riveted to the armature spring,



A Cheap and Simple Shocking Coil.

both the spring and the contact screw having platinum contacts. The electrodes are out of ⅜ brass tubing, with turned wooden handles, connected to the coils by about 1¼ yards of silk flexible cord to each. In the centre of the baseboard is placed a suitable switch with three studs. At the first stud the switch is off, at the second the current goes through a resistance of 8 ins. of iron wire, led in on the under side of the baseboard. The third stud allows the current to go straight through the coil. Old brown oak well polished is used for the wood work, the baseboard measuring 8 ins. long by 5 ins. wide. I find that the coil works well with a 1-cell bichromate battery, made on the lines of that given on page 35 of the *M.E.* handbook "Electric Batteries." Any further information your readers should require I shall be delighted to supply through you, and I may, in conclusion, say that I have nearly completed a model tramcar, with overhead conductor, a description of which I hope to send you at a later date.—Yours truly, A. H. M.

Broad Oak.

A Home-Made 4½-in. Centre Screw-cutting Lathe.

To the Editor of *The Model Engineer*.

Dear Sir,—Many of your readers will doubtless have felt the necessity of having a lathe, if they are to make the interesting models as are described in this paper. Being in a similar position myself, about two years ago I set to work on a lathe of my own design, the photograph of which I send. Perhaps a few particulars concerning it would be helpful to those in the same plight.

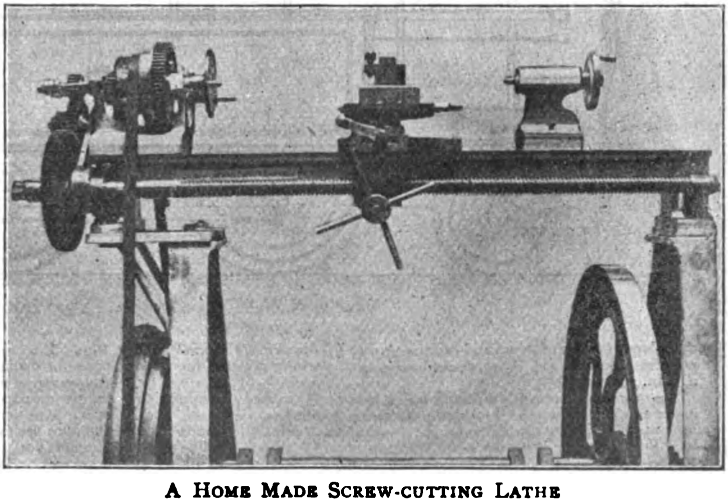
I commenced it after serving only two years of my apprenticeship in a comparatively small shop, where I had the advice of a first-class mechanic who had built three or four foot lathes. For the bed I obtained two pieces of T-iron which were cut of equal length, also two castings for the feet at each end, which were machined the same width at the top to ensure the tees being parallel; these were then fastened very securely at each end, and a stiffening piece was fastened between the T's in the centre of bed. It was then ready for planing, which I had done for me at an engineer's. The headstocks next claim our attention; these I constructed out of flat-bottom steel rail, measuring 3⅛ ins. from the centre of the head to the base, and mounted them on two plates 1 in. thick, with a spigot planed on the underside, a sliding fit for the T's. To mount them on the plates as described greatly adds to their appearance. The fast headstock has adjustable steel cone bearings, a thrust bearing acts on the back of mandrel, and is back-geared.

The tailstock is arranged for cross-sliding for turning long tapers. The slide-rest came next, and for this I bought castings in the rough, and machined them in a shaping machine which the foreman kindly allowed me to use. It is made for turning taper. The transverse screw is squared thread, while the top screw is ⅜-in. Whitworth thread. The rack is ⅝-in. square steel with wheel, both of which have machine cut teeth from the solid.

The traversing screw is mild steel, 1⅛ ins. diameter, four threads to the inch. I have fitted the lathe on two C.I. standards with treadle. The cranked axle runs in hardwood bearings. The length of bed is 3 ft. 6 ins., and will take work about 25 ins. long between centres.

I may say that it has quite come up to my expectations. It has taken me fully eighteen months to make, working during dinner-hour at the works and Saturday afternoons occasionally. I only regret that now it is finished not to have any accommodation for it. I trust anyone trying their hand at the above will not regret the time and labour given to it.—Yours truly,

Whitehaven. G. W. McA.



A Home Made Screw-cutting Lathe

Case-Hardening Iron and Mild Steel Parts of Working Models.—This may be done with yellow prussiate of potash, which can be obtained from almost any chemist. Supposing it is desired to harden the eye of an eccentric rod, bring the part to a bright red-heat and place in some powdered prussiate, directly afterwards plunging it in cold water.

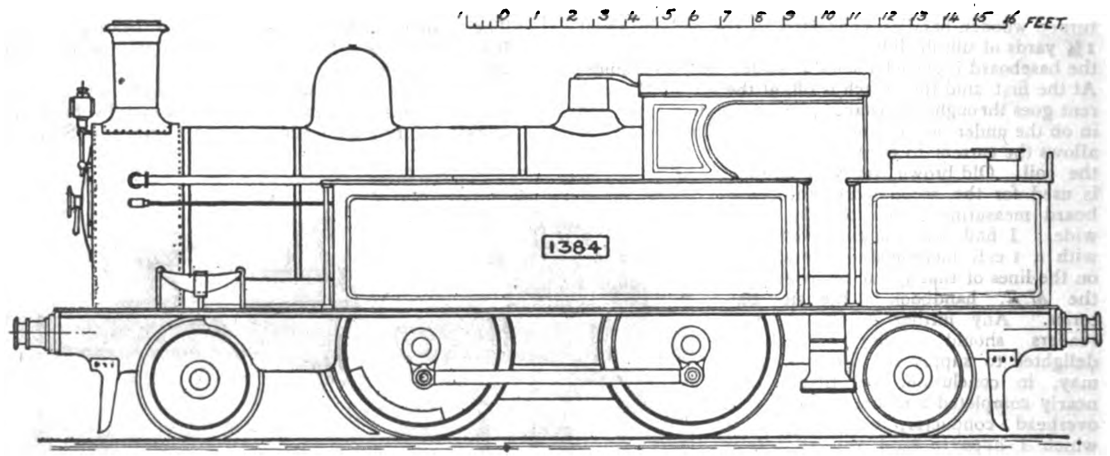
Queries and Replies.

[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-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, *37 & 38, Temple House, Tallis Street, London, E.C.]*

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

[7076] **L. & N.W.R. Passenger Tank Locomotives.** H. A. T. (London) writes: Could you oblige me with a side elevation of the 8-wheeled inside cylinder passenger tank locomotives of the L. & N.W. Railway, and also kindly give me—(1) the measurements of cylinders; (2) size of steam and exhaust ports; (3) diameter of steam-pipe from boiler (4) What would be the best working pressure for a ¾-in. scale model?



L. & N.W.R. Passenger Tank Locomotive.

We reproduce herewith a sketch which is as nearly to correct scale as we can get it with the information to hand. Cylinders, 7-16ths in. by 1-in. or ¾-in. by 1 in.; steam-pipes, ⅛-in. bore; exhaust, 5-32nds in. Best pressure is really what you can obtain. We do not like to see it fall below 20 to 25 lbs. in any case; 30 lbs. is a good all-round pressure The model, if internal fired, will require 60 sq. ins. of heating surface. You do not state the class of passenger tank you require us to sketch. We illustrate one of the larger ones, with 5 ft. 6 ins. driving wheels.

[7204] **Dynamo Driving by Gravity.** R. J. H. (Tuckingmell) writes: Last winter I wanted drawings of a small dynamo. I sent to you for help but since heard nothing. I have resolved to ask you again whether it is possible to make a dynamo to give the light of one or two candles. Also power to drive it to be from falling weights on the same principle as the clock, only simpler in construction. Why not have a change in subjects? We were to be given coupled engine and dynamo; why has it not appeared? Please oblige me by writing in THE MODEL ENGINEER, whether above is possible; if so, kindly help.

We publish this Query and Reply to show how much of many a querist's time and trouble need not be spent uselessly if a little forethought were exercised.—ED. *M.E. & A.E.*

We are very sorry to hear that your last query was not answered; but it must either have been through our rules not being complied with, or perhaps an oversight on our part. You should have written us again. We are much afraid that your idea is hardly practicable. It is, of course, quite possible to drive a small dynamo by means of falling weights, provided you had a suitable system of gearing. As an illustration of what you would need, we give you the following data: A weight of 33,000 lbs., dropping 1 ft., would develop exactly 1 h.-p., which is equal to 746 watts. Supposing you had a 10-watt dynamo, you would need $\frac{10}{746}$ h.p. to drive it = $\frac{1}{74}$ h.p. Thus, 1000 lbs. falling 33 ft. = 1 h.p. and $\frac{1000}{74}$ lbs. × 33 ft. = $\frac{1}{74}$ h.p.; but allowing for loss in efficiency we must add to the weight required at least 50 per cent., which makes it 13·5 lbs. + (50 per cent. of 13·5) = 20 lbs. So you would have to rig up some arrangement to allow a weight of 20 lbs. to drop at the rate of 33 ft. per minute to generate the required power to drive a 10-watt dynamo, which, we think, is hardly practicable. You will find our handbook ("Small Dynamos and Motors") just what you require to enable you to build a small dynamo. It may be had from The Book Department, 6, Farringdon Avenue, London, E.C., price 7d., post free. We will hear your suggestions in time and do what we can in the matter.

[7366] **Field-Magnets.** A. E. S. (Leyton) writes: In your book on "Small Motors and Dynamos," you have given a scale for making different sizes of field-magnets. Will you kindly inform me how to use this scale? For instance, I wish to make a 10-watt machine, using the second scale. Does the length of the scale (4) mean that the field-magnet is 4 ins. in height? If so, the field-magnets for the 10- and 20-watt machines are the same height. Will you please say if this is so?

Supposing, as in your own case, we wish to find the actual sizes of the various parts of the dynamo or motor depicted on page 18, Fig. 8. Take, first of all, the armature. Mark off on a slip of paper the diameter, and then see from the 10-watt scale referring to Figs. 8, 9, 10, or 11 (note the same scale does for all these types of machines) that the diameter in inches is 1¼. Next find the length of field-magnet casting—the over all length. Tick off the length on paper as before, and see from the same scale what length it is. You will find it to be just about 4 ins. For all the other parts the sizes are found in the same manner. To get the width of field-magnet, you, of course, refer to the right hand diagram of Fig 8. This will be found to be about 1⅞ ins. If you require to find sizes for a 60-watt machine, the process is just the same, only that instead of referring to the 10-watt scale of the fig. in question, you take the readings from the 60-watt scale. This varies greatly with the type of machine you wish to get. Your best plan is to select a machine which you like, and then drop the firm of manufacturers a postcard asking for price, if it is not advertised. Prices range from 12s. to £1 or more, according to finish, etc. Theoretically, the h.-p. would be 1-74th, 1-37th, and 1-25th, but off this, of course, must be taken, say, 30 per cent. for inefficiency. The number of batteries necessary depends upon the voltage of the motor. Supposing the 30-watt machine was wound to take 10 volts and 3 amps., then five cells in series would give the requisite voltage, and if accumulators were being used, 3 amps. would not be too high a rate of discharge, but as bichromates would very soon run down at this rate, it would be better, perhaps, to use five sets of two in parallel. If these are the outside dimensions, it depends upon the thickness of case what size your plates will be You can get three plates in each case, *i.e.*, two negative and one positive—the positive placed between the other two. Leave about ⅜ in space at the top for filling in with pitch when the plates have been connected up, and 1/8 in. at each end, and the same at the bottom—the plates standing on little pieces of vulcanite or rubber, with notches cut out the thickness of the plates for them to stand in. This prevents any possibility of them coming together, and so short-circuiting the cell. The capacity should be about 3 amp.-hours. The charging at first will be at a low rate—not more than 1/2 amp. for, say, eight hours at a stretch; afterwards you can go up o 1 amp. without doing them any harm.

[6924] **Series Wound Motor.** B. D. (Blackpool) writes: I have just completed the building of a series-wound motor with the intention of driving a tricycle with it. The field-magnets are wound with No. 18 wire with 500 turns on each pole of the horse shoe. My idea was to couple these in parallel, so that the current has two paths open, taking care, of course, that the resultant poles do not oppose each other. The armature is of the drum type, with slots for the wire. There are 16 slots, with two rows of wire in each slot, and five wires in each row, making 80 turns of No. 18 wire on the armature. When the current is switched on the armature does not revolve, but is absolutely locked, and cannot possibly be turned round by hand power. I should be glad if you can explain the cause of this, and the remedy. I may add that by dividing my battery of accumulators into two, and energising the field with one half, while switching the other half on to armature, the motor revolves freely without sparking. I beg to acknowledge, with thanks, the receipt of yours of the 15th ult. (6924). I enclose full-size tracing of field-magnet (not reproduced); this is 12 ins. long. The armature is 12½ ins. by 3½ ins. in diam. My battery consists of forty-eight 7-plate accumulators. Your suggestion that the field-magnet is too strong for armature agrees with my first impressions, but Sylvanus Thompson and other authorities lay very special stress on the great importance of having the field as strong as possible. The length of armature is, I admit, out of proportion to its diam., but I saw an electric motor car at the Paris Exhibition in which the disproportion was still greater. The rough sketch below gives the wiring diagram, but I may say that I have tried the two magnets in series. The power obtained would be ample to run the car were it usefully employed, as it is impossible to turn the armature. I can, of course, cut the field-magnets in two, and build two motors in place of one; but I wish to avoid this, if possible.

The cause of armature becoming locked is probably due to weakness in the spindle, owing to the great length of armature core in comparison to its diameter; when the whole battery is used to energise the field-magnet, the magnetic pull on the armature is so strong that the teeth are pulled against the pole face, and the armature prevented from turning. The magnet having very sharp horns to its pole-face, will tend to hold the teeth at these points, even with clearance existing. The magnet is not wound with a suitable gauge of wire, the resistance being so high that the E.M.F. of the battery is practically absorbed by the field coils. The resistance of your armature, measured from brush to brush, will be about ·25 ohm, and the resistance of your field-coils when connected in parallel, as you propose, will be about 2·6 ohms, or when connected in series, about 10·5 ohms. In a series-wound machine the correct resistance of the field-coils should be two-thirds that of the armature. The remedy for your trouble is to see that the armature clears the pole faces when the current is on, round off the sharp corner of the pole tips, and rewind the field-magnet with thicker wire, getting it's resistance down to as near the correct figure as possible; with a small machine it is not always practicable to obtain the same results as with a large one. With the field-coils connected in series No. 10 gauge wire, or, if in parallel, No. 14 gauge wire, will be suitable.

[7305] **Harmonograph.** A. B. (London) writes: In reply to J. A.'s (Bristol) query in your paper of October 15th, he will find the information he requires in the *Boy's Own Paper* for October 14th, 1893, November 4th, 1893, and November 11th, 1893.

[7159] **Model Steam Yacht.** J. C. (Annan) writes: Would you kindly send me the lines for a model steam-pleasure yacht about 6ft. long and oblige?

We have not any good drawings to give you or refer you to at this moment, and the working out of a design would involve a great expenditure of our time, and, therefore, as we are now rather pressed, we must respectfully decline to supply such.

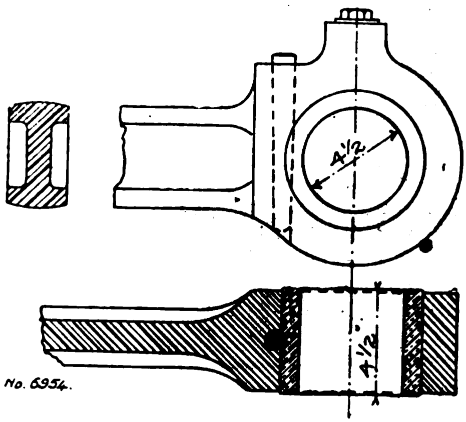
[7179] **Charging Accumulators.** "Red Cross" writes: I have four E.P.S. 200 ampère-hour accumulators that I wish to charge from 100 volt direct current service. I understand how to do the business by putting the current through lamps, that is for small accumulators; but I do not want to do it that way, at any rate in the day time. If I run direct from dynamo—which is a 100-volt 2 unit shunt-wound "Avery" machine—what resistance must I put between positive pole and accumulators? I am running about twenty 16 c.-p. lamps each evening. Suppose I put the whole current through these cells, will it do any damage? To do so, I should bring all branches to *one return* to positive of first accumulator and from negative of last cell to negative of dynamo. Would that be right?

The charging current permissible is ·026 amp. per square inch of positive plate area, and we assume, as the accumulator is of 200 amp. hours' capacity, that the plate area is about 800 sq. ins. Thus, 800 × ·026 is 20 approximately, which is the maximum charging current allowable, so that if you do not wish to use the lamps when charging, a very small resistance would be suitable, say 6 or 8 ohms. Twenty 16 c.-p. lamps will take about 12 amps., and this current will do nicely, as it is of no advantage to use a heavy current for charging. If you have occasionally five or six, or even a less number of lamps running at a time, it would be convenient to charge with this current, and would do the cells good. Your connection are quite correct.

[7256] **Gas Engine.** R. W. Y. (Middlestown) writes: If I have a 2 h.-p. gas engine and have only the work that a 1 h.-p. could do, do I run at a loss, or less economically than if I had a 1 h.-p. engine that would just nicely do the work?

No; you will see from the recent gas engine queries published, that in a well-designed engine the cost of running is strictly proportional to the work done. In fact, it is not economical to run a gas engine at its maximum load.

[6954] **Caledonian Railway Locomotive "Dunalastair III"—Coupling Rod.** A. M. (Glasgow) writes: I am working at 3/4 scale model "Dunalastair," as described in The Model Engineer. Kindly let me know the width of flute in coupling rods, and the depth of flat parts of rods at each end. In the article in *M.E.* the depth at centre of rods is given as 5-16ths, but the rods, I think, tapers towards the ends. Correct sizes of the rods on real engine will oblige. It seems strange to ask this information from Glasgow, but it is very difficult to get any particulars relating to this engine.



Caledonian Railway Locomotive Coupling Rod.

We give above a sketch of the coupling rod for this engine, as nearly as we can reproduce it from a rather complicated 1/2 in. scale drawing of the actual locomotive. On this drawing no taper is apparent, but a glance at the photograph of the locomotive shows that such is provided. It is not usual to taper fluted rods; plain rods are so treated, but not invariably. The drawing is reproduced double the size required for a 3/4 in. scale engine. The exact construction of the pin used for fixing the brass bush is not clear in the original drawing, but the plain taper pin shown herewith shown will do very well for the model.

Amateur's Supplies.

[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.

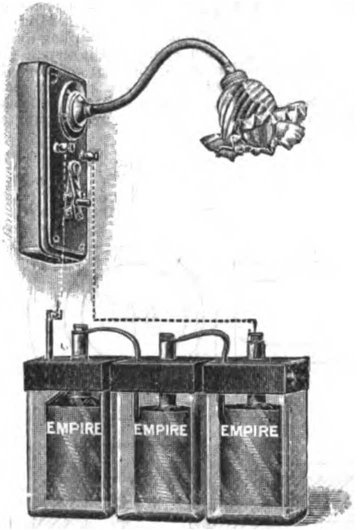
**Reviews distinguished by the asterisk have been based on actual editorial inspection of the goods noticed.]*

*To Remove Grease from Belts.

G. T. Riches & Co., 4, Gray's Inn Road, London, W.C., send us a sample bottle of their new grease remover, "Plaxine," which is especially intended for use on motor vehicle driving belts, brakes, and clutches. They state that although petrol may be used for this purpose, it is a very temporary remedy; the new preparation keeps grease from accumulating, destroying its greasy properties as soon as it gets on the leather. It is not what is usually known as a belt grip, but a destroyer of the cause of slipping. It may be used in a diluted form for removing grease and oil from painted work and metals. The price per bottle is 1s. 6d.

* New Batteries and Electric Lighting Sets.

The Universal Electric Supply Co., 60, Brook Street, Chorlton-cum-Hardy, Manchester, send us a list of their latest specialities, which consists of electric lighting sets, powerful primary batteries, pocket flash lights, which appear to be excellent value for the money. The illustration shows their "Empire" primary battery, which we have had an opportunity of testing in conjunction with the bracket electric light also depicted. The battery is a very convenient one where small powers are required for motors, shocking coils, etc., and they are capable of use for a surprisingly long period continuously. We coupled three batteries to the bracket light to see if what is claimed for it was actually a fact, and instead of running for the half-hour promised it worked for 2½ hours continuously, with hardly any appreciable loss of power through polarisation, and next morning in another test it worked a small



UNIVERSAL ELECTRIC SUPPLY CO.'S "BRACKET" ELECTRIC LIGHT SET.

motor and the light again with satisfactory results. The lighting set now before us is a very neat production, and at 12s. is as cheap as such a set could be desired. The bracket is brass, lacquered, fastened to a polished board with nickelled switch, and the lamp is provided with a very pretty shade. For photographic dark rooms, the lighting set is especially suitable, and ruby lamps can be supplied for a few pence extra. A cheaper set at 9s. 9d. is the "Atlas" table light, and the same batteries are used, as in the bracket set. Readers should send at once for the price list of these novelties. Whilst we write, we have received a sample cheap bichromate battery set in which, to prevent short circuits, the zincs are made round. The price of this battery, without bottle or jar, is eightpence.

Second-Hand Machinery.

The Britannia Company, Houndsditch, London, E.C., and Colchester, send us their latest "Register" of second-hand machinery. Any reader on the look out for second-hand tools, engines, boilers of all sizes and types, or for customers for such, should invest in a copy of this publication, which may be obtained for 3d. post free. The Britannia Company make a point of buying and selling machinery of any description.

Catalogues Received.

Vandam, Marsh & Co., Ltd., 15, Gerrard Street, Soho, London, W., send us their splendid list of electrical supplies for installation of electric light, bell, and telephone work. The list, which is neatly bound in stiff covers, and has over 300 pages, is very well got up and illustrated, and includes fuseboxes, switches, lamps, holders, ceiling-roses, electroliers, and pendants, table standards, insulators, pushes, bells, and telephones.

F. E. Wilkins, Camomile Street Chambers, London, E.C., sends us his illustrated price list of Swedish petroleum wickless cooking stoves, atmospheric wick stoves, and benzoline brazing lamps. He states that the qualities of these articles are fully equal to anything similar now on the market, whilst the prices to the trade are comparatively very low. Readers should mention THE MODEL ENGINEER when writing for this list.

W. J. Bassett-Lowke & Co., Kingswell Street, Northampton.—We have received this enterprising firm's new catalogue—a tastefully printed, well-illustrated book of 108 pages, with a rather novel design of cover. The catalogue considerably increased this year, and we notice several new and special lines in all classes of goods. In the stationary engine and working model section there are several new ideas, such as a working model printing press, with separate type, threshing machines, and several designs of clockwork model motor cars. Another feature is the listing of castings and finished parts of a 4 b.h.-p. steam tricycle engine, as were described in a contemporary, and Messrs. Bassett-Lowke are open to supply finished engines and flash boilers for same, which they state are suitable for launches as well as cars. In the model locomotive section several new designs are given, the most noticeable one being a G.N.R. 8 ft. single-driver express engine for 2½ in. gauge, with link reversing motion, worked from a lever in the cab. Designs for clockwork locomotives are plentiful, and include a rack-rail mountain railway engine, with complete track, and "two-penny tube" locomotives. Amongst the new productions in railway rolling-stock and fittings which may be mentioned is a model L. & N.W.R. goods brake van (in several sizes), stations, gates and railings, etc. Prices for special points and crossovers in tin are quoted, and also ordinary curved pieces, which can now be obtained to special radii at practically the same price as the stock patterns, which, as we have before mentioned, are rather too sharp—for steam locos in particulars. In boiler fittings several new designs are given; the one specially brought to our notice is a new starting valve or "regulator" for locomotive and other steam boilers. We have a sample to hand, and may say it is one of the best designs we have yet seen. It is very neat, and splendidly made, suitable for locomotives from ⅝ in. to 1 in. scales. Fitting it to the shell is simplicity itself. It has the further advantage in that the valve is always capable of instant removal in case of accident, or sticking, through not being used for some time; but, as it is of a pattern not at all likely to fail, such taking out will seldom, if ever, be required—all the same, it can be removed. A new line in gunmetal cocks, with key handles, is catalogued. A useful table of threads used in this firm's fittings is included, and really good fluted taps are listed. Screws, taps, drills, hacksaws, hand drillers, motors, dry batteries, model steamers, gas engines, are some of the other items of interest in this very good catalogue, which should be in every model engineer's hands, and will be sent, post free, on receipt of 6d., which is returnable to customers of 10s. and upwards.

"Crypto" Works Company, Ltd., 29, Clerkenwell Road, London, E.C., send us a preliminary leaflet, illustrating their new productions, viz., 2 h.-p. and 2¾ h.-p. motor bicycles, and giving a specification of each. Readers on the look-out for a suitable motor cycle should write at once for this sheet.

The Automobile Transport Company, 72, Comeragh Road, London, W., send us their list of "Twentieth Century" motor cars and cycles. The list contains notes on the advantages of motor traction particulars and prices of several kinds of motor vehicles.

Selig Sonnenthal & Co., 85, Queen Victoria Street, London, E.C., the well-known tool makers and importers, send us their splendid list of all classes of large and small tools. Chucks and drills of all kinds form the chief feature of the list. This firm are the sole agents for the genuine American Cleveland twist drills, which are supplied for holes 3-16ths to 2½ ins. diameter, as well as in smaller sizes suitable for model makers, and also supply patent packing blocks. "Green river" screwing tackle, reamers, cutters, grinding machines, twist-drill grinders, wheel cutting attachments, "Stow" flexible shafts, etc., useful for engineering shops, are illustrated and priced.

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 6s. 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," 37 & 38, Temple House, Tallis Street, London, E.C.

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THE

Model Engineer

AND

Amateur Electrician.

A JOURNAL OF MECHANICS AND ELECTRICITY FOR AMATEURS AND STUDENTS.

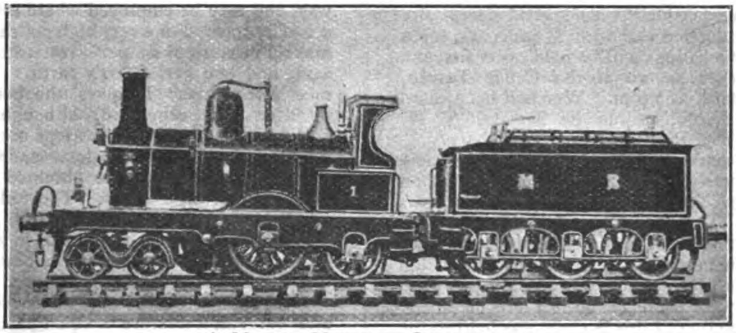
EDITED BY PERCIVAL MARSHALL, A.I.MECH.E.

VOL. VII. No. 86. DECEMBER 1, 1902. PUBLISHED TWICE MONTHLY

A Cheap Model Locomotive.

By AMOS BARBER.

THE following particulars and photograph will describe a model railway engine which I made in my spare hours, and I think it will show a few readers that a good engine may be made without spending an enormous sum in castings and fittings. Before starting this model I looked through all the numbers of THE MODEL ENGINEER and put together all the best hints, until I got what I thought would make a good working and, at the same time, a fairly good looking model. The resultant locomotive is the outcome of my own designing, and is not intended to be a model of any railway company's engine. The model has been made from my scrap heap, the only castings about it being the wheels and the dome, and these I cast in brass myself from patterns I made.



A MODEL MIDLAND LOCOMOTIVE.

The cylinders, which are double oscillating, were built from brass tube, the dimensions being 9-16ths-in. bore and 1¼-ins. stroke. They are fed with steam from the top of dome, and the pistons are lubricated from the left side of smokebox. The side frames and foot-plate were cut from sheet brass 1-16th in. thick. The buffer beams were made of hard wood, and screwed to pieces of sheet brass, flanged at each end, and riveted to side frames. The crankshaft was built up from ¼-in. round steel, and four flat pieces were brazed on for the webs. The driving wheels are 3 ins. diameter, and 5-16ths. in. wide. The trailing and tender wheels are 2 ins., and the bogie wheels 1½ ins. diameter. The gauge of rails are 2⅞ ins. The buffers are the ordinary pattern with spiral springs, and are fastened to buffer beam with four brass screws. The vacuum brake pipes are only put on to give the engine a finished appearance. The screw brake coupling links, draw hooks, screw jack and lamps were all made from brass rod.

The boiler is made from a piece of seamless copper tube—8½ ins. long, 2½ ins. diameter—cut at one end and straightened out to form outside firebox. There is one flue tube—5¾ ins. long, 1¼ ins. diameter—and crossed with ten ¼ in. copper tubes set diagonally; these are expanded and well soldered. The internal firebox is 2¼ ins. square, tapering to ¼ in. less at the top, and is crossed with three copper tubes ⅜ in. outside diameter. The boiler is fired with a kerosine burner made from the description in THE MODEL ENGINEER No. 22, and is worked with steam from the top of dome. This works very well, and keeps up a good supply of steam. I have a small back-pressure valve on the boiler screwed at the bottom to suit a cycle pump, a few strokes of which works the lamp, and steam appears in a few minutes, when the pump is unscrewed and the lamp regulated to suit the steam pressure. The front of boiler is fitted with regulator, small cock for burner, water-gauge, and back-pressure valve; this is coupled to hand-feed pump, which is fastened to top of tender. The cab is fitted with glasses mounted in small brass rings, quadrant for reversing gears, and screw brake, which is coupled to driving, trailing and tender wheels. The tender is made of sheet brass 1-32nd in. thick, and is divided lengthways, the top half for water, into which the feed pump is screwed, and the lower half for kerosine—a small tap being screwed to the bottom to regulate the flow, and coupled by a flexible tube to the burner. I have never had this engine running on a track, but I have thoroughly tested it on the causeway. The only rails I have are those on the ash stand. These were made in lengths, and fastened together by fish-plates. The chairs I cast in white metal, and fastened them to wooden sleepers. The total length of engine and tender between buffer faces is 25 ins., and the height from rail to top of funnel is 7½ ins. It has been made some time (nearly two years) now, and took me about eighteen months to make, the cost being short of 10s. I am at the present time building a traction engine, which I hope to send you a description of when finished.

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 eighteen days before its actual date of publication.*]

London.

THE next indoor meeting of the Society will be held at Holborn Town Hall, Gray's Inn Road, W.C., on Monday, December 15th, at 7 p.m., when a paper will be read by Mr. E. W. Fraser on "Cheap Workshop Appliances," not on "Materials" as previously announced. There will be no ordinary meeting in January; but the Fourth Annual Conversazione will be held on Friday, January 16th, 1903, at Holborn Town Hall, for which a specially interesting programme is being arranged. Members are urgently requested to do all in their power to make this function successful by helping the Committee in every way possible, and exhibiting models freely. The Provincial Societies are especially invited to exhibit, and every effort will be made to ensure careful handling and packing of all exhibits sent to the Secretaries.

Provincial Societies.

Bradford.—The fortnightly meeting of the above Society was held on Monday evening, November 3rd, Mr. A. P. Drake presiding. Several of the members showed models, among which were several accessories for a lathe and an induction coil with ½-in. spark for a motor bicycle. The meetings will be held every first and third Monday in each month at the Coffee Tavern, Tyrrell Street, Bradford, at 7 p m. We shall be pleased to welcome anyone wishful to join the Society.—J. W. Lamb (Hon. Sec.), 109, Rushton Road, Thornbury.

Glasgow.—An extraordinary meeting of this Society was held in the Society's room, 309, Shields Road, on Wednesday, October 15th, at 7.30 p.m. Mr. Rogers occupied the chair. The chairman referred to the business before the meeting, viz., to discuss and decide as to the conditions of membership. A lengthy discussion ensued, and as a result the annual subscription was fixed at 10s., with an entrance-fee of 2s. 6d. for new members.

The fortnightly meeting of this Society was held in the Society's room, on Wednesday, October 22nd, at 7.30. In the absence of the president and vice-president, Mr. Beith occupied the chair. Mr. James Allan and Mr. Macdonald were appointed auditors in connection with the annual statement of accounts and balance-sheet and several matters were thereafter discussed.

The annual general meeting of the above Society was held in the Society's room, on Wednesday, November 5th, at 7.30 p.m., Mr. Robert Allan presiding. The minutes of the previous meeting were read and adopted, and thereafter the following office-bearers were elected for the ensuing year: President, Mr. John Rodgers; Vice President, Mr. Robert Allan; Secretary, Mr. Jas. R. Beith; Treasurer, Mr. Hugh A. Park; Committee, Messrs. Hornal, Falconer, Erskine, Granger, and R. McMillan.

After some discussion it was agreed that the meetings be held on the first and third Wednesdays of each month, instead of every second Wednesday as at present. The annual report was read and adopted, and the Committee were requested to revise the present membership rules and to put the result before the Society at meeting to be held on November 19th. There being no other business, the meeting terminated.—James R. Beith, Sec.

