THE

Model Engineer

AND

Amateur Electrician.

A Journal of Mechanics and Electricity for Amateurs and Students.

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

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A JOURNAL OF MECHANICS AND ELECTRICITY FOR AMATEURS AND STUDENTS.

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

VOL. VI. No. 64. JANUARY 1, 1902 PUBLISHED TWICE MONTHLY.

The Model High-Speed Steam Yacht, "Dorothy."

By R. HUTCHISON.

THE following short description, together with photographs, will enable the readers of THE MODEL ENGINEER to form a fairly good idea of my first attempt at model boat building.

The general ideas of the *Dorothy* were taken from the famous high speed steam yacht, *Norwood*, owned by Mr. Munro, of New York, a picture of which appeared in the *Scientific American*.

The best material that I could secure for the modelling of the hull was a block of California redwood, 50 ins. long and 6 ins. square, which, when modelled, was, over all, 49 ins.; beam, 5¼ ins.; and depth, 4¼ ins., hollowed out to a thickness of ⅜ in. The covering-board is of teak, cut out, fore and aft, the planking consisting of black walnut and yellow cedar. The coaming around the well is of brass. The stem and stern posts are fitted with brass. The stem is 3-16ths in. half round wire, and the stern a flat strip extending up the stern post and along the counter in the form of a Y. To the hull a false keel is fastened. The keel is ⅜-in. square at the stern post, and tapers to meet the half round brass wire at the stem. The hull, inside, is fitted with two bulkheads, which serve the double purpose of holding up the ends of the grating, and holding down the sheet copper, with which the space for the machinery is lined. That is what I would advise anyone, who may be building model steamboats, to do, as it looks neat and clean, and, furthermore, it is easily kept so. The after cockpit has a seat running around both sides, and is fitted with a plush cushion.

A glance at the photograph, Fig. 2, showing the top and inside view, will make the arrangements of bulkheads, gratings, and all internal parts, clear. The stern tube runs right into the after bulkhead. The propeller and rudder are made of sheet brass, and soldered with pure tin, which I find is almost as strong as silver soldering for these small pieces, and it does not soften them as much as when the hard solder is used. The stanchions for the handrail were turned out of a ⅛-in. round brass rod, and the rail itself is brass spring wire.

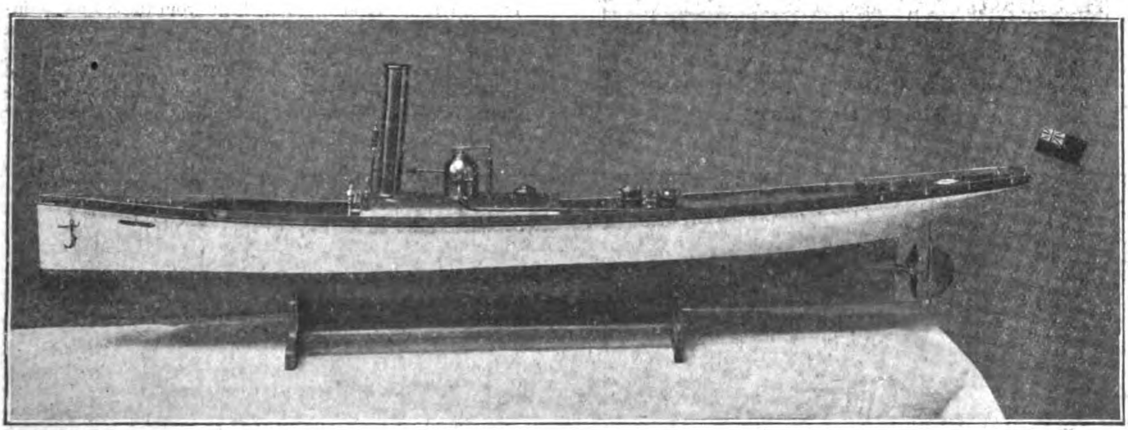
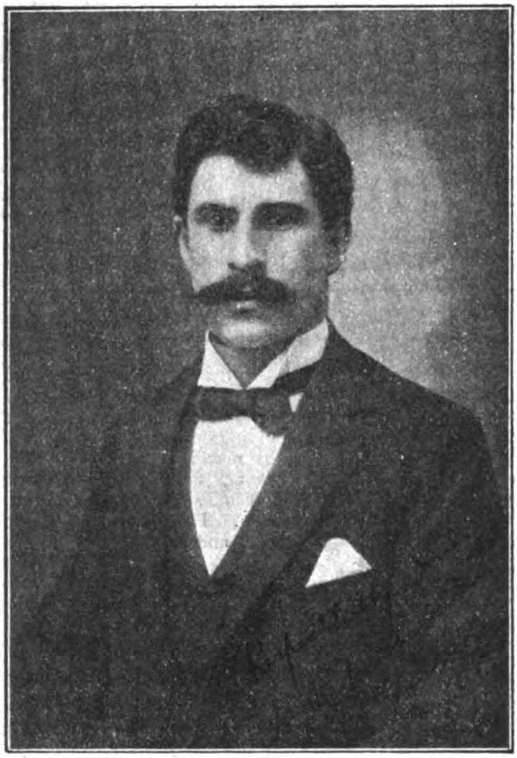


FIG. 1.—THE MODEL HIGH-SPEED STEAM YACHT, "DOROTHY."

The engines are made up from a set of Messrs. Lucas and Davis castings, ¾ in. bore and 1 in. stroke, and are too well known to need any comment or description, with the exception of the crankshaft. Regarding that I have made a slight departure in the method of building up. The crank pins and webs are in one piece, being turned out of a flat bar of mild steel, and then put on a 3·16ths in. silver steel wire shaft, and soldered, pinned, and the piece sawed out between the webs.



MR. R. HUTCHISON.

does fairly well, it is not as good a steamer as I thought it would be. As "Eos" has stated, the tubes are too straight. Of course, it is simple to construct, and, withal, a very strong type of boiler; yet I do not advise the making of one of the same type. Outside of the fires the boiler is much the same as mentioned. The method of firing the boiler, though, was what took up most of my time. I did a great amount of experimenting before I ob·ained any really satisfactory results. The spirit used is wood spirit, formed into a vapour, but not in a separate tank, as in other models. The spirit is carried beneath the forward grating in a small tank, made of copper, and is carried down to the burners through two small ⅛ in. brass tubes fitted with stop cocks, one supply tube being used for each fire. The accompanying sketch (Fig. 3) will show the construction of the burners.

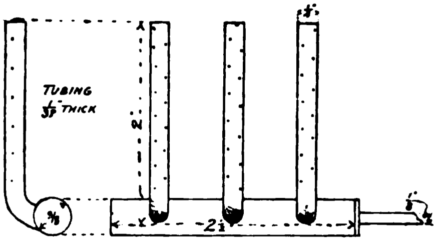


FIG. 3.—BURNERS FOR WOOD SPIRIT.

When starting the fires the tubes and branches are heated to a high degree; then the spirit is started slowly, and striking the hot tubes is formed into gas, and issues out of the twelve small holes in each branch—a little bluish flame about ⅝ in. high. When once started, they will keep the tube hot enough to keep up the supply of vapour. The heat from these fires is immense, and I have no doubt that any readers of THE MODEL ENGINEER who will try these fires, after having got into the method of handling them, will be delighted with the clean and powerful fires that they make. The boiler is covered with sheet iron, then comes an asbestos

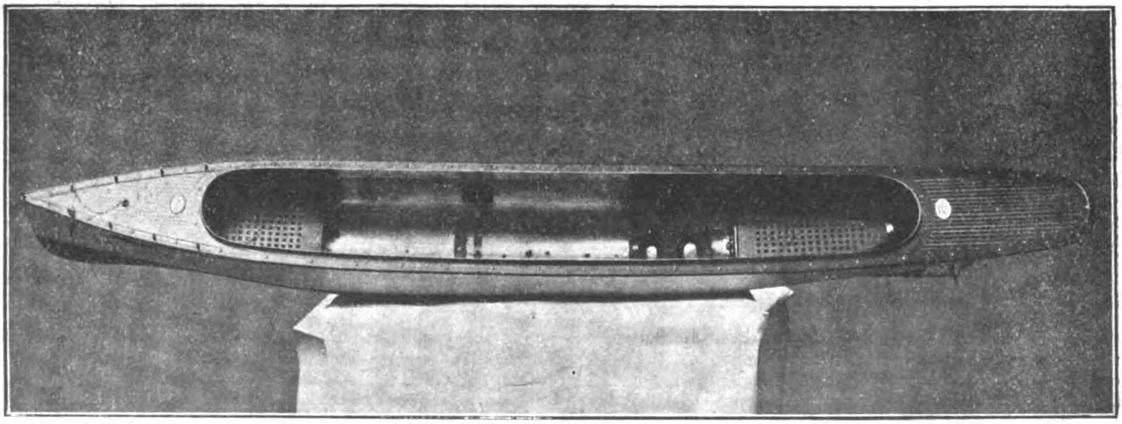


FIG. 2.—A TOP VIEW OF THE HULL OF THE MODEL STEAM YACHT, "DOROTHY."

The boiler is of the same type as the one used in the noted cruiser *Tigress*, only the main body is round, there being 12 tubes each side, ⅜ in. diameter, 3⅝ ins. long, and 1-20th in. thick. I might state that while my boiler

sheet, and over that Russian iron lagging. The fittings were supplied by Messrs. W. J. Bassett-Lowke & Co.

The accompanying photographs need little explanation—Fig. 1 clearly showing the exterior of the boat with boiler and engines fitted in working order, and Fig. 4 illustrating the boiler and engines themselves.

To conclude, a word or two regarding my experience and the lessons I have learned from the making of this model may be of considerable benefit to those who, like myself, are ever ready to profit by the experiences of others. I find, as "Eos" writes, that boats are made too fine, not having enough beam. My model, when finished, had to be fitted with a keel of lead to hold her upright, yet the proportions are right as far as scale goes; but it appears to be the same with model hulls as it is with model engines, &c. For myself, I generally take the scale as far as the size of what I want to make is consistent with the best results, making the parts in proportion so that they will look all right to the eye. As we all know, there are parts which cannot be made to scale or proportion, and be at the same time practical. For instance, a gauge glass, to work properly, has to be made entirely out of the scale and proportion. This is where the difference between a successful and an unsuccessful model maker lies. A friend of mine, residing here, has no idea whatsoever of proportion, having no judgment of his own as to the proportion of the thing he desires to construct. There is nothing too fine for him to make, however, as long as he has the sizes in front of him. Taking into consideration the distance I am away (at Victoria, British Columbia) from the source of model-making supplies, and that the lathe used was a little large for model making—being known in this country as a 14-in. swing lathe—I think that I have done fairly well. The construction of the model was completed in very good time (the time occupied being 375 leisure hours), and afforded me the greatest pleasure while I was engaged upon it. Lastly, I trust that the readers of THE MODEL ENGINEER may gather from my model making some information which may be of some benefit to them, as I have myself derived much at different times from articles appearing in that splendid little publication.

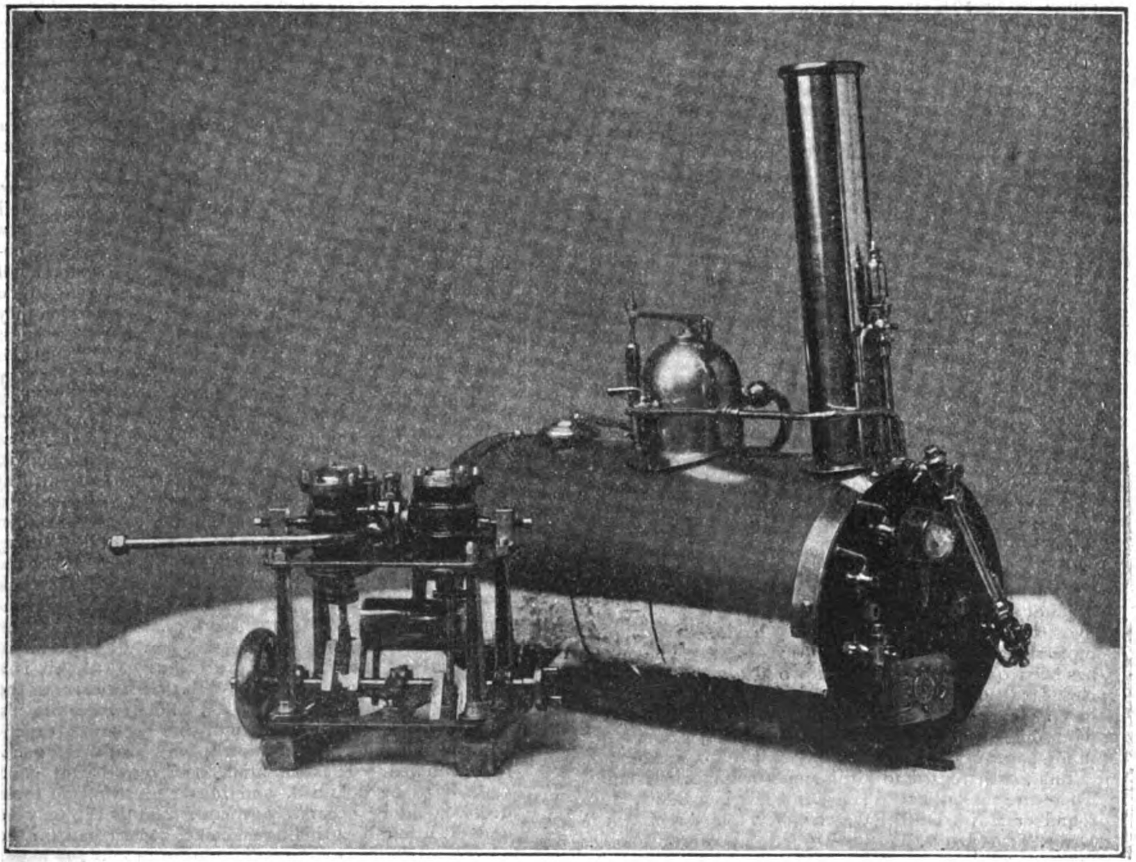


FIG. 4.—ENGINES AND BOILER FOR STEAM YACHT, "DOROTHY."

A Natural Electrolytic Deposit.

A DEPOSIT of gold on a piece of wrought iron, originally used in a mine track, and which had lain in the gutter carrying off the mine water, has been found at the Mount Lyell Mine, Tasmania. The gold was found deposited principally near three bolt holes, in the form of bright yellow plates. It was firmly attached to the iron, and had probably been deposited by the electric action of the iron-copper couple from traces of chloride in the acid mine water. No gold, however, could be detected in the water.—*Engineer.*

The Pitmaston Moor Green Model Railway.

WE have much pleasure in presenting with this issue a photograph showing a passenger train on the Pitmaston Moor Green Model Railway, near Birmingham. For this interesting picture we are indebted to the courtesy of Mr. H. C. Holder, who, with his two brothers, has been responsible for the installation and equipment of this business-like model system. The locomotives, three in number, are of the G.N.R., the G.W.R., and the American types respectively, and have over-all lengths of 9 ft., 7 ft. 5 ins., and 7 ft. 6 ins., the gauge being 10¼ ins. Anthracite coal and charcoal are used for fuel when running, steam being raised in the first instance by a gas jet lighting a layer of charcoal. Coal is added as soon as the steam-blower can be turned on. The American model locomotive which leads the way in the photograph we give, recently did a timed run over a distance of 30 yards at the rate of just under 15 miles per hour. This was done without any load behind. The same engine holds the record for the longest distance run over Mr. Holder's track, covering 15 complete laps of 303 yards each. She was then pulling two people besides the driver. We hope before long to publish a fuller account of this particularly interesting model railway, together with some further photographs which Mr. Holder has been kind enough to prepare for us.

Tools for Small Engineering Work.

By W. H. Dearden.

IN the description of tools, &c., given in this paper, which was read at a meeting of the Society of Model Engineers some little time ago, I have dealt not so much with those used for model work alone, but upon tools generally, as I am of opinion that a more general knowledge will be better adapted to suit our requirements.

As a mechanical engineer, and having been in the profession for about twenty-two years, my knowledge has been obtained by constant workshop practice and a close study of the same, and I feel confident that I have had an experience which should enable me to speak with some degree of efficiency upon the subject contained in my paper—viz., tools, such as drills, taps, rimers, etc.

First, with regard to drills and their various kinds. There are the ordinary Plain Drills, Lipped Drills, Half-round or Swiss Drills, Watchmakers' or Archimedean Drills, Twist Drills, and Pin Drills. There are also other kinds, but I think the above will suffice for the present. I will just refer to these separately, endeavouring to show how they are made.

The first consideration should be to obtain suitable steel from which to make them. This should be of the best quality cast steel. For small drills, such as those used for model work, what is known as silver steel is about the best I can recommend, it being perfectly round and straight. It is made in lengths of about 12 ins., and can be obtained almost any size. To make an ordinary Flat or Plain Drill obtain a piece of steel the required length, and a trifle smaller than the size of the drill when finished. Heat this to a blood-red, and flatten out a little longer than required, so as to allow for filing or grinding, thereby obtaining a clearance. But, if preferred, it may be filed up out of a piece of steel the right size, giving it a clearance above the cutting edges. A drill should be the same size, or parallel for a short distance up, so that it may be kept steady, and drill a more perfect hole, and so as to allow for re-grinding and still retain its diameter. Do not make the point too thick, as this adds to friction, but proportionate according to size. Most drills for metal have two similar cutting edges, in which case they are broadly distinguished from those used for wood.

The Lipped Drill is an improvement upon the ordinary plain drill, as its cutting edges are somewhat advanced, by means of a flute filed in the front face of each cutting edge. A ½-in. lipped drill, when working well, should perforate a wrought iron plate 1 in. thick, in about three-quarters of a minute. But this style of drill has also its disadvantages, as it will not admit of very much grinding.

The Half-round, or Swiss Drill, is made simply by filing away half the diameter the required distance up the piece of steel from which it is made, and only has one cutting edge, acting more as a half-round rimer than a drill.

The Watchmakers' or Archimedean Drill is made like a diamond point chisel, and will cut whichever way it is revolving, but is only suitable for small hand brace work.

The Twist Drill. These drills have of late years come much into use for drilling holes of large as well as small diameter, and they fully deserve the preference which is now generally accorded to them. These, I believe, are obtainable up to 3 ins. diameter, and as low as ·030 in., a full set of these containing about fifty-six drills. Owing to the large extent of their guiding surfaces, the holes which they produce are both superior in straightness and smoothness to those made with drills of the old patterns. The blades are made thick and strong, and are carefully cut by machinery to the form of a double-threaded spiral. This is done in a milling machine, the drill being first turned to the required diameter. It is placed in the machine at a certain angle with the cutter, which operates upon it, and, as the table travels towards the cutter, the drill at the same time revolves, thereby cutting the groove in a spiral form, instead of straight. Both sides are then backed off to within about 1-16th or so of the cutting edge, all the way along the drill for clearance. As the drill is re-ground farther back, the two cutting edges are always found at the same inclination. One very important advantage is that the shavings are forced up the spiral grooves, and the hole is thus easily kept clear of the metal cut away. With the ordinary drill this is a great hindrance to the work. With these advantages the twist drill is decidedly the best one to use, where you can obtain the size required, although they are more expensive. For rapid and good work, twist drills are generally adopted. It is essential, however, that if good work is to be obtained, and breakages avoided, these drills should be accurately ground, and this can only be done by a suitable grinding machine, constructed for the purpose; they cannot be satisfactorily ground by hand. In grinding, the following points require to be taken into account (and they may well apply to all drills). First, both cutting edges should be exactly the same length; secondly, both cutting edges should have the same clearance angle, and they should also both be equally inclined to the axis of the drill. Otherwise all the work will be done with one side of the drill, and the hole would of necessity be larger than required. I shall now proceed to deal with Pin drills.

(To be continued.)

IT is announced that from March 1st, 1902, a motor-car service of parcels post will be established between Manchester and Liverpool, the authorities having for that purpose entered into a contract with the Motor Haulage Company.

THE PITMASTON MOOR GREEN MODEL RAILWAY.

(For description see page 4.)

Two Useful Galvanometers and How to Make Them.

By "Nemo."

A SMALL detector galvanometer is of much use to the amateur who likes to do his own bell fitting, dynamo and motor building, induction coil making, &c., for testing wires for continuity or short circuits and other faults incidental to the construction and repair of electrical apparatus. The necessary parts for making either of the following instruments can readily be obtained from advertisers in THE MODEL ENGINEER. We first procure a small compass with a dial about ¾ in. diameter. These are sold as pendants for the ends of watch chains, and cost 4d. or 6d. each. A hole is bored in a piece of hard wood, which may be 1½ ins. diameter and ¾ in. thick; the hole to be of such a size that the compass is a tight fit in it, and ⅜ in. to ½ in. deeper than the thickness of the compass case. Two holes are next drilled through the side of the wood to come level with the bottom of the centre hole. These are to take the shanks of a pair of terminals—cost, about 1½d. each—the ends of which should just show through the wood on the inside of the centre hole. A short length of copper—No. 36 or 40 B.W.G., and either silk or double cotton covered—about 5 ft. long is wound in a close coil on the finger or a piece of wood about ⅝ in. diameter. The coil is now taken and twisted into a figure 8 shaped coil.

Bare the two ends of the coil, and place the wire in the centre hole of the hardwood case, soldering one end to each of the terminals. Place the compass in position, and our little instrument is completed, save for a coat of varnish to the wood case. The finished instrument may be had for about 1s. 1d. from advertisers in this journal. Fig. 1 shows a plan view of the instrument without the compass, and Fig. 2 a view of it finished.

The instrument described above will answer very well for short lengths of bell wire, &c.; but for all-round work and for indications of fair accuracy for varying current strengths, we require a rather more elaborate affair.

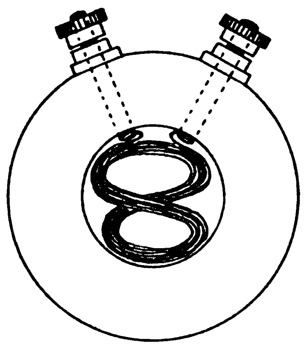


FIG. 1.

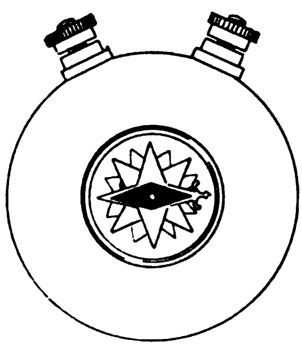


FIG. 2.

A SMALL DETECTOR GALVANOMETER.

We first take in hand the case. This is made of well-seasoned cedar, ¼ in. thick, and measures outside 3½ ins. by 3 ins. by 2 ins. in depth.

The sides may be dovetailed together, or fixed by brass corner plates let in flush with the surface of the wood (see Fig. 3). A piece of sheet brass, 3-32nds in. thick, is now cut to fit inside the case. This is for the dial plate, and should be quite flat, as one side is to be polished. To fix this plate in the case we shall require a hole in each corner to take screws screwed into the four corner pieces shown in Fig. 3. The face of the dial should be ⅜ in. below the level of the case.

The coils are wound on two formers made of thin sheet brass (see Fig. 4), which, with all the other figures (except Fig. 6, which is full size), is half size. The size of the hole through the formers is 1¼ ins. by ¼ in. wide. One flange is ¼ in. wide all round, and the other is ⅛ in. deeper on one side, and also turned up to form

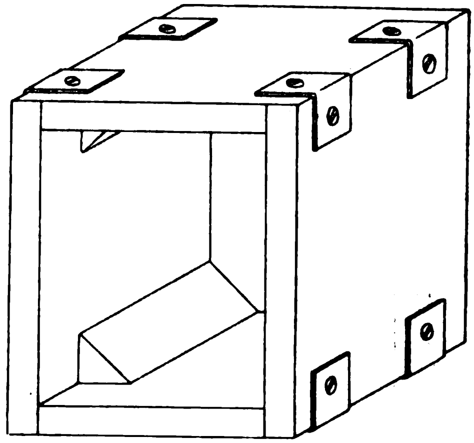


FIG. 3.—CASE FOR A LINESMAN'S GALVANOMETER.

a foot ¼ in. wide, by which the coils are secured to the dial plate. These formers are built up with the soldering iron, and must be neatly made, and all roughness in the joints, edges, and corners carefully smoothed off. The formers should now be carefully insulated with thin silk, paying attention to the corners. A layer of thin brown paper well shellac varnished, will do, if put on carefully.

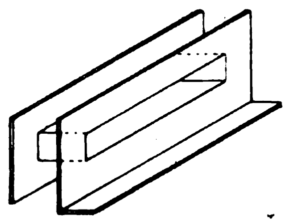


FIG. 4.—FORMERS OF THIN BRASS FOR COILS.

The "*quantity*" wire should first be put on. It consists of two layers of No. 22 S.W.G., silk covered, and leaving 6 ins. out at each end for connections. Wind both formers exactly alike. A layer of silk ribbon or thin brown paper is put over these coils, and on top of them are wound the fine wire coils, made up of seven or eight layers of No. 38 or 40 silk covered copper wire. As this wire is very fine and easily broken, it is best to solder about 10 ins. of thicker wire, say, 22, to it, and neatly wrap the joint with silk. Leave about 6 ins. out for connections as before, and winding in the same direction, and starting in the same place as before, put on the seven or eight layers. When finishing off, solder a piece of thicker wire on, so that the last three or four turns are taken up by the thicker wire, leaving a length over for connections. A layer of silk ribbon round the coils will give a better finish to the job, and also prevent the wire from being damaged.

The needle is made from a piece of double shear steel 1½ ins. long, ¼ in. wide, and 1-16th in. thick, filed to the shape shown in Fig. 5. After being drilled with a 1-16th in. hole in the centre, it is made a bright cherry-red in the fire or blowpipe frame, and immediately quenched in cold water. This hardening is necessary or the needle would not retain its magnetism for any length of time. The needle is now magnetised by any of the methods which have been given in this journal from time to time, or should the maker know anyone who has charge of a motor or dynamo he will be able to get it done for "Thank you," and "While you wait." The pointer is now made to the shape shown in the view of the dial front (Fig. 7). It can be made of brass, ivory, bone, or aluminium; the lower portion must be heavier than the top, so that the pointer always hangs vertically. The spindle is made of 1-16th in. diameter silver steel, long enough to fit between the brackets next to be described. The ends of the spindle are fitted with a pair of nuts, and also pointed and hardened.

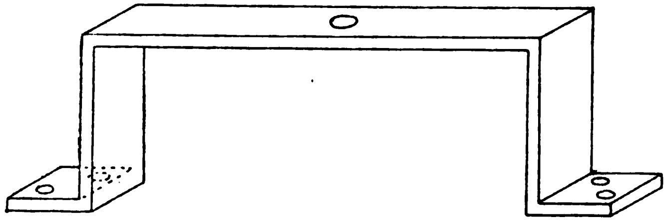


FIG. 6.—BRACKETS (Full Size).

We now require two brackets of 1/16-in. sheet brass, or they may be cast, one made to the sizes and shape shown in Fig. 6, which is full size, and another exactly similar, except that it is only 3-16ths in. high. A 1/16-in. diameter steel screw is fitted in the centre of each bracket, the ends of the screws being countersunk by a drill, the cutting edges of which are at an angle of 60 degs. to each other. The screws should also have a lock nut, and be carefully hardened.

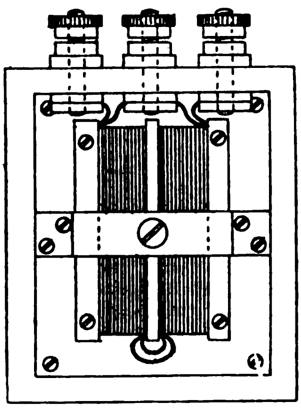


FIG. 8.—CONNECTIONS BETWEEN COILS AND TERMINALS.

The coils can now be fitted to the back of the dial plate, 1/4 in. apart, and the brackets afterwards, the smaller one on the front and the deeper one over the coils on the back (see Fig. 8). The needle, pointer, and spindle are now put into place. The magnetised needle is adjusted to swing in the centre of the coils, and the pointer just clear of the dial plate by means of the nuts which are placed one on each side of the needle. The spindle is regulated by the screws in the brackets to swing freely, but without shake, and fixed by the lock nuts. The dial plate may either be engraved, or a scale may be fixed to it by screws.

We now take the case again, and fix three terminals in the top, and then fix the dial plate with the coils, &c., in position. To the first terminal connect the starting end of the quantity coils. Now solder together the finishing ends of the fine wire coils, and also the finishing ends of the quantity coils. To avoid a lot of joints, all crowded together in the top of the case, this had best be done in the bottom, as shown in Fig. 8. We now have left the start of the fine wire of one coil and the starts of both wires of the other coil. Connect the first mentioned and the start of the quantity coil left to the second terminal, and to the remaining terminal is connected the wire remaining.

FIG. 5.—NEEDLE.

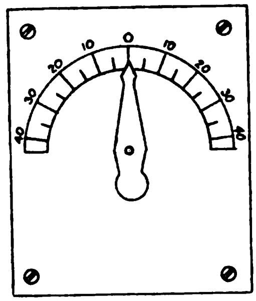
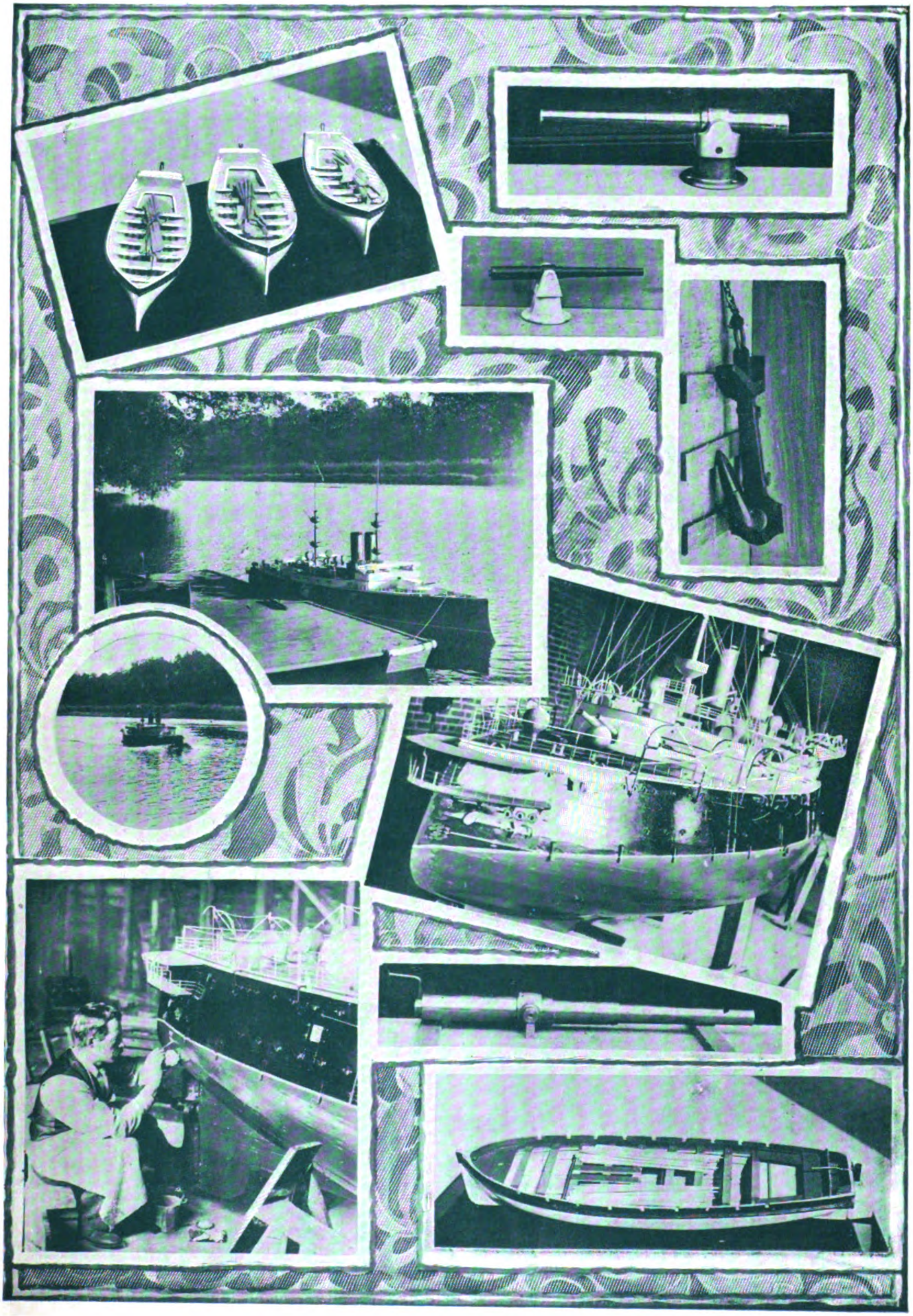


FIG. 7.—DIAL.

A glass front and plain back are fixed to the case by countersunk screws let in flush with the face of the wood, and the case varnished or polished to suit the maker's taste or abilities. For a small outlay we have now a galvanometer which would cost up to a guinea in the shops. To use the instrument the quantity coils are used when measuring heavy currents, as battery cells, and the fine coils are used for detecting leakages on line wires, etc. The instrument must not be used on large dynamos or batteries of accumulators, or the coils will be burnt out and the galvanometer ruined.

THE maximum electrical energy at present supplied by the Niagara Falls Company to Buffalo, exclusive of power used temporarily for lighting the Pan-American Exposition, is about 12,000 kilowatts, or about 16,000 h.p.

ELECTRICAL DRYING OF WOOD.—The following interesting particulars of an electrical method of drying—or, rather, seasoning—green wood for building and other purposes were contained in a report of the United States Consul at Reichenberg, Austria, recently sent to the Government:—The green wood is placed in a large wooden trough, the bottom of which is covered with a lead plate which is connected with the positive pole of an electric battery, and the trough is covered with another lead plate forming the negative pole. The wood is then subjected to a bath in a solution compound of 10 per cent. resin and 75 per cent. of soda. When the current passes, the sap is drawn out of the wood and rises to the surface while the solution takes its place. This process is permitted to continue from five to eight hours, after which the wood is removed and allowed to dry for about two weeks, and is then ready for building purposes. The drying can be considerably shortened by using artificial heat.

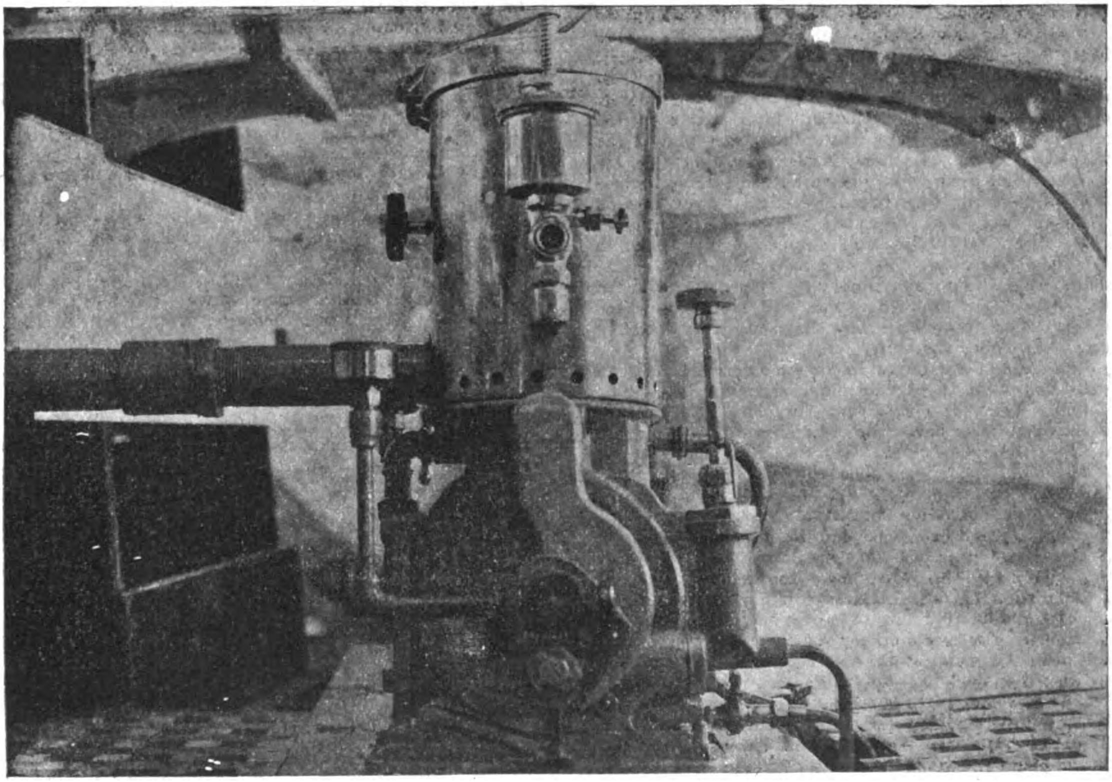


THE MODEL BATTLESHIP "MAJESTIC."

(For description see page 7.)

The Building of a Model Battleship.

ON one of the special plates given with this issue is shown a series of views of a model battleship which, we venture to think, wtll prove of special interest to our readers. Although it is a "model," it is to a somewhat larger scale than is usually selected. This, however, is rather an advantage than otherwise, since it enables the owner to comfortably get on board and indulge in pleasant cruises. The model represents H.M.S. *Majestic*, and has a total length of 18 ft., the greatest beam being 5 ft. 6 ins., and the "tumble-home" 3 ins. each side. Some idea of what these dimensions represent may be gained from the photographs we reproduce. The vessel is equipped with a complete set of boats, and also a proper armament of working model guns, some of which we illustrate, and, as will be seen, it presents a most imposing and realistic appearance. The engine consists of a "Monarch" petrol motor, and a photograph of the interior of the engine room appears on this page. The model, with the exception of the bare hull and the engine, has been built and equipped by Mr. Francis E. Foster and his brothers, and was kept for some time "in commission" on the Thames in the neighbourhood of Pangbourne. These enthusiastic model makers have at various times constructed a number of other model vessels of smaller size, and have also done some excellent work in the field of model locomotive building. We are greatly indebted to Mr. F. E. Foster for the photographs of his interesting vessel, and also for the following instructive hints on the building of a craft of this kind, which, we think, will prove very helpful to those of our readers whose tastes lie in this direction. Mr. Foster writes:



THE ENGINE ROOM OF THE MODEL BATTLESHIP H.M.S. "MAJESTIC."

"The cheapest and quickest method I have found to build models of this description is first to get your drawings, or to work from half-model to scale. Then clear out a space big enough to place the boat full size on the floor. Get the whole of the lines and measurements out exact, and then the work is much easier. Rip out a keel 2 ins. by 3 ins. oak clean. If you cannot get a piece bent the shape for upturn at bow, make the keel hot in steam, and when hot, pack up the end to the desried height, and screw the back down on to another piece of wood. Leave it there for about twelve hours, and then take the screws off, and the keel will keep the shape. Lay the keel down on floor over the chalk lines, and mark out the stem and stern post, and set off for moulds, which make 2 ft. apart from bow. Mark the floor, and then mark the keel at the exact spot. When the moulds are made, place on the exact spot on keel. You will then have the boat exactly fair in the sides.

"Make whole moulds to drawing on floor, and nail a strong piece across for breadth battens, and mark exact spots in middle of each batten. Place stem and stern post upright, and fasten piece batten on top of stem and stern post separately up to a beam or rafter to keep them upright. (First, place the keel on a stand made with 2-in. by 8-in. deal, placed on edge, and fastened about 18 ins. above the floor; this enables you to get under boat to fit planks and drive nails.) Stand all the moulds up in their exact position, 2 ft. apart, and proceed to plank up. House the ends into stem and stern, ¼ in., to take the double skins, ⅜ in. thick; proceed to plank from top by putting on a plank as wide as possible to the exact sheer, and nail that into the moulds. Then measure off the boat at body, midships, and ends, and measure each plank exact widths. Cut out a top plank to width, and place on the one you have on, and securely nail it to the first. Miss a space of 5 ins. or so, and then place on another plank 5 ins. below that. That leaves a space, and then a plank, and so on till the boat is planked from top to keel. The planking will bend fair between the moulds. Rip out the ribs or timbers 1 in. by ¼ in., out of clean ash or oak, or American elm, and place them 4 ins. apart between the moulds, and allow the spaces to work out so.

"When the moulds are taken out, you place a timber over the nail holes, and put the nails through into timbers, and there are no nail holes to plug up. Fasten the timbers into the keel, and let the ends run up the opposite side of the keel, about 2 ft. That will form double battens all over the bottom. You must either steam or boil the timbers in hot water. Steam is best, if you have the appliances to do them with. Be sure when placing timbers to bend them fair, so as to touch each plank you have on the boat. If not, when you have finished planking, your boat will not be fair, but full of holes, as it is termed in the trade. You have now two planks on the top, or the double skins. Put each timber in its place, and fasten at the keel, and through copper nail at top, and turn down. That portion is now finished, and does not require touching any more.

"Proceed now to put all in the same manner, and put a small nail into each edge of plank and draw in close to timber. The boat now is ready for planking. First fill in the open space below the top and cover it with resin, mixed with bright varnish. Place the next plank so that it covers the inside seam about the centre of plank, and, if this is done properly, there is not much fear of leaking. Be sure when planking up that all nails put in outside planking are punched in beyond the surface, so as not to be in the way when you plane the boat off fair, and scour up. Place 2½ ins. down from top inside, a stringer, 2½ ins. wide, 1¼ ins. thick, pitch pine or oak or American elm, and fasten through the boat and clinch on inside of stringer. You then mark out your space for engine, etc., and place the beams on the top of stringer. The fixtures are placed on deck and superstructure.

"Be sure you place in some of the beams before you knock out the moulds; if not, the middle of the boat will fly out of shape. In building a boat this way by placing on the plank you make the planks do the work of battens. Some builders put battens from end to end, and about 4 ins. or 6 ins. apart, to bend the timbers into them; but I find I can do the work both on models and other boats quicker by using the planks and leaving spaces, and filling spaces after. When you have the ribbons, as they are termed in the trade, fixed, you get the exact size of space and bevels and jamb them in. There are no holes or bad joints; but the work, with a little care and careful measurements, is quicker, and makes for the best job."

A FRENCH paper, *Le Petit Parisien*, is responsible for the statement that M. Goubet, of submarine boat fame, is contemplating the construction of a submarine vessel, which, deriving its motive power from a cable extending across the Straits of Dover, would be able to take 200 passengers from France to England in less than half-an-hour.

Malleable Cast Iron.

THE process of making malleable cast iron is apparently the converse of that of case-hardening, and consists in softening the surface of cast-iron articles by heating in oxidising material. The castings are made of a suitable iron, which must contain but little graphitic carbon, though the combined carbon should be fairly high, and there must be but little silicon. The metal is melted either in a cupola or a reverberatory furnace, preferably the latter, as the ordinary atmosphere will help the removal of the silicon, and is cast in sand moulds—usually green sand—in the usual way. The castings are well cleaned from adherent sand by any suitable means, according to the nature of the casting, by abrasion in the tumbling barrel, by scrubbing with wire brushes, or by pickling in dilute sulphuric acid. They are then carefully packed in iron boxes surrounded with iron scale, powdered hematite, or other suitable material, iron scale being the best, as the ore frequently contains earthy matters, which adhere to the castings, and are troublesome to remove, and the boxes are carefully luted with sand and clay, so as to exclude air. The boxes are then subjected to a high temperature—of course, below the melting point of cast iron—for a week or more (it is very important that the temperature should be kept uniform), and then allowed to cool slowly.

The castings as they come from the boxes have a fine blue colour. They are well cleaned, and are ready for use.

An iron must be selected which contains but little free graphite, or the resulting material will be porous; white iron or mottled iron are, therefore, used, and they must be as free as possible from other impurities. Hematite pig, or in America charcoal pig, are the materials usually used.

The iron must be so arranged that a uniform temperature can be maintained. Coal furnaces are usually used, but Siemens gas furnaces are coming into use. The boxes vary in size with the size of the articles being treated, but are usually about 16 ins. long and 13 ins. wide and deep. "If carefully used they will last from five to fifteen heats."

The depth to which the decarburisation proceeds depends on the time of heating, which may vary from a day or two to two weeks. The conversion may be to only a small depth or entirely through the piece. The malleable casting has a higher tenacity than grey iron, but less than malleable iron or mild steel. It cannot be welded, but contains sufficient carbon to allow of it being hardened by quenching. At a moderate red heat it is possible to forge some of the best qualities, but if it is overheated it crumbles as soon as it is struck.

The process has been modified in various ways. C. Ross proposes to increase the rapidity of the action by bringing the surface into very intimate contact with the softening material. For this purpose the article is dipped in a pasty mixture of hematite, lime, and water, which forms an adhesive layer.

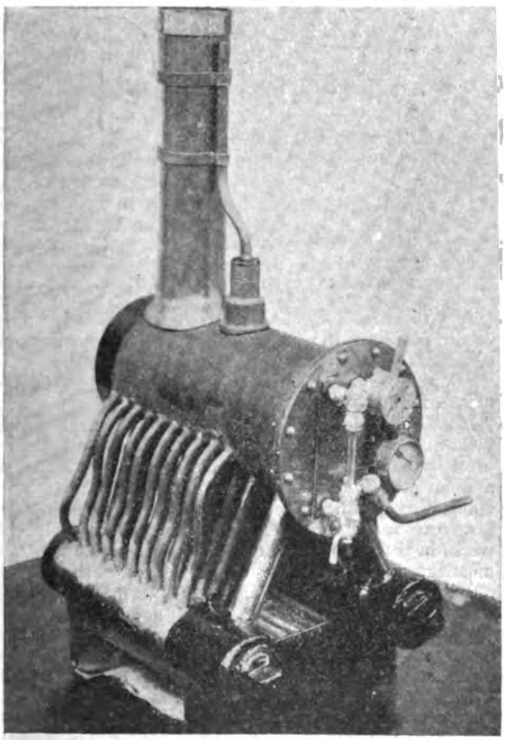
It has been questioned whether the action is as much one of deoxidation as is usually supposed, it being suggested that the carbon is converted into very finely diffused graphite.—*The Mechanical Engineer.*

ACCORDING to the *Engineer*, further engines of the 1150 class have been turned out from the Stratford works of the Great Eastern Railway, the latest out being No. 1183. All onwards from 1170 have got the enlarged cabs and larger tenders, similar to the latest express passenger engines, the tenders being fitted with the water pick-up gear.

A Model Thornycroft-Type Boiler.

By F. S. Stevens.

THE accompanying illustration is a photograph of a model boiler of the Thornycroft type for which I got first prize at the Hammersmith Industrial Exhibition last summer. It will be seen by the photograph there are two wing or bottom barrels, each 1½ ins. inside diameter of 16 B.W.G. copper; a top barrel, 3 ins. inside diameter, 16 B.W.G.; and two downtake tubes, each ½ in. inside diameter, 16 B.W.G. There are three rows of ¼ in. tubes running from the top barrel to the wing barrels, thirty-two on each side, making sixty-four altogether. The top and the wing barrels are each 6 ins. long; the top barrel has a flange of ½ in. turned over to allow for the front



A Model Thornycroft-Type Boiler.

plate of the boiler to be bolted on containing the fittings. The internal steam pipe and baffle plates are also screwed on to the inside of this plate, so that when the bolts are removed it comes off with all the boiler fittings, also the internal steam pipe and baffle plates, when the boiler can be easily cleaned or repaired. The two wing barrels have screw plug ends, which can easily be removed for cleaning or re-tubing. All the parts were well tinned before putting together, and were then sweated in with a blowlamp.

Looking at the photograph, it looks as if the funnel and the waste steam pipe from the safety valve are connected with the top barrel; but it is not so. There is a casing between of 20-gauge brass, which covers the boiler all over excepting the two downtake tubes; between these are the two fire doors. This boiler has stood a test of 60 lbs. on the square inch hydraulic pressure. It is a quick steamer, and I think if any reader of The Model Engineer takes the trouble to make a boiler of this type he will be more than satisfied with it.

How to Demagnetise a Watch.

A MAGNETIC effect may be obtained from a coil of wire carrying a current, even though the coil may have no iron core within it. Such a coil without core is called a solenoid, and is sometimes used instead of an electro-magnet. The magnetic field is, however, very much weaker, because in the absence of iron the magnetic "lines of force" cannot concentrate so well. Solenoids in various forms are often used for demagnetising watches.

A very successful apparatus for demagnetising watches can be made in the following way: A solenoid or wooden

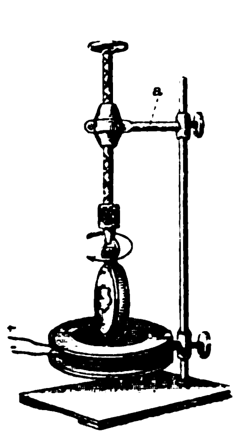


Fig. 1.

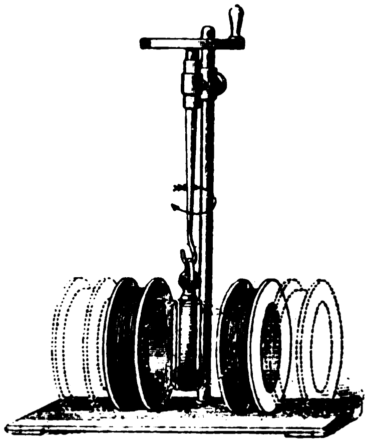


Fig. 2.

spool with an opening of 3 ins., and wound with as many turns of number 22 magnet wire, as the spool will permit, is mounted horizontally on a stand which has an extension arm *a* reaching over the middle of the spool, Fig. 1. In line with the centre of the spool, but somewhat above the latter, is fastened the nut of a spiral screwdriver, so that, by pressing down upon or lifting the screwdriver's

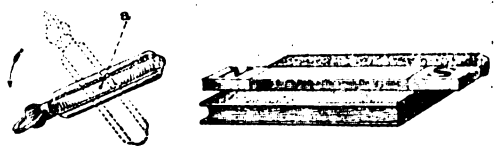


Fig. 3.

knob, the chuck holding the ring of the watch will go up and down through the opening of the spool, at the same time turning around its centre. A small rheostat connected in series with the battery and the wire of the spool controls the strength of the current, and in lowering the watch into the spool, and withdrawing it, the current is accordingly diminished and a perfect demagnetisation obtained. The apparatus is inexpensive, can very easily be made, and requires no special skill in operating it.

Another device for the same purpose is made by enclosing a watch in a wooden case, Fig. 2, and revolving it within a magnetic field of two solenoids which could be drawn apart for regulating their magnetic influence upon the watch.