Liverpool.—A meeting of the members of this Society was held on Wednesday, November 5th, at 100, Dale Street, at 7 45 p.m. Mr. Reeves read a short paper on "Steam Boilers," and described the working of the Howden forced draught system. Vote of thanks, proposed by Mr. Kirby, was unanimously passed to the lecturer, and the meeting then terminated. The next meeting will be held at 100, Dale Street, on Wednesday, December 3rd, at 7.45 p.m., further particulars of which will be posted to the members.—F. T. Stewart, Hon. Sec., 33, Cowper Road, Old Swan, Liverpool.

Tyneside.—A meeting of this Society was held on Saturday, November 1st, at Pillar's Café, 7, Pink Lane, at 7.15 p.m., Mr. B. Bamford being in the chair. It was proposed by Mr. Jackson, seconded by Mr. Patterson, that seeing it was the end of financial year and the time for the election of officers, the same officers be re-elected; and carried unanimously. Mr. Fenwick exhibited a vertical engine of the Spicer type, 1 in. bore, ⅝ stroke, working from a very novel boiler having seven field tubes 1 in. diameter, working at 30 lbs. pressure, which was raised in five minutes from cold water. The President, Mr. Bamford, also had running his double high-pressure marine model ¾ by ¾. The meeting closed at ten, after a hearty vote of thanks to the above-named gentlemen.—Geo. F. Addleshaw, 2, Gladstone Street, Newcastle-on-Tyne.

To Polish Aluminium.

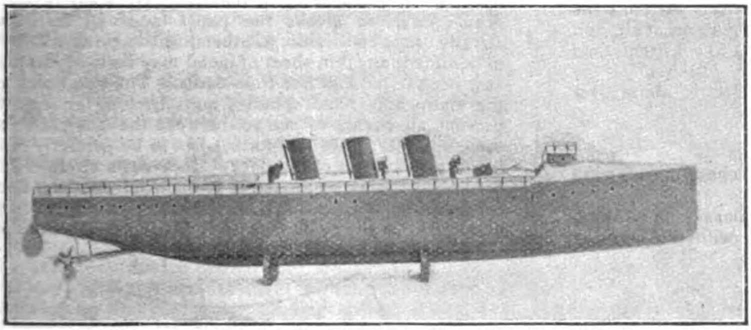
A FINE polish can be obtained on aluminium by means of a cloth buffer and rouge. This is the cheapest way, and may be employed where large quantities of work are to be done. For a very high polish with the silver effect, make a mixture of six parts rottenstone, one part stearic acid, and one part fuller's earth. Grind very fine and mix thoroughly. It gives the best results when used on a chamois skin buff, although a cotton cloth buff will do. On aluminium castings use a steel scratch brush run at high speed. For articles made of sheet aluminium, a beautiful finish may be obtained by the use of a fine brush run at high speed. The following method gives the frosted surface:—Remove all grease and dirt by dipping in benzine; now dip in a strong solution of caustic potash, strong enough to blacken the metal; then dip the articles in a mixture of two parts nitric and one part sulphuric acid; then in concentrated nitric acid; afterwards in a mixture of equal parts vinegar and water; and, finally, wash thoroughly in water and dry in hot sawdust. To burnish aluminium use a bloodstone burnisher. If no burnisher is at hand, make a mixture of melted vaseline and kerosene oil, or a solution of two tablespoons borax and a few drops of ammonia in 1 qrt. of hot water. This is applied with a piece of canton flannel to the article, which is run at a good speed in the lathe, keeping the flannel saturated with the mixture.—*Hardwareman.*

Royal Institution.—The Annual Course of Christmas Lectures, specially adapted to young people, at the Royal Institution, will be delivered by Professor H. S. Hele-Shaw, LL.D. F R.S., Professor of Engineering in University College, Liverpool, whose subject is "Locomotion:—on the Earth; through the Water; in the Air." The first lecture will take place on Saturday, December 27, at three o'clock, and the remaining lectures will be delivered on December 30, 1902, and on January 1, 3, 6 and 8, 1903.

A Model Torpedo-Boat Destroyer.

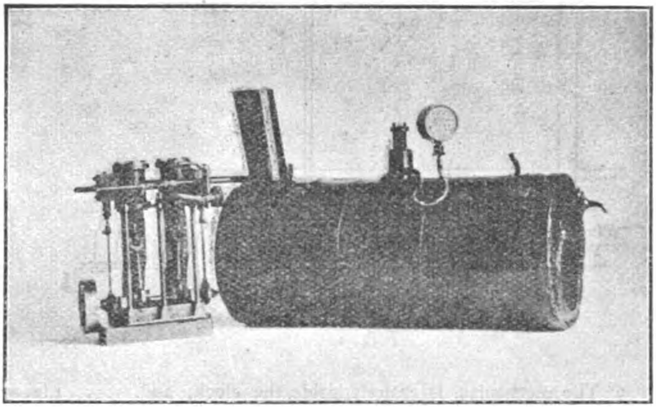
By A. Sheed.

As model steamers seem to be very popular with the readers of The Model Engineer, I think the following description of a model destroyer will

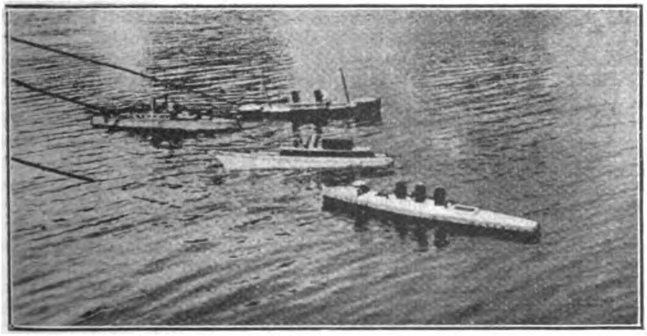


Mr. A. Sheed's Model Torpedo Boat Destroyer.

prove of interest to many. The vessel is 3 ft. 7 ins. long by 5 ins. beam and 4⅜ ins. deep, made in halves and joined together along the keel. I think by this method the inside can be shaped out easier than by any other. I spent a lot of time on the hull, but it repaid the trouble. The boiler is very similar to the one described by Mr. D. Kidd, in the issue of The Model Engineer for November 1st, 1900, but rather smaller. The dimensions over all are 9 ins. by 3⅞ ins.; the fire tube is 2 ins. diameter, and has six ⅜ cross tubes silver-soldered. The shell is made from 20 gauge sheet brass and double-riveted; the fire tube is 16 gauge solid drawn brass, and the end plates are brass castings. I tested the boiler up to 60 lbs. steam, and works at a pressure of 45 lbs. For heating I use a blow-lamp, burning benzoline, which I



Engines and Boiler of Mr. Sheed's Boat.



The Fleet of Steamers on Clapham Pond.

made myself. The cylinders are ⅝ in. bore by ¾ in. stroke. The boat maintains a speed of a little over five miles an hour, with the lamp at full power, and keeps the pressure steady at 45 lbs. to the square inch. The propellers are 2⅝ ins. diameter, about 6 ins. pitch. The total weight of the boat is 13 lbs. 13 ozs., made up as follows:—

The hull complete	6 lbs.	2½ ozs.
Boiler, with water	5 lbs.	10 ozs.
Blow-lamp, with spirit ...		14 ozs.
Engine	1 lb.	2½ ozs.

The accompanying photographs will give a good idea of the model torpedo-boat destroyer and its engine and boiler; and also of the Clapham Pond "fleet" of model steamers. My own boat has now been running for several months, and has proved very satisfactory in every way. Model engineers will note that the success of a model steamer largely depends upon the boiler, and every effort should be made to provide one which will steam well, and, at the same time, hold sufficient water for a fairly long run. The firing should receive every attention, and benzoline blow-lamps seem very suited to small marine models.

Armour for Electricians.—Electricians who wish to be secure against shocks, will have to revert, says the *Mechanical Engineer*, to a coat of armour in the shape of a complete dress, composed wholly of thickly woven wire gauze. This dress, which has been invented by a Prof. Artemieff, weighs only 3·3 lbs., and it is stated that its cooling surface is so great that a current of 200 ampères can pass through the dress from hand to hand for some seconds without perceptible heating effect. In some tests made at the works of Siemens & Halske, the professor, standing on the ground, uninsulated, drew sparks from the secondary terminals of a transformer which was giving a tension of 75,000 volts. The inventor concluded his experiments by short-circuiting a generator of 170 k.w. capacity by clutching hold of the terminals.

Automatic Electrical Alarm Clocks.

By H. E. S. Viner.

THE two alarm attachments for fitting to clocks herein described are both easy to make and certain in action. The first to be described can be fitted to any alarm clock of the round American pattern; the second is for clocks without any spring alarm at all, and requires slightly more mechanical skill to construct than number one.

The advantages claimed for this electric alarm over those to be bought at shops are:—

1. It is absolutely automatic.
2. It is much cheaper.
3. It can be fitted to an alarm clock whose alarm spring is broken.
4. If fitted to a clock whose spring alarm is in working order, it does not in any way interfere with the working of the latter.

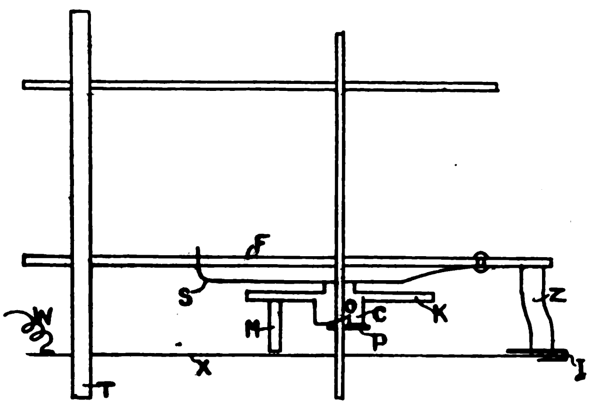


Fig. 1.

5. The mechanism is entirely inside the clock, and, therefore, does not spoil its appearance in any way.

In order that the electric fitting shall be clearly understood, it is advisable here to explain the working of the ordinary spring alarm, and this may best be done with the aid of the clock itself. Having unscrewed the winding keys and pulled off the hand-setting heads, remove the back from the clock (this is made a tight fit in the clock barrel, and simply needs pulling or levering out). Then unscrew the legs and gong and pull the works out, tilting them in the barrel so as to get the alarm hammer through the hole in the case.

If you now look between the face and the brass frame of the works, you will see a cogwheel in the position shewn in Fig. 1 at K. Here F is the framework, X the the face, and T the main spindle carrying the hands. Of course, there are other cogwheels (left out for clearness in the figure), but the special one wanted can be easily found by revolving the hands to the hour at which the alarm hand is set, when one cogwheel will be seen to jump some ⅛ in. towards the face of the clock. This jump is caused by the spring S, which presses the boss C on K against the pin P on the alarm hand spindle, so that the moment K has turned so far that the cam edge O cut in C is over the pin P, S forces K forwards. It is this forward movement of K, from what I will call the "in" to the "out" position, which is made use of to set the alarm hammer free, and which in our case connects the works to the insulated clock face, and so completes the circuit of the bell and battery through the clock.

Construction.—First remove the hands, which are held on by friction, and then the clock face. It is best to cut a circle of paper the size of the face, gum it just round the edge and stick it over the face. This will prevent the latter becoming a mass of finger-marks before the job is done, when it can easily be removed. In some of these drum American clocks the paper face will be found already backed with zinc; in others, this backing will have to be added; any thin sheet of metal may be used, so long as it is quite flat and free from dents. The two holes for the alarm and hand spindles must be long enough to prevent all chance of contact between the face plate and these spindles, since the former has to be perfectly insulated from the rest of the clock. Now cut a circle of stiff brown paper about 1 in. larger in diameter than the clock face and from the centre of this remove a circle 1 in. less in diameter than the clock face, thus making a ring of paper

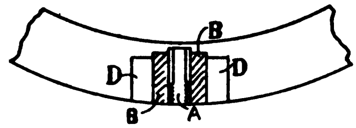


Fig. 2.

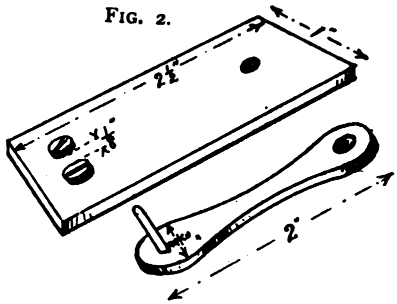


Fig. 3A

1 in. wide. This ring must be "seccotined" to the cast-iron ring Z, to which the face of the clock was originally fastened (the proper ring is shown in position at I). As soon as the Seccotine is dry, get a straightedge and lay it across from side to side of Z above K, and measure the distance between K and the straightedge for "in" and "out" position of K; add these two distances, and halve result. This will give the length of wire required to make contact. The wire should be ⅛ in. brass wire, and should be soldered to K in the position shown at M, Fig. 1. To test that M is the right length hold face firmly in position, and revolve hand spindle; M should revolve clear of the face till alarm time, when it should spring forward and hit the back of face smartly, remaining in contact for about one revolution of minute hand. Since the whole action of the alarm depends on the right length of M, care should be taken that the clearance before and friction of M after contact are good; if this is attained, the alarm will remain perfectly reliable and automatic as long as the clock will go, the scraping of M over the face backing always ensuring a good electric contact.

The hole in one of the bosses (D, Fig. 2), into which the legs screw, must now be drilled out to about ½ in., and a vulcanite or hard wood plug (B) fitted in. A small piece of copper tube (A), tapped for the leg to screw into, should now be procured, and a hole drilled in the plug for ube to fit into; the plug and tube should both be "seccotined" in position. The leg hole in clock case must also be drilled larger, so that the leg shall be insulated from it when screwed home into boss.

Now to fit together. Solder a short piece of insulated wire W (Fig. 1) to clock face backing, and having seccotined the paper ring I all round, press face into position, seeing that it clears hour and alarm hand spindles, and top overhanging edge of I over edge of face all round, as shown in Fig. 1; keep all pressed in position for a couple of hours; now solder the other end of wire W to tube A (Fig. 2). The apparatus being now complete, the works may be slipped into the barrel, and the legs and gong screwed on.

A neat method of making the connection is shown in Fig. 3. The battery is contained in a box with two binding screws, and two brass-headed nails fixed in its cover; the latter are so placed that the legs of the clock can rest one on each of them. One is connected to one of the terminals, and the other to one battery plate, the other plate being connected to the remaining terminal. The rest of the connections can be easily seen from the figure. One advantage of this form of connecting-up is that the clock can be carried into another room during the day, and replaced at night without any bother of screwing up and unscrewing binding screws, though, of course, if preferred, the legs of the clock can be themselves used as binding screws.

Action of No. 2 Alarm.—On removing the face of a clock, a train of four pinion wheels, shown in Fig. 4 at A, B, will be found, which reduces the speed of the minute hand spindle to that of the hour hand. The last of these wheels (B) runs on the minute hand spindle, and

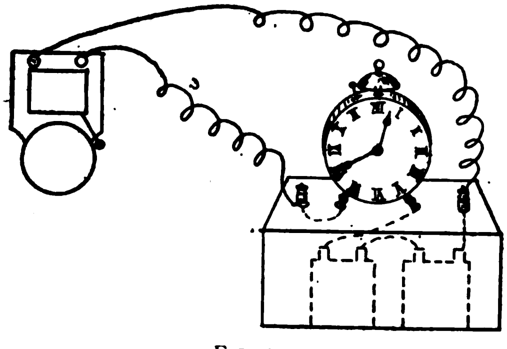


FIG. 3.

has a long boss C, which projects through the face and carries the hour hand. If an adjustable contact-maker be fitted on this boss so as to complete the circuit at any registered hour, we have obviously an attachment applicable to any clock construction. Take a round piece of brass some four times the diameter of the boss C, and about ⅛-in. thick, and file it to the shape of D, Fig. 4. A hole must now be drilled through D of such a size that D will just *not* go on to the boss C. Next, with a fine hacksaw, cut through D, to make it spring on to C. If D still refuses to go on to C, ease the hole with a round file or reamer till D can be revolved stiffly on its boss C. Next fasten a block of some insulating material to clock frame, as shown at K, and procure an old piece of clock spring (seen edgeways), which, when screwed to its support, overlaps the point of D by, in a small clock, some 1-32nd in. Up against the spring, fix on the block K a piece of ⅛-in. sheet iron G, a ¼-in. or more wide. The end of G must be in line with, and just short enough to clear the point of D.

The action of the alarm is easily seen. As the hands revolve, D comes in contact with the spring, so setting up a connection between the frame and the insulated spring. This contact is maintained while D revolves till its point passes that of the spring, when the latter springs back beside G. The exact time during which contact is made should be noted, and it is more convenient to file the spring till the time is some easily remembered number, say, half-hour. The reason for this is that, in setting the alarm, this number must be deducted from the hour at which the hands stand; for example, to set alarm for seven o'clock give the hands a complete revolution backwards, and then, still turning backwards, move them to 7.30. The alarm should now go off within a minute or two of the hour, supposing the adjustment of F to have been made rightly.

It is not necessary to go into the construction of the bell for this set; any reader of THE MODEL ENGINEER should be able to construct one for 9d., or less, which will make quite enough noise to wake him, since persistence—not loudness—is the secret of the rousing effect

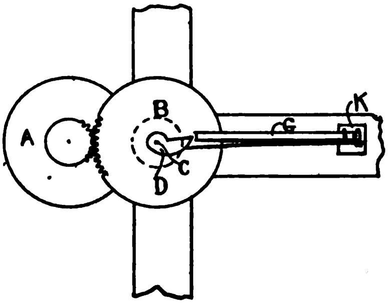


FIG. 4.

of the electric alarm; but, should it be preferred, a neat little bell may be purchased from the Universal Electric Supply Company for 1s. 6d., from whom also battery plates can be purchased very cheaply. Two zinc carbon couples in 1-lb. jam jars half filled with salt and water will be quite sufficient to keep the alarm ringing indefinitely, while the switch shown in Fig. 3A, which explains itself, completes the set.

A Peculiar Alloy.

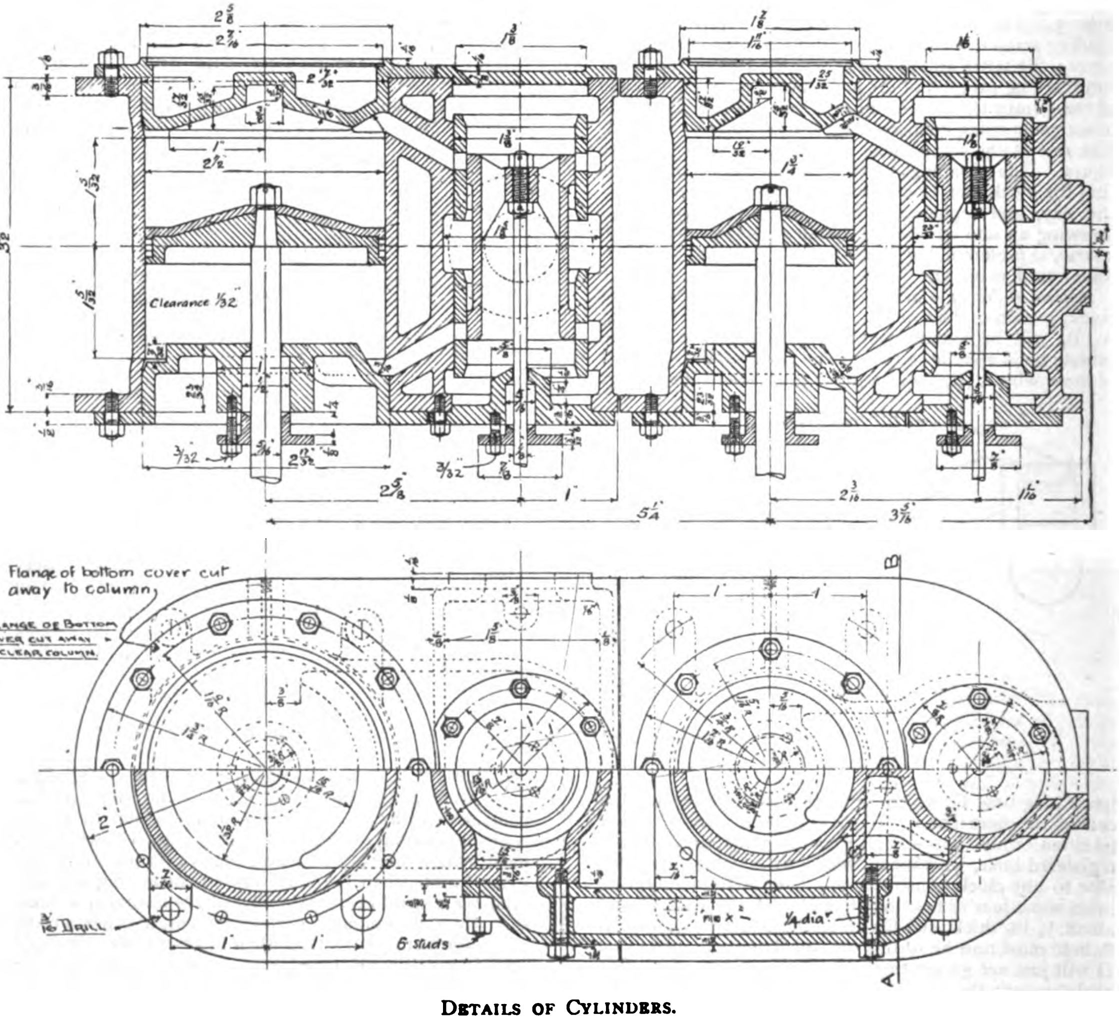
ALUMINIUM and antimony both melt in the neighbourhood of 630 degs. C., yet the alloy Al Sb, containing 18·87 per cent. of aluminium and 81·13 per cent. of antimony, melts only at 1080 degs. C., which is a most marked exception to the general rule that alloys are more fusible than the least fusible metal they contain. Another general rule is that alloys have a smaller volume than their uncombined constituents, or, in other words, are heavier or denser than their theoretically calculated specific gravity. Edmond von Aubel has examined the alloy Al Sb in this respect, and finds that it is phenomenal in respect to its density as well as in its melting point. Its calculated specific gravity is 5·225, which is the density it would have if its ingredients alloyed with no contraction or expansion of volume. Its true specific gravity is 4·218, at 16 degs. C. This shows a large expansion of volume during alloying, and is thus a marked exception to the general rule that alloying is accompanied by contraction. To put the figures in another way, 7·07 cub. c.m. of aluminium alloying with 12·07 cub. cm. of antimony produce 23·71 cub. cm. of alloy.—*Aluminium World.*

Original Designs for 750-watt Direct-Coupled High-Speed Steam Engine & Dynamo.*

By F. L. and F. P. Spicer.

General Description.

HAVING read the discussion which has been proceeding in the columns of The Model Engineer on the question of the advisability of constructing models which shall be complete reproductions deavoured to produce a model which shall, as far as possible, be acceptable to both parties. The design, therefore, represents, in all essential details, a self-lubricating, high-speed, compound engine, direct-coupled to a multipolar compound wound generator, such as is used in power and lighting stations at the present time. Considering the moderate steam pressure to be employed, and to keep the parts of such a size as to be capable of being machined on the tools at the disposal of most amateurs, the designers have settled upon a combined plant, capable of giving continuously an output of 50 volts, 15 ampères, whilst running at 1,500 revolutions per minute with 60 sq. ins. steam pressure at the stop valve.



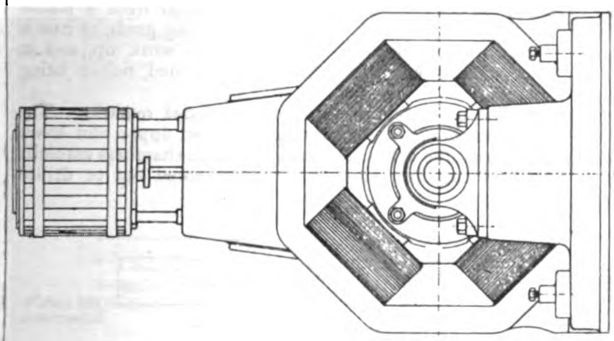
Details of Cylinders.

to scale of larger plant, or of omitting minor details in order to add to the efficiency of the models, the designers, whilst favouring the latter view of the question, have en-

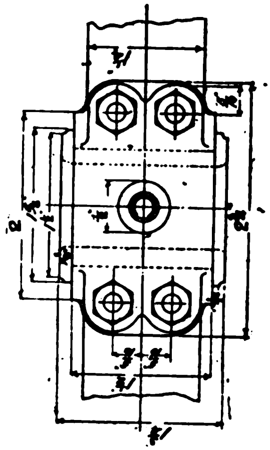
* These designs were awarded the first prize (£5 5s.) in our Competition No. 18, and are published subject to our editorial comments on page 278 of The Model Engineer for June 15th last.

The Engine.

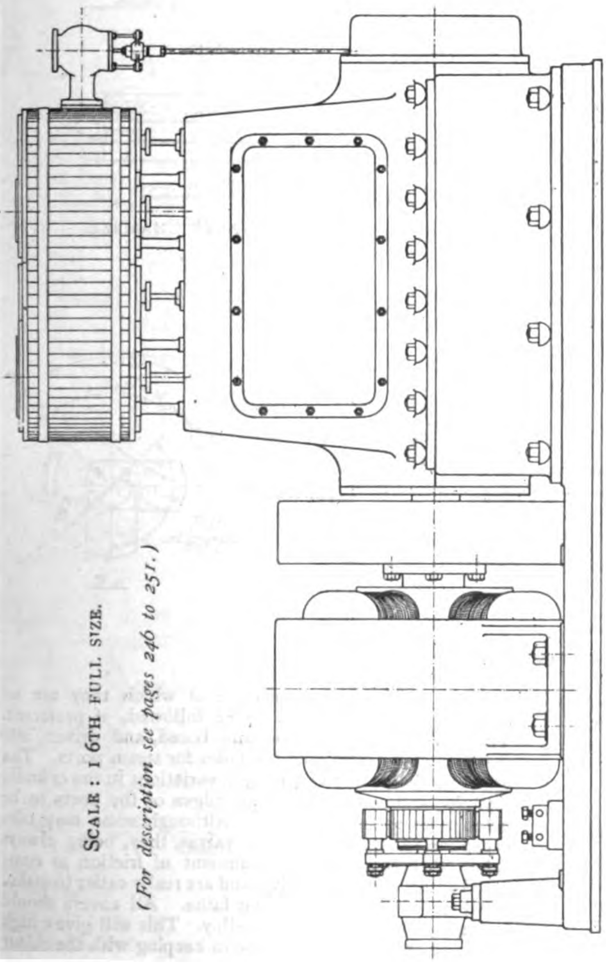
The engine, which is one of the self-lubricating enclosed type, so popular for driving electrical plant at the present day, is a compound, with cylinders 1¼ ins. to 2½ ins., stroke 2 ins., and running at a speed of 1,500 revolutions per minute, with 60 lbs. per sq. in. steam pressure at the stop valve, will give an indicated horse-power of two, and ought to develop at least 1½ h.-p. on the brake. In



VIEW FROM DYNAMO END.



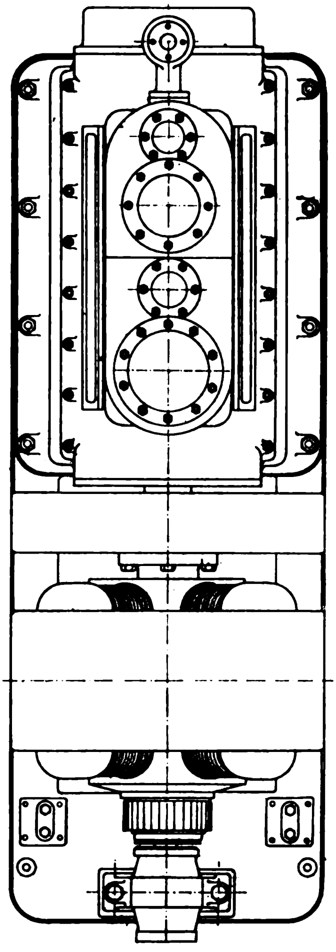
DETAIL OF L.P. END BEARING.
(*Scale*: Half Size.)



SIDE ELEVATION OF ENGINE AND DYNAMO.

SCALE: 1 6TH FULL SIZE.

(*For description see pages 246 to 251.*)



PLAN OF ENGINE AND DYNAMO.

PRIZE DESIGN FOR 750-WATT DIRECT-COUPLED HIGH SPEED ENGINE AND DYNAMO.

BY F. L. AND F. P. SPICER.

settling to make a closed type engine, the designers had in view the much greater convenience this type gives, there being no oil flying around to make a mess, coupled to the obvious advantages of self-lubrication, with which, by a very little additional labour, all working parts are kept covered with oil, and much quieter running and freedom from jar on the reciprocating parts obtained, in addition to its ability to run for considerable periods without attention. With this latter object in view, all bearing and rubbing surfaces have been kept as large as possible.

In designing the engine, the first thing to settle is the size of the cylinders, and this must be done with direct reference to the steam pressure. In practice it is usual to refer the mean pressure to the low-pressure cylinder, and calculate accordingly. After settling the number of expansions at 3·5, the expression

$$\frac{1 + \text{hyp. log. } r}{r}$$

becomes ·643; and allowing 18 lbs. per sq. in. back pressure, the mean pressure becomes

$$\{ \cdot643 \times (60 \times 15 - 5) \} - 18 = 27 \text{ lbs. per sq. in.}$$

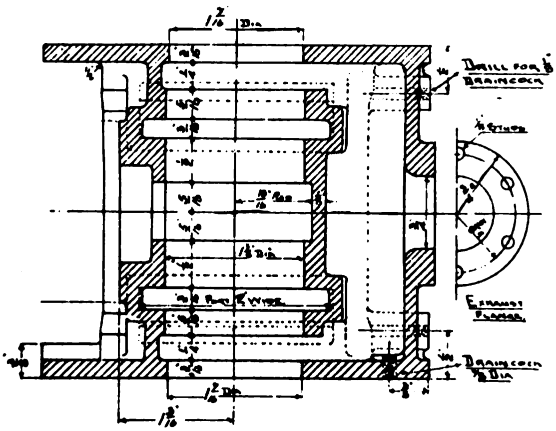
The correct ratio of the cylinders is generally accepted to be $\sqrt{n} : n$ where n = number of expansions, n in this case being 3·5.

So the ratio should be $\sqrt{3\cdot5} : 3\cdot5 = 1 : 1\cdot87$. The ratios are actually rather more, being 2 : 1.

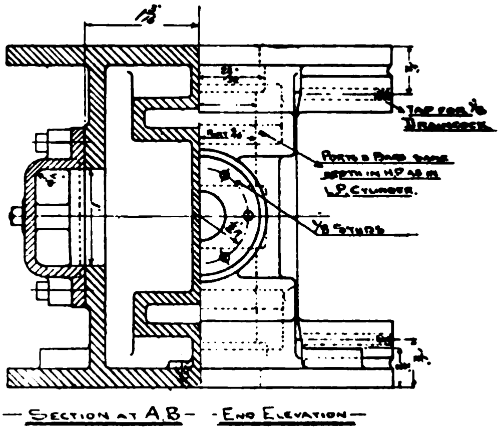
The piston speed is 500 ft. per minute, and is very moderate for this type of engine. The cylinders should be cast in good soft cast iron, this giving such a much better working and wearing surface than any other metal; but the castings should only be obtained from a maker who is used to small work, as, if a wrong grade of iron is used, the castings may be too hard to work up, and in any case they should be carefully annealed before being used.

The construction calls for no special remarks. The flanges should be turned or planed over upper and lower surfaces, the cylinders and piston valve chambers carefully bored out, the latter being either cored out or drilled from the solid metal, the angle at which they are set allowing this latter course to be followed, if preferred. The valve liners are turned and bored, and driven into position after drilling out the holes for steam ports. The use of the liners allows for slight variations in the cylinder castings, and enables the steam edges of the ports to be much more accurately made. Although some may take exception to the use of piston valves, they, being always balanced, save an enormous amount of friction as compared with a flat square valve, and are really easier to make, as all work can be done in the lathe. All covers should be made of aluminium No. 2 alloy. This will give a high finish, be easy to work, and be in keeping with the colour of the cylinder.