A number of pinions upon which the brass wheels are fastened, the spring, the anchor, and a few screws, are the principal steel parts in a watch which are apt to become magnetised if brought in too close proximity with a magnet. The steel spring is located at right angles to the pinions, and therefore will require a magnetic polarity of its own, which necessitates a certain manipulation in the demagnetising of a watch; and a very simple way to accomplish it is to revolve a watch around its centre by hand, and in front of a magnet bar, Fig. 3, at the same time gradually withdrawing it from the magnet.—*Jewelers' Review*, N.Y.

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 of future articles.]

IX.—A Miniature Wind Motor.

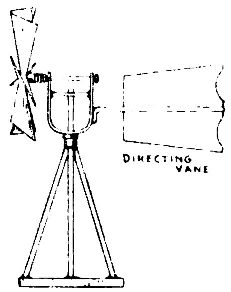
By R. F. M. WOODFORDE.

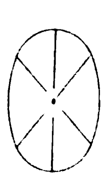
ANYONE who can use a small soldering iron and a few simple tools can make this model. It will run very fast in a moderate wind, and looks very well. Every part should be made of brass, all supports, spindles, etc., being made from stout pins, the heads and points being cut off. The base is cut from 1-32nd in. brass ½ in. square, finish and bevel the edges with a fine file; the centre is taken by drawing diagonal lines across, and here make a shallow conical hole with a drill or centre punch. A pin, with head and point cut off, is now soldered upright (using zinc-chloride dissolved in water as the flux), one end being put into hole, and then it is certain to be central. Probably the solder will have to be melted several times before this central pillar can be got quite upright; but it is not hard to do, and may be tested by standing the base on a flat surface, and then viewing it in two or three different positions against an engineer's or joiner's square. Solder a small washer, about 3-32nds in. in diameter, ¼ in. from the top of the central pillar—the easiest way is to beat a bit of brass out to about 1-50th in. thick and drill a fine hole at one corner with a very fine drill, or else punch it through with a scriber point—cut it off, and after soldering on it may be filed circular in place. Four pins are cut to ¾ in. long, and, after tinning the ends with the iron and tinning the corners of the base, these are held in place, and one after the other the bottom ends are soldered in place, and, finally, the tops soldered under the small washer. Clean up with very small files.

To make the wheel, take some very thin brass about 1-100th in. thick; with fine dividers draw two circles with the same centre—one 3-16ths in. diameter, and the other ¾ in.; step the dividers round the outer one so as to get six sections when the points are joined; then drill the central hole to take a pin, and cut down the six lines as far as the inner circle with a pair of fine scissors.

The directing vane at the back, which keeps the wheel facing the wind, is also cut from fine brass ½ in. long—⅜ in. wide at one end and 7-16ths in. at the other end. File two circular notches at the wide end with a fine round file; the best way is to put the fine brass in the vice with a thick bit (the fine nearest you) and lift the file on the back stroke; solder centrally a stout pin ¾ in. long with 3-16ths in. protruding at the narrowest end of vane, and 1-16th in. bent sharply at right-angles downwards.

The frame consists of a bit of brass, ⅞ in. long, 3-32nds in. wide, and 1-50th in. thick. Bend this over a bit of 3-16ths in. iron or brass with its edge rounded, and in this position drill a fine hole centrally in the bottom to take the vertical central pillar—great care must be taken to keep central. Square off the top of the limbs of this frame, and drill two holes for the spindle; this should be true and parallel with the bottom part of the frame. Cut a bit of brass the same size as the last, but





DISC OF METAL FOR FAN AFTER CUTTING.

A MINIATURE WIND MOTOR.

only 3-16ths in. long, and drill the central hole; solder this in place about 3 16ths in. up the limbs; all surplus solder can be removed with a pocket knife and fine files. The directing vane is now soldered in place to the back of the frame true with the spindle. Cut a pin about 7-16ths in. long, but leave the head on; this spindle must fit the bearings nice and free; some fine copper or brass wire (No. 28 or 30) is coiled tightly on to the pin, and cut ⅛ in. long. Carefully file off little burrs at the ends; this goes between the wheel and the bearings, and keep the vanes from knocking the frame. Solder the wheel in place, so as not to wobble when it runs, but it must run very freely. Finally, give each of the six vanes a twist of 30 to 45 degrees; clean up, and the model is finished.

If any little error in alignment occurs, it can be taken out by slight bending or re-heating the solder. The bits of brass can be beaten out of any brass sheets, and bits to be bent sharply should first be made red hot, and at once cooled in water. If made two or three times the size of the illustration, all parts must, of course, be made stronger in proportion.

THE French Government has recently been experimenting with the Montupet water-tube boiler, but the results obtained have not been published. However, it is stated that one important feature of this type of boiler has become known as the result of previous trials, namely, that the tubes can be removed and replaced in a remarkably short space of time. On one occasion, during a trial lasting over four hours, the fires were reduced, the steam pressure lessened, the boiler emptied, and a tube removed. All this was accomplished in a quarter of an hour. Upon the tube afterwards being replaced, the steam pressure was restored almost instantly. When the fires were out and the boiler had cooled, thirty-two tubes were removed within an hour and twenty minutes.

An Inch Scale Model L.T. and S.R. Locomotive.

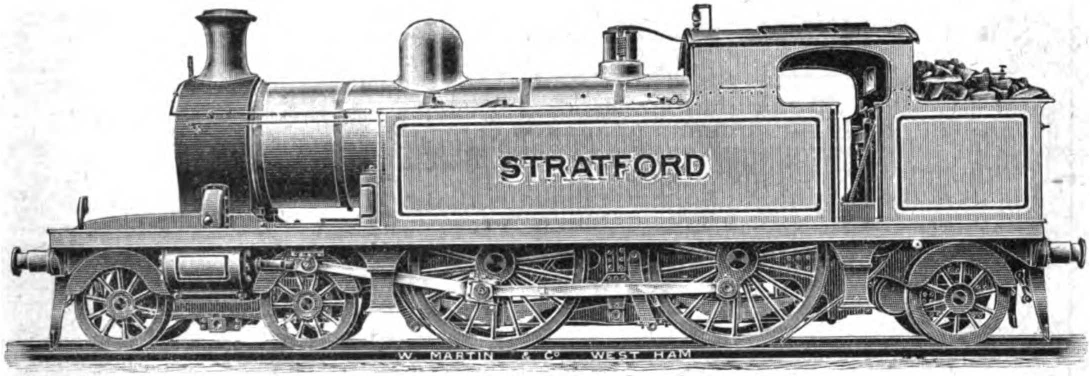
BY the courtesy of Messrs. W. Martin & Co., of West Ham, E., we are able to give full working drawings of their latest production, in the shape of a scale working model of the most recent London, Tilbury, and Southend Railway ten-wheeled tank locomotive. This class of tank engine has long been popular with those who make the study of locomotives—real and model—their hobby, and these engines, being capable of "express" work, are a very good prototype for the model locomotive builder. The absence of the tender makes the engine very compact; connections for water and oil present no difficulties. The engine is much shorter, and its wheelbase is quite as flexible as the ordinary four-coupled bogie locomotive.

The first thing that occurs to one is "how is it possible for a tank engine with a closed cab to be fired and driven"; but a reference to the accompanying drawings shows that provision for this is made in two ways—the first difficulty is removed by the use of oil fuel on the Swedish system; the second by arranging that the centre part of the roof of the cab, sufficient to allow of the operation of the various levers, be removable. To strengthen this part, and to keep it in position, it is provided with angle "irons" projecting on the under side, and to facilitate taking it off that which forms the cab ventilator in the actual locomotive is added. This makes a convenient hand-hole for the loose part of roof.

To refer in detail to the general adaptation of the locomotive as a working model, it will perhaps be best to give some of the leading dimensions of Mr. T. R. Whitelegg's splendid design. The driving-wheels of the real locomotive are 6 ft. 6 ins.; carrying-wheels, 3 ft. 6 ins.; cylinders, 18 ins. by 26 ins.; boiler barrel, 10 ft. 6 ins. long; 201 tubes, 1⅝ ins. diameter; inside firebox, 6 ft. 1 3-16ths ins. long by 3 ft. 3 ins. wide; heating surface, tubes, 929 sq. ins.; firebox, 117 sq. ins.: total, 1,046 sq. ins. The weight in working order is 64 tons 14 cwt. These engines are almost exactly the same as regards machinery as those brought out in 1898. The boiler diameter is increased from 4 ft. to 4 ft. 6 ins., chimney shortened, and steam reversing gear added. The height of the centre of the boiler in this class is 7 ft. 9 ins. from the rail level—an alteration which has improved the appearance of these engines over the earlier ones to a marked degree.

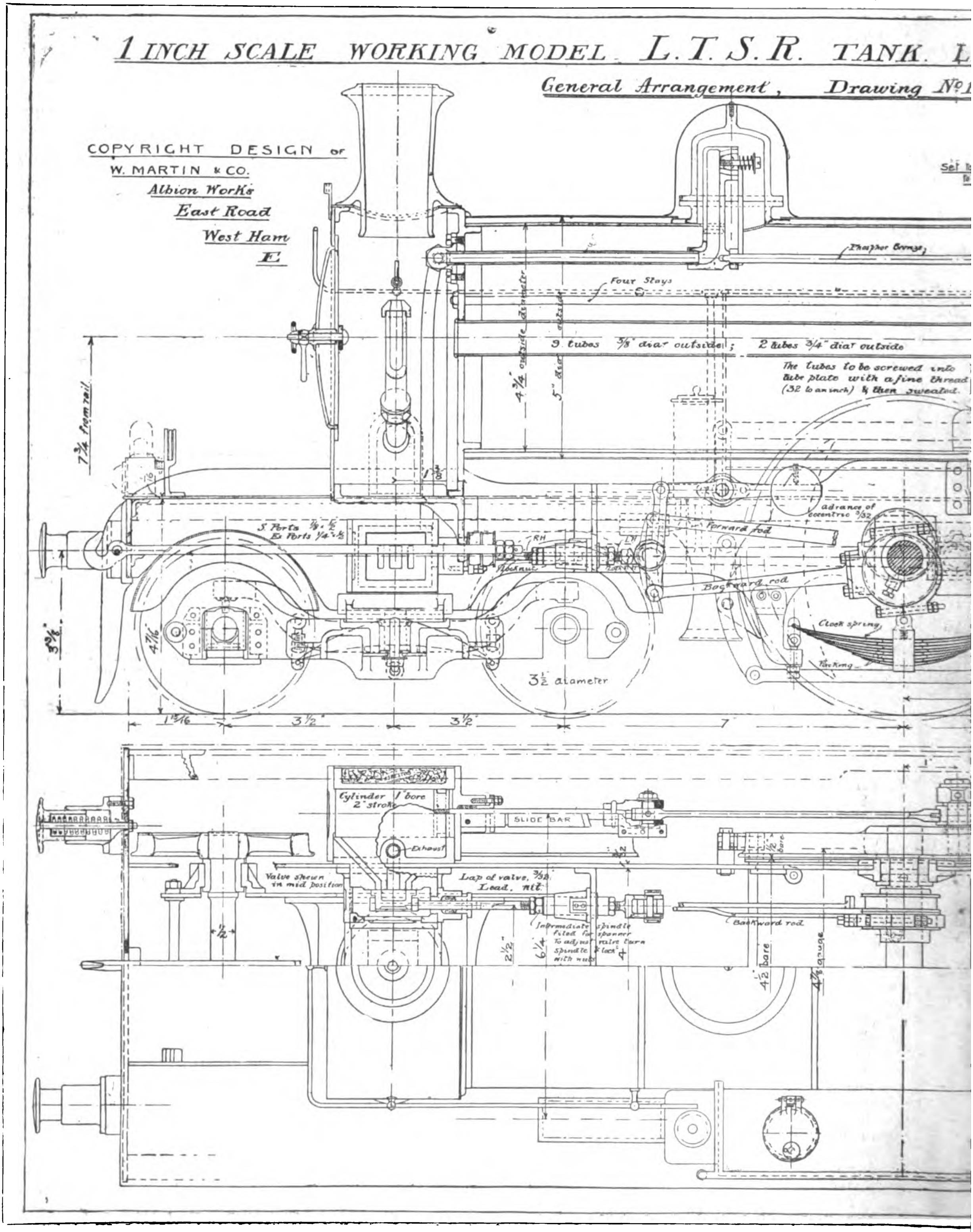
To make the model efficient in working, and of sufficient strength to withstand the various strains consequent on the jolts and jars to which it would be subjected whilst running up and down the miniature railway, and to make it possible to easily and solidly build, modifications in several parts have necessarily been made. The construction has been worked out in accordance with the best model practice without forgetting that of the original engine, or in any particular altering the external appearance.

The first point considered was the amount of reduction of the scale size which should be made in the cylinders. These, if made correctly to scale, would be 1½ ins. by 2 1-6th ins., and give a tractive force of 37 lbs. at 50 lbs. boiler pressure, and this, besides being too great, would deplete the boiler of steam at much too great a rate. The cylinders have been reduced to a minimum of 1 in. by 2 ins., which gives a tractive force at the above named steam pressure of 15·4 lbs. The completed model will weigh about 80 lbs. when finished, and if no great load is to be hauled behind it this size will be found sufficient to run the engine at a reasonable speed. There is enough metal in the castings to allow of the cylinders to be bored out to 1⅛ ins. if desired; but this diameter must be considered as the maximum. The consumption of steam, with 1-in. by 2-in. cylinders, at seven miles per hour, would be about 5 cubic ins. per minute. The boiler is arranged with some 350 sq. ins. of heating surface, and, taking the rule that 1000 sq. ins. in a locomotive boiler will evaporate 15 cubic ins. of water per minute to be correct in this case, about 5¼ cubic ins. per minute may be expected. It will be seen that if the cylinder increased to any extent the boiler will have difficulty in supplying them.

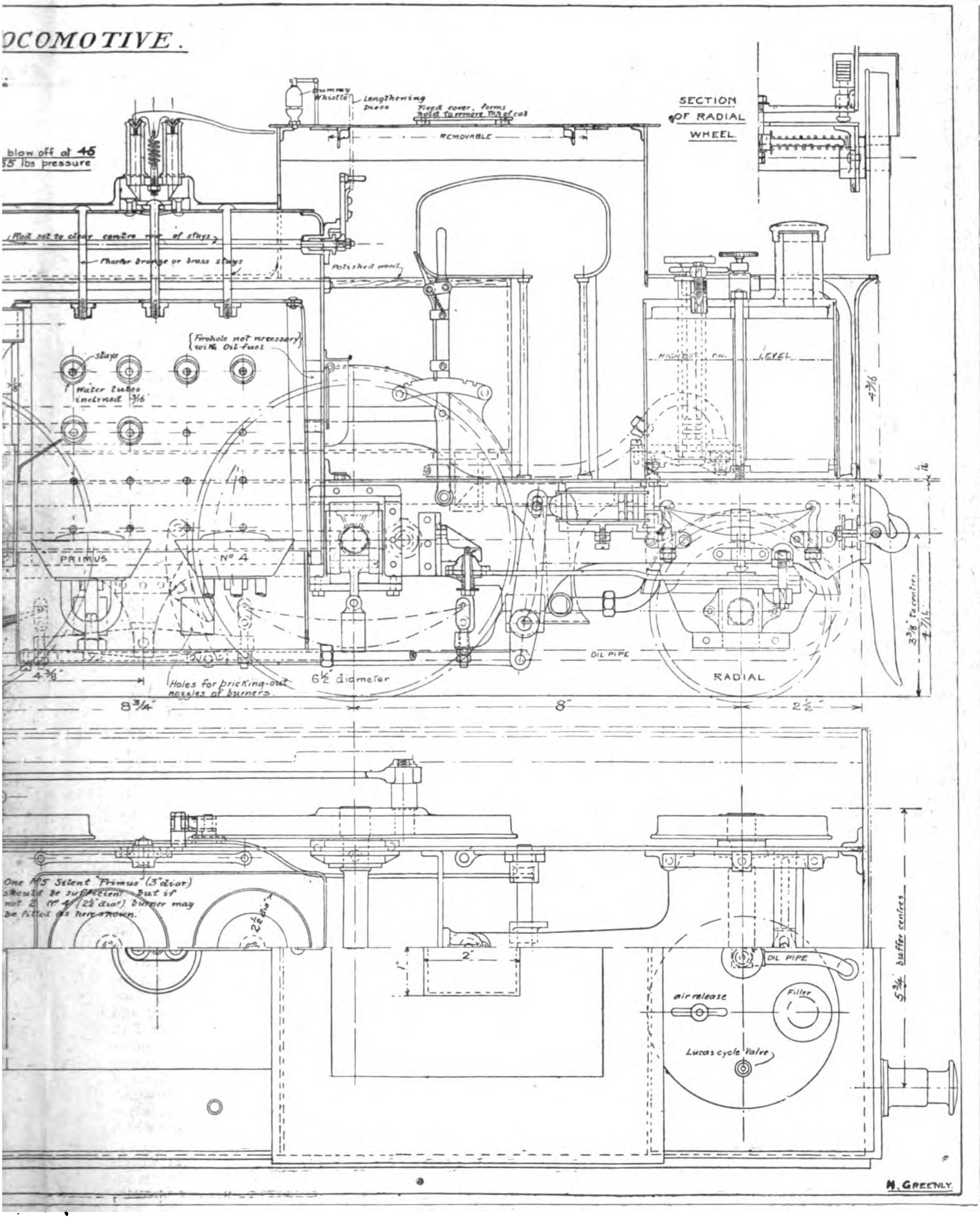


AN INCH SCALE MODEL L.T. & S.R. LOCOMOTIVE.

Dismissing the theoretical considerations, we may now review the practical features of the design. Commencing with motion, a reference to the drawings will explain more clearly than words the arrangements of the cylinders. In the original engine the casting supporting the bogie frame is in one piece with the bottom of the smokebox and drawplate, and surrounds the valve chests, except for a part of the front. This had to be modified, owing to the difficulty which would probably be experienced when erecting the cylinders, making the steam-tight joints, and setting the valves, therefore the bogie supporting casting and bottom of smokebox (together with drawplate) are in separate pieces. The steampipes, which are connected to the top of steamchest, pass through the drawplate casting, and are coupled by unions on to the tee-branch on front plate of boiler. The exhaust pipes, of slightly larger diameter, are coupled to the cylinders outside the frames, and turn into the smokebox, the exposed part being covered by a neat cas-



1 INCH SCALE WORKING MODEL L.T.S.R. TANK
General Arrangement, Drawing No 1
COPYRIGHT DESIGN of
W. MARTIN & CO.
Albion Works
East Road
West Ham
E
Four Stays
9 tubes 3/8" diar outside; 2 tubes 3/4" diar outside
The tubes to be screwed into tube plate with a fine thread (32 to an inch) & then sweated.
4 3/4" outside diameter
5" diar outside
7 3/4 from rail
Phosphor Bronze
S. Ports 1/8 × 1/2
Ex Ports 1/4 × 1/2
Forward rod
Backward rod
advance of eccentric 3/32
Clock spring
Packing
3 1/2 diameter
1 3/16
3 1/2"
3 1/2"
7
Cylinder 1" bore 2" stroke
SLIDE BAR
Exhaust
Valve shewn in mid position
Lap of valve, 3/32
Lead, nil
Intermediate spindle filed for spanner to adjust valve turn spindle & lock with nuts
Backward rod
4 1/2 bore
4 7/8 gauge


OCOMOTIVE.
blow off at 45
55 lbs pressure
Dummy Whistle
Lengthening piece
Fixed cover, forms hold to remove top of cab
REMOVABLE
SECTION OF RADIAL WHEEL.
Rod set to clear centre row of stays
Phosphor bronze or brass stays
Polished wood
Firehole not necessary with Oil-fuel
stays
Water tubes inclined 3/16
HIGHEST OIL LEVEL
4 3/16
PRIMUS
Nº 4
OIL PIPE
RADIAL
4 3/8
Holes for pricking-out nozzles of burners
6½ diameter
8 3/4
8
2½
3 3/8 to centres
4 7/16
One Nº 5 Silent "Primus" (3" diar.) should be sufficient but if not 2 Nº 4 (2½" diar.) burner may be fitted as here shown.
2½ dia
2
1
OIL PIPE
air release
Filler
Lucas cycle valve
5 3/4 buffer centres
H. GREENLY.

ing. The Y junction is cast in one piece, the passages being cored out, and is connected by unions to the exhaust pipes. This arrangement facilitates the removal of the boiler, a point which should always be considered by the model locomotive designer; nothing is more annoying than to have a trifling leak in the boiler, and to find that its stoppage cannot be made without cutting or unsoldering many parts of the engine. The nozzle of the exhaust pipe is removable; it can be taken off and altered to any desired orifice, which experiment may prove to be the best.

The stuffing-box for valve spindle must be applied to the valve chest after the cylinders are bolted to the frames. The steam-ports are cast in, and the cover at the front end of valve chest enables the faces to be milled, and the valve, with its buckle, to be placed in position. The large cover, besides providing for finishing the ports, allows the erector to see the valves during the operation of setting, lightening present labours and saving future trouble.

The centre line of the whole of the motion is horizontal. The piston-rod is guided by a single slide-bar, ¼ in. deep by ½ in. wide, made of mild steel; the end nearest to the driving axle being brought to a feather edge on the under side to allow the connecting-rod to clear it, and is affixed to a lug on a bracket from the main frames, the other end is supported on the cylinder cover. The gunmetal crosshead should be drilled for the piston-rod, which may be either screwed into the crosshead, or secured by a pin passing through both. A trough to fit the slide-bar should be milled or filed in the upper part, and a cover-plate fitted to the crosshead with six small screws.

The connecting-rod is of mild steel, and the big end should have the gunmetal brasses fitted in the orthodox way with cotter, set-screws and bolts. The little end should be plain eyed and potash hardened; the gudgeon pin may be similarly hardened.

The link motion is of the Stephenson type, with the curved link pinned to the eccentric rods on its centre line, as is usual in English locomotive practice. This, of course, necessitates the travel of the eccentrics being greater than that of the valve, the throw of the sheaves being 9-32nds in. (travel 9-16ths in.). The remainder of the link motion is constructed in the usual way, the links, &c., being counter-balanced by two weights fixed to extended arms, the only points of difference from the original being the pivots of the weigh-bar shaft and the intermediate valve spindle. The former, to save much fitting, are plain brass bushes fixed into a hole in the framing, a part of which is raised up from its normal level at this point. The intermediate spindle should be turned to a good working fit in the guide on motion plate, and bored out hollow; one end tapped with a R.H. thread, and the other with a L.H. thread; the valve spindle and crosshead being respectively screwed to fit, and provided with back nuts; the front of the spindle should be filed hexagonal to take a spanner, and by this means it may be rotated if it is desired to move the valve; when the correct position of valve is thus obtained, the back nuts may be screwed up, and the whole arrangement locked.

(To be continued.)

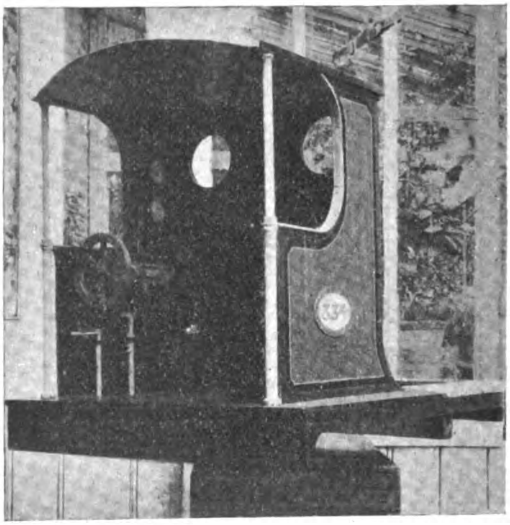
ETCHING ON TOOLS, &c.—Spread a film of paraffin-wax on the part where you want to mark; then take a pen or scriber and write whatever you wish; just sprinkle a layer of common salt over this and cover the place with strong (undiluted) nitric acid. It will be deep enough in about half-an-hour; clean off with water (hot) and smear over with grease or vaseline to keep from rusting.—A. ASTON.

A Model Electric Locomotive.

By Dr. ARTHUR C. HOVENDEN.

THE model electric locomotive and switchboard about to be described possesses many novel features. The switchboard represents an engine cab, quarter full size, correct in every detail, all the handles subserving electrically the same purposes they do on a real locomotive. The regulator becomes the main switch, the wheel-reversing gear becomes the reversing commutator, and the driver's valve of the Westinghouse brake serves to stop the motor. The model itself is to ⅜ in. to 1 ft. scale, and runs on an oval railway, 7 ft. by 6 ft., with two branches on one side. The motor it contains is very powerful, and is self-starting; but when an occasional dead point is found by reversing and going a few inches in the opposite direction, the engine can always be induced to start—in fact, one has all the advantages of being on a real footplate.

1. *The Locomotive and Motor.*—The locomotive is a

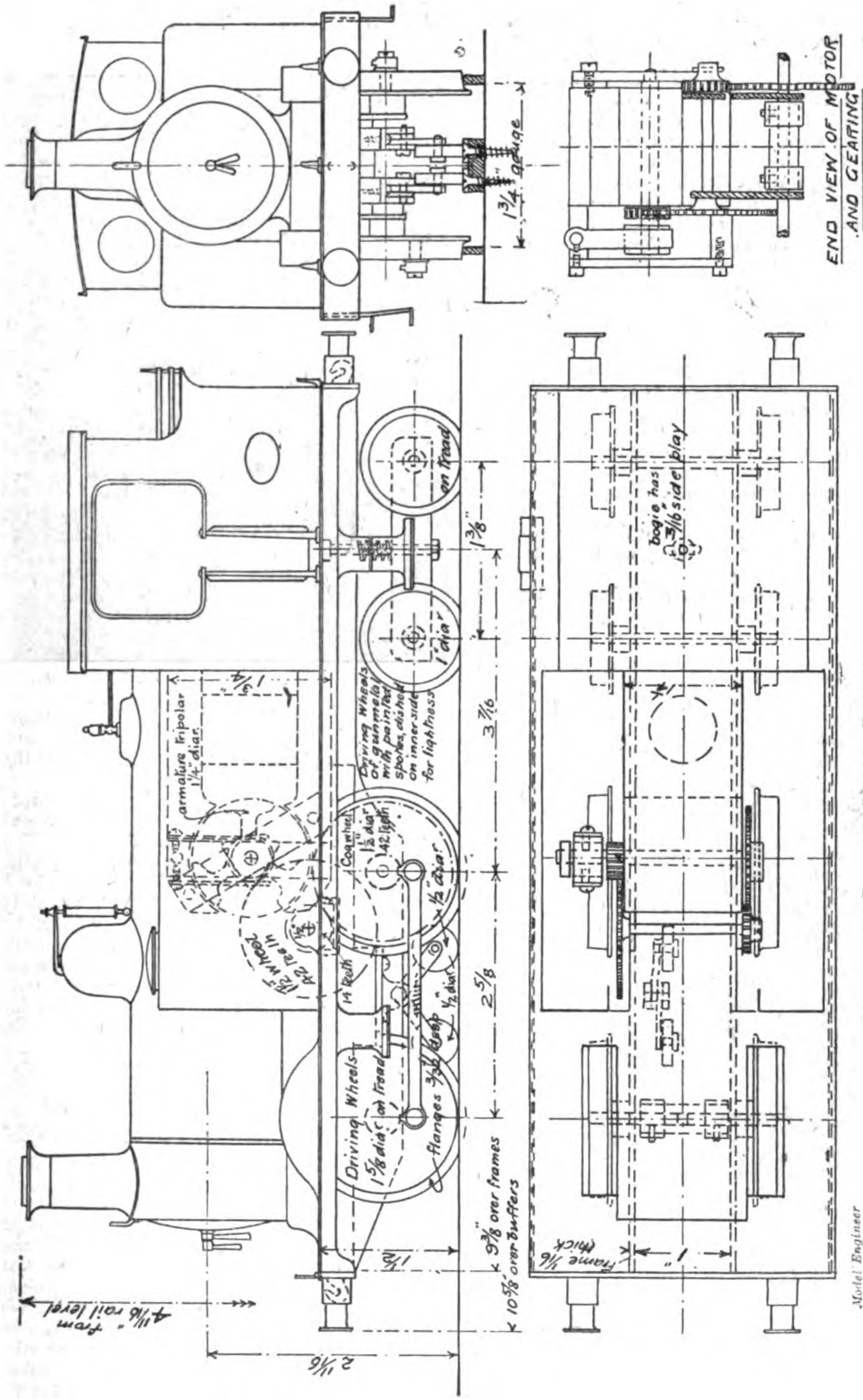


SWITCHBOARD FOR DR. HOVENDEN'S ELECTRIC RAILWAY.

model of a "D" bogie tank engine of the London and Brighton Railway, the motor being contained in the tanks and corresponding portion of the boiler and firebox; the gauge is 1¾ ins. The whole of the superstructure—cab, boiler, splashers, tank, footplate, and steps—is removable and made of sheet tin, the buffer dome and funnel being of celluloid. The motor wheels and gearing are carried on two brass frames, screwed to pieces of mahogany accurately squared up. The motor is a tripolar one, made from castings by Messrs. Whitney. The winding and general construction have often been explained in THE MODEL ENGINEER, and is similar to that of the motor described in March, 1898. The brushes are of spring brass, and are fixed; they are attached to two pieces of red fibre by means of a screw and a washer, with which holes drilled in projecting portions of the carcase are bushed. The screws and washers retain the wires which pass to the central current collectors.

The motor is geared down 9 : 1; four gear wheels being employed—two ½-in. with 14 teeth, two 1½-in. with 42 teeth. The wheel on the armature has 14 teeth, End Elevation.

Side Elevation.



Plan with Cab and Boiler Removed.

A MODEL ELECTRIC LOCOMOTIVE.

By Dr. Arthur C. Hovenden.

Scale: Half-Size.

and has three holes drilled through lined with fine rubber tubing for the passage of the wires to the commutator. There are about 2 ozs. of No. 26 silk-covered wire on the armature, and about 4 ozs. of No. 18 wire on the fields. The current is collected from four conductors; the brushes collect by means of wheel collectors travelling on two central conductors; the fields get their current by contact of the four driving wheels on the rails.

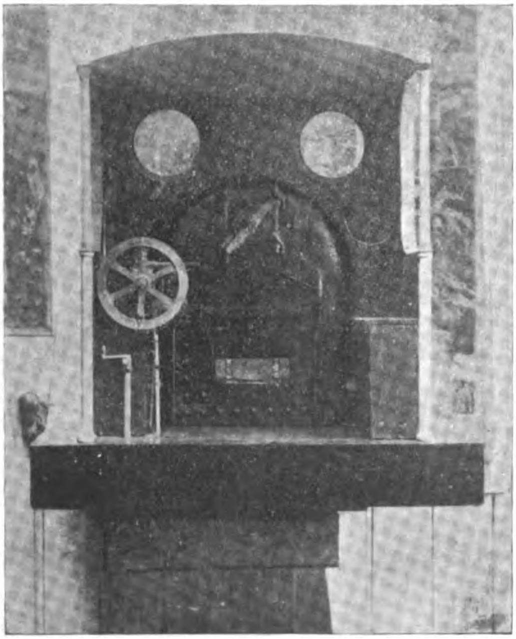
The driving wheels of each side are insulated from each other by having red fibre in the central portion of the axles, into which fit the steel axles, these being retained by small screws passing through the brass bands shown in the drawing. The bogie frame is quite separate, and since the bogie wheels are of celluloid, through steel axles can be employed. The bogie rotates on a steel pin, and is retained by a nut; a spring, the strength of which is the matter of experiment between the main and bogie frames, adjusts the weight on the driving-wheels.

It will be noticed that the intermediate cog spindle is insulated from the left-hand frame by the raised portion being cut through, and screwed on separately. The small wheel of this spindle is retained by a taper pin, and is put on after the axle has been threaded through the frames.

The central current collectors for the brushes each consist of two ½ in. wheels, hinged by a long arm to a lug screwed to the under surface of the mahogany frame; a spring connecting the two arms presses the wheels on to the conductors.

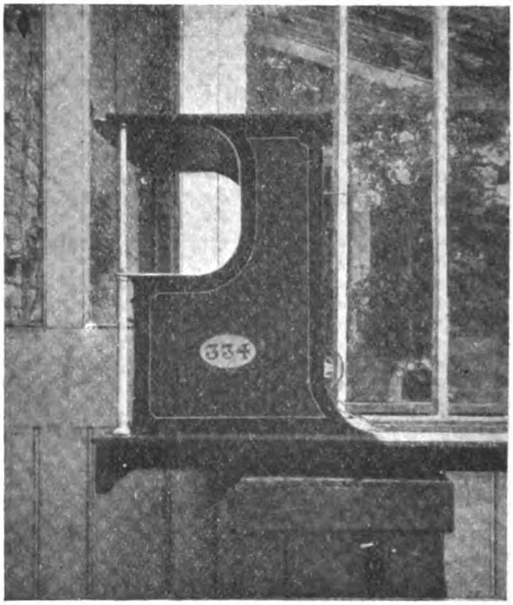
The lateral conductors, the rails, for the fields convey the current by the rolling of the driving wheels as the engine travels.

2. *The Switchboard*: *Arrangement of Wiring.*—The two central conductors pass to the two entering terminals



REAR VIEW OF SWITCHBOARD.

of the reversing switch: one rail is connected direct to the battery, which, in my case, consists of two 14-ampère-hour accumulators connected in series, the other rail passes to one exit terminal of the reversing switch, the other exit terminal proceeds to the battery through the main switch. From the terminals of the main switch is another circuit, opened and closed by the driver's valve of the Westinghouse. The motor is thus connected up



SIDE VIEW OF SWITCHBOARD.

in series, this giving a greater starting effort than shunt winding.

The general appearance of the switchboard is seen from the photographs. It is an accurate representation of a "C" class cab of the Brighton Railway. The dimensions were obtained from *Engineering*, 1876, January—June, and from Mr. Stroudley's paper in the "Transactions of the Civil Engineers," Vol. 81, 1885. The footplate is made of good deal, the sides and front of pine, all the fittings—gauge glass, cocks, &c.—are of boxwood, including the reversing wheel and screw and block. Horn-beam, a hard white wood, is employed for the reversing guides and rod, for the damper, cylinder cock and sand handles, and the straight and curved angle iron round the edge of the cab. The cab pillars are of ash. The nuts are dummies, being hexagonal with plain holes. Great pains were taken with the lining in and painting, four coats being given of Aspinall's enamel, each coat being well rubbed down before another was applied.

(To be continued.)

A NEW Edison storage battery is announced by American papers. In this battery, metallic magnesium forms the support for the negative element, which consists of electro deposited zinc. The positive element is a block of finely-divided copper oxide, which reduces to copper during discharge whilst the zinc is dissolved. The electrolyte is a 20 per cent. solution of caustic soda to which zinc hydroxide is added until it is nearly saturated. It will be noticed that the constituents of the new accumulator are practically those of the well known Lalande primary battery.

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.]

Keels of Model Yachts.

To the Editor of *The Model Engineer*.

DEAR SIR,—I am taking the liberty of writing you *re* the keels of model yachts. I see that in THE MODEL ENGINEER, September 15th, there is a photograph of a model, made by Mr. Brookbank, which has a hollow keel. Now, in my opinion, and of most model yachtsmen, it is a mistake—the keel should be a plain sheet, and as light as possible; aluminium by preference, which enables you to get all the weight as near the lowest part of the vessel as possible, which you cannot if brass or iron is used. With a hollow keel boat, there is a continual wash through the aperture in the keel, which impedes the boat. I have made a good many model racing yachts, from 2 ft. to 7 ft., and with both hollow and plain sheet keels, and in every case the sheet keel boats have been superior sailers to the others. Not only are they steadier, keeping a true course, but much stiffer in a squally breeze. This is owing to the hollow keel having practically no leverage to keep the boat in an upright position, as near as possible, except what is given to it by the lead. The pressure of water on the sheet keel goes a good way to keep a boat stiff, and able to stand up to a breeze. Whereas in the hollow keel it is all lost, and at every pull she lies down; also in the sheet keel you have one cutting edge instead of two (every little projection goes against the speed).

I am glad to see that the model Mr. Brookbank made has a good length on the bottom of the bulb; so many models have little short keels. Nearly all light racing boats with little keels "yaw" about at every puff, thus not only losing speed but ground.

If there is any little matter in which I could be of assistance to your readers, it would give me the greatest pleasure to help.—Yours truly, "SILVER STAR."

Blackburn.

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.]*

PRACTICAL *X* RAY WORK. By Frank T. Addyman, B.Sc., F.I.C. London: Scott, Greenwood and Co., 19, Ludgate Hill. Price 10s. 6d. nett. Postage 4d. extra.

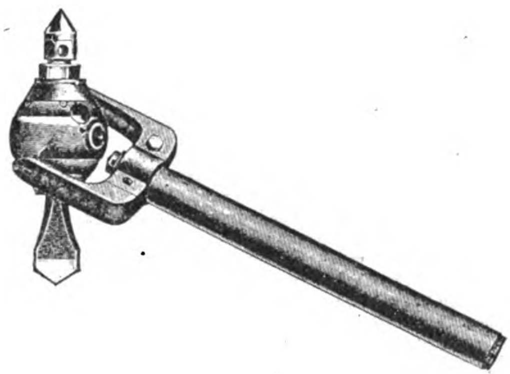
Without being able to say exactly how far this book will meet the needs of the medical profession in the matter of radiograph work, we are sure it will prove extremely useful to that large section of readers who devote any considerable proportion of time and attention to this fascinating branch of science. The book is avowedly for the guidance of the medical profession; but its practical and clearly written descriptions of the best methods, apparatus, and uses for *x* rays should make it an extremely handy volume for the lay experimentalist. The division into three parts—historical, apparatus and its management, and practical work—is a very happy arrangement, and the illustrations, printing, and binding are excellent. A useful portion is that devoted to the method of "location"—always a difficult part of the subject—and the long section on apparatus is invaluable. Altogether, Mr. Addyman's book is one deserving a place in the library of all interested readers.

A.B.C. OF THE TELEPHONE. By James E. Homans, A.M. New York: Theo. Audel & Co., 63, Fifth Avenue, corner of Thirteenth Street. Price one dollar; post paid.

This is an unsatisfactory work; it professes to deal with the subject in so comprehensive a manner that the non-technical reader can get an adequate knowledge of the practical working of the modern telephone industry. To this end chapters are devoted to the theories of sound and electricity, the latter being treated so "comprehensively" that in less than twenty pages the student is led through the definition of electricity and its manifestations, theories of voltaic cells, magnetism and the dynamo, the construction of various dynamo machines right up to modern commercial dynamos themselves! Now the subject of modern telephony with its myriad ramifications simply cannot be grasped by the "non-technical" reader at all, and those to whom the elementary matter in the present volume will appeal will certainly find extreme difficulty in understanding even half of the remainder. Others will similarly find the above elementary matter of no practical use, and in short we do not think it possible, in the compass of one volume of moderate size, to lead the absolute beginner satisfactorily up to a working knowledge of commercial telephony as practised to-day.

A Novel Ratchet Drill.

A VERY cleverly designed tool is described by our American contemporary *Power*, and shown in the accompanying illustration. Its special qualification is the ability to work in close or confined situations,



A NOVEL RATCHET DRILL

where the ordinary ratchet would not move, and it may be used for tightening nuts or bolts as well as for drilling. The "universal" movement of the drill is due to the fact that the axis of the two trunnions on which the handle turns is at an acute angle with the axis of the drill. About two inches of motion of the end of the handle in any direction whatever will drive the head, and the tool is strong enough to drill a 2-in. hole. By altering the attachment of handle to the body of tool, an ordinary rigid ratchet is obtained. The tool appears to be well and strongly made, as well as ingeniously designed, the makers being the Waterbury Tool Company, Waterbury, Conn, U.S.A.

WE regret that the price of Jamieson's "Steam and Steam Engines" (reviewed in our December 1st issue) was erroneously given as 3s. 6d. The price of this volume is 8s. 6d.

The Society of Model Engineers.

London.

Future Meetings.

The following are the dates which have been fixed for the ensuing ordinary meetings:—January 6th, February 4th, March 12th, April 10th, and May 5th. The subjects for these evenings are under consideration, and will be announced in due course.

The Third Annual Conversazione.

The Third Annual Conversazione was held at the Memorial Hall, Farringdon Street, E.C., on Saturday, November 30th, and was a brilliant success. Over three hundred members and guests were present, including several members from the provinces.

The proceedings commenced at seven o'clock, when the guests were received by the Chairman and Mrs. Percival Marshall, and from this hour till eleven o'clock the members of the Society entertained their friends to a continuous round of scientific and model engineering attractions. The musical arrangements, under the direction of Mr. A. M. H. Solomon, were greatly appreciated, and, in addition to the usual string band and concerts, included demonstrations of the powers of that ingenious instrument the "Pianotist," and some amusing items on the latest Edison phonograph, ably manipulated by Mr. Waller Martin. Mr. T. C. Hepworth gave two capital lecturettes on the subject of "Shipwrecks and Ship-raising," illustrated by a fine series of lantern slides, and Mr. W. J. Tennant, A.M.I.Mech.E., discoursed in an admirably lucid and entertaining fashion on the problem of "Perpetual Motion."

The exhibition of models was generally acknowledged to be one of the finest ever arranged by the Society, every available portion of space being occupied. The new track was arranged in the centre of the hall, and several fine model locomotives were shown running under steam. These included Mr. J. C. Crebbin's well known oil-fired engine, "Boorman," Mr. F. Smithies' single express, "Don," which gave an excellent performance, Mr. A. Bowling's L. & N.W. Ry. single express, "Owl," which we described in a recent issue, and Mr. W. T. Bashford's new model four coupled "Dunalastair," which we specially noted as being a splendid example of high-class amateur workmanship. Another railway item which attracted much attention was a working model showing a new method of taking up and delivering parcels from express trains. This was exhibited by the inventor, Mr. Britain, and a number of highly successful demonstrations of this clever contrivance were given. This invention seems to fill a decided present-day want, and doubtless more will be heard of it in the near future. Messrs. Burnham & Terrey showed one of their new model electric locomotives at work on a short length of track. The general neatness and satisfactory working of this exhibit were much admired, as also were the sample set of castings and working drawings of this model.

A large number of model engines were shown working by compressed air, during the evening, these including a fine series of marine and stationary engines made by Mr. T. Duddles, a splendidly made model of the "Skinner" launch engine by Mr. J. C. Taylor, a model vertical engine by Dr. J. Hobday, and a very interesting model of an old side-lever marine paddle engine by Mr. G. F. Tyas. Mr. Alf. Loebl had a model electric light plant running under steam, this consisting of a vertical boiler and horizontal engine driving a small "Crypto" dynamo and lamp, while Mr. H. Greenly had another horizontal engine also under steam. Mr. F. W. Webb, of the L. & N.W. Ry., kindly sent a fine working model of the "Diamond Jubilee" locomotive, and also a model showing the valve and cylinder arrangements of this engine.

A good show was made of engineering pictures and drawings, the Society being indebted for the loan of these to Mr. F. Moore, Mr. David Joy, Mr. G. F. Tyas, and Mr. C. E. Oxbrow. The Coast Development Company, Limited, lent a handsome model of the steamer *Yarmouth Belle*; Mr. James Holden lent some interesting railway models, including some full sized examples of his patent liquid fuel burners; and a large number of other attractive exhibits were contributed by the following:—Mr. A. Jakins, Model Steamer *Victoria*; Mr. F. Smithies, Model Railway Carriages; Mr. H. Hildersley, 5-in. Spark Induction Coil; Mr. E. M. Yetts, Portable Hand Lamp and Accumulators; Mr. J. E. Clogg, Model Steamer; Mr. H. C. Sprange, Marine Engine, 1¼ ins. by 1¼ ins.; Messrs. Bassett-Lowke & Co.—Model Railway Rolling Stock and Equipment; Messrs. W. Martin & Co., Drawings and Sets of Castings of a Model London, Tilbury and Southend Railway Locomotive (described elsewhere in this issue), and of a L. & S.W. Railway Locomotive; Messrs. W. H. Harling, a fine assortment of high-class Mathematical and Surveying Instruments; Mr. H. G. Riddle, Model Travelling Crane and an early form of Shocking Coil; Mr. H. C. Willis, Model Steam Launch; Mr. E. R. Dale, Several Models and Pieces of Electrical Apparatus; Mr. A. M. H. Solomon, Model Trucks and Pictures; Mr. H. W. C. Williams, Model Factory Engine; Mr. E. C. Prince, Photographic Album of Ocean Liners; Mr. S. H. Wratten, 1-6th-h.-p. Horizontal Engine; Mr. T. King, Model Traction Engine and Threshing Machine; Messrs. S. M. Stuart-Turner, Model High-speed Vertical Engine and a Set of Castings for the same; Mr. F. P. Kirton, Model G.N.R. Locomotive (in course of construction); Mr. W. Eastabrook, Model Locomotive; Mr. A. Bowling, Model Crane and Model G.W. Railway Locomotive; Mr. N. H. Simmons, Wimshurst Machine; Messrs. Marshall & Woods, Finsen Lamp for the Cure of Lupus, a Rectifier, and a "Bijou" Arc Lamp; Messrs. Brearley & Stevenson, Model Engine Castings, Condenser and Governors; and Mr. H. A. Godby, Model Cardboard Locomotive.

Great credit is due to the late Hon. Secretary of the Society, Mr. Herbert Sanderson, for the admirable arrangements made, and a word of thanks is due to those members who acted as stewards, or otherwise assisted in carrying out so important and so successful a gathering.

Provincial Branches.

Glasgow.—The annual general meeting of the Glasgow branch was held in the National Halls, on Monday, November 18th, Mr. A. Lang presiding. The chief business was the election of office bearers, which resulted as follows.—Hon. Secretary, Mr. John Rogers; Hon. Treasurer, Mr. Hugh Park; Committee: Messrs. James R. Beith, Robert Falconer, John Erskine, and Thomas Hornal. The election of Chairman and Vice-chairman were left over to the following meeting. It was proposed by Mr. Ralston, and seconded by Mr. Beith, that we meet once a month, the first Wednesday of every month being agreed to, with the exception that the January meeting will be held on the 8th of the month. The annual subscription is now reduced to 6s.—Andrew Lang, Hon. Sec., 11, Dale Street, Bridgeton, Glasgow.

At a Watford bazaar held recently in aid of a local charity, one of the chief items on the programme was a model railway over 100 ft. long, fully equipped with sidings, signals, and station, the construction and working of which were due to the labours of Mr. F. Smithies.

The Editor's Page.

TO our readers, one and all, we extend the old, old wish that they may have the happiest of times during the festive Christmas season, and all prosperity during the coming year. We offer our good wishes with more than ordinary sincerity, for we feel that we have much to be grateful to our readers for, both with regard to their loyal and regular support of our journal, and to the expressions of kindly appreciation and encouragement which reach us continually throughout the year. It is, of course, an impossibility that we should have personal acquaintance with even a tithe of our thirty thousand readers, but we feel that among the many whom we have not had the pleasure of meeting, we have made a host of friends, who will reciprocate the greeting we have ventured to express above. This is our only means of extending the hand of good fellowship to them, and we take advantage of this seasonable opportunity to do so right heartily.

* * *

The New Year is an appropriate time for forming new resolutions, or, as it is sometimes called, "turning over a new leaf." We believe that once upon a time a budding enthusiast in engineering turned over a new leaf by selling the contents of his workshop and buying rabbits with the proceeds, but as none of the models he made ever worked there was some excuse for him. We do not advocate so drastic a change as this in the reformation of one's hobby; but we venture to suggest a few New Year resolutions, which may be taken more or less seriously by those whom they most concern. They are as follows:—(1) To clear the rubbish out of my workshop and give it a good clean up. (2) To put up proper racks and drawers for the tools now lying about on my bench. (3) To keep the tools in the places provided for them. (4) To make some better models this year than I did last year. (5) To return those copies of THE MODEL ENGINEER I borrowed from Jones, and to order my own copy regularly. (6) Not to send up a batch of ten queries or a request for a set of working drawings for a locomotive or a motor car to the *M.E.* Query Department, and expect a reply by return of post.

* * *

While on the subject of what to do and what not to do, may we remind those of our readers who write to our American advertisers for their price lists that the postage to America is 2½d. for letters weighing ½ oz. or less, and 1d. for post cards. It is necessary for us to refer to this matter because several of our American friends have had to pay excess postage to no small extent on letters from our readers on this side of the water. Probably the fault is due more to forgetfulness than to ignorance, but we hope this reminder will not be without effect.

* * *

No. 8. of THE MODEL ENGINEER series of handbooks, entitled "SIMPLE ELECTRICAL WORKING MODELS," is now ready, price 6d., post-free 7d. This contains drawings and descriptions of how to make a number of interesting electrical models, such as a model telegraph, electric bell, simple telephone, several types of simple motors, &c., and is a capital handbook for the beginner in electrical work who is wondering what to make. Most of the matter has been culled from back numbers of THE MODEL ENGINEER, so that the book may be of interest to those readers who do not possess complete sets.

* * *

The entries for our Prize Competition No 17 have not been so numerous as usual; but this is, perhaps, hardly a matter of surprise, since the subject of model crane building is one which we do not think has received the attention from model makers which it deserves. No design was sent in which we could regard as being really satisfactory, although several of the competitors appear to have taken a lot of trouble with their work. After giving all the entries our careful consideration, we have decided to increase the prize money to £1 10s., and divide it between the following two competitors:

MR. DAVID SHANNON,
161, Broomloan Road,
Govan, Glasgow;

and

MR. ALEXANDER MACLAREN,
Carridon,
Motherwell, N.B.

A cheque for 15s. has, therefore, been forwarded to each of the above named readers. We hope to find space in our next issue for some comments on the various designs sent in.

* * *

The publishers ask us to announce that bound copies of Volume V of THE MODEL ENGINEER will be ready in a few days, price 3s. 6d., postage 4d. extra. Early application is desirable. A few copies of Vol. III and Vol. IV are still to be had, the price of the former, which contains three issues extra, being 4s., and of the latter 3s. 6d., the postage on each being 4d.

* * *

The present issue commences a new volume, and incidentally marks the inauguration of the fifth year of THE MODEL ENGINEER'S existence. Its size and its contents need no comment from us to emphasise the remarkably healthy nature of its progress, and we shall spare no efforts to make the matter in future issues as interesting and instructive as ever. We have recently indicated some of the special articles for which we have made arrangements, and we may now add that we shortly intend giving, for the benefit of our younger readers, a series on the mode of entry, the training for, and the prospects of the various branches of the engineering profession. We shall also announce some further interesting Prize Competitions in an early issue.