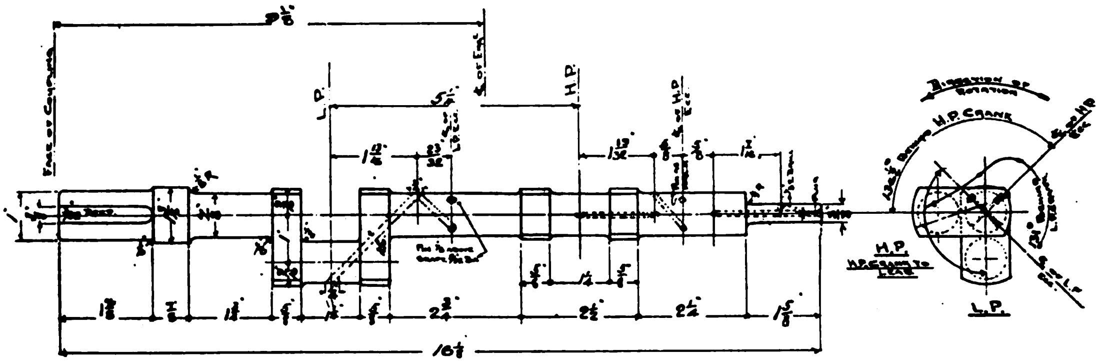
The main difference in detail between this engine and



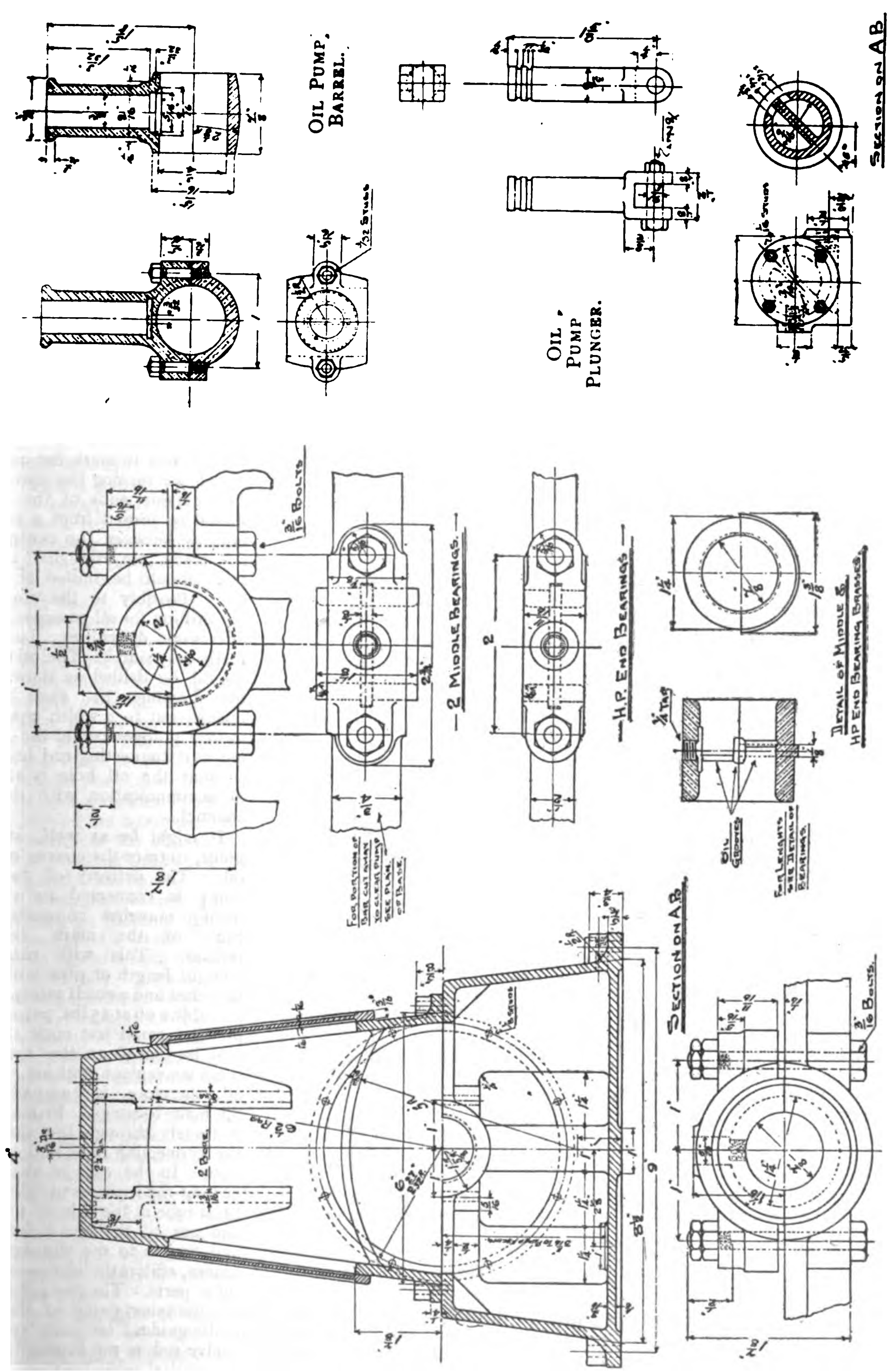
Low Pressure Valve Chamber.



High Pressure Valve Chamber.



Detail of Crank Axle showing Oil Ways.



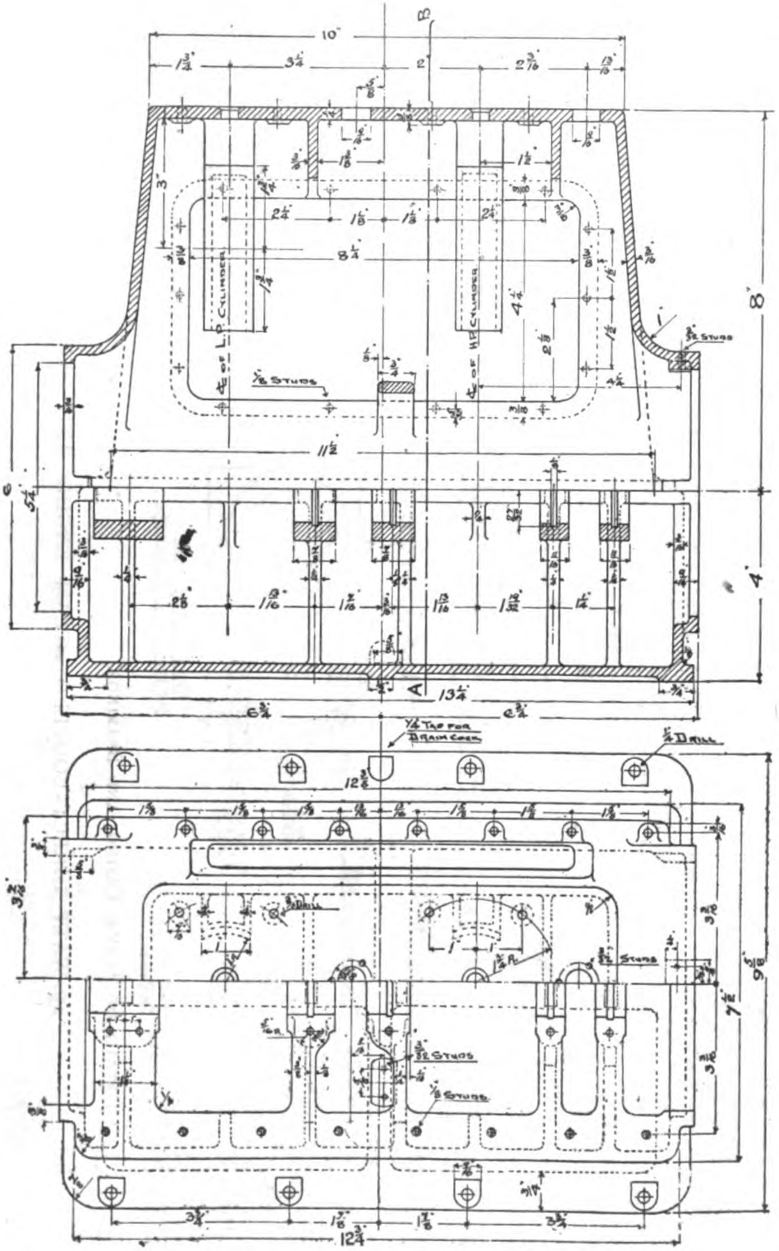
DETAILS OF FRAME, CASING, AND BEARINGS.

750-WATT DIRECT-COUPLED STEAM ENGINE AND DYNAMO.

Scales: ½ and ¼ Full Size.

(For description see pages 246 to 251.)

those of large makes is seen in the mounting of the cylinders on columns, instead of on cast-iron distance pieces. The main reason for this is the inaccessibility of



Details of Frame and Casing of Engine.

the stuffing boxes, &c. where a cast-iron distance piece is used and the great difficulty of re-packing the same. The columns give a very neat appearance, and should be carefully turned and polished all over.

The frame and base next demand attention. The mos suitable metal for this is the No. 2 alloy, there being no wearing surfaces on this, with the exception of the guides, and as these are very large, and steel and aluminium run together very well, they should give no trouble. If this metal is used, a great saving in weight will be effected, which, whilst of slight importance in a stationary engine, nevertheless saves considerable labour in lifting and handling parts, &c.; the frame doors should also be of this metal. If the recess at the top of the guides is machined out, it will considerably simplify the pattern-making, the rib across the middle of the frame being made radial, and sliding out through a slot in the side of the core box. The crankshaft is of the usual type and calls for no special remarks; a mild steel forging should be obtained for it, and should have bosses left on the ends to mark the centres out on for turning the pins, etc. The outside ends of the webs should be turned from a centre midway between the centres of the crank pin and shaft; the sides should be milled or filed flat. Possibly to the amateur the drilling for oil passages may offer some difficulties; but it is really very simple. The oil holes should be drilled as shown on the drawings, the ends being opened out to a width equal to the oil grooves cut in the bearing and connecting rod brasses, so that the oil hole is always in communication with the oil channel.

It might be as well, at this point, to trace the course of the oil. The delivery of the oil pump is connected to a pipe having branches connected to each of the main bearing brasses. This will mean a straight length of pipe with five branches and a small safety valve set to blow off at 15 lbs. per square inch; a small test cock should also be placed on the main in some convenient position. The oil, therefore, is pumped into the main bearings. From these it travels through the shaft to the connecting-rods and eccentrics. In the case of the connecting-rod it passes up the small brass tube at the side of the rod and out to the crosshead pin, and thence to the slippers and guides, efficiently lubricating all these parts. The passage of the oil in the eccentrics is much the same, going up the rods and out to the valve spindle guides; but care must be taken that the end of the valve rod is not screwed down so as to blind the oil hole to the guide bracket. This explanation should make clear the oiling arrangements to the principal parts; the governor sleeve is oiled from a small hole drilled up the end of the shaft. The keys for the eccentrics are simply pegs driven into the shaft, the eccentrics themselves being made in halves and bolted together over them.

(*To be continued.*)

Alternating Currents Simply Explained by Hydraulic Comparison.

A FAMILIAR way to simplify the comprehension of certain electric terms and phenomena is to point out the analogy between a direct current and a flow of water in a pipe. In this case the pressure producing flow is likened to the *voltage* or electromotive force, and the quantity of water passing through the pipe to the *ampèrage* or amount of current. The initial pressure is gradually consumed in overcoming resistance in the pipe or conductor, and in strict analogy the losses in either case are proportional to the square of the current and the first power of the resistance.

This analogy has been carried a step further by H. T. Eddy in a recent paper,* and applied to the phenomena of alternating current transmission. He assumes a double-acting pump cylinder and piston in which the two ends of the cylinder are connected by a long pipe or by-pass without valves. When this apparatus is filled with water and the piston is moved by a uniformly-rotating crank, the water flows alternately back and forth from one end of the cylinder to the other. It will be quite evident that at the beginning of the stroke the pressure will be greatest, for at this point the pump cylinder has to overcome the inertia of the moving mass of water and change its direction of flow. The maximum current occurs when the piston is near the middle of the stroke, for at a point near the middle the piston velocity is a maximum. In other words, the maximum current lags one-quarter of a revolution behind the maximum pressure, and when the pressure is a maximum the current is a minimum, and *vice versâ*. This is precisely the action of an alternating current due to the *inductance* of the circuit.

If, now, the connecting pipe be made of some elastic material, the effect of each impulse will be to distend the pipe and send a wave along its entire length. If the pipe be of sufficient length a number of waves may be present simultaneously. By a moment's consideration it will be seen that the distension of the pipe tends to neutralise or diminish the inertia effect of the water; in other words, the capacity of the system in enlarged. This is analogous to *capacity* in an alternating electric circuit, the effect being to assist each reversal of current.

By assuming a receiving pump at the other end of the system it is possible to compare the resultant effects with those obtained in the case of an alternating circuit delivering power to a distant motor. Under such circumstances counter waves are sent out which greatly complicate the action of the circuit as a whole. Professor Eddy has carried this analogy out with some detail. In all cases, however, the comparisons show that the elasticity, inertia, and friction in a hydraulic circuit co-operate in the same manner as capacity, inductance, and resistance in an electric circuit.

These analogies do not attempt to explain the fundamental principles underlying the theory of alternating currents, and the mistake must not be made in applying these analogies to confuse cause and effect.

* Paper read at a meeting of the American Association for the Advancement of Science.

S.M.E. Medallists and their Work.

Henry S. Boorman.

THE name of the winner of the highest award in Class 7 (Tools) of the recent Model Making Competition is usually associated with the model railway track, for the major part of the construction of which Mr. H. S. Boorman, the Hon. Secretary of the sub-committee entrusted with this part of the Society's work, is responsible. Mr. Boorman is very popular with the members, and is one of the most energetic workers the

MR. HENRY S. BOORMAN.

Society has had. With regard to his lathe, which is now nearing completion, the following notes Mr. Boorman has penned will more clearly describe the various methods he employed to construct the machine, which, by the way, we hope will in turn be the means of his producing, with less exertion, a large amount of still better work in the future. He says:

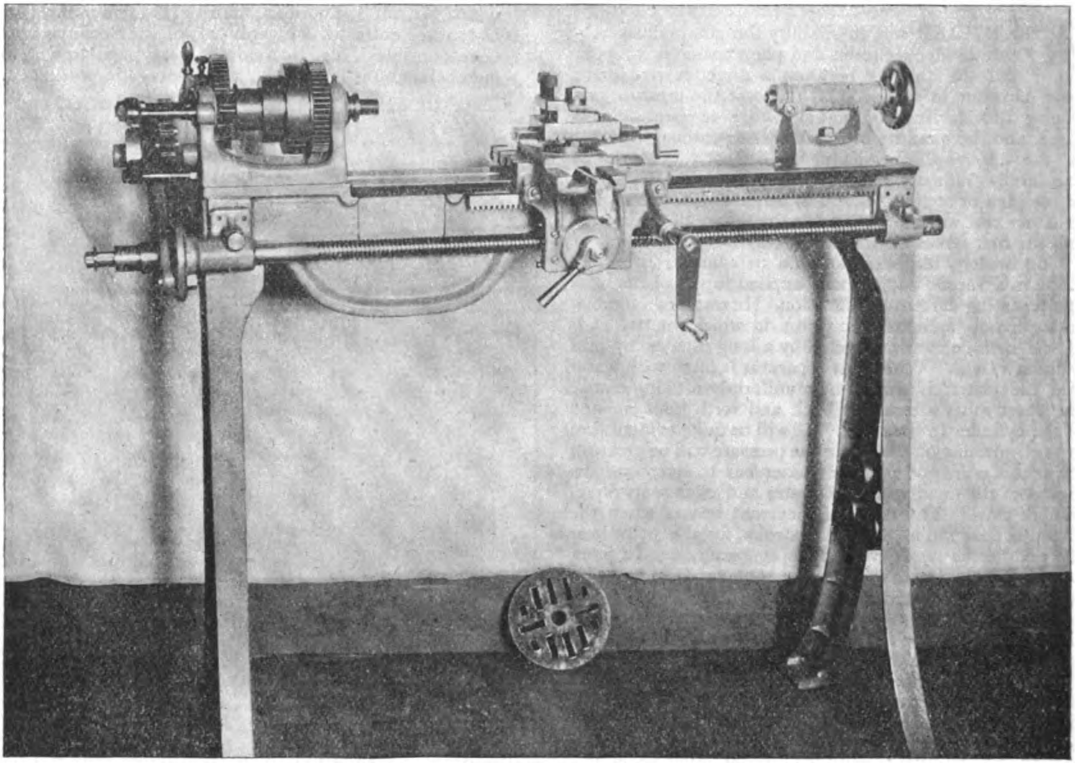
To those of a mechanical bent, the possession of a lathe is their chief ambition; and to possess one that would do a fair range of work has been mine. Perhaps I was too ambitious, for I felt that nothing less than a gap bed screw-cutting lathe, that would do a fair range of work, would suit me. My mechanical hobby—or craze, as some like to call it—started with the usual vertical engine, the catalogue description of which ended something after this style—"with beautiful oscillating cylinder, safety valve, manhole, and spirit lamp complete. Post free." I am sure this species will be recognised. This engine was soon smashed, and I passed to the Fury and Ajax locomotive stage. Considering oscillating engines inferior, I turned my attention to the slide-valve. Becoming possessed of a catalogue of model engines, I read of a certain man that bought a set of castings and who did not use a lathe at all, but had fitted them together with common files and emery cloth. My mind was instantly made up. I had no lathe, but could soon get the files and emery cloth. The castings were procured, and after buying sundry drills, &c., the engine was finished, and I got it to work by steam; but I often thought of that certain man and his emery cloth, and came to the conclusion that emery cloth was useful stuff, but no good for turning and fitting, and I set about getting a lathe. Later on I came across an old bench lathe with 2⅝-in. centres and 26-in. bed, and after fitting a Whiton chuck and a slide-rest I thought I could manage to make a larger lathe with it.

I might mention that the driver chuck described in *M.E.* January, 1900, was for this small lathe, and has been at work ever since, and still runs perfectly true. This speaks well, for it has done some very heavy work for the lathe I am about to describe. I wrote to Messrs. F. & H. Shaw, of Hebden Bridge, for tracings of lathes, and I found that I could just manage to get the parts of a 4 in. to swing in my own lathe, so I started the job. The castings were got from Messrs. Shaw by degrees, as I was ready for them in order, as follows: Headstocks, gap-bed, slide rest, and saddle castings, slide rest screws, leading screw, and standards. Messrs. Shaw also did all the planing, and bored the headstocks, as these jobs were out of the question in my top back room machine shop.

Before starting to turn or fit any of the parts, I had to file them all over to remove the scale, as I found it impossible to touch them with a tool in the lathe. I also had to get a slow-speed, and this was done by mounting a small wooden wheel on the crankshaft, next to the driving wheel.

The gear wheels of the headstock were first taken in hand, and only just cleared the lathe bed when mounted. Of course, they were too big to put in my chuck, so I fitted them on the faceplate by drilling holes in the webs, and bolting them on, as in Fig. 1. First a ½ in. hole was drilled in boss, and bored out to 1 in., the sides turned and polished, and a light cut taken over the teeth. The pinion went in the chuck all right. These wheels were a very long job, as I could only turn them very slowly; in fact, they were not really turned; it would be more correct to say scraped, as the lathe was too light to stand a cut, the metal coming away in fine, dust-like filings. The speed cone was solid. This needed a 1-in. hole bored through it, so I had to put this out to be done, as a 1-in. hole through 5 ins. of cast iron was too big a job for me. The mandrel made from a steel forging was a simple turning job, but the keyways, and the sliding cones especially, were very difficult. The gunmetal bushes were bored conical, and the outside turned to fit the headstock at one setting, to ensure the outside being truly concentric with inside, otherwise they would have been out of line when mounted. The mandrel was ground to a true fit with flour glass with bushes in position.

Next came the back gear, and this required more scheming than any other part of the lathe. I could not



Mr. Henry S. Boorman's 4 in. Screw-cutting Lathe.

fit it as it ought to be fitted, so I had to build the hollow shaft up. I first got two pieces of steel 1¼ ins. long, and drilled ¾-in. hole through each. A piece of ¾-in. steam barrel or tube was slotted at each end as Fig. 2. These slots formed keyways. The pieces of steel were turned to a driving fit into each end of the tube and brazed in, and thus I had the necessary hollow shaft with steel-wearing parts, as shown in section at Fig. 3. Mounted on a mandrel the ends were turned to fit the wheel and pinion, and fitted on with two steel keys, and shown at Fig. 4. It is thrown in and out by eccentric shaft, which needs no description. The thrust plate is supported by three turned steel pillars, and holds an adjusting screw with dead hard thrust pin, and also holds the reversing wheels, which can be altered simply by pulling up a spring pin. The loose or poppet head was a difficult job. I found I could get nothing ready made that I could use for the purpose, so I had to get a piece of 1¾ in. steel drilled at an engineer's

noted and rubbed down with fine files and emery cloth; afterwards being ground to an even fit the whole length of the bed with flour glass, and oil. The two slides were treated in the same manner. The holes for the slide-rest screws were first marked out with dividers, and a surface gauge and small holes drilled through first, afterwards having larger drills put through. These holes, which had to be perfectly accurate, were drilled by blocking up the slides on pieces of wood to the exact height and feeding up with the back centre placed in the opposite hole to the one being drilled—as in Fig. 6, which shows the saddle being drilled. The apron, which carries the lock-nut and pinion, is fixed to the saddle at A (Fig. 6); and to drill the necessary holes for the bolts, I made a long ¼-in. drill out of an old square file.

Fitting the leading screw came next. The brackets I had to bore on a friend's lathe. The sliding nut blocks and split nut were fitted to the apron, and the leading screw, with the brackets fitted on, was laid on the bracket

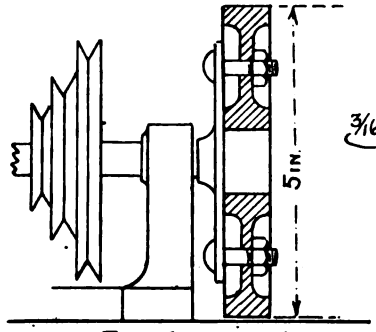


FIG. 1

FIG. 2

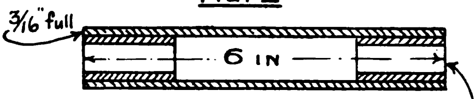


FIG. 3

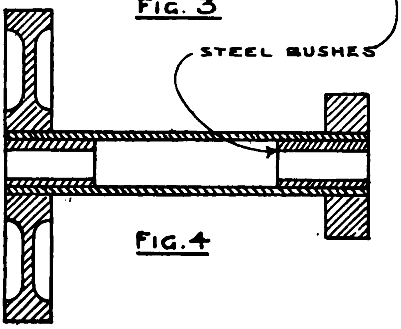


FIG. 4

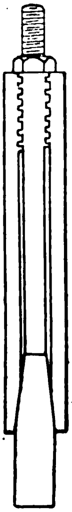


FIG. 5

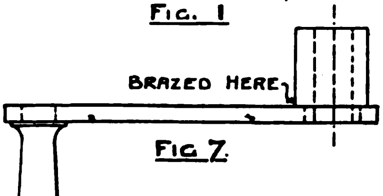


FIG 7.

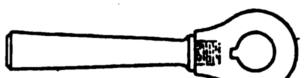
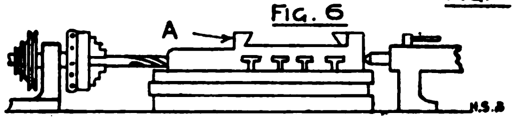


FIG. 8

FIG. 6



shop. This hole was drilled 9-16ths in. up to within 1½ ins. from the end, where it was left ⅝ in. to tap for ½ in. square thread screw. The taper end to take the centre was done by chucking the opposite end and supporting the end to be turned with a supporting stay made of ½-in. iron plate bent to an angle of 90 degrees, the upright side having 1¼-in. hole drilled and filed the same height as lathe centres; the other side with two holes for bolting to bed. A mandrel was made to fit the taper end, and mounted on this it was turned down to 1 in., and finally finished with emery cloth to exactly fit the poppet head. I should mention that before being turned, the square thread was tapped in it, so that any mark made by the vice would be turned off afterwards. I made the left-hand square thread screw on a friend's Barnes lathe, and the end of the sliding barrel was tapped with a tap, which I had to get specially made. Fig. 5 shows the barrel mounted on the mandrel and held by a nut.

The sliding saddle, after having the adjusting strip fitted, was put on the bed, and all high and tight places

facings. The saddle was placed at one end of the bed, and the nut shut on the screw. The screw was then set exactly parallel with the bed, the nut opened, and again shut on the screw at the opposite end, and after testing for parallelism with edge and face of bed, the holes were drilled and tapped for ¼ in. screws. The lever to operate the split nut and also the rack handle, being too large to make in one piece, were made up as in Figs. 7 and 8, the piece of iron to fit the pinion spindle being brazed in after being turned.

The rack is fitted in two pieces. The holes in bed, which take the screws to fasten it, I had to drill with a breast drill, and these and all other holes in bed and standards were tough jobs. The driving-wheel (not shown) I shall, of course, have to buy ready-turned and finished, and with the exception of this and the change wheels, the lathe is ready for use. The driving-shaft, as will be seen, will run on roller bearings and have outside cranks. For this purpose, and also the treadle shaft, I shall use two lengths of 1-in. steel shafting.

The Motor Bicycle: Its Design, Construction and Use.

By T. H. Hawley.

(*Continued from page 220.*)

VII.—The Motor—Boring the Cylinder, the Connecting-rod, Piston, etc.

In presenting the accompanying design of motor I make no claim for great originality, but have endeavoured to compromise matters by providing for maximum efficiency as nearly as may be in combination with minimum cost of castings and parts, and simplicity in machinery.

This little engine is thoroughly practical if well made, and gives certainly a full 1½ h.-p. on the brake, though its size is fully equal to some motors for which 1¾ b.h.-p. is claimed; the bore is 2½ ins. by 2½ ins. stroke. A close study of the general design will prove that the whole mechanism is simplified to a considerable extent, as compared with many other designs, and that the efficiency is at the same time increased; for example, the joint between the cylinder and combustion chamber has been discarded, and the two parts are, in this design, incorporated in the one casting.

The valve chamber is much on usual lines, the inlet being above the exhaust valve, and in the same vertical line; but the sparking plug is placed in the centre line of the cylinder bore on the top of the combustion chamber in the position commonly occupied by the compression release tap, the latter being shifted over to the extreme side of the top of the combustion chamber.

Other points which have been especially studied with regard to the amateur worker are that the valve dimensions correspond to the standard pattern "New Werner," a similar remark applying to the contact-breaker, so that all these parts, which are rather troublesome to construct, may be purchased ready finished, if desired.

Other points in the design to which attention may be drawn are that in all the bearings ample diameter and the greatest length of bearing consistent with outside dimensions have been secured, and the pulley side bearing in which it is so important to secure maximum length is neatly arranged by deeply recessing the pulley, and thus bringing the belt line almost over the centre of the bearing, so that there is no overhang whatever. The engine crankshaft bearings are in case-hardened steel running in phosphor-bronze bushes inserted in the aluminium crank chamber, the cross-pin of piston and also the crank-pin being also in hard steel working in hardened steel bushes, to which the pins are ground a perfect fit, these bushes being made very slightly tapering and driven tight into the eyes bored in the ends of the phosphor-bronze connecting-rod.

The guides for the exhaust valve and valve lifts are of extra length and screwed in position, thus being easily renewed. The cam operating the exhaust is in tool steel, and the distribution gears should also be cut from solid tool steel or from mild steel well and deeply case-hardened. The crank-pin and main bearings are connected up to the flywheels on a taper fitting with key-ways, and held up to position with nuts of large diameter. The flywheels are 5½ ins. diameter, and ⅞ in. thick on the rim; the crank-pin bearing is ½ in. diameter by 11-16ths in. long, the piston pin being ⅝ in. by 1⅛ ins.

Two clips are provided for attaching the motor to the frame, one being cast in the usual position on the crank chamber and the other being an arm from the cylinder, thus affording a very firm and rigid connection in any desired position.

As to settling the position of the motor on the bicycle frame, I am able only to say that, whilst I consider the Minerva position—*i.e.*, the motor underneath the lower diagonal tube, and as near the bottom bracket as possible—as being the best position for this type of motor for securing the best cooling effects in combination with low centre of gravity, I cannot advise fixing the motor in this position without at least warning makers that this position of the motor is at present the subject of proposed legislation, so that without stating an opinion as to the

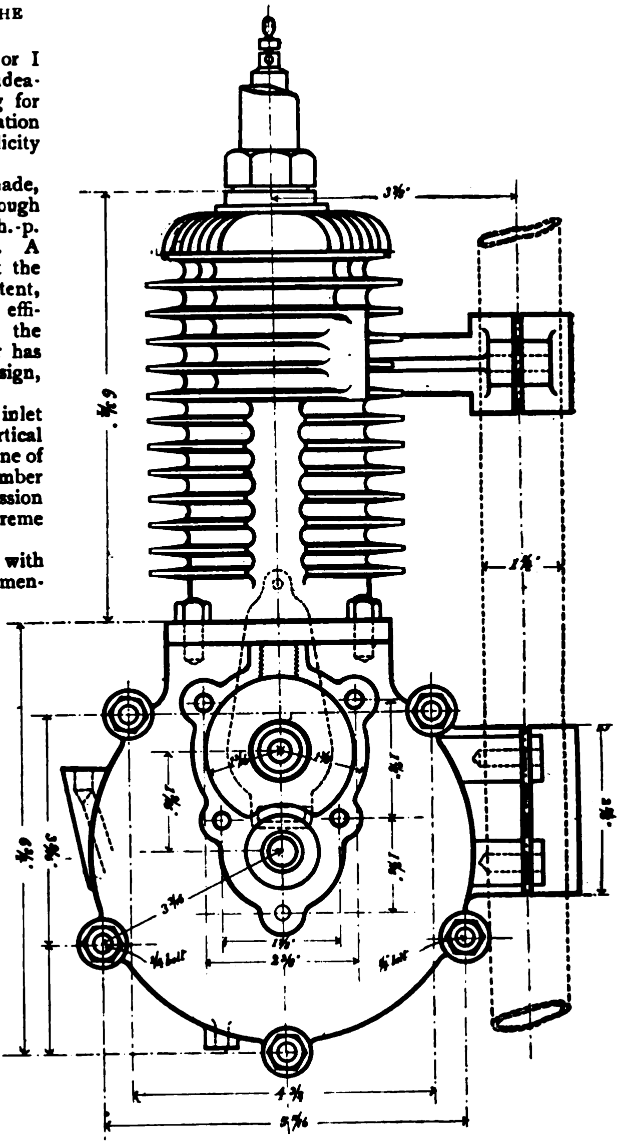


Fig. 32.—General Arrangement of Motor.

merits of the claim, I leave it to readers to use their own discretion in the matter, merely remarking that by placing the engine on the seat-post, and forward of it, I consider they will lose little in efficiency, but that in this position the motor takes up a certain amount of room which might otherwise be devoted to the petrol tank, carburettor, etc. In the accompanying drawings, the engine clips for attaching to the tubes are shown as being 1½ ins. diameter, which would be correct were the motor bolted to the bottom bone of our frame, as shown; but if it is to be attached to the seat-post, then the bore of the clips must be 1⅛ ins. only, and this fact should be noted before commencing work.

Fig. 32 shows the general arrangement of motor in elevation on the contact-breaker side, and gives many of the most important dimensions.

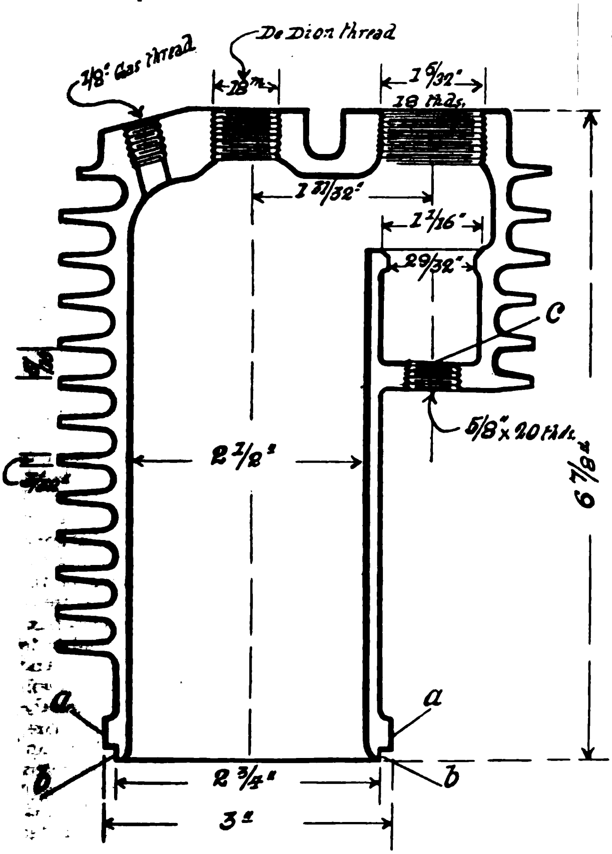


Fig. 33.—Section of Cylinder.

eccentricity would ruin the job. It may be asked why cut the wall down so very thin; but it is just because so many amateurs, working on badly designed castings, and not knowing the value of keeping the walls thin, in their endeavour to provide strength, that they find their engines fail to work by reason of over-heating.

As previously mentioned, the great point in designing the cylinder for a small air-cooled motor is to evenly distribute the metal, avoiding heavy lugs or projections, and all internal sharp corners, points which have received full attention in the present design, as it will be seen on examining the sectional view (Fig. 33) that the thickness of the wall is equal to the thickness of the radiating webs at the base, and the cylinder head is cut away as much as possible to leave the necessary strength for the screwed fittings.

It will also be noted that the corners are rounded off, and in the centre where the sparking plug projects the head is formed dome shape, for which there is a special reason, for this recess allows the sparking plug points to project further into the body of explosive mixtures, and there is a better scouring effect on exhaust with corresponding advantages in obtaining a better flow of new

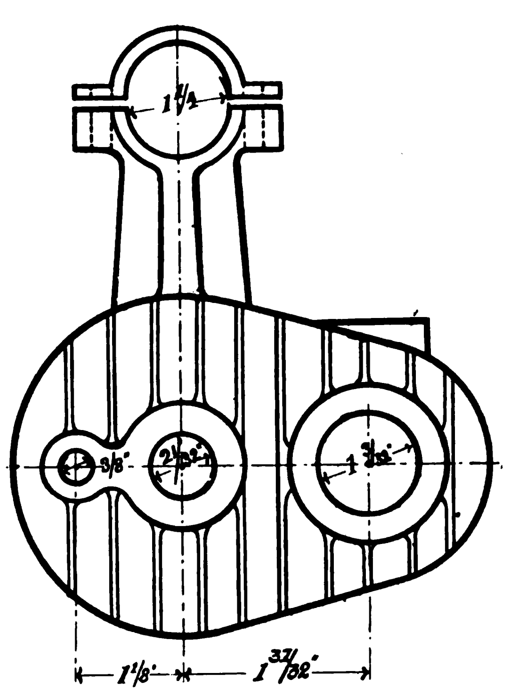


Fig. 34.—Plan of Cylinder.

The engine cylinder will naturally be the commencing point in construction, and by whatever means it is bored it forms one of the most difficult, and, at the same time, the most important job in the whole engine; for it is absolutely necessary, in the first place, that the boring tool shall travel perfectly truly through the centre of the casting so that the metal may be of equal thickness throughout, as, in order to gain efficiency in the air-cooling process, the casting has been cut down to the finest point, the cylinder wall being but 5-32nds in. thick at the base of the radiating webs, so that it is apparent that there is no room for deviation from the true path of the boring tool in any direction, and a very slight amount of

mixture round the sparking points on the suction stroke. To those who have had no previous experience of these small engines, the points referred to above may seem trifling, and hardly of the importance I have attached to them, but it must be remembered that one of the chief difficulties in running is the proper lubrication of the cylinder and piston, even when the air-cooling effect is a maximum, and any excess of metal will detrimentally affect the running of the engine, even when supplied with the best lubricants obtainable. Then again, solid masses of metal in the vicinity of the sparking points frequently have the effect of maintaining these points, or some other portion of the structure at a red heat, or sufficiently hot to explode the charge, so that premature firing occurs, though under those conditions there are other agencies at work which will frequently prevent the engine firing at all by reason of not drawing a sufficient charge of the explosive mixture. In turning up the dome and rounding off the corners on the inside of the combustion chamber I would offer a word of warning against going too deep in, as it is an easy matter to cut through or get the metal too thin at this point, and by reason of the one piece casting the position is rather awkward for examination as the works proceeds, but frequent examination and calipering must be resorted to in order to make a good job.

It will be gathered from all this that the chucking of the cylinder for boring purposes is a rather delicate matter, and demands every care, especially as we can not chuck the casting by the bore but by the outer surface, and as there is no straight regular line in the outer surface the scribing points have to work from the base of the hollows between the radiating flanges, and there are the projections caused by the valve chamber at one side and the bracket arm on another. (See Fig. 34). However, in the present set of castings this difficulty is largely overcome by the excellence of the pattern-making and the moulding of the radiating fins; these being sufficiently accurate to permit of the casting being truly chucked from outside setting; this accuracy of pattern-making being one reason why some castings cost more than others, and explaining why amateurs cannot get good results from cheap castings which merely look like the real thing. Then, of course, there is the quality of the iron to be considered, for there is a tendency on the part of the founder to use a very fluid mixture in order to bring out the fins sharp and clear, but such a mixture cannot be the best for the purpose of wear. The exact class of mixture required is one which shall be as hard as the tool can cut to ensure a good wearing surface, yet sufficiently elastic to withstand the high pressure of explosion, and the strains due to expansion and contraction.

I have no wish to frighten the young engineer from attempting the job by setting out a lot of difficulties, for as a matter of fact they are not difficulties but simply points demanding careful work, and I am doing my readers the best service in pointing out where the greatest care must be exercised to ensure a satisfactory job.

It is obvious that the exact method of boring the cylinder may be varied according to the tools available, but in most cases it will be done by strapping the casting to the lathe carriage, using a fixed boring-bar mounted between lathe centres, and running the carriage along on the self-acting gear. Another plan is to lock the carriage and use a boring-bar with a movable cutter head, working along a featherway cut in the shaft and feeding the cutter head up by a screw, this plan being available when the lathe has no self-acting gear, though but few amateurs will possess the requisite boring-bar, or care to trouble to make it; in which case, another plan may be resorted to in adopting the simple fixed cutter boring-bar, as the carriage may be fed along the lathe bed by any simple screw rig which will apply end pressure to the carriage body, though with this method of feed it would be difficult to ensure the necessary smoothness of bore in the finishing cut.

Another method, which must *not* be attempted (except with a very large and accurate lathe), is to mount the cylinder in a chuck or on the faceplate, for two things would almost certainly happen—the cylinder would be bored taper and would probably crack under the unequal stress in this manner of chucking, as there is no body of metal for mounting directly on the faceplate or chuck, and a pretty big angle-plate would be required to strap the casting to, this in turn demanding a big heavy gap lathe of 7 or 8-inch centre, whereas by the boring-bar method the job can be done on a 5-inch size.

In the best factory practice these small cylinders are bored in a special jig, immovably fixed to the carriage of a special lathe or to a vertical boring machine, the jig being nothing more than a hinged box whose inner surface is cut away to exactly correspond to the shape and number of the radiating fins on the cylinder, so that when the jig is closed by a suitable screw pressure at the opening joint, the cylinder is securely held in position with its outer walls perfectly in line and true to the lathe centres. I mention this as it will afford a clue to how to proceed in rigging up an extempore device for dealing with a single cylinder, the elementary plan being to strap the casting by two iron straps, one either end, by holding-down bolts to the lathe carriage, interposing a block of soft wood between the casting and the straps, and another between the casting and the lathe carriage, when, under the action of the holding-down bolts, the cooling webs will enter the wood far enough to secure a firm even grip, though I should have mentioned that the blocks must be hollowed out somewhat to the shape of the casting, to prevent movement sideways.

The weak point about this plan is that the operation of chucking the casting exactly true is rendered more difficult by the wood blocks being in the way of the scribing points, and moreover, it is difficult to move the casting a little at a time without slacking off the bolts, and any variation in tightening up the bolts would throw the casting out of truth by digging it further into the wood base.

To improve these conditions we may retain the same wood blocks, but permanently and securely bolt the casting to a stout iron baseplate, in which four holes are drilled in suitable positions for bolting it to the T slots in the lathe carriage, so that the whole may be bodily moved in either direction, or may be raised to the exact height by packing pieces.

This, however, does not get rid of the difficulty of exact chucking by the outer surface, and if the best possible job is to be made, we must go to some further trouble, and I would suggest the following method. First find the exact centre in the combustion head—where the spark plug goes, the centre hole (21-32nds in.) in Fig. 34—by using the scribing block around the outside of the casting or the centre boss. Next in similar manner find the centre of the inlet valve bore, which should be 1 31-32nds ins. from the other centre (a measurement we must remember to repeat exactly when dealing with the crank chamber and valve lifter later on). The first of these centre dots will enable us to truly chuck the cylinder at that end, and the other or open end may be roughly chucked by the bore, ignoring for the present the outside; or if the bore appears at all eccentric or irregular, it will be the better plan to chuck by the outer surface at *a* (Fig. 33), which should bring the casting pretty well into line. Now run a ½ in. or 9 16ths-in. twist drill through the cylinder top, first testing the accuracy of the chucking by running the carriage along until the lathe centre point is seen to strike the centre punch dot, and commencing with a small drill. We have now got a thoroughfare for the boring bar, which, for the shortest necessary portion of its length, should be turned down a sliding fit to the hole in the head, but should not be less than 1 in. diameter for the rest of its length, and preferably 1¾ ins. to 2 ins. in the head carrying the cutters. The cutters may be two, three, or four in number, four giving the steadiest cut; though, with a stiff bar, one bit of steel passing right through the bar and forming a cutter each end will suffice, as the hole in the cylinder head forms an excellent steady rest for the boring bar.

If, at this stage, sufficient confidence exists in the truth of the chucking, the actual boring may be proceeded with straight away; but, in case of doubt, I was about to suggest a light roughing or clearing up cut for a depth of about an inch or so, the cut being no more than is necessary to get a clean circle of metal; then to the mouth of the cylinder fit a turned plug of hard wood or cast iron, which has been previously centred and turned up true to this centre.

We may now remove the casting from the jig and place it between lathe centres, when the whole of the outer surfaces may be tested by scribing point held in the lathe tool post, the scriber not being moved except lengthwise of the bed, different positions between the radiating webs being secured by lifting the work out of the lathe centres.

Of course, this is a lot of extra trouble and a severe test; but it tells us the exact state of affairs and may save further trouble later on. If the cylinder passes the test satisfactorily it remains simply to replace it in its former position, which should readily be done by aid of the centres; but if it is found necessary to make a correction, it must be done by setting the centre dot in the plug over a little way with the punch, until the casting is judged to be true when between the lathe centres. The top end with bored hole cannot easily be altered, hence it is necessary to exercise care in the scribing and drilling; but if the hole be drilled true to the outside of the boss, it will occupy the proper position for boring.

Before replacing the casting in the jig, and assuming it can be "swung" in the lathe, the recess at *b*, *b* should also be turned up to a diameter of 2⅝ ins. exactly, and to a depth of ½ in. from the cylinder end, this recess forming the fitting to the crank-chamber top, and it being important that the fit be a good one.

The cutter should be ground rather keener in angle than is usual for cast iron, about midway between the shape for cast iron and steel or wrought iron. The cutters must cut on the forward face only, and not on the ends, which should act merely as steadying guides, the best shape being got by turning the ends up when in position in the bar, and afterwards giving the necessary backing or clearance with a file; the cutters must be so shaped that their cutting edges are in a straight line with the boring-bar centre, or, in other words, the whole of the cutter body must be behind the line of greatest diameter, or so that a line drawn from outer corner of one cutter to that of the cutter on the opposite diameter would intersect the centre of the bar or cylinder; as if the cutter edge is forward of this line, it will be necessary to give its end so much backing off to get clearance that the guiding action is lost, and the bar will spring and "chatter," a condition not permissible in this class of work. If a one-piece cutter is used, it will be obvious that two or three different sizes will be required to complete the work from roughing to finishing cut, so if the bar prove stiff enough and the casting free from hard patches, the job may be easier and more quickly done with a single point cutter, which can be set out bit by bit, reserving the double-ended cutter for the finishing cut, which should be a rather light one at very slow feed, but with the lathe running moderately fast.

This finishing cutter should be made as described, and should measure about ¼ in. thick on the cutting face by ¼ in. deep, so that ample guiding surface is provided. A special cutter will have to be made to get the dome-shaped end, but this need not be more than a mere scraper; in fact, the shaped end of an old flat file would answer if ground like a drill. The open end of the cylinder requires "bell mouthing" to a slightly greater extent than is shown in the drawing, in order to permit of easy insertion of the piston rings. The bell mouth should extend about ½ in. into the cylinder, and may be done with a broad scraping cutter in the boring-bar.

The next operation on the cylinder will be the boring of the valve chamber, which, it must be remembered, must be perfectly parallel to the cylinder bore, which is easily accomplished without disturbing the casting in the jig, provided the cylinder has been chucked horizontally, as shown in the drawing, with the centre found the same distance from the lathe bed as the other centre—a point I omitted to mention in describing the method of chucking.

Now notice if the drill runs perfectly true, and if so it will be long enough to reach right through the lower end of the chamber and bore the guide hole (C), care being taken in this drilling that the whole casting is not

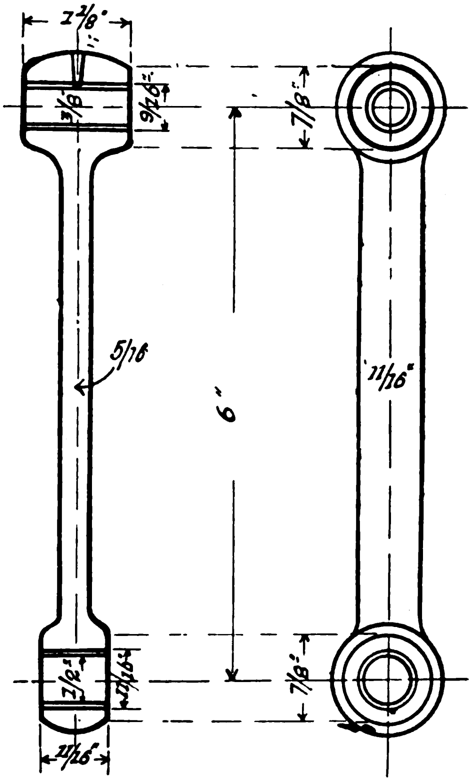


FIG. 35.—CONNECTING-ROD.

shifted, feeding up to the cut with the back centre, and at the same time easing the saddle forward by the lever handle.

The ½-in. hole being produced in the proper position, it remains only to turn down one end of the boring-bar to ½ in. and proceed as before until the requisite diameter for the inlet is reached; then a screwing tool must replace the cutter for making the thread; but unless you are making your own valve as well, it will be necessary to have the purchased valve at hand, as the measurements given in English inches are not exact for French Werner valves. Of course, if no screw-cutting lathe is at hand, a tap will have to be made or borrowed.

The smaller holes may be tapped to the sizes shown, and the exact pitch is unimportant except in the case of the sparking plug hole, for which a De Dion tap may be procured from dealers in Continental motor sundries, and this thread must not be deviated from, as all sparking plugs are made to this standard. I have not the exact pitch and dimensions at hand, but know it is an odd decimal size which could not well be cut on an English lathe with ordinary change wheels.

Of course, a facing cut will have been taken over both bosses on the cylinder top, and also on the lower end of the cylinder, together with the under surface of the valve guide box, so that all joints and connections may sit perfectly tight and square—a most important consideration in each case named.

Practically the only remaining job is lapping out the cylinder to a dead, smooth surface, and this should be done before the plug thread is made, as we again require the hole to act as a guide for the lap. The best method of forming this lap is, procure a length of 1-in. square iron or steel, turn down about 4 ins. or 5 ins. at one end—a good sliding fit to the guide hole. Then cast a block of lead on the bar, say, 4 ins. in length by 2¼ ins. diameter, the bar being straight, with holes drilled for lathe centres, and cast as nearly as possible in the centre of the lead cylinder; then turn up the lead on its own bar until it is a distinctly easy fit in the cylinder bore. The lap is loaded with emery and oil, varying the grade to finer emery as the work proceeds, running the lap at the highest speed of the lathe, and holding the cylinder in the hands, supporting the weight, and occasionally rotating it to prevent it forming an oval, but all the time keeping it moving up and down the lap to prevent formation of rings, the cylinder being removed frequently for a wipe out and inspection; but the grinding *should* be continued until a smooth polished surface free from tool marks is produced, as anything approaching roughness will absorb a lot of the little engine's power in friction, and render lubrication more difficult, ordinary steam engine cylinder finish being useless. This I think completes the cylinder, except that I forgot to mention turning the valve seating for the exhaust, which requires a cutter in the boring-bar, having cutting faces at an angle of ninety degrees to each other. I have rather exhausted my space on this portion of the work, but engine efficiency is so much dependent on the way it is carried out, and on the points raised, that to suit all—especially the junior mechanics—I could not well condense the subject further, especially as we have all no doubt encountered some good work spoilt through want of forethought or the absence of explanation of what to many may appear a very simple little matter.

The next group of work will be the piston and its connecting-rod, work which presents no especial difficulty and requires no special jigs or tools beyond a good lathe; but there is ample scope for good and careful workmanship. We may take the connecting-rod first. This is in phosphor bronze, and the drawing (Fig. 35) almost explains itself, all necessary dimensions being clearly marked, and although the drawing provides for hard tool steel bushes for bearings, the engine will not greatly suffer, except in durability, if these are omitted, and they could be added at some future time when the bearing needed re-bushing; still, in a first-class engine they should be there at the start.

The great point in boring these connecting rod eyes is to ensure them being exactly parallel to each other, and free from any warping or twisting tendency, and, of course, the size of the hole must be exact as well as the distance apart. If a good drilling machine is at hand, this is quite the best method of assuring alignment, for the connecting rod may be bolted down to a true packing block of hard wood, with a strip of iron packing at the lower end to bring up the level, and the two holes may be roughed out to near the finished size by drilling—simply moving the block from one position to the other on the drill table, and then substituting a reamer of the finished size for the drill. All the care necessary is in setting out the work and mounting it. To this end set out the centres in the ordinary way; then pack up the rod lying on its flat side as near as may be to level, and with the scriber block resting on the drill table, draw a line along the centre of the rod edge; then reverse the rod by turning it over, and scribe again. If the two lines coincide the mounting is true, or if the lines are parallel, it is true, and the boring may proceed. If no bushes are to be fitted the ordinary standard ½ in. and ⅝-in. reamers are used; but if steel bushes are to be fitted, the finished size of the holes will be 9-16ths in. and 11-16ths in. respectively. The end faces of the bearing might be dealt with also in the drill by using a cutter in a small stiff boring-bar; but in these operations, and in strap-

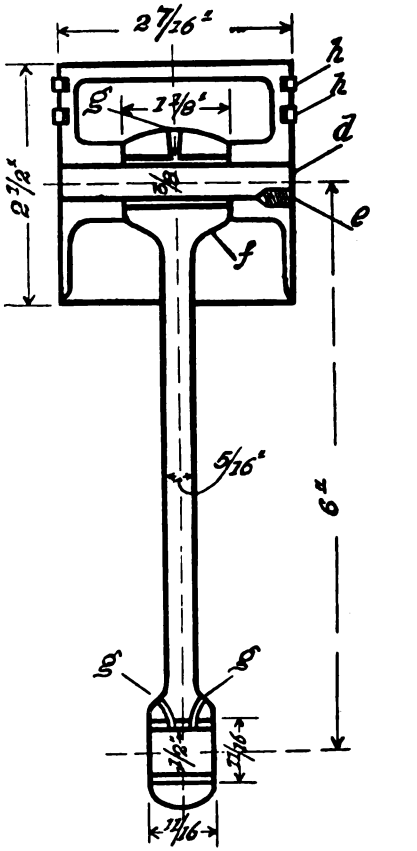


FIG. 36.—PISTON AND CONNECTING-ROD COMPLETE.

ping down the rod, care must be taken that it is not bent, as the clearance between the connecting-rod and flywheels is so small that any deviation from the straight line or any of the measurements, would cause the rod to foul, and this must be remembered also in connection with setting out and machining the rod end faces, scribing lines made by the reversing process being produced exactly where the cut should terminate.

The piston is a simple, straight-away piece of work until we come to boring the hole for the cross-pin, and cutting the grooves for the piston-rings. It will be noticed in the drawing (Fig. 36), which shows the assembled piston rings and connecting-rod, that the piston body is

1-16th in. less than the cylinder bore, and this is essential, or, at any rate, it should be 1-32nd in. less, otherwise there is a chance of its seizing; but where two rings only are used, some makers prefer to run the sizes somewhat nearer, and to turn the lower end of the piston almost a fit to the cylinder to act as a guide.

At the same chucking as the finishing cut on the piston, with a pointed tool, a well-defined V groove should be turned at the point where the cross-pin is to be fitted, and if the lathe is fitted with division plate the opposite diameters may be scribed off, and from these points the holes for the cross-pin are drilled, leaving enough for a finishing cut with a long reamer to be passed right through.

The grooves for piston rings are 5-32nds in. wide and ⅛ in. deep; the great point here being to ensure the groove being the same width throughout and finished perfectly smooth. The distance from top of piston to cross-pin centre must be adhered to, or the compression space will be interfered with.

Referring to Fig. 36, *d* is the cross pin bore; *e* a set screw to hold the cross pin in position; *f* is a point where another set screw must be fitted if hard bushes are fitted to prevent the bush rotating; *g*, *g*, *g* are oil channels drilled in the connecting-rod ends.

The piston rings are turned from close grained, slightly springy cast-iron, but the description turning, fitting, and finishing of these I must leave for the next contribution.

(*To be continued.*)

NOTE.—*Arrangements are being made for the supply of full sets of these castings, with full-size working drawing, for which see advt. in next issue.*

Turning a Thin Brass Disc.

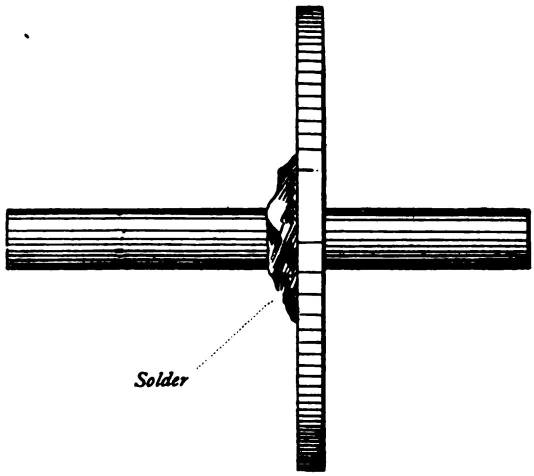
A CORRESPONDENT sends to *Modern Machinery* the following amusing but instructive account of how an awkward piece of turning was successfully accomplished by a cute apprentice. He writes:—

"I saw Joe do a rather neat little trick the other day. It didn't amount to much, only in the knowing how to do it, which is pretty much all there is of anything that a fellow tries to do. Joe is Jobson's best apprentice, sure. Been with him nearly four years, and gets just as good work as the journeymen get. At the time I speak of Jobson brought a flat sheet brass disc, 3-16ths in. thick, into the shop, and gave it to Joe with instructions to bore a ⅜ in. hole through it, turn it 4½ ins. diameter, and face it up true on each side. It don't take more than half-a-minute to say this; but the burning question is how are you going to do it? Everybody liked Joe; but he had such an independent way of getting around uncomfortable little puzzling jobs, that Jobson kept him pretty well supplied with them, and the entire shop force was waiting with considerable anxiety to see him get stuck.

"Joe got the kinks out of the piece, and he got a hole through it.

"'Anyone could do that,' slippers said; 'but how in thunder is he going to hold it on a mandrel for turning and facing? That's what will stick Joe, sure as you live.'

"It rather looked that way. Everyone—that was only fifteen altogether—smiled at Joe's coming discomfiture; everyone but Joe, and he knew what the smiling was about. Well, sir, the job didn't trouble him a bit. He turned up an iron mandrel just a little—not much—tapering, bored a hole a little larger than the mandrel through an old flat plate of cast iron that he found in the scrap pile, and laying the disc on this, drove the mandrel through it, quite lightly, of course, because it would not stand much driving, which was where we all thought Joe would meet failure. Then Joe put the mandrel on the centres, rapped the disc lightly with a wooden mallet till it 'run true,'' and, taking it to the shop tinker, caught the mandrel in his vice, and asked him to solder the disc to the mandrel. This he did, under Joe's instruc-



TURNING A THIN BRASS DISC.

tions, piling up the solder on one side till it looked like the sketch above. Then he took it back to the lathe, turned to diameter, and faced up the side opposite the solder with a sharp tool and light cuts. Then he faced the other side down to the solder and nearly through it, turned the hump of solder up, and cut away the little corner of brass left. When he was all through that less than 3-16ths in. surface was soldered so tightly that it seemed advisable to melt the solder by applying a hot soldering iron before driving the mandrel out.

"It wasn't much of an undertaking, as undertakings go, to do that disc; but it would have puzzled many an older head than Joe's to have got as good a job out of it as he did. The truth is, Joe reads technical journals more than the rest of us do, and I suspect that some time he has read something that gave him the idea of soldering that little disc to the shaft.

RAPID METAL CUTTING.—Examples of rapid cutting are now becoming common with the advent of the new tool steels. Two recent examples are supplied by the Bethlehem Steel Company, in which their Taylor-White steel tools were employed. In one instance, a cut 1 3-16ths ins. deep, was taken on a nickel-steel shaft, mounted on a 90 in. lathe, and revolving for a cutting speed of 25 ft. per minute, the rate of feed being 3-16ths in. per revolution. In the other, a nickel-steel crank shaft was machined in a 50 in. slotter by a cut 1⅛ ins. deep, and a feed of 1-16th in. per stroke, the cutting speed being 18 feet per minute. The former case corresponds to a removal of 66·78 cubic ins. of metal per minute, or 2·318 cubic feet per hour. The great capacity of such rapid cutting can be better appreciated when it is considered that the rate mentioned corresponds to the removal of 1,134·9 lbs. of steel per hour, or of 5·67 tons per day of ten hours' steady cutting.—*Mechanical Engineer.*

The Editor's Page.

It will be remembered that a short time ago we inserted some particulars of an English model yacht, which had found its way across the Channel, and was awaiting an owner to claim it. Our paragraph has been the means of clearing the matter up, as the following letter from the owner, Mr. F. Dicken, of Dover, will show. He writes :—"The model was mine. She got away from here on the 4th of August. I have made enquiries, and find that I should have to pay 60 francs, 10 francs being for salvage, and 50 francs for coast dues. They valued her at £30. That was too much for me to pay, so I have let her go. I built her in my spare time on the lines of the design by Mr. Paxton in your issue for January, 1900, with some alterations of my own, to make her class as a five-rater instead of a ten-rater. She is very fast in calm water." While we sympathise with Mr. Dicken in the loss, we trust he will find some consolation in the compliment paid him by the French authorities in their exceptional valuation of his work at £30.

* * *

We should like to take this opportunity of directing attention to the very healthy progress being made by the Society of Model Engineers. The convenience of being able to meet fellow model-makers to discuss matters of mutual interest, to get help in points of difficulty, and to inspect materials, tools, and finished work, is of the greatest possible value to every amateur, and is keenly appreciated by those who have already experienced the advantages of membership. Not the least commendable feature of the Society is that beginners are made just as welcome as those who are more advanced in their work, and, indeed, it is probably the beginners who derive the most tangible benefits from contact with their fellow-members. Those who contemplate joining either the London Society or any of the Provincial Branches, should do so while the season is still young.

* * *

"J. H. C." (Tinsley) writes: "I have followed with a great deal of interest the letters on Steam *v* Electric Locomotives, but think that the advocates of the latter system have very much overrated their case. In the first place, I very much doubt whether a *model* electric loco has yet been built; at all events, it has not yet been described. To many of your readers this statement may seem a trifle absurd, but I maintain that a perfect model should be an absolute copy of the original, made to some definite scale. Now, some of the steam locos which have been described in your paper approach very nearly to perfection, except that they do not contain the proper number of bolts, rivets, and tubes; the vacuum brake gear is also usually omitted; further, they will often work at one third to one-half of the pressure carried by the original locomotives. Can any electric loco at present compare with the steam loco in these respects? Why the best is simply a painted box mounted on wheels, with the motor slung—no, they are not slung, but ought to be—anywhere, and I have not yet heard of one of these machines that will pick up current at one-third to one-half of the usual pressure, say 175 to 250 volts. Look at the matter another way, take a steam loco such as has been described lately, increase each and every part, eight, twelve, or sixteen times, according to the scale; now do the same with the electric loco. Which machine when built will most nearly equal its original in appearance and performance? I think that a *model* electric loco, with its ironclad motor, single gear reduction, its complicated controller and connections, is a far more fascinating task than constructing a model steam loco; but please don't compare one with the other until they are both on the same footing. Why, at present, the former is only to be compared with the copper-boilered oscillating cylindered engine (not model) of our younger days. They both resemble the original in the fact that the wheels will go round—sometimes; but I cannot see any further likeness."

New Prize Competitions.

Competition No. 26.—A Prize of £2 2s. is offered for the best article entitled "The Amateur Electrician—What Should He Make?" This should be written on the assumption that the reader is about to take up electrical work for the first time, and is desirous of having a progressive course in electrical apparatus and model-making mapped out for him. The work suggested should be progressive, both in point of knowledge and tools and materials required, and the subsequent uses of the various pieces of apparatus for experimenting or testing should be borne in mind. The closing date for this Competition is December 15th, 1902.

Competition No. 27.—A Prize of £2 2s. is offered for the best article on "My Experiences in Model Locomotive Building." This should describe briefly the various model locomotives built by the competitor, and should deal as fully with his difficulties and failures and their causes, as with his successes. If possible, it should be illustrated by photographs or dimensioned drawings, showing the principal features of each engine described. The article should deal with steam models only. The closing date for this Competition is December 15th, 1902.

Competition No. 28.—A Prize of £2 2s. is offered for the best article on "Workshop Fitments." This should describe useful home-made workshop fittings, such as shelves, tool-racks, nests of drawers, and other devices for the convenient arranging or storing of tools, parts, and materials. It should be illustrated, if possible, by photographs or dimensioned drawings of the various fittings described. The closing date for this Competition is December 15th, 1902.

Competition No. 29.—A Prize of £2 2s. is offered for the best article on "Screws and Screwing Tackle for Model Engineers." This should describe the characteristics of the threads in general use for small work, such as the Whitworth thread, the B.A. thread, pipe threads, &c., and should point out the advantages or disadvantages of each from the model-maker's point of view. Suggestions should be made as to the best class of thread to be used for various purposes, and hints on the most suitable screwing tackle—home-made or otherwise—should be given. The closing date for this Competition is January 1st, 1903.

Competition No. 30.—A Prize of £2 2s. is offered for the best article on "SOME TOOLS I HAVE MADE." This should deal with the various bench or lathe tools the competitor has made either for general or special use, and should describe clearly how each tool was made. Dimensioned sketches of each should be given The closing date for this Competition is January 1st, 1903.

Competition No. 31.—A Prize of £2 2s. is offered for the best article on "EXPERIMENTS WITH INDUCTION COILS." This should be written on the assumption that the reader possesses an induction coil of moderate power, and desires to know to what uses it can be put. Sketches or diagrams should be given where necessary. The closing date for this Competition in January 15th, 1903.

Competition No. 32.—A Prize of £2 2s. is offered for the best design for "A MODEL STEAM TURBINE." In setting this subject we realise that we are setting a problem of some difficulty, but we believe many of our readers are equal to getting out a design for a workable model. The model should be reasonably simple in construction, and should be capable of being turned to some useful purpose, such as propelling a model steamer or driving a small dynamo. Full working drawings, with dimensions, should be given, and a written description sufficient to clearly explain same should accompany each design. The closing date for this Competition is January 15th, 1903.

For the general conditions governing the above Competitions please see our last issue (page 236).

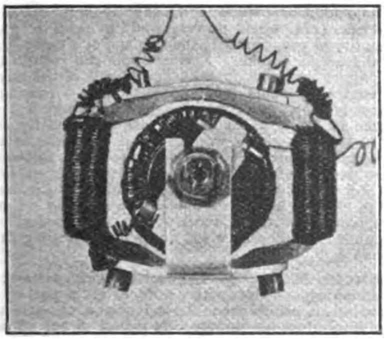
Practical Letters from Our Readers.

[*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.*]

Electro-motor Weighing only One Ounce.

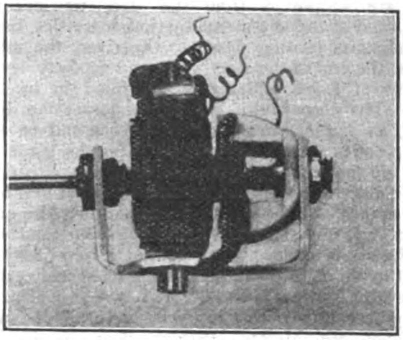
TO THE EDITOR OF *The Model Engineer*.

SIR,—Seeing your splendid invitation to amateurs, who have constructed models under your invaluable advice, in



END VIEW OF MOTOR.

a recent issue of your paper, to send photos of these models, I sincerely hope I may be privileged to contribute. I therefore enclose two photo prints (reproduced herewith) of the model electric motor weighing 1 oz., which I have made with great success under your directions. The photos are exactly full size. The only modification of your original ideas is that I have constructed the brush-holder of ivory, as seen in the photos, which revolves about the shaft. By loosening the nut seen at the end of the shaft on the commutator side, I can thus alter the diameter of commutation at will, and so secure maximum



SIDE VIEW OF MOTOR.

efficiency by experiment. The motor for its size is exceedingly powerful, and drives a 3-in. fan with great speed. The armature core is built up of soft fine iron wire.—Yours truly, A. F. C. POLLARD.

London, W.

Running Small Gas Engines.

TO THE EDITOR OF *The Model Engineer*.

SIR,—I think Mr. Jackson's article, in the issue for October 15th, will prove very useful to owners of small gas engines; but he seems to have overlooked one very important point—the provision of a cock to drain the water from the cylinder jacket, for, if this is allowed to freeze, the cylinder will be ruined. This is accomplished by fitting a stop-cock on the "flow" pipe near the tank, and the drain cock between that and the cylinder. A stop-cock will also have to be fitted on the return pipe if a ball tap is used, which, in a small engine, is not really necessary, as a bucketful of water occasionally will keep the level right.—Yours truly, A. H. S.

Bury.

The Institution of Junior Engineers.