* * *

We give at the commencement of this issue an interesting account of an unusually smart model launch built by one of our Colonial readers. We hope this may stimulate others of our friends abroad to send us some particulars of their work.

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.*]

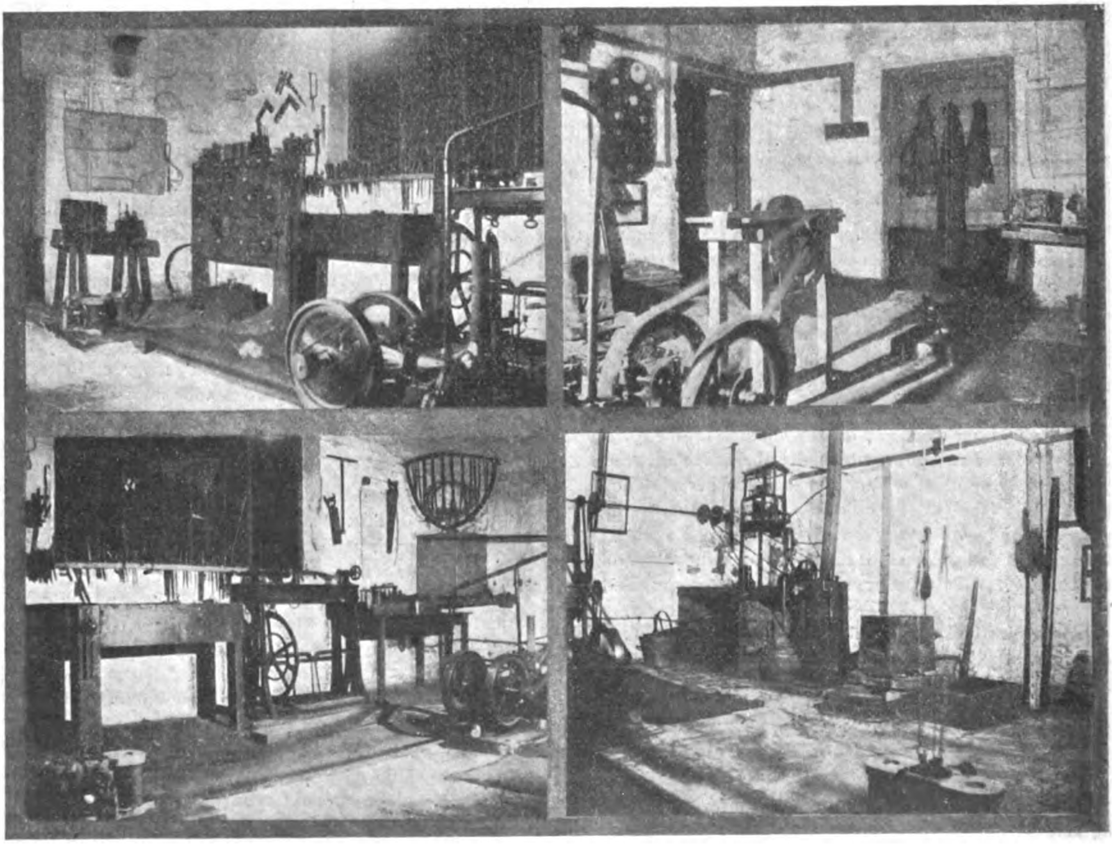
An Amateur's Workshop.

TO THE EDITOR OF *The Model Engineer*.

DEAR SIR,—I enclose four photographs of our workshop and electric installation, which are interesting from the fact that they were *taken by arc light* by my brother, the current being generated by the engine and dynamo, run rather slack, and therefore flaps about considerably. The shafting seen in one photograph can be driven by the oil engine or the vertical steam engine, and drives grindstone, blast fan, small dynamo (10 volts, 2 ampères), and the model thrashing machine. The model workshop is driven by an independent 1 in. by 2 in. horizontal engine. I think these photographs are very fair ones for interiors, and hope they will interest your readers.

In conclusion, I can recommend any model engineers who go in for photography to try some by arc light, if they can get the necessary current. In many cases good photos of interiors cannot be got by daylight, owing to the presence of windows, &c.—Yours truly,

Warwick. R. B. VERNEY.



FOUR VIEWS OF MR. VERNEY'S WORKSHOP, SHOWING GAS ENGINE, TOOLS AND DYNAMO.

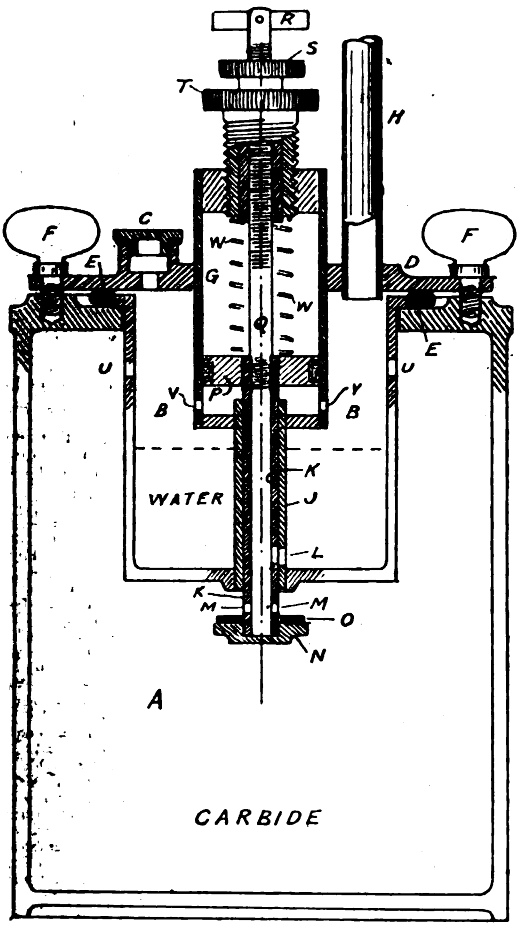
which, as you see, are running. The lamp was simply a rough frame to hold the carbons, which were adjusted by hand. The current was about 6 ampères at 40 volts, the exposure being three minutes. Two 10 c.-p. incandescent lamps were also alight, also the switchboard and model workshop lamps. The glow from these lamps can be noticed on some of the photographs. These incandescent lamps were lit from the battery. The photos were taken from the four corners of the shop; in three of them the circular saw has been removed, in order to show the engine, &c., better; in the other it is shown in place, and running. The saw is 7 ins. diameter, and will cut 1-in. elm planks with ease. The driving belt of the dynamo is not plainly visible, as the drive being long the belt is

An Automatic Acetylene Gas Generator.

TO THE EDITOR OF *The Model Engineer*.

DEAR SIR,—I have much pleasure in sending you a drawing of an acetylene gas generator, which will automatically regulate the generation of gas as required. The idea is my own, and the following particulars, together with the diagram, will illustrate its action.

The large container, A, holds the calcium carbide, whilst the water is poured into the vessel B through the filling plug C. The two vessels are sealed by means of the cover D, a rubber ring E making all tight, and the fly-screws F being used to secure the cover. The piston chamber G is fixed air-tight in D, by soldering, and a pipe H leads away the gas as it is generated. J is a brass tube, firmly screwed and soldered into the bottom of B, and sliding into a hole in the bottom plate of G when this is put on with the cover D. Inside tube J is another tube K, which must be a good sliding fit in the outer tube. Holes are drilled in both tubes at L, and two or three holes in the inner tube at M. The bottom of K is closed by a disc N, which is turned true on top, and carries a soft leather washer O. The top of K is screwed into a piston, P, which is packed with cotton, &c., and slides in the chamber G. Into K, at the top, is also screwed the piston-rod Q, attached to the top of which is the handle R. The rod Q is screwed



An Automatic Acetylene Generator.

and works in the long nut S, *sliding* in a second nut T, which again is screwed into the top of chamber G. Holes, U, are drilled near the top of B, and others, V, in the bottom of G. A light spring, W, presses upon the piston, and keeps it down as long as there is no pressure of gas below it. The action is as follows:

Carbide having been placed in A, the cover screwed down, and water poured in B, the rod Q is turned by means of the handle R, so that the two holes at L correspond. The piston being down, water will pass through the holes L and out at those marked M, and thus into the carbide chamber. As gas is generated it escapes by the holes, U, into the water chambers, and thence to the outlet tube H.

When no gas is being drawn from H, it accumulates until a sufficient pressure exists to lift the piston, P, against the force of the spring W. The generation of gas then ceases, the leather washer, O, securing against any leakage of water. If required, greater pressure can be had by screwing down the nut, T, on to the spring. To cut off the supply of water altogether the piston, rod, and tube K, are turned round by means of the handle R, so that the holes, L, miss one another. Of course, all the work on the generator must be well done, when I think it will be found a practical and useful apparatus.—Yours truly, Fredk. C. Gore.

Upper Edmonton.

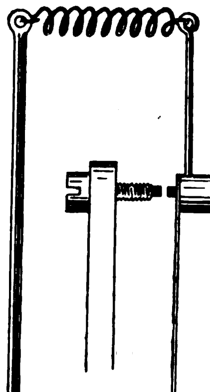
Queries and Replies.

[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.

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:—

[4939] **Sparking Coil Unsatisfactory.** H. H. H. (Anerley) writes: I have made the spark coil described in your March 1st issue, but cannot get the full length of spark; I can only get about 2¾ ins.; and this is not continuous, although I have added two discharging posts, one with a point, and the other with a disc, which really ought to increase the length of spark. I have tried all connections, battery (3 bichromate cells), adjusted the contact-breaker, and reversed the current, but cannot increase the spark. I have made the iron core out of No. 16 iron wire instead of No. 22. (1) Would this make any perceptible difference in the length of spark?



Query No 4939.

(2) Does it follow that the better the insulation of the condenser the longer the spark? (3) Could you recommend a good tube to use with this coil for *x*-ray work?

(1) No. 22 iron wire will certainly make a better core than 16. You would get a stronger magnet. It is more sub-divided, and more iron in it. This would affect your spark perhaps ¾ inch. Have the core perfectly *annealed*, and filled with varnish. (2) The better the insulation of condenser the greater its capacity, less sparking at contacts, and to a slight extent the secondary spark is lengthened, at

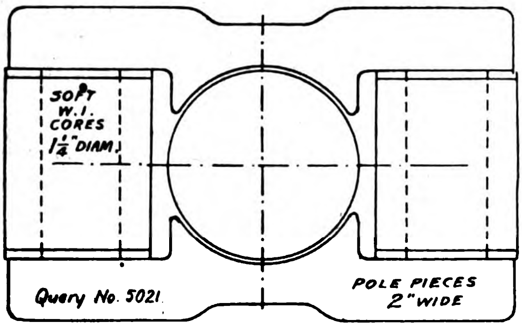
the retarding effect of self-induction of primary is lessened. (3) Try Messrs. Cossor, of Farringdon Road, who is a specialist in *x*-ray tubes. Messrs. Apps, Strand, also supply a very good one; Harry Cox, Cursitor Street, or Watson and Sons, optician Strand. Before altering coil in any way (i) try the effect of cells with larger plates, if possible—the larger the better; (ii) fix a piece of wire to top of hammer of contact-breaker with a light spring to pull it, as in sketch; (iii) keep a good surface on the platinums. There must be some slight defect in your secondary. Perhaps a section or two reverses, or a pinhole through disc. With very careful workmanship you could get nearly 3-inch spark. It is not so much quantity of wire as insulation and good disposition magnetically.

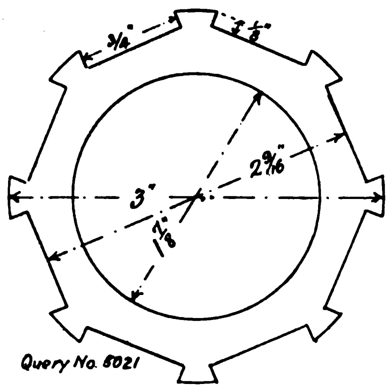
[4833] **Crucibles for Casting.** H. S. (Kirby-in-Ashfield) writes: Can you tell me where I can get a small crucible from, to melt, say, two or three pounds of metal in? The crucible will be made of plumbago.

Messrs. Melhuish, Sons & Co., of 85, Fetter Lane, who advertise in our columns, supply plumbago crucibles of all sizes.

[5021] **"Manchester" Dynamo.** G. T. (Sunderland) writes: I want to make a Manchester Type Dynamo, with an armature 3 ins. diameter and 2 ins. long, ring pattern, and I want to put eight slots in it. (1) How deep and what width should slots be, and what quantity of wire would I require for winding? I have 63 yards of 22 D.C.C.; would that be of any use? (2) Size of field-magnets and cores, and what quantity of wire would I require for winding; also speed and c.p.; should armature be insulated all over? what power required to drive? (3) What size should air gap be from armature?

The drawings below show the outline of a suitable field-magnet and stamping for ring armature. Premising that a ring armature





3 ins. diameter is not an easy matter to wind, owing to the very limited space inside, the dynamo should make a good little machine if carefully put together. (1) The slots should be ⅜ in. by ¼ in. (armature stamping is drawn two-thirds full size, and field-magnet one-third) The 63 yards of No. 22 should do very well, winding 48 or 50 turns on each slot, requiring just about the amount you have. (2) Wire for field-magnets, 2 lbs (total) No. 22 D.C.C., 1 lb. on each limb. Field magnet coils connected in shunt with armature. *All* parts on which wire is to be wound must be carefully insulated. (3) Air gap not more than 1-16th in. Output, 3 amps. at 20 volts. = 60 watts, at 2000 revs. per minute, requiring 1-10th to ⅛ h.p. to drive.

[5134] **Boiler Design.** N. P. G. (Kidderminster) writes: I am making a boiler for a stationary engine, 2⅞ ins. × 3½ ins., and will be very much obliged if you will give me the following particulars:—(1) Most suitable size and shape to give plenty of steam. (2) Most suitable metal and thickness (shell). (3) Number and diameter of tubes (if any). (4) Formula or principle which enables the size of the boiler to be determined.

The most convenient type is an ordinary vertical boiler. The range of water in these is large, and the pump may be adjusted to force in almost the same amount of water as the engine is using; also, if oil fuel is adopted the boiler would work with the minimum of attention. The best rule to go upon for models—for fairly large models, with cylinders over 1 in. in diameter—is that for every 12 cubic inches of water to be evaporated per minute not less than 1000 square inches of heating surface must be provided, and for smaller models for every 1 cubic inch per minute, a provision of no less than 100 square inches of heating surface is necessary. To calculate the amount of water an engine will consume, it is best to not take into consideration the amount of cut-off provided, but to allow for losses by condensation and for steam which fills the clearances and ports; and if it is reckoned that the maximum amount of steam the cylinder itself could contain at each working stroke is the amount really used, the estimate of the actual consumption will be fairly true; for small engines 25 per cent may be added to make success certain. The cubic capacity of the steam used per minute must be found by the following formula:—Area × stroke × number of strokes per minute, which, in your case, works out as follows: $4\cdot9 \times 3\cdot5 \times (2 \times 300) = 10{,}290$ cub. ins. per minute. Now as the volume of steam to that of the water from which it was produced bears a certain ratio according to the pressure, it will be necessary to state a pressure before the size of the boiler can be determined. Above we have taken the revolutions per minute as 300, and to complete the calculations we will consider the boiler pressure to be 50 lbs. It will be necessary to refer to a table of "Properties of saturated steam," a copy of which we append. Number of cubic inches of steam obtained from one cubic inch of water at various pressures:—

10 lb. pressure	= 1 cubic inch of water		= 996	cubic inches of steam.		
20	,,	,,	,,	= 726	,,	,,
30	,,	,,	,,	= 572	,,	,,
40	,,	,,	,,	= 474	,,	,,
50	,,	,,	,,	= 405	,,	,,
60	,,	,,	,,	= 353	,,	,,
75	,,	,,	,,	= 298	,,	,,
100	,,	,,	,,	= 225	,,	,,

From the above table your engine will consume, at 50 lbs. pressure (and 300 revs.) $\frac{10290}{405}$ = about 52½ ins. of cubic water per minute. A reference to the rule as to heating surface, that every 12 cubic inches of water consumed will require 1000 square inches of heating surface, will show that you must arrange for $\frac{25\cdot5}{12} \times 1000$ square inches = 2,125 square inches at least. For the details of such a boiler you had better refer to "Model Boiler Making," price 7½d. post free, from our publishers. This book also instructs the reader how to find the working pressures of any boiler shell. You may design a boiler similar to that described on page 35 (Fig. 11), with a shell about 3 ft. × 18 in. If oil fuel is used the copper fire-box should be fitted with some small cross tubes of about 1¼ in. diameter, arranged as shewn in *M.E.* for July 1900. The shell should be of mild steel plate, No. 8 I.W.G. in thickness. A correspondingly larger number of flue tubes should be arranged. The proportion of heating surface to grate area should not be less than 10 to 1. So many amateurs think that an increase of pressure will augment the output of the boiler, and that they have only to double the pressure to get double the power. Neglecting the strength of the boiler, say that a certain boiler puts into an engine in the form of steam 10 cubic inches of water, the resultant i.h.-p. being ½. The mere fact of doubling the pressure will not double the power of the boiler. The above boiler giving 10 cubic inches at 50 lbs. would practically still evaporate the same quantity at 100 lbs. pressure, the steam not being in so great a volume. The engine would only run at about half the number of revolutions per minute, and still develop the ½ h.-p. If it was run at the same number of revolutions when working at 50 lbs., the 100 lbs. pressure would not be kept up for long, as the engine would be making a greater demand on the evaporative power of boiler than it could meet.

[5179] **Charging Small Accumulator.** D.T. (Edinburgh) writes: I have a 4-volt pocket accumulator, plates 3 ins. by 1½ ins. I wish to make a dynamo to charge it. What is the heaviest current I could charge it with? What would be a suitable output for the dynamo? Also, how long should it take to charge accumulator at this output? If I charge accumulator off town mains (230 volts), what size of lamp will be required as a resistance?

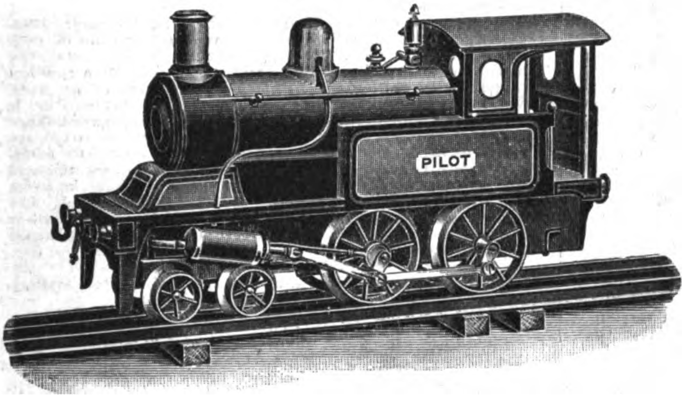
You can calculate the charging current from our little book "Small Accumulators," although for so small a battery the ordinary rate might be exceeded without much harm. About ½ ampère would be the maximum in any case and this would require only the smallest, 5 or 6 volt dynamo that could be obtained. Of course, the dynamo must be shunt wound and it must not have a Siemens' H armature. If the battery is of good construction it will have about 1½ ampère hour capacity, so that charging it at the rate of ½ ampère will take 3 hours. About the most convenient lamp to use when charging the accumulator from your supply mains would be a 32 c.-p., which would make the charging rather longer than in the above instance. You do not conform to Rule 1 in the "conditions" printed at the head of the Query Columns.

Amateurs' 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.*]

Model Locomotive for 2 ins. Gauge.

There seems a good dema d amongst model railway makers for a locomotive which will run well on a small g uge or track. Messrs. Bassett-Lowke & C ., of 18 & 20, Kingswell S reet, Northampton, have placed on the market a cheap engine for 2-in. gauge, which we have had the opportunity of seeing at work. The "Pilot" locomotive has two double-acting slide-valve cylinders, fitted with a



Model Metropolitan Railway 4-coupled Tank Loco.

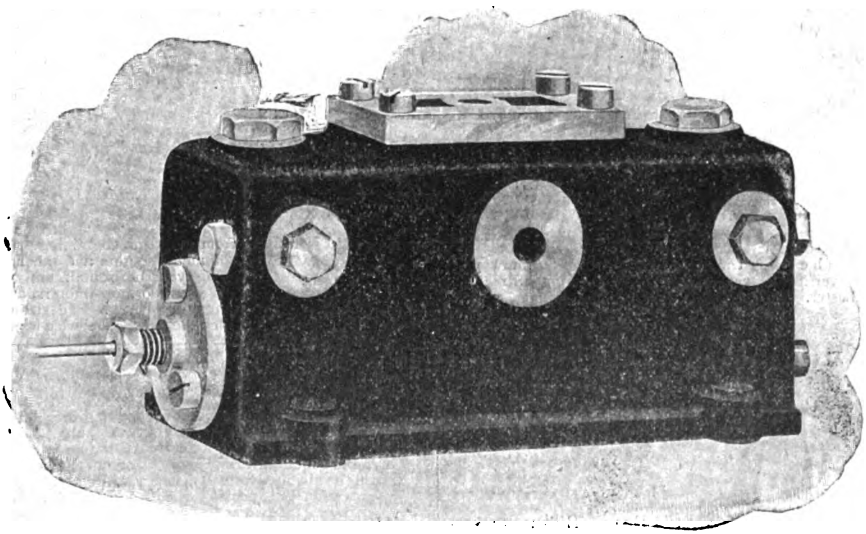
special design of reversing gear which can be actuated rom the cab and is a great impovement as regards running powers and convenience in handling upon this firm's previous 2-i . gauge models. As will be seen from the illustration here reproduced, the engine is a four- oupled tank engine the prototype being those used on the Metropolitan Railway. Prices can be obtained from Messrs. Bassett-Lowke's List.

Electrical Apparatus.

A perusal of the list of second-hand electrical apparatus or sale by Sam Middleton, 65, Southampton Street, Camberw.ll, London, S.E., reveals the fact that he has just the goods to suit the majority of electrical amateurs. Those who require good sound apparatus, secondhand, but in guaranteed good order, will find many t ns to choose from, of all kinds, and at very moderate prices. Medical and sparking c ils at no more than a third of the original cost, and electric telegraph apparatus form important items, whilst many old ele tro-magnets containing large quantities of good wire, are to be had at equally reason bl rates. Mr. Middleton has supplied apparatus to many noted schools and universities, and corresp ndence from such institutions will r ceive every attention. A stamped envelope should accompany any enquiry.

Condenser for Model Horizontal Steam Engines.

In the course of a notice in these columns recently of Messrs. Brearley and Stevenson's model condenser, we expres ed the hope that we should be able to illustr te this useful adjunct to any good model steam engine. A view of the condenser is given below, and a set of drawings whi h lie before us give a clear idea of the good con truction of the apparatus. Those who are interested in the matter will find further particulars on page 240 of our November 15th issue, Vol. V, or may obtain a descriptive list, which will be sent on receipt of 1d. stamp.



A Condenser for Model Horizontal Steam Engines.

Up-to-Date Models.

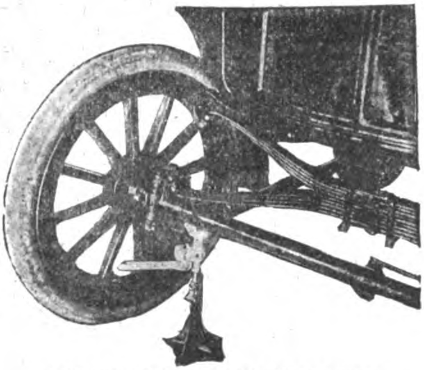
We have received some "advance" sheets of Messrs. Drake and Co.'s new supplementary list and are glad to notice that the firm keeps well up to the times by constantly introducing sets of casti gs and parts for the m dels described in this journal. Practically all the ordinary requirements of the modeller, whether his interest is electrical or mechanical, are studi d in the present list, but a strong point of the firm is their willingness to undertake special work at moderate prices We hope to give a more extended notice of the firm's special ties at a later date. Readers should send a penny stamp to M ssrs. Drake & Co., 4, Balfour Street, Bradford, for the above list.

Cold Lacquers.

Lacquers and enamels of various kinds for work which cannot be "stoved," are supplied by The Frederick Crane Chemical Co., 22 and 23, Newhal Hill, Birmingham. Varnishes, gold paints, cycle enamels, waterproof cement, and polishing materials are also supplied either in large or small quantities.

Ball Bearing Automobile Jacks.

The Frasse Company, 38 Cort'andt Street, New York, is putting on the market a new line of ball bearing jacks, made in various sizes to adjust in height from 12 to 26 ins. The small sizes are intended for automobile , ight trucks, and carriages, or for rai ing vehicles weighing 2003 lbs. or less. The m dium size will lift up to 3000 lbs. in weight, and the large one, which weighs only 18 lbs. has be n tested on a hook and ladder truck, the weight of which is 5,600 lbs. It was also tried under a fire engine which weighed 7,600 lbs., lifting the entire rear end easily without effort. These jacks are adju ted quickly and on account of the ball bearing head, a slight movement of the lever will raise the weight clearly from the ground. While these jacks were originally intended for the purpose of lifting automobiles and carriages, they are also of use for levelling billiard tables and setting up machines; in fact, they accommodate themselves to almost any class of machinery where the regular bell bottom jacks would be in the way on account of their size. On account of their lightness the ball bearing jacks can be carried in chests of tools for riggers or millwrights. Anyone interested should write to the makers for illustrated price list and information. As will be seen from the illustration, the spindle has a



AUTOMOBILE JACK IN OPERATION.

ratchet which allows of moving the ball head as required, saving time. These ball bearing jacks are also furnished with round head for use under machinery.