BY permission of the Bridge House Estates Committee the Members of this Institution recently paid a visit to the London Bridge Widening Works, and had the opportunity of witnessing the erection of the last girder of the temporary footbridge. The Resident Engineer, Mr. W. B. Cole, Asso.M.Inst.C.E., assisted by Mr. Lynton and Mr. Hugh Cruttwell, showed the party over.

The works are being carried out with the object of widening the footways of London Bridge from the present width of 9 ft. 6 ins. to a width of 14 ft. Advantage will be taken of the opportunity of increasing the width of the roadway also from 34 ft. 6 ins. to 37 ft. giving an additional 2 ft. 6 ins. The existing width between parapets is 53 ft. 6 ins., the new width will become 65 ft. The extra width will be carried on granite corbels or cantilevers projecting from the outer spandrel walls of London Bridge, the bed for these corbels being that of the existing dentil course. It is intended to place refuges at intervals over the Bridge, and to light the bridge from standard lights fixed on these refuges. In order to carry out the work it is necessary for the footways to be closed. For the convenience of foot-passengers temporary foot-bridges are under course of construction, on both the East and West sides of London Bridges. Each foot-bridge consists of five spans of steel work, one span 157 ft. 7 ins. and four spans 145 ft. 5 ins., which are supported from the piers by steel work trestles, and at the abutments by timber trestles built up from the stairs leading down to the river, the intervals between the end of the steel work and footway levels at the ends of London Bridge being filled in by timber work. The clear width of the temporary foot-bridges is about 11 ft 2 in., and the length from end to end is about 1,006 ft. On the top booms of the girders and on the top timbers of the timber work a crane road is laid and two electric cranes are mounted on each foot-bridge. These cranes will be used for dismantling the existing parapet, &c., and setting new stones. The total weight of steel work is about 750 tons and the new granite will amount to about 50,000 cubic feet. The architect for the work is Mr. Andrew Murray, F.R.I.B.A., City Surveyor, the engineer is Mr. E. Cruttwell, M.Inst.C.E., and the contractors are Messrs. Pethick Bros., of Plymouth, with the Patent Shaft and Axletree Company as sub-contractors for the steel work.

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, *37 & 38, Temple House, Tallis Street, London, E.C.]*

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

[7266] **Conversion of Small Gas Engine.** J. A. B. (Irthlingboro') writes: I have bought a set of the model gas-engine castings, 1 in. bore, 1½ in. stroke, as advertised in THE MODEL ENGINEER. If you kindly refer to the last paragraph of the enclosed directions, which were given with them, you will notice it says "an explosion will occur at every revolution," that is, the gas and air are drawn in at every forward stroke of the piston, and when the piston uncovers the hole T, Fig. 1, the flame of the burner is drawn in and an explosion occurs. There being no compression, and the explosion taking place at the half stroke, I am doubtful if any useful power can be obtained from this engine I should like to alter the engine so as to compress the gas and fire at every other stroke. I can manage the inlet and exhaust valves, but not the ignition valve. I do not wish to use an electric spark. Will you please tell me how to make the ignition valve and tube to fix on the cylinder cover, and work it by a cam on the side shaft (which will revolve once to two turns of the crankshaft), as shown on the enclosed sketch (not reproduced)? I am aware the flywheels are too light to give compression, but I thought of overcoming the difficulty as follows: To put a 1½-in V-groove pulley on the crankshaft, and with a gut-band drive a 2¼-in. pulley mounted on a spindle, and from another 2-in. pulley, mounted on the same spindle, run a gut-band on to a sewing machine wheel, which weighs 13 lbs., and runs very freely. If I were to pull the sewing machine wheel round by hand to start the engine, would there be sufficient force to compress the gas, and would the engine keep running? That is a splendid article on carburettors in the present number of THE MODEL ENGINEER, but, unfortunately, it does not give any sizes. Please inform me what size Fig. 1 should be, also the size of the tin canister, and what size tube was used to supply the ¼-h.-p. gas engine mentioned. Also please explain why a gas-bag is used on a gas engine.

Your remarks about the small gas engine are very true; that type of engine is purely a model, and develops very little useful power, although we believe it runs at a high speed. With regard to fitting an ignition tube at back end, you will know that the valves will have to be driven from a cam shaft with a one to two motion, and the gear wheels will necessarily have to be changed from their present sizes. If it is possible to get through by drilling into the combustion chamber, we might then possibly devise some arrangement by which the engine could work on the other principle, but some ingenuity must be brought into play when such a radical alteration is to be made as in your case. We should need detailed scale drawings to work upon, then perhaps we might be able to design some suitable ignition arrangement. We should also need some idea of the shape of combustion chamber (inside), as that has a great deal to do with the satisfactory working of any gas engine. No firing valve (timing valve) would be necessary if compression were introduced, as the quality of the mixture and general adjustment of valves is all that is necessary to ensure firing at the right moment. Another point to be considered is—would the cylinder stand the strain brought about by an increase of pressure, and would the rings radiate the heat generated fast enough? Your method of increasing the momentum of flywheels would absorb most of the power generated, and we do not think it at all advisable to adopt it. Besides, any variation in the speed of the crankshaft would not be governed unless the gut-band was exceedingly tight, and so we come again to our first supposition, viz., that most of the power generated would be uselessly spent. The compression on a small engine like this will be a very few pounds, and it may be started by giving one or two sharp turns to the flywheel. Should you find it difficult to start, and the engine inclined to fire back, then introduce a relief cam, to keep the exhaust valve open until the crank is on the bottom centre of compression stroke. Gas-bags are used to prevent, as far as possible, the fluctuation of pressure in the supply pipes, supplying, not only the engine itself, but also the lights in its immediate neighbourhood. In small engines the effect is by no means so noticeable as with large ones; but, were even a small engine at work without a gas-bag, the fact would be very apparent in the lights "bobbing," although they might be some distance away from where the engine was at work. This is why it is always advisable to supply an engine with a meter and supply pipe exclusively for its own use, and to tap a separate supply—the ordinary house or workshop lighting supply—for the Bunsen burner, which heats the ignition tube. With regard to query *re* carburettor, we are enabled, through the courtesy of Mr. C. N. Turner, to give further particulars of his apparatus, described in the October 1st issue:—"I am in receipt of yours, and have much pleasure in responding to your request *re* my carburettor for running small gas engines with petrol, as described and illustrated in October 1st issue. The reservoir is a Huntley & Palmer's biscuit tin, measuring 12 ins. by 12½ ins. by 4½ ins., and the carburettor is a 1 lb. coffee canister, 3½ ins. diameter, and lengthened to 11 ins., and with bottom taken out, and some small V-notches cut out of the bottom edge, to allow the petrol to pass from the reservoir. This reservoir holds abouts 1½ gallons, and will run a ¼ b h.-p. gas engine all day without consuming all of the petrol. Pratt's motor spirit acts equally well, and benzoline may be used in absence of petrol or motor spirit, but without quite such good results. For a ½ b.h.-p. engine, it would be better to have a larger canister for the carburettor to hold additional wicks, and a slightly larger diameter of the perforated tube (1 in. would do very well), in order to vapourise a larger quantity of gas, to satisfy the demand of a larger gas engine cylinder and longer stroke. The reservoir can remain the same, but may require replenishing towards the end of the day. For a ¾ b.h.-p. engine, it would be desirable to have a rectangular carburettor instead of a round canister, so as to carry a longer perforated tube air inlet, to further increase the quantity of vapourisations. A larger reservoir would, in this case, also be an advantage, so as not to need replenishing. I used ⅜ in. full way taps for air inlet to perforated tube, and ¼ in. outlet tap on lid of carburettor. For ½ and ¾ b.h.-p., use ¾ in. inlet and ½ in. outlet taps. I omitted to mention in my previous article that the lid of the carburettor should have a flat indiarubber band sprung round the point to confine the vapour when not in use. Hoping this will be explicit enough."

[7087] **Electro Motor.** G. L. (East Dulwich) writes): An electro motor, working at 6 volts with 3 cells, exerts a pull of, say, 1 lb. at 1000 revolutions per minute. It is required to exert the same pull at 120 revolutions per minute. Is it best to cut off one or two of the cells or to introduce a resistance into the 3-cell circuit? In a model railway, of which the motive power is electricity, would it be possible to run two trains at the same time if the resistances of the motors were made equal? The current is taken from the rails.

We do not clearly grasp your meaning. A motor running at 1000 revs. exerts a pull of 1 lb.—where? Are you referring to a brake test? It would not be possible to run such a motor at 120 revs. per minute and get any appreciable power out of it. By inserting a resistance in the circuit, you would only reduce the power, and cutting out one or two cells would have the same effect Yes.

[6636] **Boiler Query.** F. H. (King's Cross) writes: I have a boiler (horizontal), 10 ins. long, 5½ ins. diameter, internal firebox 6½ ins. long, 3 ins. diameter, two cross (water) tubes, and one horizontal tube in end of firebox, and steam pipe 1-16th in. bore in chimney. I am also making a horizontal engine, 1½ in. bore, 3-in. stroke, will you kindly state (1) Whether boiler would supply enough steam for engine? (2) If not, what size cylinder would be most suitable? (3) Is steam pipe in chimney the right bore? I have tested boiler to 50 lbs. pressure, and would like to work engine at 30 lbs. pressure, the fuel being charcoal. Any improvement you could inform me of would greatly oblige.

The boiler has about 60 sq. ins. of heating surface (effective), and if properly fired would work a cylinder about ¾ by 1½ at a moderate pressure and speed. A 1½ in. by 3-in. cylinder, worked even at 10 lbs. per sq. in. pressure and a speed of 100 revs. per minute, would require a boiler with over 100 sq. ins. of heating surface. See p. 22 of issue of January 1st, 1902.

[7087] **Model Railway Curves.** G. L. (East Dulwich) writes: What is the smallest curve that can be taken by 7 in. wheelbase, 6 in. wheelbase, on a 2½ in. gauge at 2 miles per hour, or 6 miles per hour?

Your query does not suggest that you understand that there are more factors in the cases you submit than are given; it is solely a matter of experiment to find what is the smallest curve around which a vehicle (with a rigid wheelbase or otherwise) will pass safely at given speeds. Although the difference between the two wheelbases given would certainly make a difference, that difference cannot be pre-determined. To enable a long rigid wheelbase to pass around a small curve a certain amount of play must be allowed, and this is provided for by increasing the gauge of the railway at the curves. We have found that a vehicle with 4 inches of rigid wheelbase (the total being 8¾ ins.) will travel safely round a curve of 2 ft. 2 ins. radius at a speed of about 2½ miles an hour. The super-elevation of the outer rail was about 3-16ths of an inch, gauge 2½ ins., and total side play between the flanges of the rail about ⅛ in. To enable the carriage, with 6 or 7 in. wheelbase, to run 6 miles per hour we should think that the smallest available curve would be 6 ft. or 7 ft. radius, the super-elevation being about ¼ of an inch, and the gauge at the curve laid 2 9-16ths of an inch. To run the same vehicle safely at a speed of 2 miles an hour we should advise a curve of not less than 3 ft. radius, with the 3-16ths super-elevation, and the gauge of 2⅝ ins. You will understand that there is a considerable increase in the rolling friction of any vehicle (more so when it is long and rigid) on a sharp curve, and therefore the locomotive is taxed rather heavily at such points. Model railway builders should always endeavour to obtain curves of the greatest radius possible and not try to cut them down to an irreducible minimum.

[7059] **Model Boiler Queries.** F. G. B. (Cheadle) writes: Will you kindly let me know as soon as possible what pressure a vertical 7½ by 8-in. boiler will stand? It is made from enclosed specimen of copper plate (1-16th in. thick) single riveted, as sample herewith. Seven tubes 1 in. diam., expanded and soldered at each end, no water round firebox, well sweated throughout.

The boiler would appear to be all right for a working pressure of 40 lbs. per square inch. The factor of safety adopted in calculating is about six if you wish to work at a higher pressure you must take it upon yourself to use a smaller factor.

[7409] **Books to Read.** A. H. S. (Cardiff) writes: I have noticed a few lines in THE MODEL ENGINEER, Series No. 6, referring to the making of small accumulators and how they are used. I have bought that book and found it very satisfactory. But this being the first time to study electricity, it was not quite the right thing for me. I have served three years out of five years' apprenticeship to the marine engineering, and the majority of the people think that electricity is going to hold the upper hand of steam engineering, I am desirous of learning from books the electrical engineering. I, therefore, ask you to kindly consider my case, and oblige by referring to books on the introduction of electricity, which I hope to favour you by purchasing same. I am still studying Series No. I, and have greatly benefited myself by reading No. 6, and during my progress I hope to have all the series, trusting you will help me in my further progress.

Your best course is to get hold of some elementary text-book on electricity and magnetism, such as S. P. Thompson's, and master that first of all; then you should read a few books such as Perren Maycock's "Electric Lighting and Power Distribution," "Electric Light Fitting," by Urquhart; "The Elements of Electrical Engineering," by T. Sewell; and "Electric Light Installations," by D. Salomons. The main thing is to get a firm hold of the first principles and theories as you go on, then the more advanced work will become comparatively easy. But if you pass by any portion of the elementary work without having thoroughly grasped its meaning, or without seeing clearly the why and the wherefore of all that is put before you, your troubles later on will be hard to face. You will find any of the above-mentioned books especially useful, for as you intend to be a sea-going engineer, any electrical knowledge you may possess, in addition to that which is absolutely necessary to pass the Board of Trade examinations, will undoubtedly be of great service to you some time or another, as so many vessels now are installing the electric light. You need have no fears regarding the destiny of steam engineering for many years to come. Were we deprived of steam, what could be used in its stead to generate large quantities of electricity?

If E. A. Graham will send us his address, we will be glad to forward reply to his query, the same having been returned to us from his last address.

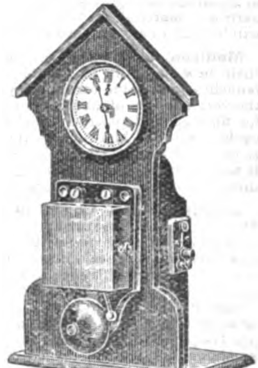
Amateur's Supplies.

[*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.*]

*An Electric Alarm Clock.

Model engineers who cannot be certain of waking to any given time in the morning, should give a trial to an electrical alarm clock. The fault of the old-fashioned alarm was that before the sleeper was awakened the spring had run down, and the alarm, to all practical purposes, might as well not been set, but with an electrical device, there is the means of ringing a bell for—even with



THE ELECTRICAL SUNDRIES MANUFACTURING COMPANY'S ELECTRIC ALARM CLOCK.

an inferior battery—some half-an-hour at least. The clock the Electrical Sundries Manufacturing Company, 152, Grey Mare Lane, Manchester, are supplying at 12s. 6d., is sent out with bell, switch, wooden stand, clock, and a No. 2 Leclanché cell, complete, and the one we have tested works satisfactorily, and accurately "goes off" at the proper time by the clock. We can recommend this set to those of our readers who have need of something of this kind. The Electrical Sundries Co. wish us to mention that their list can be obtained, post free, for twopence.

*Reliable Small Power Steam Engines.

The "Stuart" engines are now too well known to need lengthy description, and the latest design, No. 4, suitable for amateur engineers with smaller pockets and lighter machinery at their disposal, will appeal to many. We have had the opportunity of inspecting a finished engine and a set of castings. The engine is practically a reproduction of the No. 1 "Stuart" (except that it is provided with a balanced disc wheel in place of the ordinary flywheel), and has a cylinder 1½ ins. bore by 1½ ins. stroke. It is much simpler in detail than previous types, but without any sacrifice to efficiency or strength. The connecting-rods and eccentric-rods are in *phosphor bronze*, and are cast in one piece, the top half of brasses being cast with the rods. This is an excellent idea, and, combined with the metal used, is one which permits sound work with the least expenditure of labour. A full list of parts is given in the price lists sent. We can heartily recommend this set as one which is very good value for the money; and when the amateur has made the engine from these castings, which are very clean, sound and of very good quality, he will, with even a reasonable finish, have a good engine capable of doing a comparatively large amount of work. The price of the castings packed in a strong box is 10s. 6d., and working drawings of the usual high standard of excellence, are included. Readers should remember that this price only holds good until the end of the year, when it will be raised. Finished engines of various sizes are on view at Mr. Stuart Turner's London agents, Messrs. Melhuish, Sons & Co., 84, Fetter Lane, E.C.; and Mr. Turner states that he is also bringing out boiler and other castings, which will be listed at the earliest possible moment. Mr. Stuart Turner's address is Shiplake, Henley-on-Thames, and lists can be obtained post free for threepence.

"Lathes for Everybody.

We have had sent us by Mr. P. W. Jones, 70, Coton Road, Nuneaton, a set of castings for a small lathe, which, as regards cheapness and value for money, may be commended. The castings are for a 2½-in centre lathe and are despatched and marked out for drilling and filing and surfacing. The pulley wheel is in wood already turned for driving on to the mandrel. Bolts, nuts, and screws and a wooden straight edge are also supplied, together with a pamphlet describing the making up of the lathe. The castings are clean and sound, and at the price of 8s. 6d. the material for a lathe should be within everyone's reach.

Catalogues Received.

Drake & Co., St. John's Works, Paley Terrace, Bradford, Yorks.—We have received the above firm's new list, a booklet of seventeen pages, which contains particulars and prices of the castings, parts, and finished examples of the majority of the most interesting and useful models, tools, and appliances, which have from time to time appeared in our pages; and besides, catalogues model ship fittings, telephones, sparking coils, Whitworth pitch screws, bolts and nuts, engine and boiler fittings, dynamos and motors. Model railway builders will note that Messrs. Drake state they are in a position to supply rolling-stock, tracks and signals and various parts and materials for these supplies are included in the list which will be sent to any reader for 4d., post free.

Madison Castings Co., Woolrych Street, Derby, send us their new price list of gas, oil, and petrol engines for land use, launches, and motor cars and cycles. The list is well printed, and the various types of motors are illustrated; also prices are quoted for finished and partly finished engines, including for cheap motor cycle sets. The Madison Castings Co. send us a drawing such as is provided with castings of the latter sets, but although the same is neat it is not more than a guide to the construction, no scale, dimensions, or details being given. Post free 3d.

Crypto Works Co., Ltd., 29, Clerkenwell Road, E.C.—Model engineers and amateur electricians requiring good reliable motors, dynamos, should write at once to the above firm for their new lists, which contain illustrations, prices and particulars of small machines of various types and sizes, many of which, it is stated, have recently been brought thoroughly up-to-date in small details. A few of the special items, in addition to the excellent designs of small electro motors and dynamos, are vacuum tube rotators, model arc lamps, self-starting fans for continuous or alternating currents, ammeters and voltmeters, accumulators, and incandescent lamps of all powers for various voltages. Resistance boxes or "pressure regulators" for use where current is required at lower voltage than is supplied by mains are also supplied, and illustrated in the catalogue. Post free 2d.

The Ardwick Engineering and Machine Co., Bennett Street, Ardwick, Manchester.—A well illustrated price list of small power engines—steam, gas, and oil—suitable for land use, and for launches; horizontal and vertical engines, with cylinders, from 2⅜ ins. by 2¼ ins., to 6 ins. by 10 ins., and yacht and launch engines, both simple, compound, and condensing, from ½ h.-p. to 50 h.-p. are catalogued and illustrated. Several designs of gas and oil engines are included: horizontal Otto type engines, from ¼ b.h.-p to ½ h.-p., and the "Compact" engines of the vertical type, suitable for launch work, may be obtained, from ¼ h.-p. upwards. Motor car engines are stocked, also castings for and complete cold-sawing machines, steam hammers, drilling machines, lathes, donkey pumps, and hand test pumps. Prices are quoted for castings, drawings, finished parts, and boring cylinders, etc., and altogether the reader will find this list extremely useful. Post free 6d.

Alfred H. Avery, Fulmen Works, Tunbridge Wells, sends us a very well produced list, which should find a place on the catalogue shelf of every amateur electrician. The dynamos and motors made by Mr. Avery are too well known to need special mention here, but he writes us saying that during the past year a good deal of time has been devoted to improving all his standard machines. The one item in the catalogue which will appeal to the model maker is the new direct-coupled set—a multipolar dynamo and high-speed vertical engine—which, since it was first designed, has also been the subject of practical experiment and improvement. Particular attention may also be drawn to the page describing the armature laminations, and also to the electric pumping plant, which consists of an Avery-Lahmeyer motor, coupled direct to a centrifugal pump. Where electric power is unavailable, gas engines may be obtained from Mr. Avery to suit these pumps. Among the other supplies listed are desk fans, accumulators, motors for model tram cars and electric railway locomotives, measuring instruments, rotary transformers or "Boosters," and enclosed dynamos for charging the ignition cells on automobiles whilst the car is in motion. Readers should enclose four penny stamps and mention THE MODEL ENGINEER in writing to Mr. Avery for the new list.

Wellington's Monthly Motor Car Register.—We have received the last issue of this periodical, which is full of particulars and prices of second-hand motor cars and cycles of all descriptions now for sale. This *Register* may be obtained from F. F. Wellington, Ltd., 36, St George's Square, Regent's Park Road, N.W., price 1½d., post free.

Millington & Everitt, 18, King's Parade, Cambridge, send us their list of dynamos, motors, bells, batteries, telephones, coils, and other electric supplies, amongst which accumulators of all sizes for motor cars and other purposes are the most noticeable. A portable electric light set is also illustrated in this list. Post free 2d.

Joseph Gleave & Son, 8, Oldham Street, Manchester.—A useful list of tools of all kinds—grindstones, saws, planes, hammers, axes, chisels, gouges—and one which will appeal to the model engineer who makes his own patterns. The section specially devoted to engineer's appliances includes lathes, vices, callipers, dividers, micrometer gauges, pliers and squares.

Messrs. Thwaite & Dobson, Machine Toolmakers, Todmorden.—Where can I get castings for lathe and workshop appliances is a question very often asked. We have received Messrs. Thwaite's list of specialities for amateurs, which include hand-planing machines, independent chucks, swivel machine-vices, surface plates, slide-rests, vertical slides for milling on the lathe, flywheels and footgears, face and angle plates, and many other accessories useful to the model engineer, and to whom this catalogue will prove of service. Castings are supplied and prices are quoted for finished articles and for the machining of the various portions.

Newton & Co., 3, Fleet Street, Temple Bar, E.C.—We do not often receive such a well illustrated scientific catalogue as that issued by the old-established firm of Messrs. Newton & Co., as list No. 2, "Philosophical Apparatus," which gives particulars of the instruments, models, and appliances nowadays necessary for use in science classes of any description. In sound, light, and heat, examples of most of the well-known instruments employed in technical schools—tuning forks, Duhamel's apparatus, Savart's toothed wheel, syrens, sound wave instruments, spectroscopes, prisms, mirrors, pyrometers, calorimeters, etc., are shown. Electricity, hydraulics, and hydrostatics are treated in a similar manner, and each piece of apparatus being referred to in brief with a description of its use. The apparatus for chemistry classes, and for demonstrating the fundamental laws of mechanics, can also be obtained, and the list provides splendid photographic illustrations and sketches of the various models and implements. This catalogue, which can be had for 6d., should be in the hands of every science teacher, educational worker, and also readers whose hobby is scientific experimenting. Crooke's x-ray tubes are listed, also complete wireless telegraphic instruments, Tesla and Apps-Newton coils, and other high tension current apparatus.

A Correction.

The Universal Supply Co.'s address is 60, Brook Street, Chorlton-on-Medlock, not Chorlton-cum-Hardy, as mentioned in our last issue.

A NEW slide rule, invented by Professor Perry, is being brought out by Mr. A. G. Thornton, St. Mary Street, Manchester, from whom all particulars can be obtained.

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 6s. 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," 37 & 38, Temple House, Tallis Street, London, E.C.

All correspondence relating to advertisements to be addressed to THE ADVERTISEMENT MANAGER, "The Model Engineer," 37 & 38, Temple House, Tallis Street, London, E.C.

All subscriptions and correspondence relating to sales of the paper to be addressed to the Publishers, Dawbarn & Ward, Limited, 6, Farringdon Avenue, 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.

THE

Model Engineer

AND

Amateur Electrician.

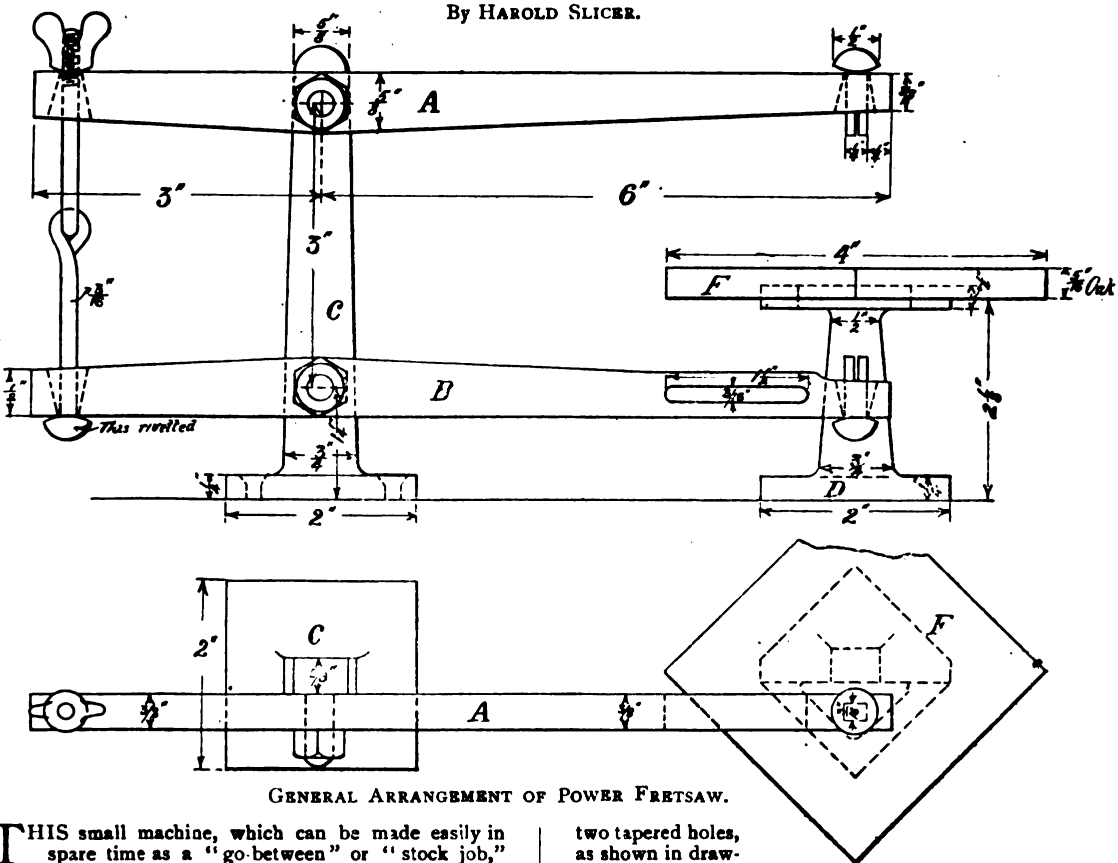
A JOURNAL OF MECHANICS AND ELECTRICITY FOR AMATEURS AND STUDENTS.

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

VOL. VII. No. 87. DECEMBER 15, 1902. PUBLISHED TWICE MONTHLY

How to Make a Power Fretsaw.

By HAROLD SLICER.

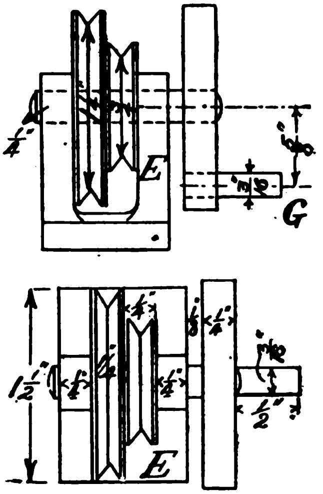


GENERAL ARRANGEMENT OF POWER FRETSAW.

THIS small machine, which can be made easily in spare time as a "go-between" or "stock job," will amply repay the maker, and enable him to turn out better work in a shorter time than is possible with the hand fretsaw. Its construction is as follows: The arms A and B are 9 ins. long, ⅜ in. thick, ⅝ in. broad at broadest part, ½ in. × ⅜ in. at ends, and having two tapered holes, as shown in drawing, to carry pins and tension rods. The arm B has a slot 3-16ths in. broad and 1½ ins. long, through it horizontally.

The stand C should have two 5-16ths in. holes drilled in it, 3 ins. apart and 1½ ins. from base, and two 5-16ths in. pins let in. The upright of the stand should be ⅜ in. thick, ⅝ in. broad at top, and ¾ in. at bottom, having a base 2 ins. square, ¼ in. thick, equally divided around the upright.

The stard D should be formed of an upright ½ in. broad at top, and ¾ in. at bottom, ⅜ in. thick, with cap and base ¼ in. thick and 2 ins. broad across diagonals; the base having a part cut away to allow the bottom arm to oscillate without an obstacle, and to allow the head carrying the driving pin to come close up to engage with arm B. The cap also has a piece cut out of it to allow the pin carrying the fretsaw to travel up to table F,



ELEVATION.

PLAN.

DETAILS OF DRIVING GEAR.

thereby giving a larger stroke than otherwise possible. The table F is made of oak, finished size 5-16ths in. hick, let in the stand D.

A spindle, ¼ in. diameter, is required to carry pulleys, which are ¼ in. broad and 1¼ ins. and ¾ in. diameter respectively, running in a head or block E. The end of spindle carries a disc 1⅝ ins. diameter, with a pin 3-16ths in. diameter, projecting ½ in. out of it, to engage the slot in the arm, and provide a working stroke of 1¼ ins. All sizes and further particulars not given here will be found on drawing, on which all dimensions are finished ones. The action of the machine is as follows: The pulleys in head E, giving motion to pin G, which moves arms up and down, and on the down stroke cutting work in hand of table F. The speed of this machine must be greater for thin wood and slower for thick.

The whole machine to be fastened down to suitable wooden boards, large and strong enough to hold all steady, and the machine, besides providing ready means of fretting wooden objects, such as patterns, etc., should prove very useful to model engineers for cutting brass sheet for model locomotive frames and superstructures.

The Society of Model Engineers.

London.

THE fifth Annual General Meeting of the Society was held on November 13th at the Holborn Town Hall. The report and balance sheet was presented and accepted, and the following was the result of ballot for new officers: Chairman, W. T. Bashford; Vice-Chairman, D. C. Glen, M.I.M.E.; Hon. Secretary, H. Greenly; Hon. Treasurer, J. Wills, junr.; Committee: W. H. Dearden, E. W. Payne, H. A. Bennett, H. S. Boorman. The various resolutions printed on the agenda paper, sent to all members, were carried unanimously.

A new Track Committee was elected, Mr. H. S. Boorman being Secretary, and also a Sub-Committee to encourage marine and stationary engine work amongst the members. Mr. G. J. Walker, who will act as Secretary *pro tem*, will be glad of cordial support.

After the formal business, and upon Mr. Percival Marshall vacating the chair, the new Chairman, on behalf of the members, presented Mr. Marshall with a gold fountain pen as a mark of esteem and appreciation of his services during the past four years. Mr. Marshall was closely identified with the founding of the Society, and has been present at every visit, meeting, and Committee meeting since.

The next meeting of the Society will be held at 7 p.m. on December 15th, at the Holborn Town Hall; and following the Annual Conversazione already announced will be held at the same hall on Friday, January 16th, 1903. The new Chairman specially requests that members should heartily help the Committee in the matter of exhibits. Mr. Herbert C. Willis, of Victoria Road, New Barnet, will act as Exhibit Secretary.—HENRY GREENLY, Hon. Sec., 2, Upper Chadwell Street, E.C.

Provincial Societies.

Glasgow.—A meeting of the above Society was held at 309, Shields Road, on Wednesday, November 19th, at 7.30 p.m. The Secretary read over the new rules, as amended by the Committee at a meeting on the 13th inst.

After some discussion, Mr. Burnett formally moved, and Mr. Kennedy seconded, the adoption of these rules. In conclusion, the Chairman addressed the meeting, pointing out the benefits to be derived by the members of the Society relatively to the small amount of the subscription, viz., 10s. per annum.—JAMES R. BRITH, S cretary, 39, Hope Street, Glasgow.

Edinburgh.—On Thursday, October 16th, a party of members and friends visited the St. Andrew's Steel Works of Messrs. Redpath, Brown & Co This firm make a speciality of steel girder, bridge, and roof work, and, as the works were going day and night in order to get some large contracts completed, the party were fortunate in seeing the works in full operation.

The usual fortnightly meeting was held at No. 13, South Charlotte Street, on October 31st. The Secretary announced that up to date the Loan Fund had been promised £8 It was agreed to spend this money in the purchase of lathe chucks and a grindstone.

Mr. Pratt had brought up his model 2-i.h.-p. winding engine, which has won several medals. Mr. Pratt also showed a dynamo, which won the first prize in the Industrial Exhibition this year. Mr. Bissett showed some patterns of a cylinder, and the Amateur Castings Company, of Nottingham, exhibited some back geared lathe castings.—W. B. KIRKWOOD, Hon. Sec., 6, Duke Street.