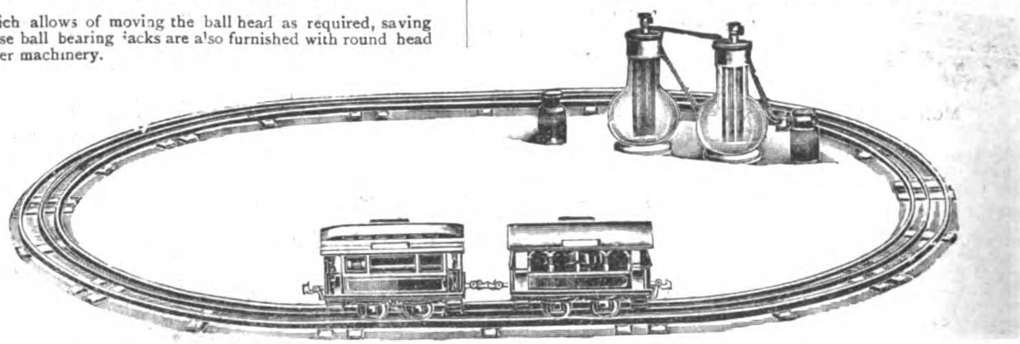
supplied with a set of rails complete for 15s., or with an extra car or extra length of rails for 24s. The firm states that only a limited number are being supplied for the season, so that early application is necessary. THE MODEL ENGINEER should be mentioned when ordering one of these sets.

Catalogues Received.

Ohio Electric Works, 76 & 78, Ellen Street, Cleveland, Ohio, U.S.A.—A neat descriptive price list is issued by this firm, dealing in battery lamps, carriage lights, necktie lights, batteries, motors, fans, telephones, telegraph outfits, wire, and other electrical sundries. English readers should remember, when writing, that the cost of postage to America is 2½d. per half-ounce, and not send letters underpaid.

Messrs. Kingscote Bros. & Williams, Patricroft, Manchester, have produced a catalogue in a style worthy of their mechanical productions. Model engineers have had an opportunity of realising the latter by our illustrated description of the excellent model high-speed electric light engine in February 1st issue, Vol. IV, and this engine takes first place in the new list to hand. It is made in three sizes—either rough castings and forgings or finished engines being supplied, while vertical or marine type boilers are also to be had on the same terms. Prices will be quoted for machining the parts if desired, and the catalogue contains straightforward instructions for building the engine in a proper and workmanlike manner. A good backgeared lathe in four sizes is also listed. The highest commendation is deserved by the firm both for the excellent printing and binding of their catalogue and for the well-arranged and carefully illustrated contents. It will be sent for 4d., post free, to any reader who mentions THE MODEL ENGINEER.

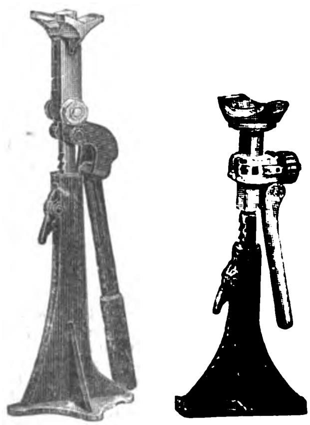
The British Modelling and Electrical Co., Leek, Staffs.—



MODEL ELECTRIC TRAMWAY BY THE UNIVERSAL ELECTRIC SUPPLY COMPANY.

A Model Electric Tramway.

We are glad to be able to illustrate a smart little electric tramway supplied by the Universal Electric Supply Co., 47, Crosscliffe Street, Moss Side, Manchester. The model car is about 7 ins. long, and



LARGE AND SMALL BALL BEARING AUTOMOBILE JACKS.

contains a motor which, it is stated, will work the car at a high speed. The current is collected by a sliding brush from the centre rail, and the car is provided with seats, and figures of driver and conductor. It should make a great window attraction, and is

A new list is to hand from this firm, containing prices and particulars of every variety of model engine and other mechanical and electrical goods. Locomotives, horizontal, and vertical engines, boilers, fittings, castings, dynamos, and motors, are some of these items, while model gas engines, lathes, and steamers go to make up a catalogue of considerable size. The price is 3d. post free.

Notices.

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

This journal will be sent post free to any address for 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 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

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AND

Amateur Electrician.

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

VOL. VI. No. 65. JANUARY 15, 1902. PUBLISHED TWICE MONTHLY.

Hints on Building a Model Steam Pinnace.

By E. C. WEBSTER.

IN the second volume of THE MODEL ENGINEER I gave a short description of a boiler for a model steam pinnace, and now am able to illustrate and describe the little craft itself, in the hope that I may be helping some of the younger amateurs to make a simple working model, which will be at the same time fairly correct in proportion and appearance. Fig. 1, which is a photograph of the completed boat, shows her lines fairly well.

The hull is of wood, made in two halves lengthways, and joined together by glue, after each has been quite hollowed out and nearly finished exteriorly, wooden pins being put through wherever practicable; added to this there are some strips of brass about 1-16th in thickness, which are screwed across the join inside the hull.

There is a strip of wood fastened along the gunwale, and another smaller inside, both of which will be seen in Fig. 2, the cross section, which also shows at B the manner of fastening in the boiler C, for particulars of which I will refer my readers to the May number of THE MODEL ENGINEER, Volume II.

A good idea of the hull may be obtained from the photograph, Fig. 1, together with the line of shear, and the cross section on the right of Fig. 2 gives the shape amidships, while the left hand side of the same figure shows the end piece of stern, which is marked A, and was put on separately, the hull being hollowed right out at this part, which is better than leaving a block while scooping out, besides being much lighter. When the hull was quite finished I gave it a coat of thin oil paint,

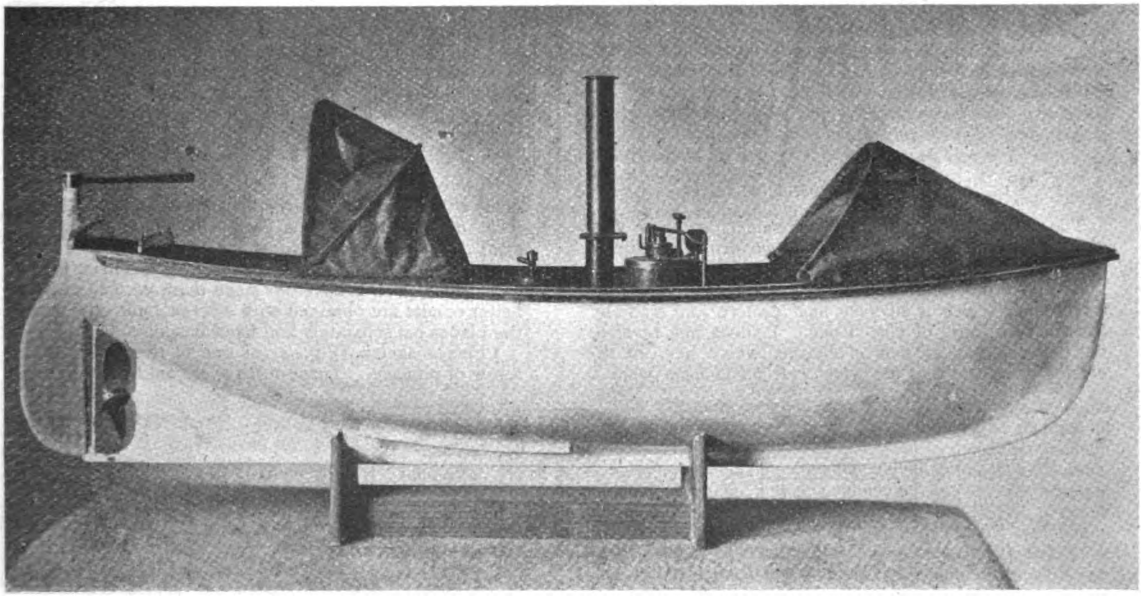


FIG. 1.—A MODEL STEAM PINNACE.

and when dry finished with two coats of "Aspinall's Bath Enamel," the tint being what I think is called "chalk white." The surface of the enamel must be well smoothed down with fine glass paper between each coat.

The interior woodwork shown in the half-deck plan (Fig. 3) may be mahogany French-polished, or white wood neatly painted a light yellow or chocolate. The floor boards should be marked neatly with a pencil and varnished with white varnish, the wood being white.

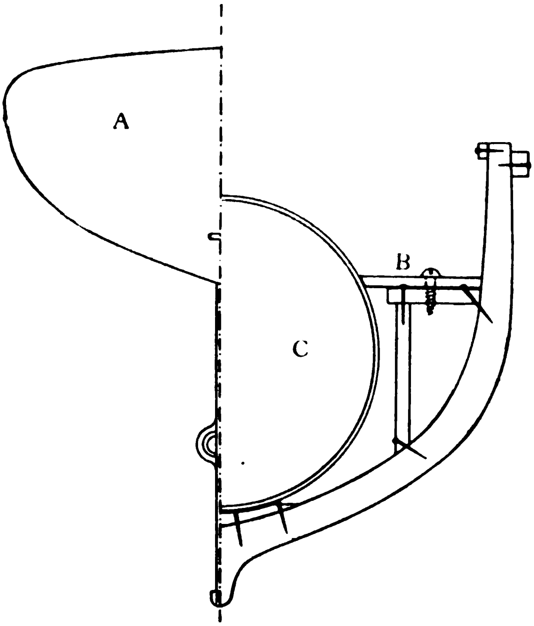


FIG. 2.—CROSS SECTIONS OF HULL.

The darker part along the gunwale (Fig. 1) is varnished over the white enamel with two or three coats of shellac varnish.

As I had no lathe when I made this boat, I bought the engine, which is of very neat pattern and made by Messrs. Whitney, of City Road. It does not reverse, but the same pattern can be obtained which has link reversing gear, and they are very well made from what I have seen of them, and work excellently. The cylinder is $\frac{5}{8}$ in. bore with $\frac{1}{2}$ in. stroke.

The copper tube condenser referred to in my previous article can be seen in Fig. 1; it is merely a thin copper tube made of sheet metal, a part being filed out near each end, so that the ends can be turned up at right-angles to the other part, which is slightly bent to follow the curve of the hull. The after-end is connected to the engine; the forward end only protrudes a $\frac{1}{2}$ in. into the hull.

The exhaust tube passes though a hole in the bulkhead aft of the engine, and passing under the seat behind is connected to the condenser by a short piece of rubber tube; the bulkhead will be seen in Fig 3. Presuming that my reader has a lathe, the pump ought not to be difficult to make from castings; but if no lathe is at hand, it must be bought. The sizes made for hand-feed are as a rule too large; but a handle is easily fitted to one smaller intended to be worked from an engine shaft, and a screw union is strong enough to fix it to the side of the boiler, if the shape of the pump base allows; this is how mine is fitted, as will be seen in photograph of boiler.

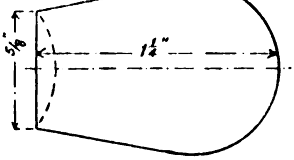


FIG. 4.—SHAPE OF PROPELLER BLADE.

The stern tube is formed of a piece of brass tube 4 ins. long, the ends being stopped with brass, and holes being drilled to allow a length of $5\frac{1}{8}$ ins. of steel wire of about No. 15 gauge to turn freely when passed through. The brass tube is $\frac{1}{4}$ outside diameter. On the inside end of wire shaft a spiral of No. 19 brass wire is soldered, the other end of spiral being fixed to the hub of flywheel of engine; this forms a flexible coupling, and works much better than the usual pins and catchplate.

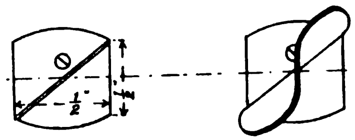


FIG. 5.—DETAILS OF PROPELLER.

Now comes the vexed question of propeller. I think many will agree that good models are often spoilt through want of attention to this part. Personally, I have no sympathy with the cast brass screws usually sold; they are generally heavy and of bad shape. There may be good ones, but I have not seen them yet; in any case better results are obtained with a screw built up—that is, the blades cut separately and fixed into boss.

I give a sketch (Fig. 4) of one of the blades of the screw of pinnace. Three of these are cut from thin brass, and soldered into a boss, which has three cuts made in it with a saw at equal distances, and at the angle shown in Fig. 5. After the blades are soldered they should be bent with the thumb and finger, till they assume the outline (Fig. 5), if looked at "end on." This screw works well on my model, and was the nearest I could get to the correct thing, after looking at several full-size pinnace propellers.

The boss may be turned from brass rod, or, lacking a lathe, may be merely cut oft the rod, drilled as nearly in the centre as possible, and fitted with a set-screw. It should be fixed on shaft, so that the spiral of brass wire

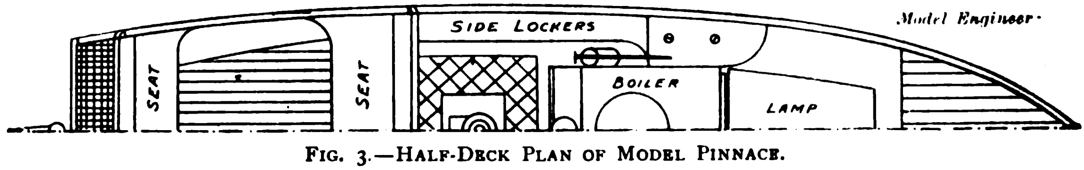


FIG. 3.—HALF-DECK PLAN OF MODEL PINNACE.

within the boat causes it to slightly press against end of stern tube; if neatly fitted, this arrangement will be found quite water tight in a small model, and will work far easier than the conventional stuffing box. Of course, the propeller should be adjusted on the shaft after the engine is fixed in position.

Everything in model steam craft should be kept as light as possible, and the lighter the whole is when finished the faster it will go when on the water; also a small light engine driving a small screw at a high speed is more effective than a larger engine ponderously driving a large screw.

The Society of Model Engineers.

London.

FUTURE MEETINGS.

THE following are the dates which have been fixed for the ensuing ordinary meetings:—February 4th, March 12th, April 10th, and May 5th. The subjects for these evenings are under consideration, and will be announced in due course.

The usual monthly meeting was held at Memorial Hall, on Thursday, December 12th last, Mr. Percival Marshall taking the chair at 7.30 p.m. After the Track Committee for the present year had been elected, a telegram from the Rev. W. J. Scott, B.A., was read saying that he was unable to attend and give his lecture on "Modern North Eastern Locomotives."

Among the exhibits was an oil-fired ¾-in. scale standard gauge ten-wheeled tank locomotive, belonging to Mr. Wm. Eastabrook, Vice President of the Cardiff Branch, which had just been completed by Mr. M. S. Don to the designs and specification of Mr. H. Greenly. On being asked, Mr. Greenly gave a description of its salient points, illustrated by sketches on blackboard, and concluded by giving the model its trial trip, which was performed successfully upon the Society's new track. The meeting terminated at 10 p.m.

Mr. Scott has since promised to give his lecture at a future date, and regrets that illness prevented him fulfilling his previous engagement.—HENRY GREENLY, Hon. Sec., 4, Bond Street, Holford Square, W.C.

Provincial Branches.

Birmingham.—The fourth meeting of the Birmingham branch was held on Thursday, November 14th, five members being present. Mr. Knipe informed the meeting that owing to business engagements having called Mr. Fabb from Birmingham, he felt compelled to resign the post of Hon. Secretary. The members much regretted Mr. Fabb's inability to hold the post longer. A vote of thanks to him, for his great help ever since the branch was founded, was carried unanimously. Mr. A. B. Loach then read a paper on model boilers, which Mr. J. C. Crebbin, of the London centre, had very kindly lent. The paper was illustrated by lantern-slides, and also by a boiler which Mr. Crebbin had sent. Mr. Clarke proposed a vote of thanks to Mr. Crebbin for the use of his paper, and also to Mr. Loach for reading it that evening. Mr. Knipe seconded, and said that it was to be regretted that more members had not been able to be present. A discussion followed, and the meeting terminated at 9.30.

The fifth meeting took place on Thursday, November 21st, when six members attended. The Chairman called upon Mr. F. Peers to describe several novel lathe tools which he had made. He also exhibited a very fine set. A most interesting discussion ensued. A vote of thanks was passed to Mr. Peers for his description and fine display of tools.

The Hon. Secs. acknowledge the receipt of Messrs. T. Thwaite & Co.'s catalogue.

On Monday, November 25th, at the invitation of Messrs. J. & W. Kean, several members visited their Birmingham works, where the firm had arranged for a view of some of their well-known English model railway plant, including several coaches and wagons, some rails, and a fine 14-lever interlocking cabin. All these, part of a large order, were ready for despatch, and Messrs. Kean's arrangements to enable us to view were much appreciated, and the substantial build and general finish were much admired, the details being well thought out.

The sixth meeting was held at the White Horse Hotel, on December 5th, 1901. There were comparatively few members present. Mr. Knipe read a paper on "Refrigeration and Ice-making Plant." A vote of thanks was passed to Mr. Knipe for his paper. Mr. Clarke exhibited several parts of his 1-in. scale model locomotive.—ARTHUR KNIPE, Hon. Sec. (*pro tem.*), 119, Lodge Road, Birmingham.

Cardiff.—The usual monthly meeting of this branch was held at the Society's rooms, 7 and 8, Working Street, at 8 p.m., on the 3rd ult. A good number of members were present, besides visitors. After the audited accounts had been presented, it was decided that, taking into consideration the fact that the branch had only been in existence six months, subscriptions already paid should cover the remainder of the winter session, and new ones not become due until the commencement of the next. It was considered that the financial position of the Society was strong enough to warrant this step. A number of books were placed in the reference library, on loan by Mr. Hancock.

Mr. Eastabrook then read Mr. H. Greenly's lecture on Model Locomotives, illustrated by lantern-slides, a paper which was highly appreciated by the members, and the best thanks of the Society were voted to the author.

The attention of members was drawn to numerous lists and catalogues which had been received, and which are filed for handy reference. The Secretary will be glad to receive lists for this purpose from makers who have not already supplied him with them.

The lateness of the hour prevented the further discussion, among other matters, of Mr. Allen's blue prints of Trevithick's locomotive, which were produced towards the close of the meeting.—R. T. HANCOCK, Hon. Secretary, 168, Newport Road, Cardiff.

Edinburgh.—The opening meeting of the Session was held at the Heriot-Watt College, on Thursday, November 28th, when the Hon. President (Professor F. G. Baily) delivered a lecture on "Electric Forges and Furnaces." There was an attendance of fully 200.

The Professor, who prefaced his lecture with some highly complimentary remarks regarding the objects of the Society, described and exhibited in operation some of the more common forms of electrical forges and furnaces. Commencing with the most elementary form of electric furnace, a hollow carbon cylinder connected at each extremity with a conductor and surrounded with some non-conducting material, he subsequently illustrated his lecture by some very interesting experiments with the electric arc, demonstrating its use not only when enclosed as a furnace, but also in the form known as the "electric blowpipe."

Perhaps the most interesting—and certainly the most sensational—experiment shown during the evening was the welding of two pieces of iron *under water*. Though immersed to a depth of fully 2 ins., the metal rapidly reached the welding temperature when the current was turned on, and the somewhat uncanny spectacle was witnessed of two pieces of metal gradually becoming white hot and then flowing together though entirely surrounded by water.

By means of the lantern, Professor Baily showed in section many of the different types of furnaces, and described a process for softening the surface of a Harveyised steel armour plate for the insertion of bolts, &c., as an instance of the great advantage derived from the local application of a temperature which would be quite unattainable by any other means.

The lecture, which lasted for about an hour and a half, was listened to with rapt attention by the large audience, and at the close Professor Baily was cordially thanked for his interesting address.

A meeting of the Edinburgh Branch was held at the rooms, 13, South Charlotte Street, on December 11th, 1901, about a dozen members being present. After the minutes of the previous meeting had been read and approved, and four new members had been admitted, Mr. Pratt exhibited the model back-geared, screw-cutting lathe constructed by himself, which has won medals at the Industrial Exhibitions. This lathe, which occupied two years of Mr. Pratt's spare time in its construction, and is perfect in the smallest detail, was examined with the greatest interest by the members present. Mr. Fraser and Mr. Macdonald then exhibited two different forms of phonographs, both of which delighted the audience by the clearness of their reproduction. The meeting terminated at 10.30 with a vote of thanks to the Chairman and the exhibitors.

An informal meeting of the branch was held in the rooms on December 19th, when Mr. C. F. Fraser exhibited a phonograph of the concert type. There was a large attendance of members. The performance of the phonograph—a fine machine costing £30—was quite a revelation to the majority of the audience, and it was listened to with keen attention. Some sixteen "records" were given, and the immense volume of sound produced by the machine, and the clearness of expression were commented on by the members present, whose experience of these instruments previous to the preceding meeting had, for the most part, been confined to the "squeaking" variety to be encountered in bazaars, &c. The "concert" lasted for about an hour and a half, several items being encored. At the close, a hearty vote of thanks was awarded to Mr. Fraser.—W. B. KIRKWOOD, Hon. Secretary, 5, North Charlotte Street, Edinburgh.

Glasgow.—The first monthly meeting of the new season was held in the Grand National Halls, on Wednesday, December 4th. There was a fair attendance of members. The minutes of the previous meeting having been read and accepted, Mr. Park exhibited a cutter bar and several high-speed steel tools (Taylor-White process) followed by a general discussion as regards the efficiency of high-speed steel tools for roughing cast iron, mild steel, or steel on an ordinary foot lathe back-geared. The next meeting will be held on Wednesday, January 8th, at 7.30, when Mr. Dunnett will kindly exhibit a patent rotary engine of his own invention.—JOHN ROGERS, Hon. Sec., 79, Dundas Street, S.S. Glasgow.

Leeds.—A meeting of the Leeds Branch of the Society of Model Engineers was held in St. Andrew's Church Schools, on Tuesday evening, November 26th, when Mr. F. C. Speke exhibited a pair of inverted cylinder engines of three-quarter horse-power. The completeness and workmanship were excellent, and the models of every part of the engine, including flywheel, and, in fact, every portion, made entirely by himself. Mr. Wood exhibited a very neat hand-power dynamo, and Mr. Broughton a set of machined castings of Smart's "Simplicity" milling attachment for the lathe. The meeting terminated at 10 p.m.

On Tuesday evening, December 10th, a meeting of the Leeds Branch was held in St. Andrew's Church Schools, when Dr. Wear gave Mr. Greenly's lecture on Model Locomotive Design, well illustrated by a lantern. All present were unanimous in their appreciation of Mr. Greenly's generosity. The meeting terminated at 10 p.m. —W. H. BROUGHTON, Secretary, 262, Carlton Terrace, York Road, Leeds.

Liverpool.—A meeting in connection with this branch of the Society took place at the Stork Hotel, Liverpool, on Saturday, December 7th, when a number of members of the Manchester branch were entertained, the party altogether numbering about thirty. Tea was provided at 5.45 p.m., and the Chairman (Mr. Dawson) on behalf of the Liverpool members, proposed a hearty welcome to the Manchester members, who in their turn reciprocated by inviting the members of the Liverpool branch to pay a return visit. A number of models were afterwards on view, although the collection was not so large as had been anticipated. A short musical programme was then rendered, including mandoline and guitar selections by Messrs. Kirby and party, and songs, with pianoforte accompaniment, by Messrs. Palfreyman and Beale. Votes of thanks were afterwards accorded to the musicians, and also to the Hon. Secretary, and the meeting terminated at about 10 15 p.m., the Manchester members having to leave rather earlier in order to catch their trains.—F. T. STEWART, Hon. Sec., 14, Adelaide Road, Kensington, Liverpool.

Norwich. — A branch of the Society of Model Engineers has been formed in Norwich. On October 18th a preliminary meeting was held at the Technical Institute, the initiative having been taken by Col. Harvey. There was an attendance of about twenty-five, and the following officers were elected:—Chairman, Col. Harvey; Vice-Chairman, Mr. E. Coe Committee: Mr. R. Wright, Mr. W. H. Clark, Mr. T. A. King, Mr. J. C. Walker; Hon. Sec. and Treas., Mr. G. N. C. Mann. It was decided to adopt the rules of the Society with some slight local modifications, and it was then decided to hold meetings on the first Friday of each month, the months of June, July, and August being excepted.

The first monthly meeting of the Society was held on November 1st, and there was an attendance of about twenty-five members. A paper by Mr. H. Greenly, on the Designing of Model Locomotives, illustrated by lantern-slides, was read by Mr. R. Wright, assisted by Mr. E. Coe. After a discussion on the paper, in which several members joined, a vote of thanks was passed to the author, and the proceedings terminated.