Bolton.—The first meeting of the new session was held on Tuesday, November 18th, Mr. Booth occupying the chair. Considering that this was the annual general meeting, the number of members present was small, being only fourteen. Various suggestions were put forward, amongst others that of holding an exhibition of finished models. It is hoped that members who have models will avail themselves of this and make a g od show. Several models and parts were on view. Mr. Mitchell's model hydraulic press, also a partly finished vertical engine by the same member. A pair of model traction-engine cylinders, complete, also the crank shaft for same, turned out of the solid, by Mr. C. A. Hays.—ERNEST MALLETT, Hon. Sec, 83, Manchester Road, Bolton.

(Other Reports unavoidably crowded out).

Model Yachts and Y.R.A. Rules.

By ALFRED E. FOSTER, Official Measurer of the Wirral M.Y.C.

IT is apparent that model yacht clubs generally are passing through a transition stage, and that, dissatisfied with the unlovely type evolved under the $\frac{L. \times S.A.}{0600}$ Rule, they are desirous of a yacht more like the creations of Fife, and Watson, and Herreshoff.

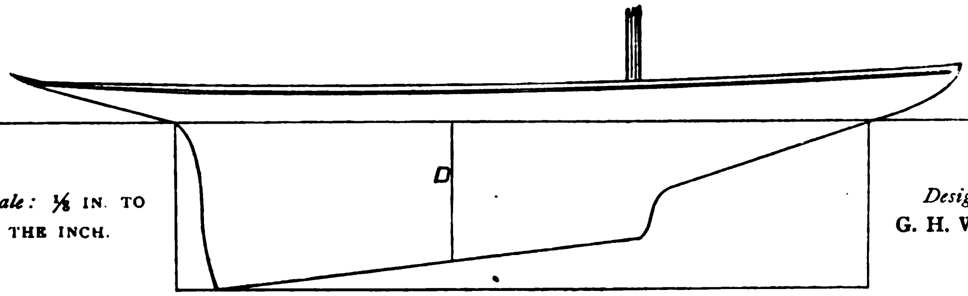
Nothing but undue timidity and hesitation has marked the opinions of your correspondents, when commenting on the admirable article by Mr. W. H. Wilson-Theobald, in the issue of August 1st last.

and club racing is now so keen that the difference between the best boat of a class and any one of the rest is slight. No happy-go-lucky methods now succeed, and hulls, sails and gear are, with most, matters of thought and careful calculation. The club classes are 24 ft., 30 ft., and 42 ft. linear raters, and racing is conducted on the tournament system.

As showing the extreme reliability of the type produced, it might be well to mention that, during the past summer six inter-club matches were sailed with Liverpool clubs, whose boats were 10-raters under the $\frac{L. \times S.A.}{6000}$ Rule.

In each of the features six 42 ft. raters of the Wirral Club competed with six 10-raters of their opponents, on the tournament system. Despite the unlimited beam of the latter, and their absurd draught (sometimes 12 ins., 14 ins., 17 ins.), in the six home and away matches, the

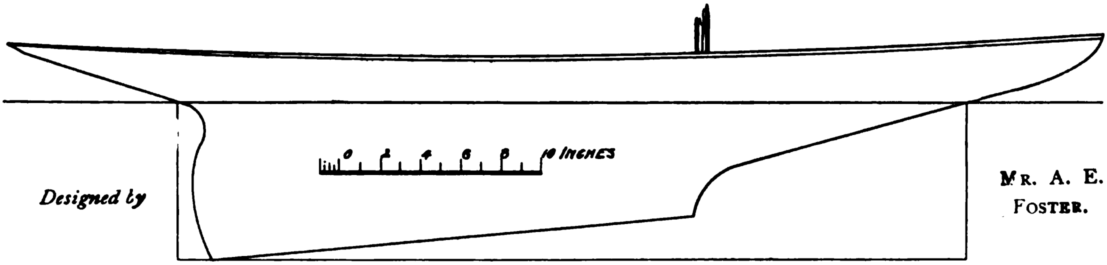
Scale: ⅛ IN. TO THE INCH.



Designed by G. H. WILLMER.

PROFILE OF THE WINNER OF THE 30-FT. RATER CHALLENGE CUP, 1902.—WIRRAL MODEL YACHT CLUB.

Designed by



MR. A. E. FOSTER.

PROFILE OF THE WINNER OF THE 42-FT. RATER CHALLENGE CUP, 1901 2.—WIRRAL MODEL YACHT CLUB.

So far from seeing in the Y.R.A. Rule the opportunity of raising the pastime of model yachting to the high level of a scientific sport, they see in it nothing but what I have heard called "too many condemned decimals," and "a rule too hard for *our* fellows."

Now, since a simple record of actual experience is worth a great deal of academic discussion, the following particulars will be of interest.

In November, 1900, the "Wirral M.Y C" adopted the Y.R.A. Rule of measurement, in place of their then rule of "Length on L.W.L." There was, of course, the difficulty of "vested interests" to surmount; but, as the men most hardly hit were the sponsors of the new order, this caused little real trouble. With the other stock objection—"the complexity of the rule"—there was rather less trouble, for most of the members were guilty of a fondness for designing, and one or two were professional experts.

And now for the sequel. The club has just completed its second racing season under the changed conditions. Some thirty new boats of modern type have been built, total points gained by the Y.R.A. boats were 149 heats as against sixty-one heats.

The beaten side always ascribe their defeat to two causes:—(1) the Y.R.A. boats sailed too fast, and (2) they kept a better course.

It may be asked what style of boat does the rule produce. The type is well illustrated by W. H. Wilson Theobald, M.A., in his design of August 1st. Indeed, were the keel given a little less rake, and extended aft, as in Fig. C on page 63, the design is almost exactly the lines of the 42 ft. L.R., designed by the writer in 1900, and which for the past two seasons has won the 42 ft. L.R. Challenge Cup, presented to the club by the Commodore, Roy M. Laird, Esq., N.A.

Might I urge, that, during the coming winter, the adoption of the Y.R.A. rules be discussed by those enthusiasts which every model yacht club boasts. There is nothing to fear, and I am convinced that every club bold enough to break away from tradition, will find that their sport possesses new charms, and possibilities hitherto unknown.

Some day, perhaps, we may see model yacht clubs affiliated to some central council, sailing under an accepted code, acting with cohesion, and competing in inter-provincial tournaments. That day may be nearer than many think; but its advent is certain.

Superheated Steam.

THE economy of superheated steam may perhaps be best realized by comparison of the steam consumption of various types of engine with saturated and highly superheated steam. Thus: 24 lbs. of steam per i.h.p. hour may be taken as a good average for single cylinder engines with steam jacketed cylinder running non-condensing. The use of highly superheated steam (that is, steam at a temperature of about 600 degs.) leads to a reduction in the steam cylinder consumption per i.h.p. hour in an engine of this type to about 17 lbs. A similar comparison between single cylinder condensing engine running with saturated and highly superheated steam yields an equally marked result. The figures obtained as the result of several trials are as follow: Single cylinder condensing engines with saturated steam require 22 lbs. per i.h.p. hour, but with highly superheated steam only about 14 lbs. Results of tests on compound non-condensing and compound condensing, with and without superheat, show similar results, but not in so marked a degree. The steam saving in the case of the compound non-condensing is 28 per cent. when working with superheated steam as compared with saturated steam, and in the case of the compound condensing the relative economy is 31 per cent. To put the matter plainly, the use of highly superheated steam places a single cylinder non-condensing engine on a par with a single cylinder condensing engine using saturated steam, and enables the compound non-condensing to give similar results to those obtained when working condensing.

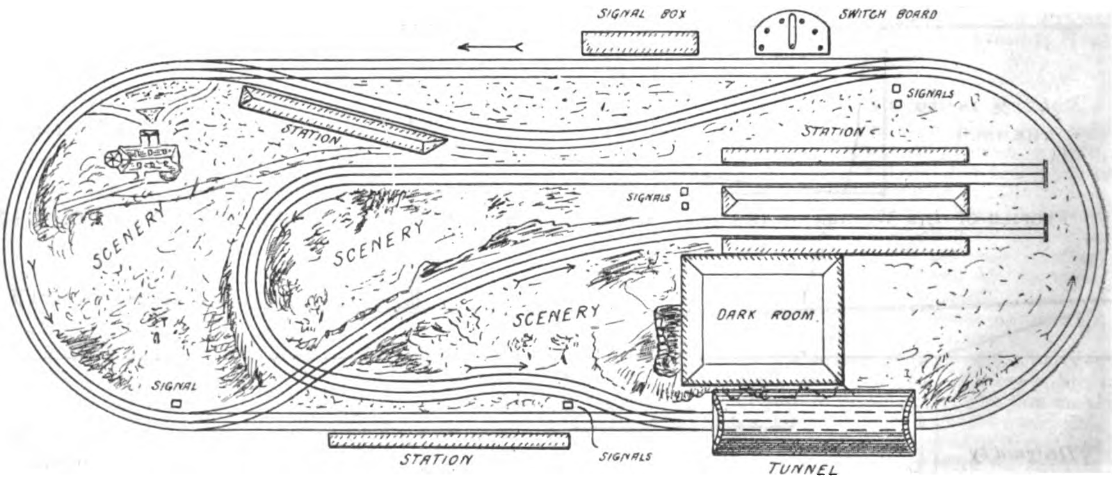
THERE are few, if any, towns in these isles which derive their light directly from the natural resources of the county, but we hear that Penrith (Cumberland) is to be lighted by electricity, power being obtained from the River Eamont.

A Compact Model Electric Railway.

By H. W. HARRISON.

I THINK a short description of my model electric railway, together with a few photos of it (taken by myself) will interest your amateur readers, and besides—when the conditions under which I worked are known—give encouragement to those who think they cannot do anything in a similar direction because they have no elaborate tools.

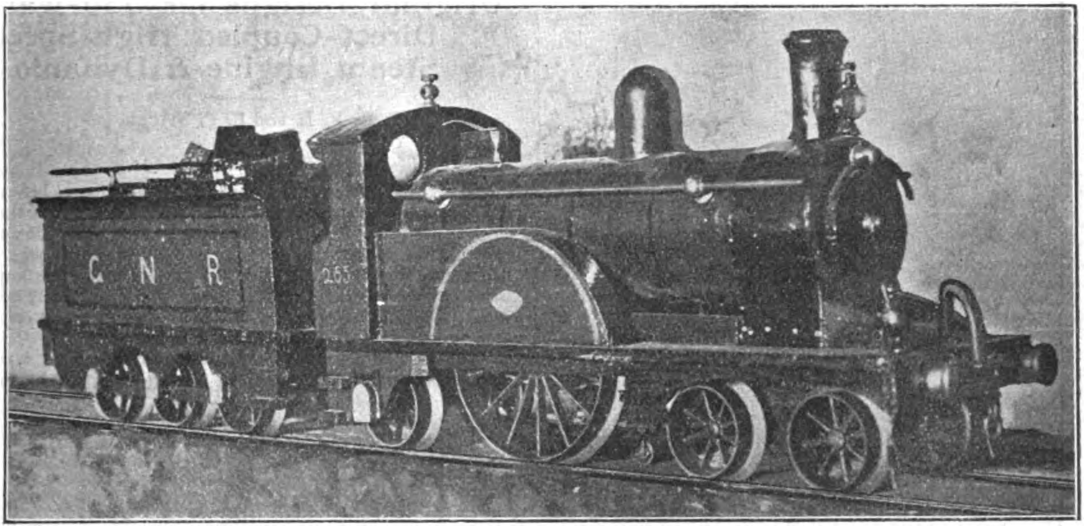
I may state, first of all, that I am an organist, and, having been ill, during my convalescence I thought that I should like to try to construct an electric railway. I had no knowledge of the science, except that gained from my careful perusal of THE MODEL ENGINEER and its handbooks, and also no tools beyond those to be found in almost any model engineer's workroom, viz., a vice, drill, files, screws, &c., and which, together with common sense, sufficed. The track is laid down in



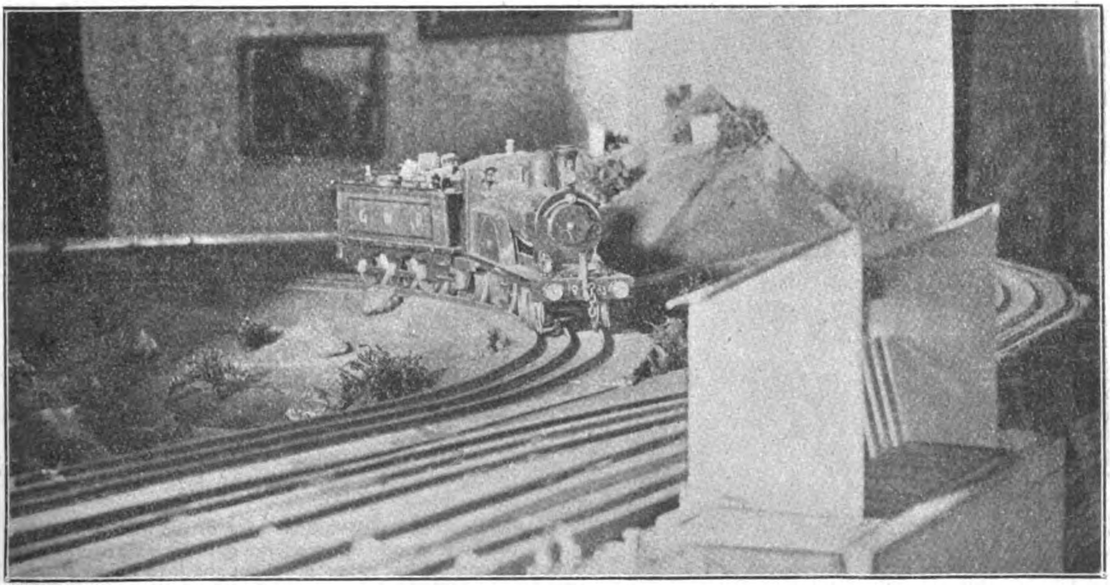
PLAN OF MODEL ELECTRIC RAILWAY.

an attic of my house, and is 12 ft. long and 6 ft. wide, with semi-circular ends, and is raised 2 ft. 8 ins. above the floor. My photographic dark-room stands in the centre, and forms a strong support to the framework of the track. The rocks and scenery are made from old carpet, etc., formed and painted in natural colours. The trees and shrubs are made from dried moss and grasses, and the river of silver paper. At night it looks very effective, as I have scattered some "Jack Frost" on the rocks, and have made two waterfalls of the same, which sparkle in a highly realistic manner. The rails are of tin, tacked down to a framework of ½-in. wood. I found it very easy to make the points and crossings with these and the help of a soldering iron. There are three stations; one signal-box, containing eleven levers for seven signals and four points; a switch-board for "Stop," "Quarter," "Half," and "Full-speed"; a tunnel, and a crossing. To drive the loco I used one of Messrs. Whitney's 6-volt 30-ampère hour accumulators, which answers all requirements, and as yet this railway has not been marred by any accidents.

The engine, including tender, is made entirely of thin hard wood and cardboard, with exception of wheels and motor. The latter is one of the above-named firm's self-starting tramcar motors. The length of engine and tender



THE MODEL ELECTRICALLY-DRIVEN RAILWAY LOCOMOTIVE.



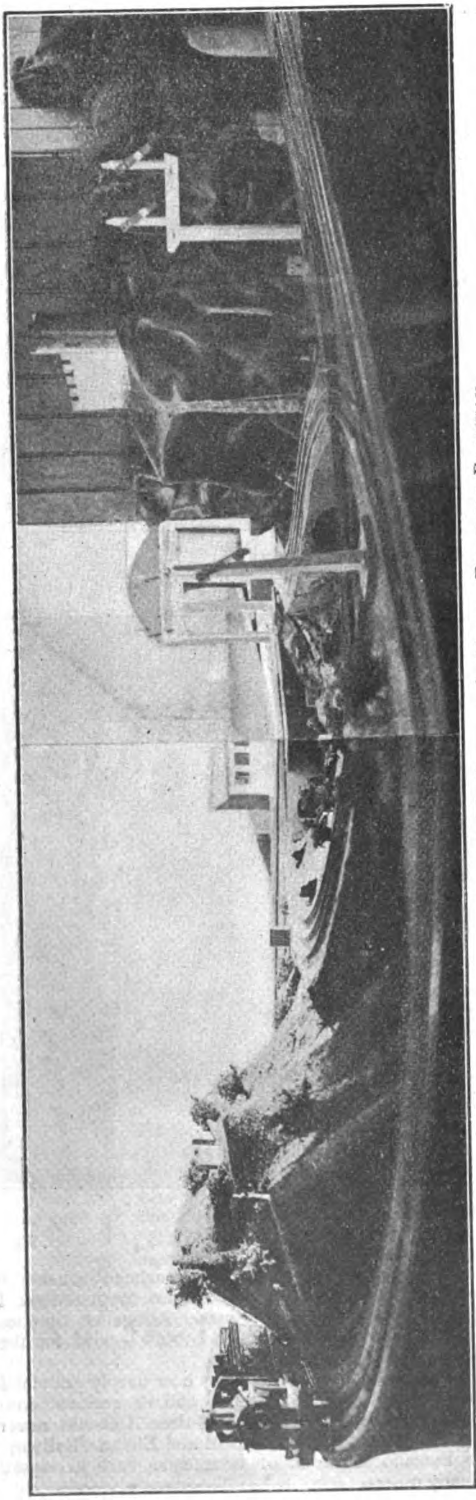
A PART OF MR. H. W. HARRISON'S MODEL ELECTRIC RAILWAY.

is 23½ ins.; gauge, 2½ ins.; diameter of driving-wheels, 3½ ins.; bogie, 1½ ins.; trailing, 1¾ ins. Speed between four and five miles per hour. Total weight, 4 lbs.

The motor is inside the boiler barrel, and is geared by a worm to driving axle. There is also a reversing lever inside the cab. The funnel was made from a cotton reel, and for the dome I cut off the rounded end of the domestic broom handle (for doing which I got into hot water). I mention these things only to show what can be used at a pinch. The whole is enamelled green to represent the same numbered engine on the G.N.R. (No. 265).

The rolling-stock for the goods department consists of six waggons and guards van, while for the passenger I have as yet four corridor bogie cars. Altogether the loco will haul a load of 12 lbs., which I think is good for the small size of motor.

In conclusion, I feel I must say how deeply grateful I am to THE MODEL ENGINEER and its eminent contributors, for had it not been for them I should never have been able to construct this Model Electric Railway, which has afforded hours of amusement both to myself and many others.



PANORAMIC VIEW OF MR. H. W. HARRISON'S MODEL ELECTRIC RAILWAY.
(For description see preceding pages.)

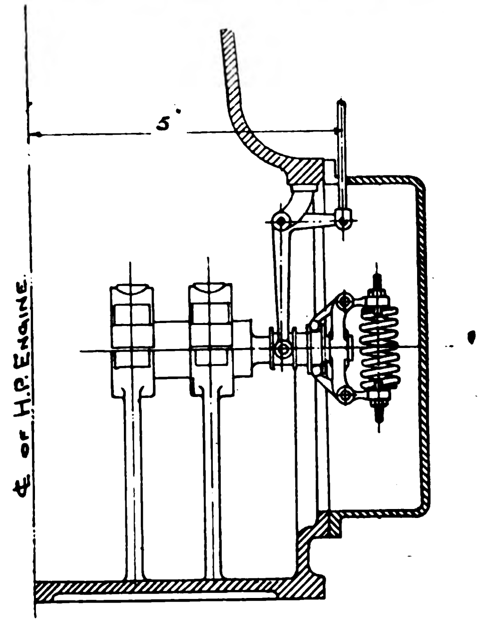
Original Designs for 750-watt Direct-Coupled High-Speed Steam Engine & Dynamo.

By F. L. and F. P. SPICER.

(Continued from page 251.)

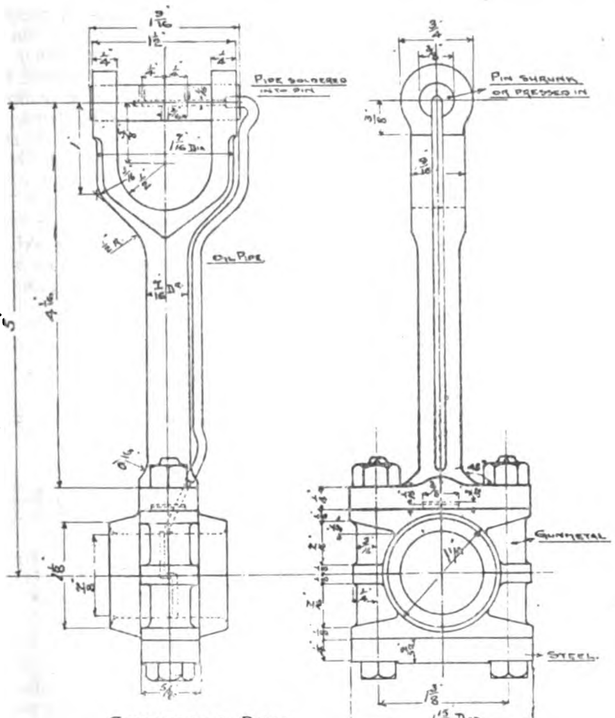
IT will be noticed that the eccentrics are placed behind their respective cranks. The reason for this is that the steaming edges of the piston valves are inside and not outside as on the ordinary slide valves, although it does not follow that all piston valves are made this way. The keyway for the flywheel must be very carefully cut, and the key well fitted, as, if the flywheel were to come off, serious damage would be done to the plant.

The connecting-rods are of the ordinary marine type, with heavy gunmetal bushes at the big ends, and having

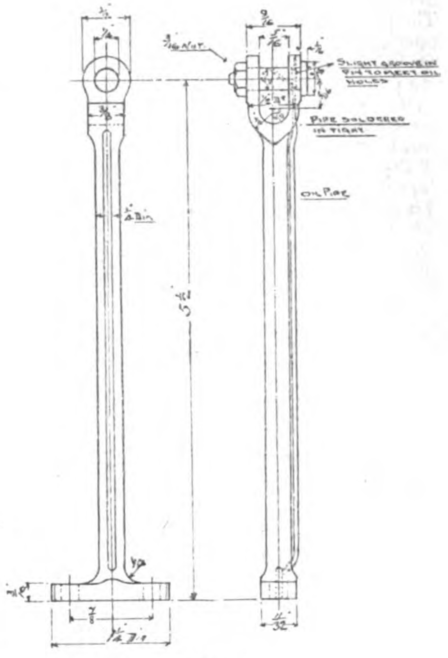


GENERAL ARRANGEMENT OF GOVERNOR.
Scale: ⅓ Full Size.

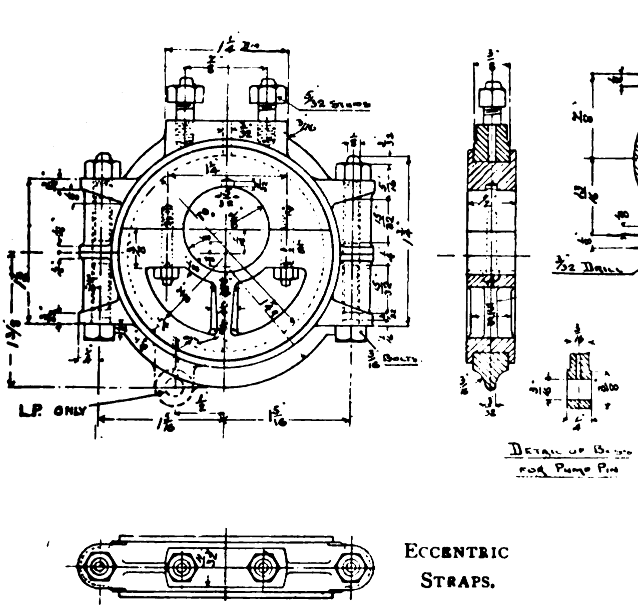
the crosshead pins shrunk in or driven in tightly. The rod must be made from a forging, the outside being turned up and the jaw either sawn out and then finished with a file, or else milled out to the exact size. The oil tube should be as light as it is possible to obtain, although the bore should be not less than 1-16th in. diameter, the bore being drilled and the pipe sprung into place and soldered. In all cases, when fitting up the oil pipes, &c., make quite sure, by blowing or passing water under pressure through the pipes and holes, that all the passages are clear, or a hot bearing may result. The eccentric rods will require much the same treatment as the connecting rods, as far as the steel work is concerned, the principal exception being that the pin in the jaw is removable. The smal nut is made to screw up to a shoulder on the pin, and not against the side of the jaw, thus avoiding the possibility of springing the jaw, gripping the guide, and thus causing a great deal of unnecessary friction. There are other



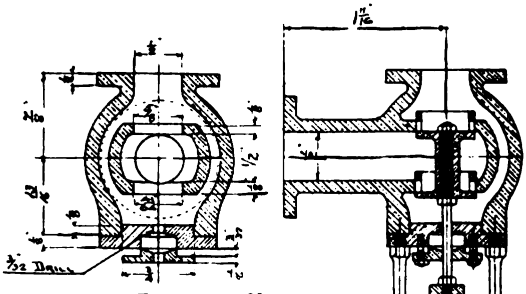
CONNECTING RODS.



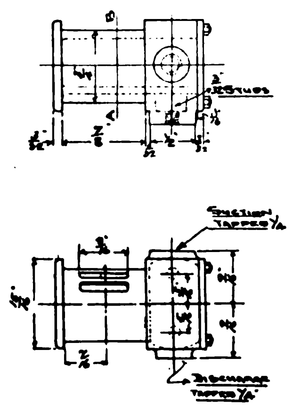
ECCENTRIC RODS.



ECCENTRIC STRAPS.



THROTTLE VALVE.



OIL PUMP BARREL.

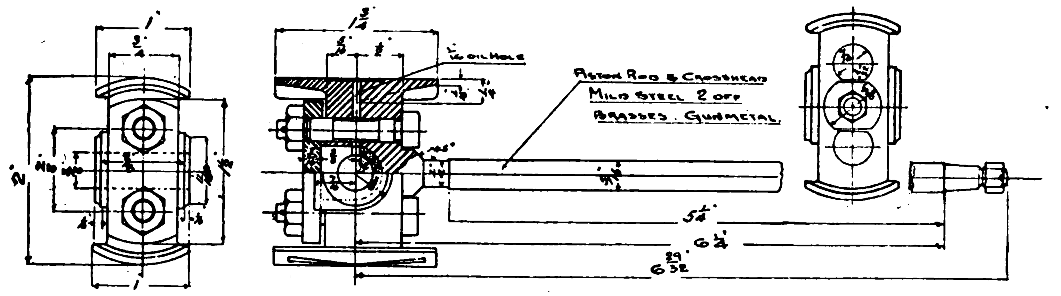
DETAILS OF HIGH-SPEED ENGINE, 750-WATT DIRECT-COUPLED SET.

cases where this same construction is adopted, as will be seen on referring to the drawings.

The piston-rods should be of mild steel, the crosshead slippers being forged on to the rod, thus obviating the difficulty of securing the slide blocks to the pin—this being rather a nasty job in a small engine. The guide should be bored first. The crosshead can then be turned a nice sliding fit, the sides being planed flat, and brasses fitted, the recesses for these being drilled and slotted out, and caps and bolts fitted. It is necessary to drill oil holes through the crosshead to lubricate the guides. The rod is shown reduced slightly in diameter near the crosshead, this being to allow those, who have the necessary gear, to grind the rod up, this being by far the best method of finishing up true.

to take the screws which hold down the bands. The lagging would then be made as follows:—A piece of wood is bored to fit the flanges, and then turned on the outside to the required thickness. It is then sawn in half and one piece put at each end, and sides fitted from straight pieces, the lines being scored with a penknife, this being much superior to fitting separate strips, and not so liable to collect the dust in the cracks. If sheet steel is used, it is simply fastened to the top and bottom flanges by round headed screws tapped into the edges, and finished off flush with the top of the cylinder.

The governor is of the ordinary centrifugal type and is very simple, its action being as follows:—The weights, cast on small levers, tend to fly out when the engine is running, due to the action of the centrifugal force, and this



DETAILS OF CROSSHEAD AND PISTON ROD.

The oil pump is of the usual type employed for this class of engine. It is of ample size; but as the pipes and passages are small, it is as well to have an ample margin, too much oil being better than too little, the safety valve relieving the pressure when necessary. The pump should be bored a nice fit on the trunnion and also for the plunger. The plunger has a few small grooves, turned at the lower end, to help it to retain the oil. The pump is made in two halves, to permit of the ports being cut. The ports must be very carefully made, as the angular movement of the pump is so small that a small error will prevent one port from ever opening at all. When first starting up, a small piece of fine wire gauze should be placed in front of the suction pipe to prevent any filings, etc., that may have been left in the base, from being sucked into the pump. Of course, the base should be well washed out with hot water to remove all sand, etc., before erecting the plant.

When the engine is started up for the first time oil should be poured into the base until the pump trunnion is covered. This will help the pump to start well, as the oil will flow into it. Of course, if the builder does not wish to go to the trouble of fitting the forced lubrication, the engine can be run with the connecting rods dipping in the oil and splashing the running parts like a Willans' engine, but the designers consider the pump to be a better and more certain method. It will be noticed that an underbase is provided so as to make the plant self-contained, and it would add materially to the ease of erecting if this were first planed over, then the pedestal, magnets, and engine base bolted down in position, and a boring bar put through them all in place. This would save a lot of trouble in lining up if the builder has a bar long enough to do this as the engine bearings could be done first, and then used to steady the bar whilst boring the larger diameter of the magnets.

The cylinders may be lagged either with planished steel, or wood and brass bands; if the latter is used additional flanges or bosses should be cast on the cylinders

tendency is checked by the spring. Thus, when the lever is drawn towards the governor plate by the weight moving out, it brings the sliding sleeve with it, which, in turn, moves the governor lever connected to the throttle valve. If additional weight is required, nuts are screwed on to the end of the spring holder, or pieces of lead may be used instead. If the engine runs too slowly the weight must be lessened or the spring shortened by screwing the spring holder down, the spring thus causing the throttle valve to open wider as the valve opens downwards. It will be noticed that the trunnion is bored larger than the sleeve; this is to allow for the end of the governor lever, which swings in an arc and would otherwise require slotting.

The throttle valve is fully explained by the drawing, the bottom valve being made slightly larger in diameter, so as to take some of the weight of the rods, &c., off the governor and add to its sensitiveness. The principal point to remember is to pack the gland as lightly as possible, so as not to make the spindle stick, otherwise the governor will not always act. In large engines a long bush, perhaps 8 ins. long, is employed and bored a perfect fit on the spindle, a special alloy being used for the bush to keep its expansion as near as possible the same as that of the spindle; but, of course, in a small engine this is impossible.

Although, at first sight, the arrangement may look complicated, on studying the drawings the designers think that this will not prove the case, and an engine of this size ought to have a sensitive and efficient governor. As regards the spring, this may want a little dodging about, for, even with large engines when a new size is made, the best spring is as often as not arrived at as much by experiment as calculation. So if the spring given as a basis does not work, others can easily be made, either stronger or weaker, as experience may suggest; but with the adjustment provided by the addition of weights and screwing up on the spring hold, this ought not to be necessary. The flywheel calls for no special remarks. Make the coupling bolts a nice tapping fit in the coupling, and be sure that the wheel is keyed on tight, as if it came loose when running at its full speed (3,930 ft. per minute) the result would be disastrous. The drain gear for the cylinders has been left to the makers to arrange, bosses only being provided to screw the cocks into; but it is best to connect all the drains to one pipe and so lead the water away.

If the maker likes, grease cocks can be screwed into the cylinder covers; but the main bulk of the lubricant should be passed into the main steam-pipe between the stop valve and the throttle valve, as it then lubricates all valves, pistons, &c.; but this is largely a matter of individual taste. The top of the cylinder cover is filled up with some non-conducting material such as asbestos and a lid made of thin steel or brass sprung in, which gives a good finish. Asbestos should also be used under all cylinder laggings, etc.

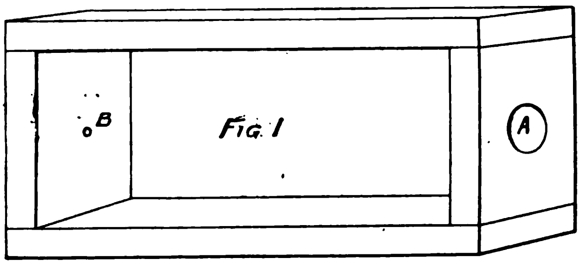
(To be continued.)

How to Cast Zinc Battery Rods.

By J. A. B.

IN the opinion of some electricians, drawn zinc rods are preferable to cast rods. They may be. I have used cast rods made as here described for twelve years, and have always found them perfectly satisfactory; but being very brittle, they must be carefully handled.