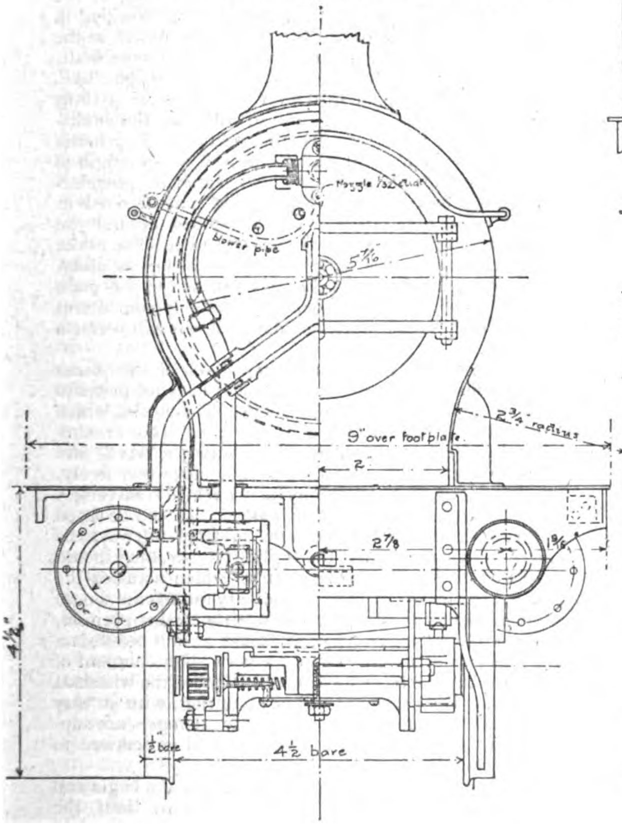
The second monthly meeting was held on Friday, December 6th, when a paper on the History and Development of Motor Cars was read by Mr. H. W. Egerton. There was an attendance of nearly fifty members and friends, and after an interesting discussion a vote of thanks was passed to the author of the paper, and the proceedings terminated.—G. N. C. MANN, Hon. Sec. and Treasurer, 2, Redwell Street, Norwich.

Oldham.—The ordinary meeting of the Oldham Branch was held at the Oriental Restaurant, Church Terrace, on December 17th, fourteen members, including two new members, being present. Mr. Bodden occupied the chair. After the minutes of the last meeting had been read and passed, Mr. J. Pollitt introduced for inspection a model compound tandem slide valve engine, with Wolstenhulme and Rufe automatic cut-off gear, which he explained in a most interesting manner; and after a little discussion, a vote of thanks was conveyed to Mr. G. Penglington for the loan of his workshop to the members and also to Mr. J. Pollitt and Mr. Bodden, chairman. Next meeting, January 20th. The meeting closed at 10. —R. L. COLLINGE, Hon. Sec., 15, Widdop Street, Westwood, Oldham.

An Inch Scale Model L.T. and S.R. Locomotive.

(*Continued from page 14.*)

GREAT care should be exercised in fitting the link motion. The eccentric sheaves—each two of which are cast in one piece—should be accurately turned on a mandrel fitted at each end with a throw-plate, upon which the various centres have been marked. The eccentric straps and rods require also to be carefully marked out and fitted, so that the distance from the centre of the strap to the centre of the eye in the rods shall be exactly the same in all four of them. The coupling rods are filed or machined from the solid; the ends, which are plain eyes, may be potash-hardened if the steel is of too mild a quality to be hardened by quenching. An oil hole, 3-32nds in. in diameter, should be drilled vertically in the ends. The crank pins, which are of different profile for

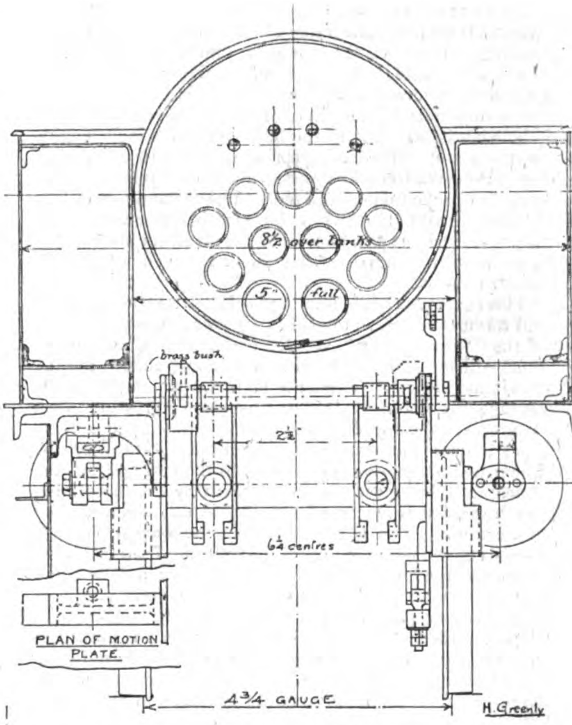


Section through Smoke-box and Cylinder. **Front Elevation of Engine.**

the driving and trailing wheels, should be turned a driving fit in the boss of wheel, and be riveted over slightly at the back. The rods are kept in place by a screwed nut prevented from slacking by a taper pin drilled through the nut and the crank pin, or, if it is desired, by a plain collar secured in the same way.

The main frames are of 3-32nds-in. mild steel plate. The plate should be accurately marked out, drilled, cut, and filed to the proper profile, and have the horn-blocks, spring and other brackets, and stretcher plates, fitted and riveted to them. The buffer planks are from the same thickness of plate, and should be riveted or screwed with countersunk headed screws to angles placed inside and outside the main frames.

Owing to the impracticability of adopting the radial



Cross Section in Front of Driving Wheels.

axlebox with the curved guide, it will be noticed that the trailing radial wheel is arranged in an unusual manner. The ordinary method would, if used for the model, prevent a reasonable amount of up and down play, unless an undesirable proportion of play is allowed between the guide and the axlebox. The Bissel truck shown on the drawings may be considered to be a bogie with a single pair of wheels. The frame, which is entirely separate from the main frames, is pivoted at a bracket attached to the stretcher-plate behind the trailing coupled wheel, the joint being a ball and socket. The ball of this joint is riveted to the bedplate of the radial frame, and to keep it in its place and yet allow perfect freedom of movement the stud has a small spiral spring secured by a washer plate and nut under the frame.

At the other end the bedplate is, in the centre, provided with a curved slot of sufficient length to allow the swinging of the wheel to its maximum extent. Through this curved slot a pin, which projects downwards from a cast stay stretching from main frame to main frame, the underside of which is shown about 3-16ths in. above the bedplate of the radial frame, and 3-16ths in. below the bedplate the pin should be filed square to take the combined support for the controlling spring and stop for preventing both excessive side play and the frame of the radial wheel falling adrift when the engine may be lifted from the rails.

The axleboxes should be permanently fixed to the side frames of the radial truck, which in turn are secured to the bedplate by strong angles. A hornstay is provided, so that by its removal and the release of the screws holding axleboxes to the frames, the wheels and axleboxes may be taken out for repair or examination.

The weight on the radial frame is taken by a laminated spring, the pillar of which is provided with a rounded face, and should rest on a small bearing plate of brass riveted to the bedplate. The pillar should be guided by a bracket from the main frames. Similar brackets are also required to receive the hangers, which should be provided with ball-faced washer above the nut, so that the hangers may have the amount of freedom necessary when the spring deflects, and therefore alters its length.

The construction of all the bearing springs of the engine are the same. The driving spring is shown in detail upon the main elevation and contains about nine plates; these must be packed out in the method particularly described in THE MODEL ENGINEER for October 1st, 1901, page 154. The bogie springs should have about six plates each, and those of radial wheels about five, but of slightly lighter material.

The bogie and bogie framing is of the orthodox pattern, and no further description of this seems necessary in view of the "Dunalastair" article, completed some months ago, which dealt fully with the construction of the "Adams" bogie. The only point which may with advantage be noted is that the model is provided with means of adjusting the weight upon the bogie spring. Such adjustment is of great importance, otherwise the model will not work at all well upon the springs, and the appearance will most likely be marred by the footplating and frame not being parallel with the rail when viewed in elevation. The back-plate (*i.e.*, the longest plate) of the spring should have a steel-bearing pin hard soldered on to it at the end, and this should rest in a hollow made by drilling a hole right through in the box fork.

The upper part of the fork should be drilled and tapped to receive the vertical eye bolt which is pinned to the equalising bar. To adjust, the fork is removed from the spring and turned one way or the other, so that the length of the complete hanger is increased or shortened, according to requirements.

The driving and coupled wheels are supported by an equalising bar between them, a fork being riveted to the frames and the bar being bolted between it. This bolt, 3-16ths in. diameter, should be countersunk on the inner side. The hangers are articulated, and are of similar construction to that used for the bogie. The nuts should be adjusted so that the drivers and coupled wheels take a weight sufficient to prevent slipping on a smooth rail. About half the total weight of the engine on these wheels is desirable.

Returning to the consideration of the main framing and its accessories, the method of arranging the footplates may now be dealt with. The latter should be correctly marked out, cut to shape from 1-16th in. steel plate, and may be in two or more pieces, so long as the joints are made to butt to each other in a workmanlike manner. The square piece in front of the smokebox must be made separate, and should be fixed to angle brass, which has been previously riveted to the main frames at the proper level. It seems desirable that the back piece forming the bottom of the back tank be made separate from the sides, the two side plates coming as far as the centre line of the trailing coupled wheel. The joint can be made very conveniently at this place, as the plates are only ⅛ in. wide. The sides will have to be cut to clear the rods, crank pins, etc., and at points where they butt upon the main frames they should be supported by angles riveted to the latter. Over the crosshead a hole must be cut, and a lid, which can be easily removed for oiling and attending to the crosshead and slide bar fitted to the space. A clear passage for the exhaust pipe must also be arranged.

The footplate is supported at its outer edges by an angle, ⅝ by ⅝ of iron (or brass, if angle iron cannot be readily obtained, although the latter is distinctly preferable). Countersunk headed screws should be used for connecting the two, as any other would mar the appearance of the model locomotive. At each end the angle edging should have its horizontal flange cut longer than the vertical, and be turned at right angles, so that a ready means of connecting it to the buffer planks may be afforded.

The construction of the buffers and drawhooks are clearly shown in the drawings. The buffer-castings are connected to the planks by three screws driven from the back. The front drawhook is in one piece with the bar, which is connected to the drawplate by double nuts, two pads of india-rubber intervening. The drawhook at the trailing end should have, where it enters the buffer plank, a square shank which, engaging the rectangular hole in the latter, will prevent it from "turning turtle."

A steam brake is provided, the piston being of the plunger type, with two grooves for packing, working in a steam-jacketed cylinder. The plunger is forked at the end, pinned to a long lever attached to the brake shaft, so that the plunger can travel freely in a straight line. The hole in the top of this lever must be about 3-16ths in. wide by 7-16ths in. long, and to withdraw the brake-blocks from the wheels after the steam in the cylinder is released, a small spiral spring, the size and strength of which is a matter of experiment and cannot be predetermined, must be arranged. This spring may be fixed at one end into a hole in the lever, and looped around the set screw forming the steam trap at the other. The brake shaft may be a plain steel spindle, 5-16ths in. in diameter, and fitted to the split bearings attached to the main frames. It will need no shoulders to keep it from lateral displacement, as the shorter cranks or levers will perform this office.

The brake hangers are each shaped out of two pieces of 1-16th in. steel plate. At either end distance pieces of brass should be riveted between them. The blocks, which may be either common brass castings, or out of box or other hard, close-grained wood, should be fitted between, and bolted or pinned so that they do not move very freely. The driving brake hangers may be connected transversely by a 3-16ths in. steel rod. The brake rod should be fitted to this rod, and prevented from moving sideways by collars on either side. At the trailing hanger a lug should be riveted to it, the circular part of which actuates the hanger and blocks. In the preliminary fitting care should be taken that this lug is placed in a fairly correct position, and then if one block or pair of blocks at first presses on the wheels and not the others, a very slight amount of wear of the brake blocks will make all touch the wheels at one time. The brake rod will need setting, with an easy sweep behind the trailing hangers. The hangers are supported at the upper ends by studs riveted or screwed to the main frames.

Splashers are shown on the drawings for the bogie and radial wheels; as these, to some extent, limit the flexibility of the wheel base, if the railway is laid with curves of less than 20 ft. radius they might be dispensed with. This detail of construction—as with others which may be modified—depends largely upon the point of view of the erector. If he requires to keep the external appearance closely to scale, he will retain them; otherwise he will not.

It may be remarked that the cross-sectional drawings on page 29 are exactly one-third full size, and that these, together with the large drawing in the January 1st issue and two which will appear in our next, are intended to be complete in every respect.

(*To be continued.*)

Motor Cycles and How to Construct Them.

By T. H. Hawley.

(Continued from page 225, Vol. V.)

XVI.—Motor Manipulation.

THE actual practical work of constructing the tricycle was completed in the last paper; but although an alternative design in the shape of a quadricycle for two people will be included in the series, it may be an acceptable break in the constructional matter if I now deal with the actual driving or manipulation of the machine, and although the detailed instructions will have reference to this particular machine, it should be remembered that but little variation exists in the petrol system, whether the vehicle is a modest tricycle or a leviathan car, so that the general meaning may be taken as applying to petrol vehicles of various types.

Before attempting to run the tricycle or any other motor vehicle on the road, it should be subjected to a fair test in the workshop, so that the various adjustments may be proved correct, and to this end there is nothing more simple than the ordinary lifting jack, or some modification which will allow of the free revolution of the driving wheels, so that the speed and beat of the engine may be carefully noted under varying conditions as to the amount of "advance" given to the ignition.

In the case of the tricycle, the chief points to be watched during the progress of the first trial are the freedom of the balance gear, the correct meshing of the engine pinion with the transmission gear wheel, and the tension of the chain, together with the general behaviour of the internal parts of the engine.

The freedom of the balance gear is easily tested by braking and stopping one of the driving-wheels, when the engine will, through the medium of the gear pinions, revolve the other or free wheel in the reverse direction, and the force required to hold the stationary wheel will be proportionate to the running qualities of the balance gear.

To test the power of the motor in a rough manner it is simply necessary to rig up a board by which equal pressure can be applied to the two driving-wheels, and then note the engine beat under varying loads.

The behaviour of the engine should be carefully noted with relation to the position of the levers L and G^1 (Figs. 75 and 76), operating the advance sparking and the admission of explosive vapour respectively, so that the levers may be adjusted to the best working position to allow maximum variation of power; thus the lever L should be slowly advanced or pushed forward whilst the motor is running under a varying brake load until the point of greatest speed or limit of advance is found, and this should be attained when the lever is in its extreme forward position, and then, with the lever pulled hard back in the opposite direction, the motor should slow down, and, after stopping it, the starting should be tested, and if the lever is correctly adjusted, the motor will commence to work very quickly.

In case the results are not as described, the remedy is to move the clip which carries the levers L and M, either forward or backward on the top bar, this, in effect, being the same as lengthening or shortening the connecting-rod *l* operating the contact-breaker B. A similar adjustment may be necessary in the case of the clip carrying the levers G and G1 operating the mixture and admission valve, and those levers will be in correct adjustment when G being in the vertical position gives an equal opening to gas and air at the mixing valve g^4.

Assuming that these adjustments have been made, and that the machine is ready for the road, we may revert to the actual method of starting the engine. The carburator (Fig. 74) is first about half filled with petrol of ·680 specific gravity; if filled too full, there will be difficulty through the spirit splashing up and choking carburation.

The level of the spirit in the tank will be noted by the position of the top of the float wire F, and the tube J is next to be adjusted in relation to the height of F, as explained in the last chapter—*i.e.*, in hot weather the top of tube J should be about an inch *above* the top of the float wire, and in cold weather an inch below it, assuming, of course, that in construction the relative lengths have been maintained; but, in any case, the limit of adjustment will be about two inches.

It will be seen that as the petrol is consumed it will be necessary to push down the tube J in order to maintain the relative position of the plate W and the surface of the petrol, such adjustment being necessary every ten miles or so, according to the consumption of petrol. Having seen to the filling of the petrol tank, and the adjustment of J, proceed to lubricate the crank chamber of the engine, drawing off dirty oil by the thumb-nut screws first, and filling up with just one measure of *best* motor oil, making sure that the oil is the best obtainable, ordinary gas engine oil being no use—this question of cylinder oil being of vital importance in small air-cooled motors. A little petrol should next be squirted into the cylinder through the compression tap, and the machine pushed along a few yards; the petrol dissolves any gummy or thick oil, and allows the piston rings to work freely, and also assists the engine in starting, by reason of the vapour being given off from the petrol injected into the cylinder. Care, however, should be taken in injecting fresh petrol into a hot cylinder, as an explosive mixture may be formed and fired by the heat of the metal, so offering danger to the eyes of the operator.

The levers G and G^1 are next placed in the vertical position, and L is drawn back toward the rider, thus giving the latest ignition, M being turned to the horizontal, so opening the compression tap.

The connecting plug is now put into position in the plug switch, and the current switched on by the left handle, when, if all else is in correct order, the engine will commence to work after the first three or four revolutions of the pedals, and the compression tap M may be closed, when the engine should quickly gather power and speed.

The rider should then manipulate the mixture lever, first moving it slowly backward so that the greatest amount of air which will form an explosive mixture is found, and, after a little experience, this can be determined by the regular beat of the engine, as well as its speed and power. The position of the mixture lever will vary considerably according to the temperature of the atmosphere—on a very cold night it may have to be pushed forward of the vertical to a considerable extent, whilst on a warm sunny day the motor will work best when the lever is as much behind the vertical, the reason being that in warm weather the carburettor gives off vapour more freely and the vapour is richer; hence the supply of air to the mixing chamber is increased, and it must be remembered that perfect combustion is more nearly approached when the mixture consists of as great a proportion of air as possible to ensure regular explosions, and that complete combustion prevents carbonaceous deposits forming on valves and and cylinder—hence the importance of studying the regulation of the mixture lever. When the machine is well under way, and the proper mixture has been found, if it is desired to go faster, the lever L should be slowly advanced or pushed forward away from the rider, this having the effect of causing the ignition to take place at a somewhat earlier period of the piston stroke; for although ignition of the explosive mixture takes place *almost* instantaneously on the application of the firing spark, it still occupies a fraction of time which is sufficiently appreciable to affect the speed of the engine, especially in the case of these small high-speed motors.

Supposing the limit of speed due to the advance ignition to have been attained, and the rider requires a still higher speed, he may obtain it by pushing forward the quantity lever G^1, which will open the valve and admit a full supply of gas; but it is not good for the engine that it should be over-fed, for as the whole of the gas could not be consumed by combustion, fouling of the valves would occur; so that it is better to work with as little gas as possible, and taking every advantage of the advance sparking and correct mixing.

To retard the speed of the machine both the quantity lever and the advance lever may be drawn back, or, either in itself, will, of course, cause the motor to slow down; but skilful drivers are in the habit of regulating the speed almost entirely by manipulation of the advance sparking mechanism and cutting off the current at the switch handle. The novice, on the other hand, will progress better by driving with the quantity lever, and using but a moderate amount of advance, for it must be remembered that if the gas supply be cut down when the machine is going fast, with the advance at top speed, that when the machine has slowed down it will not pick up speed by merely turning on more gas, but will require a re-adjustment of the sparking.

When, however, the action of the various levers is thoroughly understood, a very little practice will enable the rider to get the best speed results out of the machine, as he will grow accustomed to estimating the best positions of the levers for various requirements.

When approaching a hill with the advance lever at full speed, this lever must be drawn back somewhat before the machine feels the hill, and, at the same time, the full quantity of gas should be turned on to obtain full power for the hill climb, as, of course, the motor will slow down and would stop working if under excessive advance sparking.

In going downhill, the handle switch is opened by a half-turn, thus stopping the ignition, when the motor acts as a brake, because the gases not being ignited the piston is called upon to do the work of compressing the gas without receiving the impetus from the explosion; thus the road wheels are retarded and the cylinder at the same time cooled. This cooling of the cylinder is really a most important matter in an air-cooled engine, such as the one under notice, for overheating is one of the chief causes of interruption to long runs, so that every opportunity in the way of down grades should be taken advantage of for this purpose, and the cooling action is

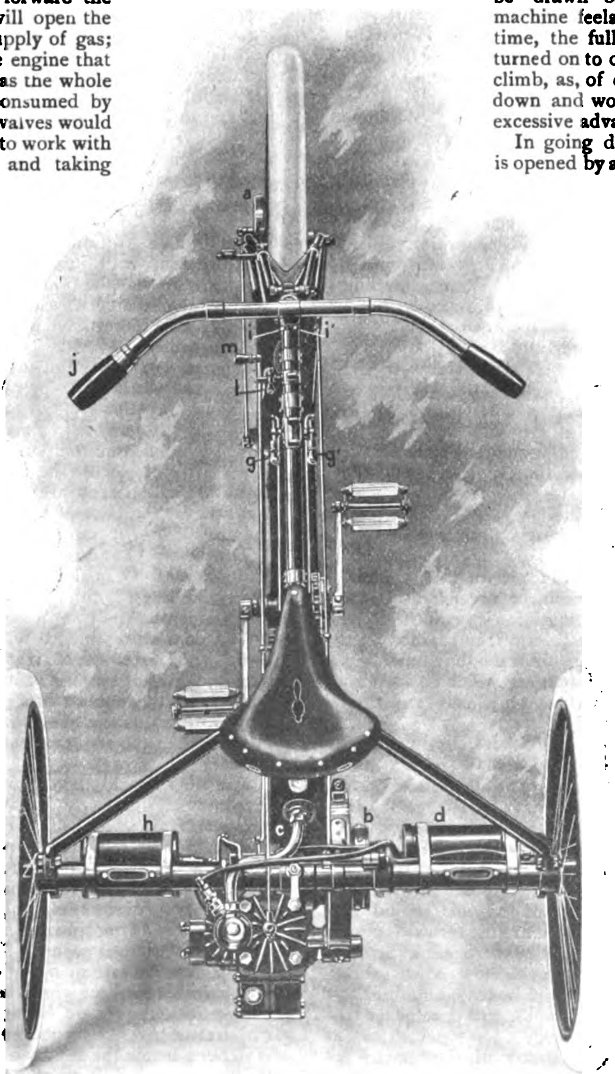


Fig 78.—Top View of Motor Tricycle.

more pronounced when in the case of a long but easy slope the compression tap can be opened—the brake action being less, but the cooling effect much greater.

To stop the motor altogether, the current would first be shut off and then the gas lever, though either would stop it; but in case of slowing down or a momentary stop, it is sufficient to switch off the current and leave the gas-valve open.

For quick stop the current is switched off, and the brakes held hard on. For a lengthy stop the switch handle is opened, the gas cut off by the lever G, and the connecting plug removed so that mischievous persons may not run down the battery by turning the switch handle on.

Driving in traffic will prove the most serious difficulty to the learner, and should not be attempted until some confidence is gained in the management of the machine. The great point to be aimed at, however, is the ability to "go on," for if the motor will answer in this respect, there is little fear about anything else—always assuming that the brake power is ample and that the brake mechanism is in good adjustment.

Most experienced drivers prefer to "navigate" traffic with the advance lever pulled back—*i.e.*, late ignition—gas tap fully open, and do the rest with the handlebar switch and the brakes, because under these conditions if the brakes proper are sufficiently powerful, added to the braking power of the motor when the current is cut off, you have sufficient stopping power for all purposes, and, at the same time, immediately the brakes are released and the current switched on, the motor bounds forward, and is equal to passing the bulk of the ordinary traffic if required to. The one thing to be avoided in driving through traffic on a machine fitted with a direct positive-coupled motor and no release clutch gear, is coming to a standstill, for however well the motor may have been running previously, it is quite likely to give trouble in starting, just at the time when it is necessary it should start quickly; and the trouble is further aggravated if it should happen on rising ground or a stiff hill.

Whenever it is necessary to walk and push the motor, the compression tap must be opened, and whenever it is necessary to leave the motor, the ignition plug should be removed.

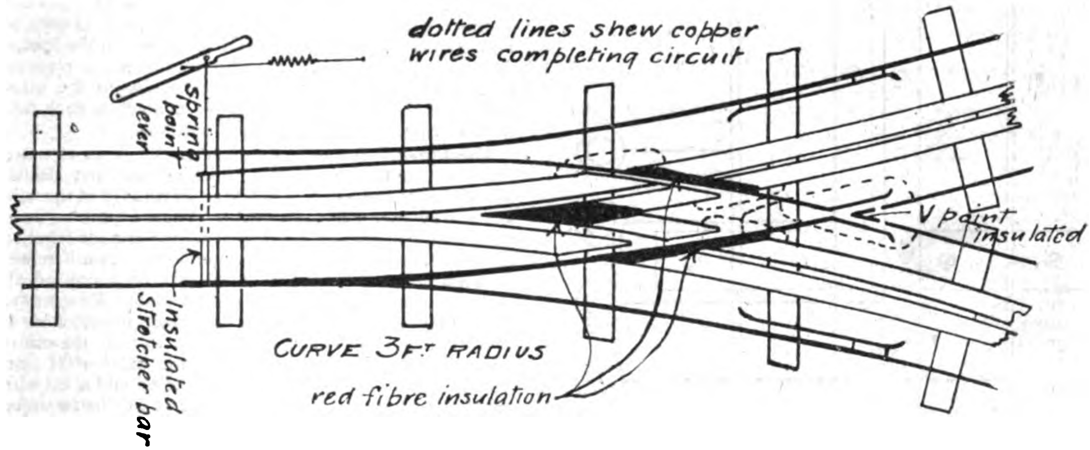
When the motor is new the crank chamber should be emptied of waste lubricating oil and refilled very frequently; but when all is in perfect working order, the engine should run thirty miles between doses.

Such, then, is the rough outline of the method of driving the machine when all is in order and going well, but where the real knowledge of motor matters is called upon is when something "goes wrong," that is, when the machine fails to answer to the usual manipulation.