To cast the rods, first make a wooden box, as Fig. 1, of ½-in. deal, 10½ ins. by 3½ ins. by 3½ ins. inside, and in one end bore a ⅞ in. hole at A; at the other end make a 1-16th in. hole at B. Then from a 1-in. thick blind-roller make a taper plug 4½ ins. long, and of such a size at its small end that when twisted tight in the hole A it will project ½ in. inside. Procure a screw-eye (such as are used for attaching the cord to picture frames) about 3 32nds in. thick; make the eye red-hot, straighten it out, and drive it into the centre of the small end of the plug shown in Fig. 2. The next thing to make is the pattern.



Moulding Box.

For this take at 7½-in. length of an old umbrella handle or other suitable round piece of wood about 7-16ths in. thick. Make a hole at one end (A, Fig. 3), and with another screw-eye of the same size as that used before cut a thread in it. At the other end (C) make a 1-16th in. hole to fit the copper wire that will be used, and then round the pattern up as shown with coarse and fine sandpaper.

To complete, give all the wooden parts two coats of size or thin glue, and, when dry, a coat of varnish.

The moulding of the rods is accomplished by screwing the pattern (Fig. 3) on Fig. 2, passing it through the hole A, twisting tightly. After this is done, take a 6 in. straight length of 1-16th-in. copper wire, and tin one end of it with a soldering iron. Pass this wire through the hole B, and slip it into the hole C in the end of the pattern, securing it in place by pressing a common pin in the hole B by the side of the copper wire.

Now put in the sand and ram it round the patterns. When the box is full, take a piece of 1-16th-in. wire, and drive it into the sand in several places near the patterns to "vent" during the casting.

The patterns can now be withdrawn by carefully loosening the plug (Fig. 2) in the hole A and drawing it out with the attached pattern of the rod; the copper wire will be left in the sand, and the molten zinc will flow around it and secure itself to it at the tinned end.

Before pouring, cut a piece of sheet iron 2 ins. long and 1½ ins. wide, bend it half round to form a shoot that will fit the hole A, and into which it will go with a slight pressure, and if the end of the hole in the sand is broken by so doing, press the mould into shape with the pointed end of the pattern, or anything suitable.

Pure zinc should be used for these rods. I have obtained it from a local plumber. It is generally light coloured,

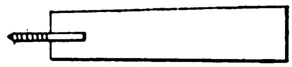


Fig. 2

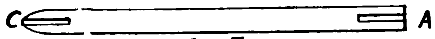


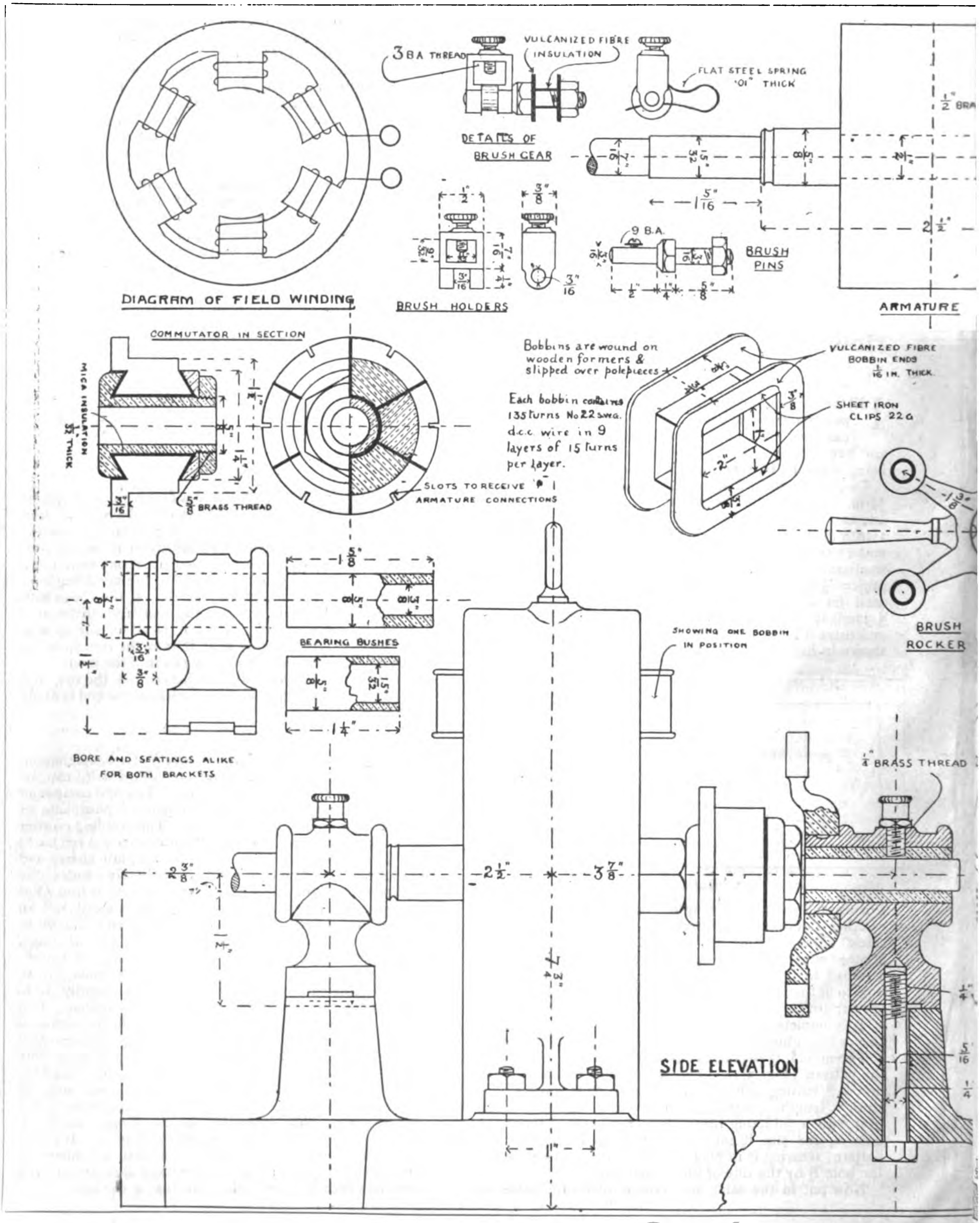
Fig. 3

Patterns.

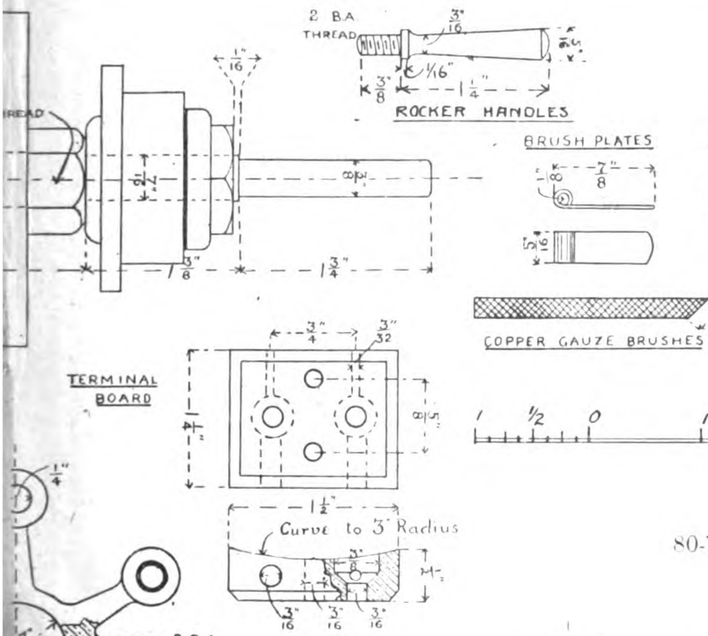
almost like tinplate; if dark and a bluish colour it generally contains impurities. Place 5½ ozs. of zinc in an iron ladle (it will melt very well over a gas boiling-burner); have ready ½ oz. of mercury (quicksilver) in an old *iron* spoon, also a piece of wire doubled up at one end, and a 3-in. block of wood to raise one end of the moulding box. As soon as the zinc has melted, scrape off the dross with the piece of wire and pour in the mercury a little at a time, as it spits about. When it is all in stir up well with the wire, and quickly pour it into the iron spout in the moulding-box, so that it may run into the mould.

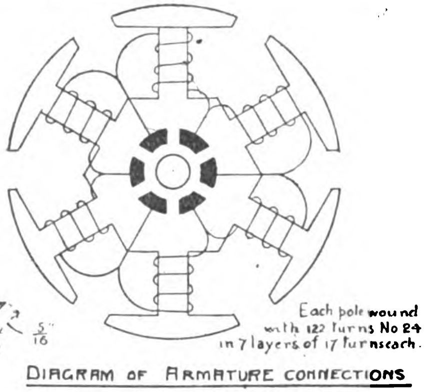
When set, break away the sand, take out the rod, and in cutting off the ragged end, take care, as the rod is easily broken.

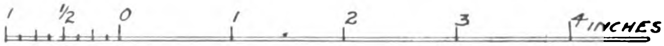
Welding Copper.—Copper, says F. G. Emmelmann, in a recent issue of the *American Machinist*, can be welded in a common blacksmith fire. The best compound for this purpose is a mixture of one part of phosphate of soda and two parts of boracic acid. This welding powder should be strewn on the surface of the copper at a red heat; the pieces should then be heated up to a full cherry red or yellow heat, and brought immediately under the hammer, when they may be as readily welded as iron. For instance, it is possible to weld together a small rod of copper which had been broken. The end should be bevelled, laid on one another, seized by a pair of tongs, and placed together with the latter in the fire and heated. The welding powder should be strewn on the ends, which, after a further heating, may be welded so soundly as to bend and stretch as if they had never been broken. It is necessary to carefully observe two things in the course of the operation: First, the greatest care must be taken that no charcoal or other solid carbon comes in contact with the surfaces to be welded, so have a good clean fire; second, as copper is a much softer metal than iron, the parts cannot offer any great resistance to the blows of the hammer, they must therefore be so shaped as to be enabled to resist such blows as well as may be. It is also well to use a wooden hammer. For fuel use charcoal. Of course, a gas furnace is better and cleaner, but with the fire a little practice will be all that is needed.



3 BA THREAD
VULCANIZED FIBRE INSULATION
FLAT STEEL SPRING ·01" THICK
DETAILS OF BRUSH GEAR
DIAGRAM OF FIELD WINDING
BRUSH HOLDERS
9 B.A.
BRUSH PINS
ARMATURE
COMMUTATOR IN SECTION
MICA INSULATION 1/32" THICK
5/8" BRASS THREAD
SLOTS TO RECEIVE ARMATURE CONNECTIONS
Bobbins are wound on wooden formers & slipped over polepieces
Each bobbin contains 135 turns No 22 s.w.g. d.c.c. wire in 9 layers of 15 turns per layer.
VULCANIZED FIBRE BOBBIN ENDS 1/16 IN. THICK.
SHEET IRON CLIPS 22 G
BRUSH ROCKER
BEARING BUSHES
BORE AND SEATINGS ALIKE FOR BOTH BRACKETS
SHOWING ONE BOBBIN IN POSITION
1/4" BRASS THREAD
SIDE ELEVATION





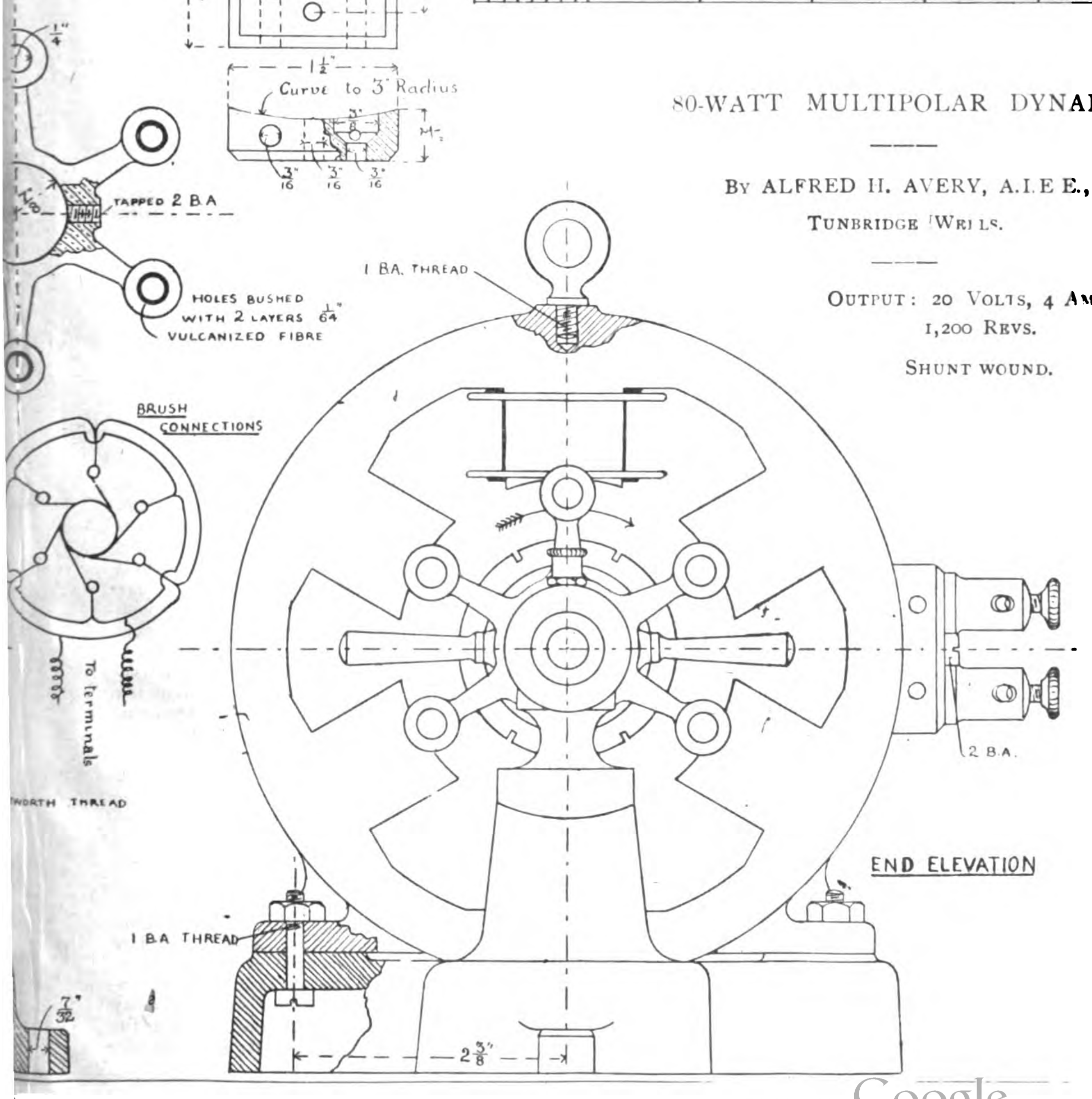


80-WATT MULTIPOLAR DYNAMO.

By ALFRED H. AVERY, A.I.E.E.,
TUNBRIDGE WELLS.

OUTPUT: 20 VOLTS, 4 AMPS.,
1,200 REVS.

SHUNT WOUND.



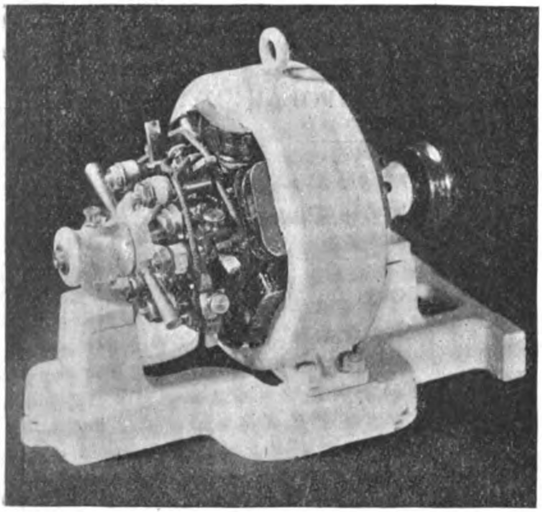
A Multipolar Dynamo for Direct Driving.

By Alfred H. Avery, A.Inst.E.E.

In recent numbers of The Model Engineer have appeared particulars of high-speed, simple acting, and compound engines of a very excellent type, designed by Mr. Stuart Turner, whose name is well known in these pages, and whose productions carry with them an assurance of high merit.

It has been the writer's privilege to be entrusted with the design of a small continuous current, self-exciting, multipolar dynamo for direct coupling to these "Stuart" engines—no light undertaking on such a small scale, and one entailing many months of experimental work before a satisfactory result was arrived at.

Success having been reached at last, however, and the combined plant being perhaps of rather exceptional interest to amateur mechanicians, as being the smallest



Mr. A. H. Avery's Multipolar Dynamo.

complete model of a multipolar steam dynamo that has ever arrived at a really practical stage, particulars of its construction are now presented to readers of The Model Engineer for the first time, and no doubt there are many among them who will be enterprising enough to exercise their mechanical powers in the coming dark evenings in the building of this unique plant.

Although designed for coupling direct to crankshaft of the "Stuart" engines and bolted thereto, the dynamo is adaptable to a variety of other combinations. For instance, it may with equal advantage be coupled to a high-speed vertical gas or oil engine, Pelton wheel, turbine, or other water motor, &c. It can be driven by another electro motor, or again used independently and a pulley fitted for belt driving. The multipolar works well either as dynamo or motor, and an interesting and useful piece of apparatus consists of a pair of these machines coupled together in tandem, one machine being wound as a motor and the other as a dynamo, the combination forming a rotary transformer or converter when suitably wound.

The accompanying scale drawings show all constructional details and winding data, the normal output of the machine being 20 volts 4 ampères at 1,200 revolutions per minute. When feasible to run it at a higher speed, however, this output may be considerably increased without exceeding safe limits.

The design has been calculated upon the basis of grey cast iron for the field magnet; but where exceptionally low speed is desired this can be attained by employing fields of malleable iron or cast steel of special grade.

A photo of the finished dynamo is also reproduced herewith.

A Year's Running of a Steam Car.

By Dr. Arthur C. Hovenden.

The following article is practically a copy of the paper read before the Society of Model Engineers on October 16th last, and is simply a short account of the year's running of a Locomobile steam car. It does not demonstrate an exceptional performance, but is a statement of facts as regards repairs, mileage, consumption of petrol, stores, &c. The general arrangement of the car is probably well known to you; essentially we have a two cylinder vertical engine, the steam being supplied by a small vertical fire-tube boiler. The fire is an atmospheric burner burning petrol vapour. The engine drives the car by means of a chain and sprocket wheels, geared 3 to 1, to the rear live axle with the usual differential gear.

The first point to discuss will be the question of *repairs*, and I will deal with the various parts, commencing with the boiler and finishing with the tyres.

Boiler.—This has never given the slightest trouble, and steams excellently. It has been blown down every day, and after nine months' use was washed out with potash solution, when a considerable quantity of deposit came away. It has never been burnt, and, in fact, has never been dangerously empty. While talking of the boiler, a few words might be said about water level. Firstly, let me set your mind at rest about the boiler exploding when there is no water. An acquaintance of mine owning a Locomobile has tried the experiment five times. The only thing he now notices is that the car is short of steam, the pressure gauge falling to zero, and that the boiler leaks when you attempt to put water in with the hand pump. He has a four-seated car, and says a horse or a trolley is the most convenient way to get the car home, as it is heavy to push. When one blows off the boiler, one is surprised at the amount of water left after the gauge glass is quite empty. If the glass is blown through regularly, and if it is noticed whether it rises quickly again to the same level, and also if it rises and falls according to the level of the road, there is not much risk. In addition, after being out a short time the action of the pump, which is very variable, is soon noticed, and you can very soon say where the water should be without looking at the gauge glass. My glass has several times tried to fur up; but, noticing it every day, one takes care to get rid of the grit and blow it through on to the road, if you have any doubt. A funny incident happened one day, when I pumped the boiler full of water until it was relieved by the safety valve, although the glass was quite empty. The cock at the bottom of the water column was leaking rather badly, and the water became lower and lower in the glass until it disappeared. It was in a crowded neighbourhood, and I dare not blow it through thoroughly on account of the noise. Then, of course, the glass filled with a rush, and I appreciated what was the matter. The water dripping away gradually had become replaced with steam, and upset the relations of gravity. Fortunately the water in my district is not given to priming, and I continued my way with the boiler full to the throttle, without knocking off a cylinder cover.

The Firebox.—This has been cleaned four times, and about a dozen tubes have been replaced. I have had no trouble with lighting back, but considerable trouble with blowing out; in fact, on a windy day we have had it blown out about eighteen to twenty times in a morning. This, of course, only happens when it is cut down, and very seldom when running. For a short time after the automatic cut out had been cleaned I had a trouble that we kept on making too much steam when standing, the safety-valve blowing off at about 250 lbs. This necessitated the fire being turned out to prevent frightening horses, if I had to pay a protracted visit.

The Torch, or vapouriser, has given no trouble, and I am using the original one purchased with the car.

The Engine.—My first trouble was a rather curious one. I had left the car one afternoon in perfect order at a coach-builder's to have some varnishing done, and two days later, on taking it, steam was raised in the ordinary manner and a careful start was made; but after a few feet the car came up dead, and did the same going backwards. I stepped down and found the pump lever broken and wedged against the frame. How it was caused I am not at all clear, but possibly a slight frost—it was in the winter—froze the pump ram, and the men pushed the car until something gave way. It had twisted the left-hand connecting-rod, but there was no other damage. I had the connecting-rod straightened, and came home with the hand pump.

My next trouble was an unpleasant one; one of the cranks became loose on the crank axle, and this had reacted on the whole engine, causing the little ends to wear, and making the engine knock badly. I largely attribute this trouble to the fact that the crankshaft revolves in ball bearings, which, although they never seize, are very difficult to adjust properly. I have since—in July last—replaced them with plain bearings of phosphor bronze, and these run beautifully. Although the ball-bearing big ends of the connecting rod have given no trouble, I must say I should prefer the ordinary split-bush. The slide-bars and piston-rods are in perfect condition, as so also are the interior of the cylinders. In these small engines lubrication is everything, and my engine gets plenty everywhere.

Recently the steam-chest and the left cylinder cover commenced blowing, but these were easily repacked.

Pump and Water Connection.—Excepting for the one pump lever mentioned above, the pump has given little trouble; but it is surprising how variable it is. One day it will feed well, other days it will hardly maintain the water level. A very trivial change puts matters right—a slight adjustment of the gland or cleaning of the bye-pass. It has only required re-packing once. Two months ago the water connections leaked badly and for several days we had to screw down the top clack to keep the water in the boiler when we were standing. This was cured by taking down the delivery pipes and connections and sweating them with solder.

Wheels.—These, themselves, have given no trouble except one broken spoke of the left driving-wheel, which was easily replaced without removing the tyre; but I have had considerable trouble owing to their becoming loose on the axles, causing the engine to "snatch" when starting.

Back Wheel Bearings.—I have worn out a number of cones, four pairs of external ones and two internal ones. The lubrication here is very poor and many cones, when removed, were quite dry. Since I have had two large sight feed lubricators fixed on the back axle; they have worn much better. The front wheels have only had one new cone apiece.

Differential Gear.—This has been taken down twice, and except for a little slackness is wearing well.

Chain.—This at times has been troublesome, and after about 2000 miles came off, but was easily put on again. About a month ago it broke on a steep hill; fortunately I was prepared for such a contingency, and my companion jumped down with a scotch and prevented our rolling backwards. I replaced the link on the road, and we worked our way home safely. Now I have a new chain, and up to the present—about 250 miles—have had no trouble.

Tyres.—On the whole, I have been very fortunate. In my year's work I have had four new tyres, one of which has never been on the car. The punctures arose from a nail in one case and flints in the others. It is interesting to note that the front tyres have never punctured, and it is the near driving wheel that suffers most.

Consumption of Petrol.—The total consumption in twelve months is about 400 gallons for 3000 miles. If there is much standing or waiting it goes as high as five miles per gallon; but I have easily done forty miles on the one tank of 3¼ gallons.

Other stores used are as follows:—*Cylinder oil*, 9 gallons; *lubricating oil*, 2 gallons; *waste*, 14 lbs. Allowing a depreciation of 33 per cent. on the car, and putting all costs and expenses to the revenue account, the total expenditure for the year is about £10 less than for my brother's horse and carriage; and, as a further advantage, I can easily travel, say, seven miles out and home, fourteen miles in all, in a morning to visit a patient, a prohibitive distance with a horse-drawn vehicle, especially if several other calls are to be made during the day. Altogether, I think a steam car is especially suited to my purpose, and is much preferable to any petrol car. Of course, the later Locomobile steam cars are much improved in construction, the makers having profited by experience, and the total expenditure for repairs, which has been high in my case and solely due to defects in design, and not of principle, should with the new pattern Locomobiles be much reduced.

THE AERONAUTICAL INSTITUTE AND CLUB.—At the monthly general meeting, held at St. Bride's Foundation Institute, on Friday, November 7th, it was proposed that a Board of Aerostation should be established to survey airships and other contrivances, which may be built to navigate the atmosphere, which should have power to issue certificates if the craft are well built, and supplied with efficient means of preventing disaster in the event of breakdown, or collapse of buoyancy apparatus. Dr. Barton also suggested that certificates should also be issued to properly qualified aeronauts. A paper was then read by Mr. O. C. Field, entitled "Airship Disasters, and the Factor of Safety." In the course of his paper Mr. Field suggested that the Institute should organise a series of parachute contests at the Exhibition which the Aeronautical Institute and Club propose holding in 1903, the slowest in descent to be declared the winner. He remarked that a great deal of useful information would be obtained. Mr. E. C. Dwyer then read a paper entitled "The Inventor and the Flying Machine." Amongst other items he called attention to the great amount of money wasted in patenting useless inventions.—Hon. Sec., O. C. FIELD, 20, Adelaide Road, Brockley, S.E.

The Editor's Page.

OUR next issue will commence a new volume, and will be the first of the weekly series. It will be published on Thursday, January 1st, and we may here say that in future the issues will be published on the actual days for which they are dated, and not several days beforehand, as has been the case hitherto. The old arrangement was a convenience from a publishing point of view, as it enabled the wholesale agents to distribute the paper at the same time as other monthly or semi-monthly magazines. The need for this will not apply to the weekly issues, so that readers will please note that the paper for the future will be on sale regularly every Thursday. One minor advantage of the weekly issue will be the greater promptitude with which prepaid advertisements for the sale column can be inserted, and we hope to be able to insert all such advertisements received not later than Monday morning's post in the following Thursday's issue. For readers who wish to effect prompt sales of any goods they may have for disposal, this will be a decided improvement over former arrangements.

* * *

The January 1st issue will be a good one, and there will be a run on it, so order early from your agent if you don't wish to be disappointed. We are going to present the best plate we have so far given—a coloured working drawing of a model undertype compound engine and boiler. This has been specially designed by Mr. Henry Greenly, who will also contribute a series of articles giving full details and description of this model. It is quite a novelty as far as models go, for we have described nothing like it in our pages before, and it will make up into one of the handsomest and best-working model stationary engines that can be built. Several new features will be introduced into the contents of the journal, and altogether a splendid start for the weekly series will be made. We would repeat our caution, and we feel sure it is a necessary one—order it early.

* * *

THE MODEL ENGINEER will not be the only journal of interest to our readers which will strike out on more vigorous lines in the New Year, for our contemporary, the *Locomotive Magazine*, is also to become a weekly. We understand that the change is mainly due to the large amount of interesting matter which at present is crowded out of its pages, but for which a weekly issue would provide sufficient space. The *Locomotive Magazine* and its Editor, Mr. Moore, are favourites with all who take an interest in the progress of the iron steed, and we offer our hearty good wishes for success in their new departure.

* * *

Our Competition No. 22, for the best design for a design for a model flying machine, has proved a comparative failure, none of the entries really fulfilling the requirements we had in view, and, indeed, most of them were nothing more than crude suggestions of something which might be made and might or might not work. Only two competitors seem to have reached the point of actual trials of their designs, and even they admit that their experiments have not been complete. Their drawings and descriptions, however, are more fully worked out than any of the others, and, while we do not feel justified in awarding the full amount of the prizes originally offered, we have decided to give a consolation prize of the value of 10s. 6d. each to the two competitors, whose names are as follows:—Mr. F. B. SCOFFHAM, Handsworth, Birmingham; Mr. DAVID SHANNON, Govan, Glasgow. We shall probably publish their designs a little later on.

* * *

J. R. D. G. (Bedford) writes: "I have read your quotations from the voting post-cards with great interest, and, if you will allow me, would like to add my opinion on the subject. I see no reason to suppress any article as long as it comes within the scope of model engineering, but I cannot agree, for instance, with your correspondent who 'would like more about motor bicycles!' It seems to me that this is a subject that is very fully dealt with elsewhere and that to fill up the model maker's only 'Guide, Philosopher, and Friend' with a subject that is not a *model* in any way, is a very serious mistake. Those readers who can afford to build a motor-car can well afford to get one of the numerous journals that specialise in this subject, instead of crowding out the valuable articles that are the monopoly of the *M.E.*, and *cannot be got elsewhere*. Now to another, and, in my opinion, a very vital point, to which I would like to call the editorial attention, namely, the undue prominence that is being given to large models of all types. Not one reader in a hundred builds a ⅞-in. Dunalastair, or 1-in. Tilbury and Southend, while your Query Column testifies to the great number who make the smaller scales. It is this latter class (the majority, by the way) that I should like to see better catered for. Model yachting has lost a lot of its popularity, owing to the great size of boats now in favour with the principal clubs, and I should be sorry to see model engineering affected in the same way. I am not protesting against the standard adopted by the London Society in any way—they fixed that to suit themselves—but the great majority of your readers don't belong to the Society, and cannot afford these large models. In consequence, they waste valuable time either in adapting your drawings to suit themselves, or in writing to your Query Column. I think the range of your articles is very good, and could hardly be improved upon, with the above exception, and I only hope that the weekly numbers will prove as successful to you as it is certain to be profitable to us. I must apologise for troubling you, but as I am going abroad (Burma) immediately, I thought you would not mind my encroaching on your space for once. I might say that the *M.E.* is already known and appreciated in Rangoon."

* * *

We think the writer of the foregoing kindly worded criticisms somewhat misinterprets the scope of THE MODEL ENGINEER, when he stipulates that we should deal with models, and models only. Our view of this point is that we are justified in describing in our pages anything of a mechanical or electrical nature which we think likely to be of interest, and which is within the powers of our readers to make. The construction of a motor bicycle requires no larger nor more elaborate workshop plant than does many a model engine, and we know for a fact that many hundreds of our readers are, or have been, engaged in making motor cycles. If we limited ourselves to dealing with *models* only, we should have to leave out many interesting and useful things, such as tools, small steam-engines and dynamos for actual work, and many kinds of mechanical and electrical apparatus which cannot be classed under this heading. We regard model engineering as really being small power engineering, and this we believe to be the wiser and more generally acceptable view. Whether we err on the side of describing too many large models, as our correspondent suggests, is a matter on which we are open to conviction, and we should be glad to have the views of other readers on this point. We think, however, that a glance through our back issues will show that the smaller kinds of models have not been unduly neglected.

* * *

"R. W." (Montreal) writes:—"Your postal, replied to in the affirmative, very emphatically so, mailed today. Your space for remarks I find too confined, however, to hold all I would say; and, first, there is nothing like the facility here for purchasing model castings, while the number of places where one may buy castings and fittings in England is enough to make our Colonial mouths water. Not all of us know what, if any, parcels post facilities exist, nor what the probable cost for railway, and the duty payable here (for instance) would amount to. Print in some conspicuous place the rates and approximate duties; and encourage your far-off kin, here and elsewhere. Again, it seems to me your manufacturers are most penny-wise and pound-foolish! Take any American firm. A postal card mailed to them will bring by return post a catalogue, properly illustrated, and often a work of art, for the asking. Does it pay them? Would they say it did if it did not? They are not in business for their health. Who is going to the bother of getting a special postal money order for a paltry 3, 10, or 20 cents? We cannot send stamps; they are useless to you in England, and so we do not bother. I do wish, for old England's sake, your manufacturers in all branches, would send once a year or so, some younger member of the firm to spend three or four months on this side, and grasp the fact that the public, always lazy, or perhaps, liking to be catered to, will deal with those aiming to please, and will often go by those possessing, perhaps better goods, but lacking *push*. If the trade, colonial or foreign, wants their goods done up in pink tissue paper, or red shavings, or tied with pale blue baby ribbon, for goodness sake let them have it so, or any other foolish way, so they be pleased. Those ordering know the trade they have to cater to and compete with better than a manufacturer thousands of miles away, and yet one hears the complaints on all sides, 'Oh, it's no use kicking; that's the only way they will send it (or pack it, or make it), and there's an end of it.' Now, some wide-awake manufacturer, make a contract with THE MODEL ENGINEER, insert a well gotten-up flyleaf, with particulars applicable to each Colony. Cry your wares in a clear tone and nice language, so all may understand, and see if it do not pay! I hold no brief for THE MODEL ENGINEER. I am simply asking for what I want, and, I think, hundreds besides me want."

Answers to Correspondents.

G. IVANENKO (St. Petersburg).—Thank you for your post-card vote. Our publishers report that your name does not appear in their list of subscribers, so they cannot send the missing number you refer to. To whom did you send your subscription?

HARMONOGRAPHS.—We are indebted to several correspondents for particulars of harmonographs they have made, or of descriptions of these instruments which have appeared in this journal. We hope to combine the matter sent to us into one article dealing with the subject.

A. H. B. (London, E.C.).—Thanks for cutting from *New York Herald*. The model railway appears to be similar to other miniature American railways, which we have previously described. Glad you are pleased with the progress of the Society of Model Engineers.

Prize Competitions.

Competition No. 29.—A Prize of £2 2s is offered for the best article on "SCREWS AND SCREWING TACKLE FOR MODEL ENGINEERS." This should describe the characteristics of the threads in general use for small work, such as the Whitworth thread, the B.A. thread, pipe threads, &c., and should point out the advantages or disadvantages of each from the model-maker's point of view. Suggestions should be made as to the best class of thread to be used for various purposes, and hints on the most suitable screwing tackle—home-made or otherwise—should be given. The closing date for this Competition is January 1st, 1903.

Competition No. 30.—A Prize of £2 2s. is offered for the best article on "SOME TOOLS I HAVE MADE." This should deal with the various bench or lathe tools the competitor has made either for general or special use, and should describe clearly how each tool was made. Dimensioned sketches of each should be given. The closing date for this Competition is January 1st, 1903.

Competition No. 31.—A Prize of £2 2s. is offered for the best article on "EXPERIMENTS WITH INDUCTION COILS." This should be written on the assumption that the reader possesses an induction coil of moderate power, and desires to know to what uses it can be put. Sketches or diagrams should be given where necessary. The closing date for this Competition is January 15th, 1903.

Competition No. 32.—A Prize of £2 2s. is offered for the best design for "A MODEL STEAM TURBINE." In setting this subject we realise that we are setting a problem of some difficulty, but we believe many of our readers are equal to getting out a design for a workable model. The model should be reasonably simple in construction, and should be capable of being turned to some useful purpose, such as propelling a model steamer or driving a small dynamo. Full working drawings, with dimensions, should be given, and a written description sufficient to clearly explain same should accompany each design. The closing date for this Competition is January 15th, 1903.

For the general conditions governing the above Competitions please see page 236 of our issue for Nov. 15th.

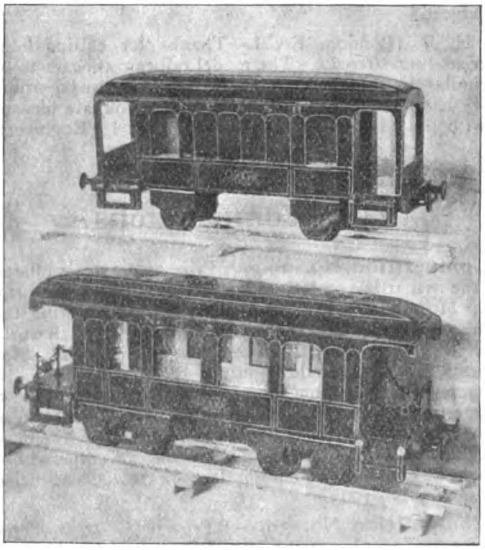
Practical Letters from Our Readers.

[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 Carriages.

TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—I have now completed the 1¾-in. gauge model Pullman car, in the making of which you so kindly gave me advice, and I herewith send you rough photos of same, also a four-wheel van.



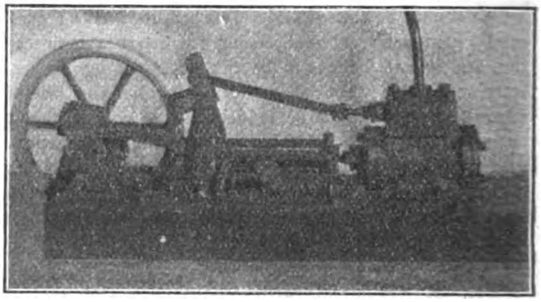
The style, &c., I obtained from THE MODEL ENGINEER January 1st, 1901, in which is illustrated the model Pullman car built by Mr. H. Soper, the only difference mine has four wheel bogies instead of six.—Yours faithfully, A. T. TOWLE.
Nottingham.

A Model Horizontal Engine with Joy Valve Gear.

TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—I herewith enclose you photograph and particulars of a model horizontal engine, which I made throughout entirely without the use of a lathe. The cylinder, which is 1 in. by ½ in., was built up from drawn brass tube, the slide-bars from drawn brass rod, ¼ in. by ⅛ in. and 2 ins. long, separated at each end by ¼ in. pieces, and are packed up to centre of cylinder by cross-pieces, the front ones nearest crank being cut out to clear connecting-rod. The crosshead was cut from a piece of scrap brass, and filed to fit between the guides; the bearings were made from drawn brass rod, ½ in. square, and cut to size; they are slit and secured by screws. The connecting-rod was made from a piece of ¼ in. diameter brass rod, filed flat on both sides, and screwed into crank-head. The crank itself is of the built up type; the webs are made from 7-16ths in. by 3-16ths-in. iron, the shaft from 3-16ths-in. steel.

The most novel feature of this type of engine is the valve gear, which is Joy's system, being worked with levers from connecting-rod, the links being straight in-



MODEL HORIZONTAL ENGINE WITH JOY'S VALVE GEAR.

stead of curved. I built it on this engine with the idea of testing it on a small model, and with a view to adopting it on a model loco, and it answers admirably, although no part of this engine is machine made, and no castings are used. It will run at great speed without flywheel. The illustration is a little more than one-third full size.—Yours faithfully, CHARLES R. WESTCOTT.
Tollington Park.

Model Steam Travelling Crane.

TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—I should like to offer a friendly criticism in reference to Mr. Shannon's steam crane.

Without much alteration in the surroundings, a boiler of 4 ins. diameter and 7 ins. high could easily be fixed on the crane, and not spoil the proportion, the firebox being 3½ ins. at the base and 3 ins. at the top, still remaining 3 ins. high. Thirty ¼-in. tubes, 3¼ ins. long, fitted between firebox and smokebox, could be used. In the smokebox, which would be ¾ in. deep, a steam-pipe could be coiled to act as a baffler and super-heater. This would do away with the steam receiver, which must cool the steam, and yet the connections could be made without perforating the boiler any more.

As the crane is built with the standard gauge, it will naturally be used on the ordinary track with the other rolling-stock. The crane will have to pass over points and crossings; how can it do this with the tooth-wheel on the axle being of greater diameter than the flanged wheels?

Below are the dimensions for a set of gearing wheels, which will allow it to pass over the points—a great consideration. Pinion, twenty teeth, diameter of pitch circle ·795, or nearly 13-16ths in. Wheel on axle, fifty-six teeth, diameter of pitch circle 2·224, or 2 7-32nds ins.—Yours truly, R. J. H.
Solihull.

CUTTING CARBONS.—Battery or other carbons can be cut with a handsaw moistened with water, or by making a deep scratch and breaking on the scratch.

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, *37 & 38, Temple House, Tallis Street, London, E.C.]*

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

[7379] **Energy, and Where it Goes to.** W. H. T. (Southsea) writes: (1) I would be very much obliged to you if you would tell me where all the energy is going to when the terminals of a dynamo in motion are not connected by any means whatever. (2) I should also be obliged if you could tell me if any current passes through a transformer when there is no current being drawn from the secondary windings, and if transformers are always coupled in parallel? (3) If no current passes through a transformer when there is no current being drawn from the secondary winding, why isn't there?

(1) As we cannot go to any length in these columns explaining away your trouble, we advise you to peruse, first of all, any elementary text-book dealing with electrical matters in order to get a firm grasp of the first principles of that science. Briefly, we might say, that so long as the terminals of a dynamo are not connected up, there can be no current flowing, and therefore no energy is being spent in producing a current. It is obvious, then, the only work the engine can be doing is the work necessarily expended on driving itself and rotating the armature of the dynamo. Under these circumstances, the set is said to be running "light." When the terminals are connected and a current is caused to flow through either lamps or motors, thus doing work—in the lamps visible in the form of light, and in motors apparent by the motion of the machinery or tram-cars they are used to drive—a load is said to be put upon the set, which load may be great or small in proportion to the amount of current consumed by the lamps and motors in circuit. The engine is fitted with a governor, which automatically regulates the supply of steam admitted to the cylinders. Thus, when the load comes on, and tends to stop the rotation of the armature and engine, the speed would be reduced somewhat, but simultaneously, the governor admits more steam to cylinder, and the speed is kept practically constant. A most convincing demonstration of the forgoing facts is afforded by observing a gas engine when it is driving a dynamo. Should such an opportunity ever present itself to you, keep your eye on the governor when some lamps are being switched on. In the ordinary way, when simply driving the dynamo light, the gas valve will be opened once in every five cycles (*i.e.*, in every ten revolutions of the crank, supposing it to work on the "Otto" cycle); but, when the lamps are in, the same valve will be opened many times in succession, and if the engine be fully loaded, the gas valve will be opened every time when the engine develops its full power for as long as the same load is kept on the dynamo. Still keeping your eye on the governor, observe what happens when the lamps are switched off, a few at a time, at intervals of, say, two minutes. Gradually, the engine will begin to "cut-out" that is, will fail to open the valve, and as the load is taken off, the engine will cut out more and more, until, finally, when all the load is off and the original conditions of working restored, you will find the power required to drive the dynamo is still what it was to start with, viz., one useful stroke out of five idle ones. We hope you will see from this short explanation "where all the energy is going to," etc. (2) Yes; a certain amount of energy is spent in the primary in rotating the transformer. Not necessarily. (3) We really do not know.

[7287] **Sac Leclanche.** J. G. (Shettleston) writes: Some time ago I purchased six small sac cells. They are new and well made. I charged them with 1 oz. sal ammoniac to each cell, and they worked capitally. I used them for lighting an 8-volt lamp intermittently. By a mistake the lamp was kept lighted for about half-an-hour. Since that happened I have washed them out and re-charged, but can only get 4 volts from the six cells. There appears to be a crystallisation round the cloth covering the element. Kindly say how this can be remedied, so that they will be of their original strength.

From what you say, we cannot attribute the failure of your cells to any one cause. Provided you have replaced the zincs and electrolyte in good working condition you should have no trouble. See that all the connections are perfectly sound and clean, and also that the electrolyte is a saturated solution of ammonium chloride. If necessary the canvas may be taken off, and the carbon and manganese oxide replaced in a fresh piece. You will probably get to the bottom of your trouble with a little careful observation and experimenting.

[7149] **Supply of Materials.** A. G. P. (Sennen), writes: Will you kindly give the addresses of several firms who can supply hexagon steel and brass for making nuts for model work at a moderate price?

You ought to be able to get this at most material warehouses, and we can recommend Messrs. Cotton and Johnson, 14, Gerrard Street Soho W.

[7083] **Steam Engine Queries.** F. H. S. (Rochdale) writes: I should be very much obliged if you could give me dimensions and a sketch for a vertical boiler. (1) It is intended to drive a horizontal engine, cylinder 2½ ins. bore, 7 ins. stroke; steam ports in cylinder are oblong, and measure ¾ in. by 3-16ths ins. (2) Please say what pressure boiler would have to work at. (3) What power would be given from engine, with suitable boiler? Engine to go between 200 and 300 revs. per minute, and to work for a fairly long time at once.

(1) An engine with a cylinder 2½ ins. diam. by 7 ins. stroke, working at 250 revs. per minute, and 30 lbs. pressure of steam would consume about 20 cubic ins. of water per minute. A boiler with about 1,800 sq. ins. of heating surface would be required. The ports are rather small, but we do not anticipate much wiredrawing of steam, or a material back pressure from this cause. (2) About ½ to ⅔ h.-p., according to excellence of construction of engine. (3) You may use a steel vertical boiler of about 3 ft. high, and 18 ins. diam., of much the same design as that on page 35 of "Model Boiler-Making" (price 7d., post free), but with about twenty 1¼-in. tubes, which may be expanded in at either end. If you are not going to make a boiler yourself, or should you want parts and materials, we can recommend our advertiser, Mr. T. Goodhand, of 38, Paget Street, New Brompton, Kent, for boilers of this class.

[7071] **Pump for Steam Boiler.** N. N. H. (Southport) writes: I should be much obliged if you would give me some assistance in the following matter. I have a model horizontal engine, 1½-in. bore, by 2-in. stroke, running 500 revs. a minute at 50 lbs. pressure. The boiler is 14 ins. long by 4 ins. diam., with single flue 2 ins. diam., and fitted with fifteen cross tubes and heated with a painter's blow-lamp. This is at present supplied with water by a hand-pump ⅜ in. by 2-in. stroke. Instead of this, I wish to fit a pump driven by an eccentric on main shaft, and wish to know—(1) Could I adapt the present pump to do this, or would the bore be too big compared with stroke? If possible, what stroke should I make it? (2) In case of it not being practicable, what size pump do you advise me to fit? (3) What would be the best way of regulating the feed when the conditions of running are not those mentioned? I presume that the supply of water must be regulated between pump and check-valve into boiler and not before water enters pump.

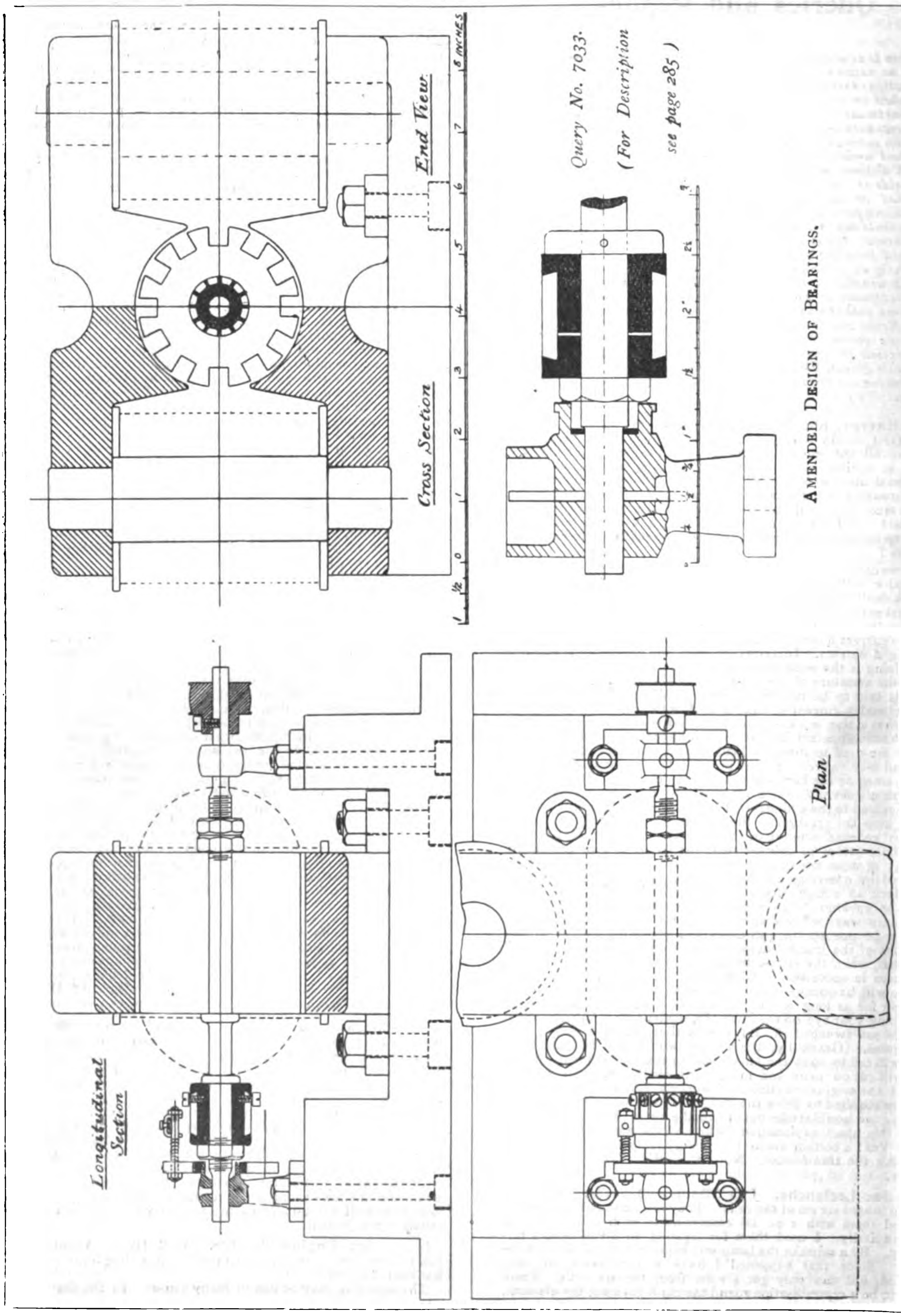
Does the boiler really keep up steam pressure of 50 lbs. when the engine is running at 500 revs. per minute? We rather doubt whether your statement is correct. With regard to the pump; keeping the plunger near to the bottom of the pump we should say that a stroke of about ½ in. would be sufficient to keep up the water supply. We are not sure whether the pump will work satisfactory at a speed of 500 strokes per minute; about 300 or 400 seems to be the maximum at which a pump will work well. To regulate the feed, you should place a very small by-pass, with a cock, on the delivery pipe between the boiler check-valve and delivery valve; adjust this cock to let by a sufficient quantity, and the pump may then be worked continuously. Until we are informed of the exact evaporation of the boiler, we could not give you a definite idea of the amount of water which will be required to be supplied. However, the matter may be easily settled by you in a few experiments.

[7064] **Methylated Spirit Vapourising Lamp.** W. B. N. (Fermanagh) writes: I should be glad if you could let me have drawings of a method of using methylated spirits in a steam spray as fuel for small model boiler, with horizontal flue. I want to know (1) shape of spray, and (2) whether pressure would be necessary in the container?

We have not heard of any methylated spirit burner in which steam is used as an atomiser. The usual way is to vapourise the spirit in the manner shown in our issue of November 15th, 1901, p. 235, and February 15th, 1902, p. 89; the latter seems to be the best burner, but in both cases the pilot lamp to ignite the flame is necessary. Methylated spirit is not like ordinary coal gas, it will not ignite of itself when issuing from a small orifice at any material speed, and therefore either baffles or pilot lamps are necessary; the latter is the most reliable arrangement.

[7 03] **Gas Engine Trouble.** A. B. (London) writes: Can you tell me how to remedy the cause of a pounding noise in a small gas engine I have?

The knocking may be due to many causes. In the first place, it

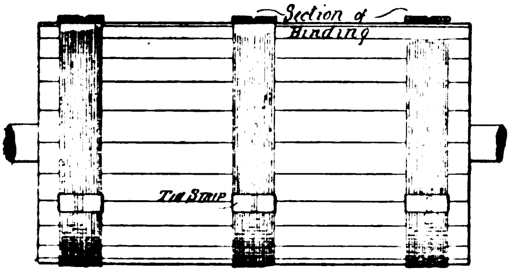


DESIGN FOR 100-WATT MANCHESTER TYPE DYNAMO.

may be sheer wear in the bearings—not the main bearings, but the crank pin or piston pin brasses, perhaps both. If the brasses have been taken up quite recently, and still the knock is heard, it is probable the piston pin itself is a bad fit in the piston, and the set screws having worked loose allow it to move. But, as a rule in the Otto cycle engines, it takes a very large amount of wear in the bearings referred to, to bring about a knock such as you describe, for the piston is under compression for three out of four strokes, the charging stroke being the only one during which the crank is pulling on the piston. If your trouble is due to wear, it is easily remedied by letting the brasses together and rounding the crank and piston pin at the same time. If this does not stop the knocking, then examine all the moving parts. Perhaps the most deceptive knock in a gas engine is the flywheel knock. The trouble can seldom be located by listening to hear where the noise comes from, as it is heard in all parts of the engine except where it originates—that is, the keyway. Take a hammer and drift (an old pulley key answers the purpose very well) and drive the flywheel key up tight. If it is found to have been loose at all, your knock will probably have disappeared when you start up again. Missing fire often causes a nasty thump, but this being an irregular and common occurrence, is detected readily. We can only offer these suggestions as you give us so little data to go upon, but if you have more trouble, we shall be pleased to assist you in any way we can.

[7033] **Dynamo (100-watt Manchester Type).** R. B. S. (York) writes: I enclose tracing of a model dynamo which I intend building. The field-magnet and armature are taken from "Small Dynamos and Motors" (No. 10 of your series of handbooks). Being quite a novice in these matters, I should be pleased if you could tell me if all parts are correctly proportioned, etc., and give me any hints or advice of use in building it. I should also like the following queries relating to it answered:—(1) Size of cylinder of gas engine to drive same at 2,500 revs., say. (2) What candle-power will be given out? Say number of 16 c.-P. H.E. lamps lit. (3) What does the "binding wire" for armature consist of, how is it put on, and what quantity is required? (4) Where can I obtain 2½ ins. laminated drum armature stampings?

We were pleased to receive your drawing and queries, and are sorry we had to hold them over till a later issue. With few excep-



METHOD OF BINDING ARMATURE.

tions, the design is very good, although the drawings showed a few slips, which, of course, would have been seen when the actual construction was taken in hand. The main bearings might be fully twice their present length, and the shaft need not be turned to ¼ in. at either end, for the more bearing surface you have—to a certain extent—the better. The insulating material in commutator should be shown in two pieces, as our sketch appended. Allow about 1-16th in. end play, and instead of reducing diameter of shaft, as you have done, leave it as full as possible, but yet allowing the locking nut to slide on. (1) As it is an 100-watt machine, the efficiency of which will not be more than 50 per cent., it will take 1-7th h.-p. + 50 per cent. of 1-7th h.-p. to drive it, which is approximately ·21 b.h.-p. or nearly ¼. We cannot say definitely the size of cylinders required for the work, as engines with the cylinders of same size develope various powers. If you have not already invested in an engine, we might caution you against getting one too small for the work. An engine well up to its work runs better, wears better, and is more economical; in fact, in every respect it is well worth a slightly greater first cost. (2) 3·5 watts per c.-p. is fairly efficient. The machine will be doing well to light two such lamps. (3) The binding may be of phosphor bronze wire, which is wound round the finished armature as shown, the proportions of tin strip and wire are greatly exaggerated for the sake of clearness. Before commencing to wind on the wire, place a few strips of tin lengthwise on the armature, and over these wind the wire. When a sufficient number of turns are on, the ends of the tin are bent over and soldered down securely, as little space as possible being taken up in order to keep the air-gap down to the minimum length. To prevent these binding wires cutting through the insulation of the conductors, a few layers of mica should be introduced between the two, although brown paper well coated with shellac would answer your requirements. (4) T. Tamblyn-Watts, of Settle, Yorks, would, we think, supply you; or the Universal Electric Supply Co., of 60 Brook Street, Chorlton-on-Medlock, Manchester.

[7375] **Accumulator.** F. D. (Liverpool) writes: I have bought a dozen accumulator grids, intending to make 4 cells (3 plates in each), 1½ to 2 ampère hours. I have pasted the positive grids with red lead and sulphuric acid, diluted with 4 parts of water. As they dried the paste swelled out, and is now something like the enclosed sketch (not reproduced). I have not put the plates in the solution of chloride of lime. (1) Should the paste be hard, because mine is just like chalk? (2) What is the cause of this swelling? (3) Could the red lead be impure, or the paste too thin? I could not succeed with the negative plates, pasting them with precipitated lead. I kept the crystals under water till I had enough formed for one grid. (4) Could I paste them with litharge, using the same positive plates? (5) How long will it take the positive and negative plates to form? (6) How can I tell when they are done? (7) Is the litharge mixed exactly as the red lead?

(1) No. Before the plates are formed they will be as you describe—like chalk in texture. (2) You may have applied the paste too wet. (3) The paste was probably too thin. (4) Yes; using the same kind of grids, we presume? (5) Some considerable time. They should be slowly charged and discharged half-a-dozen times before a good capacity will be attained. (6) By their appearance and capacity. The positive turn a chocolate brown, and the negative a light slate colour. (7) Yes.

[7368] **Dynamo.** S. J. (Buxton) writes: I have a small shunt-wound dynamo which is out of repair, so I am re-winding it. The output used to be 75 volts 10 amps., but I wish to re-wind it to give 50 volts 15 amps. The armature is the ring type wound with wire, about No. 24 or 26 in 20 sections. The field-magnet cores are of wrought iron bolted to a cast-iron yoke and screwed into the pole-pieces. The field-magnets are wound with 5,280 turns of No. 30 or 32 S.S.C. copper wire on each limb; commutator 20 parts. Could you please inform me—(1) What gauge and quantity of wire to wind on magnets or armature for output of 50 volts 15 ampères? (2) What speed should dynamo be run at? (3) Should resistance of shunt winding be 500 times the resistance of armature? Below I give general dimensions: Armature, 3½ diam. 1⅝ ins. wide; field-magnet cores, 1½ ins. diam. 2¾ ins. long; bobbins, 2⅜ ins. diam. 2⅛ ins. long; armature tunnel, 3⅜ ins. diam. 1½ ins. long; commutator, 1½ ins. diam. ¾ in. wide, 20 bars. I give a rough sketch of dynamo on separate paper.

We fail to see how the output of your machine could have been 75 volts by 10 amps., if the dimensions are such as you have stated. (1) The windings suitable for a machine of your size would be 18 ozs. No. 22 on armature (ring) and 2¾ lbs. No. 24 on fields. (2) About 2,400 revs. per minute. (3) No.

[7595] **Microphones.** S. W. F. (Sevenoaks) writes: I do not quite understand how the connections are made with the battery in the Fig. 5 Locht Labye's panelephone described in MODEL ENGINEER "Telephones and Microphones." Perhaps you will kindly give me this information.

The wires at the top of Fig. 5 are taken to the receiver. Another wire is taken from the bent brass strip or plate at bottom of Fig. 5 to the battery; the battery and receiver are connected together.

Amateur's Supplies.

[*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.*

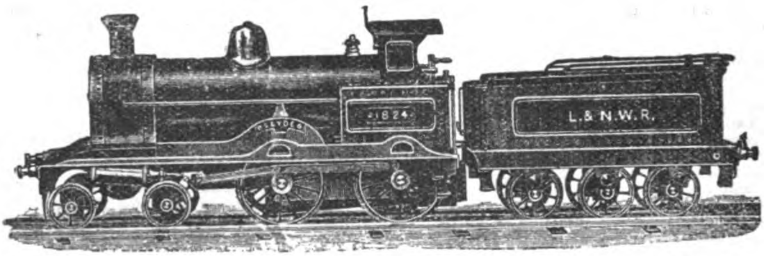
**Reviews distinguished by the asterisk have been based on actual editorial inspection of the goods noticed.*]

*New Stock for Model Railways.

Messrs. Bassett-Lowke & Co., 20, Kingswell Street, Northampton, have sent us a sample of the new G.N.R. 2½ in. gauge model locomotive, which as we mentioned in our issue of November 15th, is illustrated in their new catalogue, although the model received by us has not got quite the same smokebox plating. We have tested this engine under steam, but cannot say very much about its capabilities, owing to the small amount of track we were able to lay down. The special features are that the framing and super-structure are castings instead of being built up from tin plate and sheet iron, and a species of link motion is fitted, reversing from the cab. The regulator is in the smokebox, worked also from the cab, and no steam pipes are visible. The fuel (which is methylated spirit) is carried in the tender. To negotiate the sharp curves, the trailing wheels are fixed to a pony truck. Where larger curves are available, these wheels would be better if made rigid. A smaller (2-in. gauge) G.N.R. engine has also been sent us, but this is not so close a representation of the prototype, and is constructed similarly to the "Pilot" and "Black Prince" locomotives. It has the regulator whistle, etc., on top of boiler and the steam pipes are outside. The general finish of both the G.N.R. engines is good. We have had the opportunity of inspecting a model Goods Brake Van for 2¼ ins. gauge, which is a very good miniature of the vehicle it is intended to represent.

*** Supplies for Model Engineers and Yachtsmen.**

The Clyde Model Dockyard, Argyll Arcade, Glasgow, have sent us their new catalogue, which is a very good production of some sixty-five pages, including—besides the specialities the name of the firm indicates that they supply—electrical novelties, dynamos, motors—several of which are suitable for small boats—batteries, lamps, model steamboats, model cannons. The steam engine section is well filled with model marine, stationary, and locomotive engines of all kinds, among which may be particularly mentioned steam fire engines, reversible vertical oscillating engines, model beam engines. We have received one of the 7/6 brass four-wheeled oscillating cylinder locomotives No. 6, and had the same running. This engine, of its class, is good, well made, the bright parts being well finished. Model railway track signals and carriages are listed, and also model engine parts and boiler fittings. Model yachts are,



Model L.N.W.R. Locomotive, Supplied by the Clyde Model Dockyard.

of course, well represented in this catalogue, and the sample we had sent to us for examination—a 21-in. racing model—seems excellent value for the price charged. Model boat fittings occupy several pages of the catalogue, and comprise blocks and cleats, flags, mast caps, binnacles, ships' boats, anchors, windlasses, rigging cord, skylights, companions, and ventilators. The model L.N.W.R. engine depicted above is one of the latest productions of the Clyde Model Dockyard, full particulars of which will be found in the catalogue. We have not seen this model, and therefore cannot give our readers any opinion upon it. The list will be sent to any reader for 4d., post free.

Change of Address.

Will our electrical readers and others please note that Mr. T. W. Thompson (late of 73, Trafalgar Road) has removed to larger premises at 28, Deptford Bridge, Greenwich, London, S.E., where he will continue to make and supply his "Greenwich" dynamos and motors and other electrical apparatus?

Shop Improvements.

We notice that Messrs. Whitneys establishment at 117, City Road, has recently undergone some extensive alterations. The front and show windows have been entirely reconstructed, and they are now exhibiting much more advantageously the many model engines and electrical specialities which they make and sell, giving the intending purchaser some better idea of the multiplicity of articles which they stock.

***For Amateur Photographers.**

The *Photogram* Effingham House, Arundel Street, Strand, send us a set of their (new edition) "photogram" cards, upon which the following useful tables and information are given:—Guide to correct exposure in out-door work. Table of enlargements and reduction telephoto rules. Directions and chart for fixing the time of best lighting of any view. Thermometer scale and photographic temperatures. Weights and measures (British and metric). How to see stereoscopic slides without a stereoscope. A set of the cards will be sent to any reader of The Model Engineer for 1d., post free.

Catalogues Received.

P. Pitman, 64, Stanley Road, Halifax, sends us his latest lists, in which particulars of his well-known "Hector" water motors are given. There are many purposes, where the necessary pressure is available, for which water motors are useful, viz., driving dynamos and small industrial machines, such as bottle washers, lapidary wheels, coffee mills, and for organ blowing. Mr. Pitman also supplies air propellers for ventilating dynamos, etc. List, price 1d., post free.

Norris & Henty, 87, Queen Victoria Street, E.C.—Amongst the many makes of small gas engines, the Gardner engines take a high rank, and the splendid list sent to us by Messrs. Norris and Henty illustrates and describes various types and sizes of both Gardner gas and oil engines. Several pages of the list are devoted to the general consideration of the uses and advantages of these motors. The engines catalogued range from 1 to 20 brake horse-power. List post free, 2d.

Wiles' Bazaar, 36 and 38 Market Street, Manchester, send us their supplementary list of model steam engines, locomotives, and signals. This also includes various table tennis sets and sundries. Price 1d., post free.

Lever Brothers, 101, Dawes Road, Fulham.—We have received this firm's list of accumulators and other electrical supplies. The catalogue includes prices and particulars of ignition coils, volt and ampère meters, motor car, pocket, and other accumulators, lamps, etc. Messrs. Lever Brothers will charge accumulators, and for that purpose have branches at Wimbledon and Sherwood Street, Piccadilly Circus, W.C. Full particulars are given in the various sections of the list. Price 2d., post free.

Fred. W. Martin, Waukegan, nr. Chicago, Illinois, U.S.A.—We have received a few particulars from Mr. Martin, who has started a comparatively new departure in boat building, whereby the amateur builder may obtain the parts of a small boat, launch, or yacht involving the most difficult construction, viz., the frame, packed and delivered free on railway anywhere in the United States. We see in the leaflet sent photographs of a frame, with deck frame built up ready to "knock down," the latter "knocked down" and packed, and in another picture the whole boat served in a like manner. Mr. Martin's success in this field has, he states, enabled him to get out in addition to his "knock down" boats, designs to scale, loft drawings and full size moulds for the amateur's use. With the exception of the keel in larger boats the whole of his "knock down" frames are sent ready for re-erection. Mr. Martin issues a little volume (144 pages) showing many designs of craft of all kinds, and the construction of his "knock down" frames which can be had for 4s. 2d. (1 dol.), the price of which will be returned to any customer. Readers interested will kindly communicate with Mr. Martin for further particulars, remembering that a 2½d. stamp per half-ounce is the rate of postage to America.

The Frasse Company, 38, Cortlandt Street, New York City, U.S.A., send us a leaflet, illustrating their new improved "Success" emery grinder, which is worked by foot power and, they say, runs at 3,000 revs. per minute, the wheel being 1¼ ins. wide by 8 ins. diam. The price is 6.50 dols., or just over 27s.

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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