In Fig. 78 is presented a top view of the tricycle, with the figuring as to the manipulation levers numbered to correspond with Figs. 75 and 76. This illustration also shows the position of the switch handle *j*, the induction coil *d*, the carburettor *c*, the silencer *h*, and the brakes *a*, *b*.

The position of the levers as here shown are as they would be after coming to a stop, all the valves being closed, the ignition right back at "late," and the compression tap open, and to re-start the machine the levers G, G[1] would require adjusting as described.

(To be continued.)



RAILWAY TRACK FOR ELECTRIC LOCOMOTIVE.—ARRANGEMENT OF CROSSINGS.

A Model Electric Locomotive.

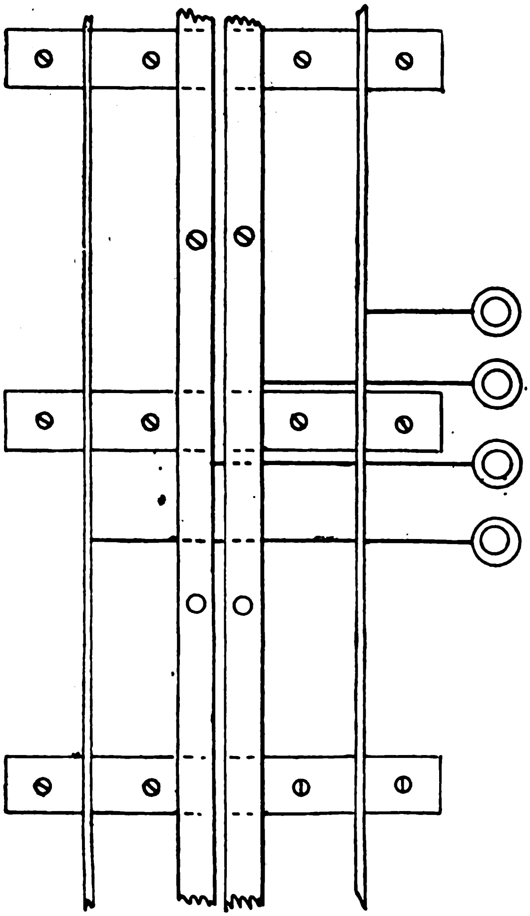
By Dr. ARTHUR C. HOVENDEN.

(Concluded from page 16.)

THE main switch, or regulator, is shown on the drawing. On the end of the regulator spindle is a boxwood disc, carrying a brass spring fixed in its centre, and by means of a flexible wire to one terminal of the switch. This spring works on a flat face of brass divided up into four segments, the first position giving no current, two intermediate strengths passing through 6 ins. and 12 ins. of platinoid wire respectively, and a fourth position giving full current. There are two steel pegs on this face, which, engaging with steel pegs on the boxwood disc, form the regulator stops.

The reversing-switch (see drawing) is of the cylindrical commutator type, a long arm passing through a slot in the top of the box supporting the reversing gear engages with two pins on the reversing-rod. The block of the reversing-rod is 2 ins. long, it has a smooth bore, and engages by means of a round headed steel pin, which projects through the bottom, with the thread of the reversing-screws. Four wires (two of entry and two of exit) proceed from this commutator to the front of the switchboard to four terminals to make the necessary connections easily.

The driver's valve of the Westinghouse (see drawing) forms a shunt circuit from the terminals of the main switch or regulator; it has three positions—forward (brake on), no current; vertical (running position), full current less a 12-in. piece of platinoid wire; backwards (brake off), no current. The spindle of wood is carried right into the box supporting the reversing gear, and forms a contact on a brass plate having three faces on the inside. The inner spring is fastened to the spindle by a taper pin, and is removable for fitting, the handles and nut on the outside end being glued. On to this spring is soldered a piece of



RAILWAY TRACK.—SHOWING CONNECTIONS TO RAILS AND CONTACT STRIPS.

flexible wire which goes to one terminal, the other terminal being connected to the centre of the three brass plates. The brake is worked as follows:—The engine is started with the lever backwards, and when it has attained full speed it is brought up to the vertical position. On approaching the station or signal the regulator is closed; but the motor still obtains some current through the brake circuit. When the station is reached, the engine is stopped with great accuracy by pushing the lever forwards and so cutting off the current. When the engine comes to a stand the lever is brought back smartly to the "off" position, and is ready once more to be started by means of the regulator.

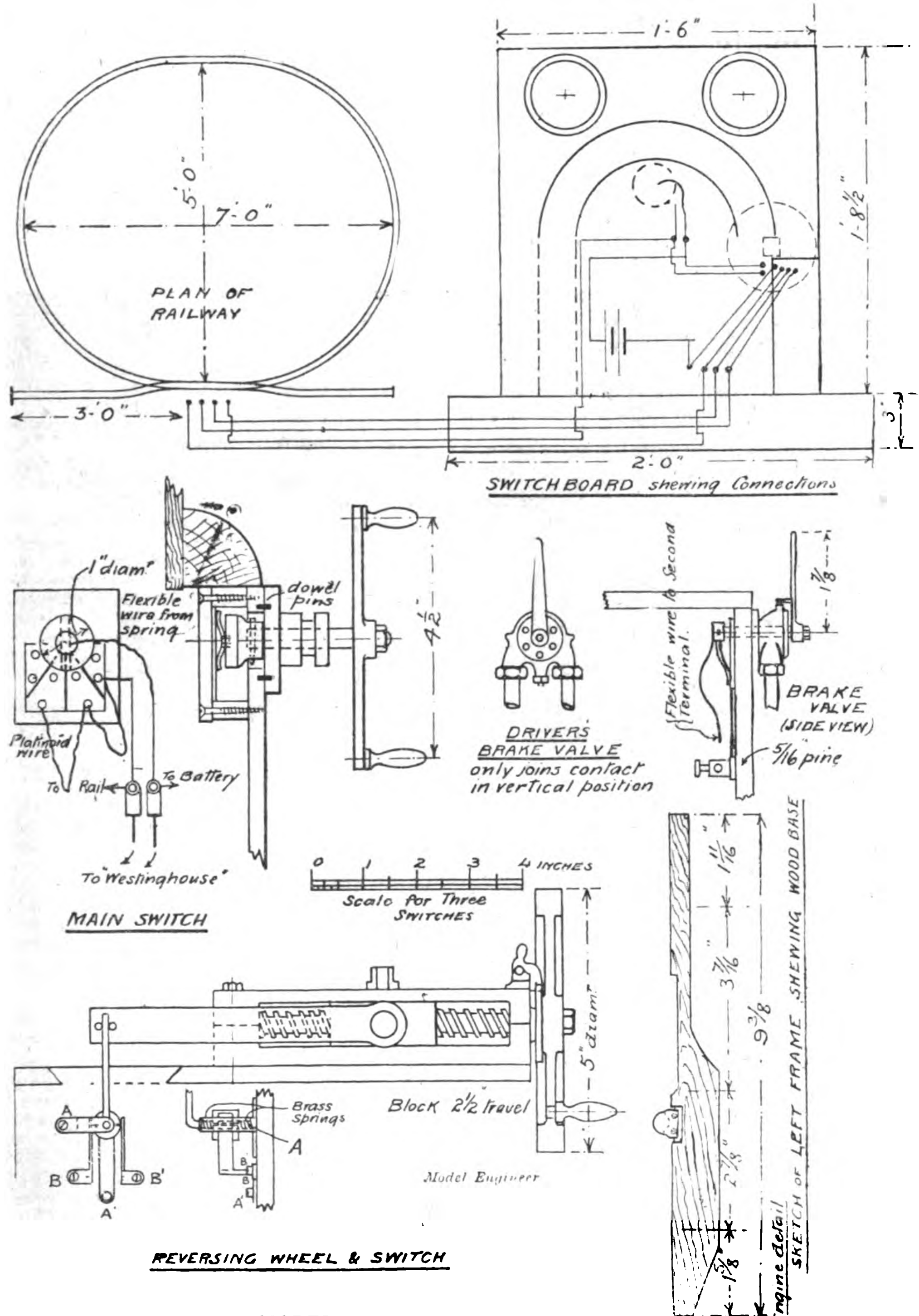
The gauges—air and steam—are dummies, but would advantageously be connected up as a voltmeter and ammeter. They are made of boxwood, with glass faces and steel hands; the dials are photographs, reduced by copying from the real dials. The lower dial on the left side is an imitation of the electric alarm between driver, passenger, and guard. All the pipes of the cab are solid copper wire, polished and lacquered; the large pipes being bar iron polished and electrically copper-plated.

3. *The Permanent Way.*—Brass strips ¼ in. by 1-16th in. form the rails, and are soldered to brass sleepers 1¾ ins. by ⅜ in. by 1-16th in. These are 3 ins. apart, and screwed down to the wood base by two screws in each. The central conductors are brass strips, ¼ in. by 1-16th (same as rail), fastened by countersunk screws to a piece of wood 3-16ths in. by 9-16ths in.; this leaves 1-16th in. between the conductors. The screws are placed every 3 ins., and pass right through to the wood base of the railway, holding the conductors tight on the sleepers and ensuring exact register with the outside rails. Points require care as to the insulation, but present no real difficulty; their construction is shown in the special drawing. Where the conductor is broken, a piece of copper wire soldered from one extremity to the other completes the circuit. The double contact on each conductor bridges over the insulated portions.

Conclusion.—In the above description it is assumed that the constructor is not attacking his first electric motor, but is possessed of ordinary knowledge of the subject and average mechanical skill. There is nothing complicated about the design, and such problems as winding the armature, making the commutator, and the differences between series and shunt winding, have been amply dealt with in the foregoing numbers of THE MODEL ENGINEER. In making the insulated axles, a piece of red fibre is chucked in a Universal chuck, turned up true, the centre marked and drilled with a twist-drill, the correct size, with the back centre. It is then parted off and fitted with brass rings, the holes drilled and tapped for the retaining screws, and it is ready for the gunmetal wheels with their steel axles.

As regards the superstructure, the detail to which this part of the motor is carried entirely depends on the taste and time of the constructor. It is built up of sheet tin with soldered joints. Care must be exercised that it does not short-circuit the frames, and little pads of red fibre (not shown in the drawings) must be provided for it to seat on. When finished, it is very light, and quite strong enough, with the strengthening of the buffer plates, to take on and off. I should be most happy to furnish any further particulars, or explain any obscure point through the Editor.

ACCORDING to a German contemporary, a new primary battery has been devised by Alexis Turnikoff and Count Anatole de Nesselrode. "In this new cell the depolariser surrounding the carbon consists of a mixture of one part of graphite, and two parts of permanganate, soaked in a mixture consisting of a saturated solution of potassium chlorate, and a 50 per cent. solution of formic or other aldehyde, the latter preventing the liberation of free chlorine. The excitant is a solution of sal-ammoniac, which becomes enriched by a zinc salt. The zinc electrode is formed in thin laminæ. The E.M.F. varies somewhat with the strength of the formaldehyde, being 1·4 volts when this is 50 per cent. The intensity is said to be equal to that of a Bunsen cell. The internal resistance is small and fairly constant, and no action takes place on open circuit."



A MODEL ELECTRIC LOCOMOTIVE.

SWITCHBOARD AND PERMANENT-WAY DETAILS. (*For Description see Page 33.*)

A Model "Contractor's Locomotive."

DOUBTLESS many readers of THE MODEL ENGINEER, who were present at the Conversazione given by the Society of Model Engineers in 1899 at the Memorial Hall, Farringdon Street, will remember a small full-sized 14-in. gauge "Contractor's Locomotive," made and exhibited by Mr. E. W. Payne, a member of the Society. The following brief description of this engine will no doubt be of interest:—

The engine, which is of the four-coupled inside cylinder side-tank type, is clearly shown in Figs. 1 and 2, and runs on a track laid down in Mr. Payne's garden, and has been built for the amusement and instruction of his little 5½ years' old daughter and her friends. Fig. 3 shows the engine ready to start, with the engineer looking out waiting for the "right away" signal.

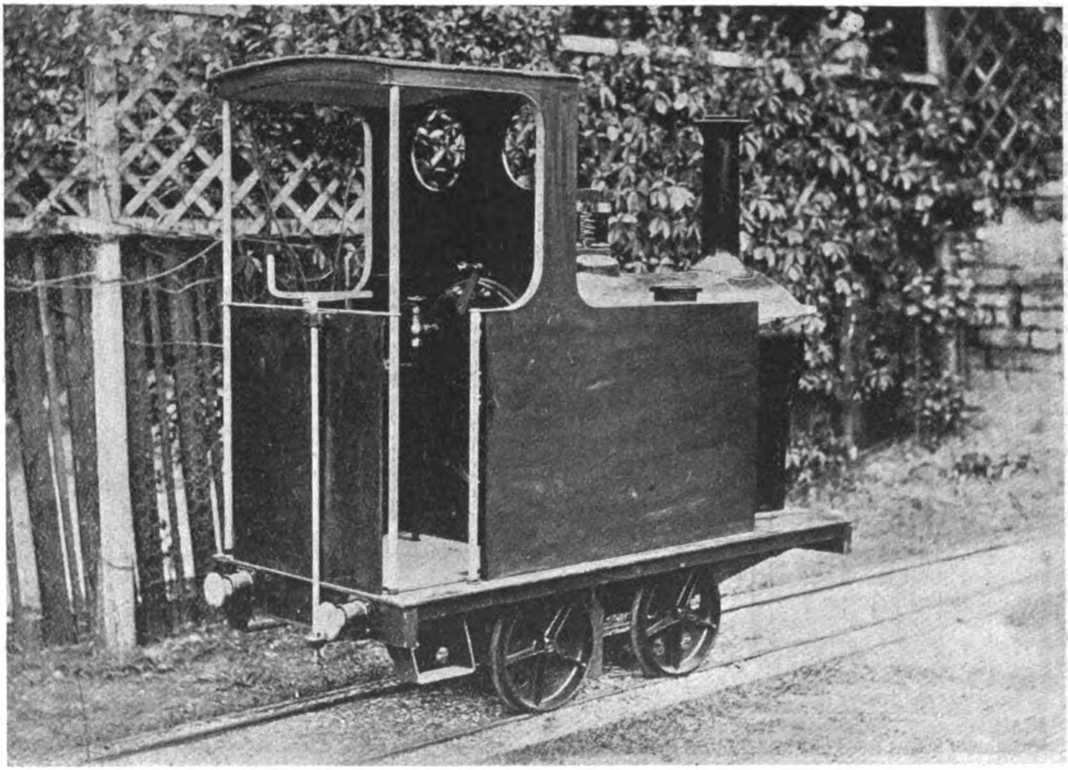


FIG. 1.—MR. PAYNE'S MODEL "CONTRACTOR'S" LOCOMOTIVE.

The loco itself is entirely made of wood, with a few exceptions, such as wheels, axles, bearings, boiler barrel, handrail, &c., which are of necessity in metal. The footplate, running-plate, and parts likely to receive much wear, are of teak, and the tank sides, front, back, and roof of cab, boiler front, &c., of American bass wood or larch, a wood which can be obtained of great width, and is very clean grained and tough.

The inner and outer frames are of pine, ⅝ in. thick, fitted securely to the buffer beams at ends, the running-plate being securely fastened down to them. The foot-plate is sunk between the inner frames, 4 ins. below the level of the running plates, forming a well, which will allow for the growing tendencies of the juvenile driver. At present the well is covered by the usual footboard, there being plenty of head room in the cab.

The wheels are cast iron, shrunk on to mild steel axles, which run in adjustable bronze bearings fitted with Stauffer grease lubricators. In the near future the engine will be propelled by a small electro-motor, geared down on to the trailing axle, the wheels being coupled by outside coupling-rods not shown in the illustrations. The engine is now propelled by a simple hand gear which works as follows: Fitted in the right-hand side of the cab, at a con-

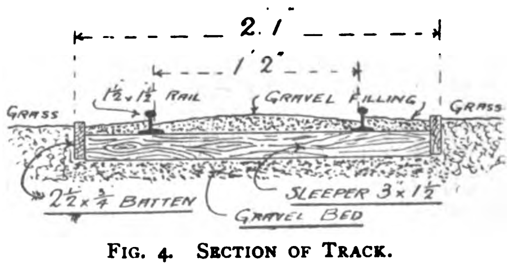


FIG. 4. SECTION OF TRACK.

venient height, there is a heavy cast-iron hand wheel about 9 ins. diameter, with a handle fixed in rim exactly the same as a wheel reversing gear on a real loco, which apparatus it is meant to represent; and this wheel is mounted on a shaft which runs forward through the front of the cab, and carries a small pulley (inside right-hand tank) on which works a 1 in. endless flat leather belt, which, by means of a pair of jockey pulleys fixed at a lower level in the tanks, is led downwards and then at right-angles over a larger pulley fixed on the trailing axle, and the engine is moved forward or backward by turning the "hand-reversing gear" in the cab. The brake is of the usual screw type, acting on the two trailing wheels, and is very powerful.

On the boiler front are mounted the usual fittings, including injector, water-gauge, regulator, &c., whilst on the boiler barrel is the whistle, Ramsbottom safety valves, and with the tank fillers on top of the tanks, handrail, and smokebox door (which opens to give access to the gear), lamp irons, &c., gives the engine a very realistic appearance.

At present, as will be seen on reference to the illustrations, the engine has only received two or three coats of priming paint; but when the electrical gear has been fitted, and the rest of the work on it—which would necessarily knock the paint about—finished, the whole job will be painted, lined out, and varnished in the usual loco style, the usual bright parts being painted a light French grey, which looks very well as a substitute for polished steel work, as will be seen on reference to the illustrations.

The track on which the engine runs, and of which about 80 ft. is already laid down, has been specially designed to interfere as little with the garden as possible, and great care has been taken in its arrangement to prevent it being an eyesore to anyone whose tastes lie more in the direction of flower gardening than model railways.

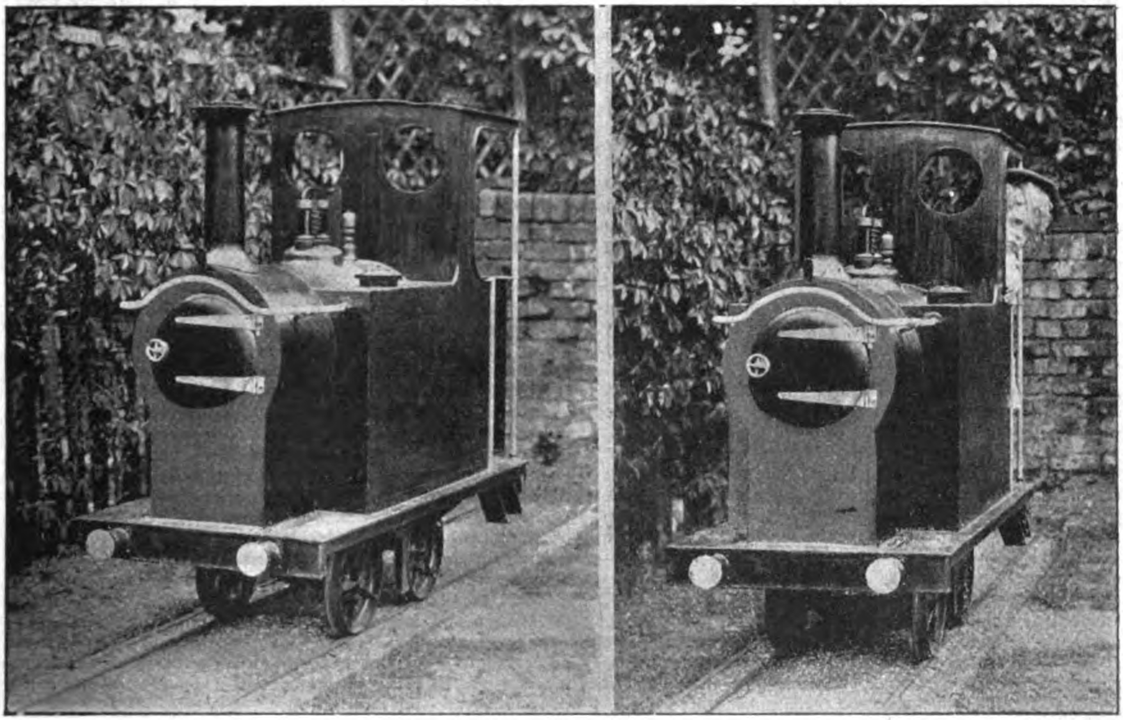
The track runs down a gravel path with grass on either side, and Fig. 4 shows a section of the road. The rails are of mild steel in 16-ft. lengths, and are 1½ ins. high by 1½ ins. wide on bottom flange, and are screwed down to the 3-in. by 1½-in. sleepers, which are spaced 3 ft. apart, with two large galvanised screws through the rail flange, two to each sleeper per rail; at the joints the sleepers are 5 ins. wide, and the end of each rail is secured by two galvanised screws, the joint not being fish-plated. To the ends of the sleepers are nailed continuous battens, 2½ ins. by ¾ in., which form a border between the grass and gravel of the track path.

The sleepers are carefully bedded on gravel well packed up underneath, and the spaces between the rails filled with Croydon gravel beaten down, which forms a good representation of ordinary railway ballasting, and at the same time a good garden path.

The photographs illustrating this article were taken by an amateur, Mr. C. E. Field, jun., of Streatham, whose photographs of other work of Mr. Payne's have appeared in a previous issue. The following figures give the leading dimensions of this unique toy:

	ft.	ins.
Gauge	1	2
Length over buffer beams	4	9
,, ,, buffers	5	6
Width over running plate	2	2½
,, ,, inside frames	1	1
Height of running plate from rails ...	1	2
,, chimney from rails	4	6
,, cab from rails	4	8
Wheels (on tread)	10¾ ins. dia.	
Wheel base	1	5½
Diameter of boiler barrel...	1	4

Total weight about 1½ cwts.



Figs. 2 and 3.—Further Views of Mr. Payne's Model Locomotive.

Notable Advances in Electric Lighting.

IT cannot be doubted that the time is fast approaching for some notable improvements in various electrical matters, and particularly in the department of electric lighting. Just as the Welsbach incandescent system has practically revolutionised gas lighting, it may be confidently anticipated that a very few years will suffice to see a big change in electric lighting methods—possibly even to the relegation of present-day methods to the realms of antiquity! The simplicity of the ordinary "incandescent" electric lamp may save it from this ignominy for a long time to come; but we have only to remember that this same simplicity in the case of the Bray gas-burner stands for nothing against the Welsbach system—with its fragile "mantle"—to see how little simplicity counts as against efficiency.

At present the likeliest rival to our old friend, with its white-hot, vacuum-surrounded filament is the Nernst lamp, which in America has at last reached the commercial stage, with an "efficiency" approaching that of the arc-lamp. Some account of the lamp was given in our issue for November 1st, 1901, and as it is hardly a suitable subject for amateur experiment, the particulars therein given will suffice to explain the action. As presented to the public, the lamp is made in nine forms, of varying candle-power, from 50 to 2000, and for indoor and outdoor use. The desirability, for street lighting, of a lamp intermediate in character between the incandescent and the arc-light is now beginning to be felt, and the Nernst lamp appears fully capable of supplying this requirement. The light of the Nernst lamp is said to closely approximate that of daylight, and it is claimed that the lamp is steadier under variations of the service voltage than the carbon incandescent lamp.

The other aspirant to the honour of an efficient electric lamp is that known as the Cooper-Hewitt incandescent vapour lamp, or, more briefly, as the "mercury-vapour lamp." The principle of this lamp is that a kind of "arc" is established between two electrodes of mercury enclosed in a hermetically-sealed tube. The arc may be started by bringing the two bodies of mercury constituting the electrodes, into actual contact with each other and then separating them, the electric current then being caused to arc across from one electrode to the other. Such method of starting has, however, been found impracticable for any extended use, and requires the presence of a considerable outside resistance to prevent an excessive current flow when the bodies of mercury are in contact, and even when started they have been incapable of commercial operation with efficiency or for any considerable period of time; some materials when in a gaseous or vapourised state, possess the capacity of emitting light under the influence of electric currents in a much higher degree than others. The vapour of mercury is efficient as a light-yielding material, and, owing to its molecular weight and its low boiling or vaporising point, it is suitable. Moreover, it readily serves under the influence of the current to transfer the heat generated in the lamp to convenient points for radiation. Some of the materials normally existing in the form of gases may, however, be used—such, for instance, as nitrogen; but the amount of light which may be obtained from nitrogen per unit of length appears to be less than that which can be obtained from mercury vapour, other things being equal. Mercury gives a light which is clear and white, but wanting in red rays; while lithium and similar materials yield spectra with red and other colours. Nitrogen and other gases develop red rays in abundance, and when combined with the mercury rays a beautiful result is obtained. As there may be more or less heat developed, the structure should be such as will radiate the heat at a suitable rate. If the temperature of the lamp is allowed to become too high the lamp is liable to extinguish itself, although the lamp may be made of such a size as to render a special cooling chamber unnecessary.

The ability to start the lamp readily is of the utmost importance, and the inventor has found that certain materials, one of which is sulphur, added to the lamp, or while in the process of manufacture, produce a condition which makes it possible to start a current under a moderate increase of electric pressure, and thereupon the continuous or an alternating current of low pressure readily traverses the lamp, producing an intense, enduring light. When no starting material is present in the lamp, it is possible to start by heating it by any convenient means—such, for instance, as a Bunsen burner, or an electric heating coil of any convenient construction—and simultaneously applying to the terminals a difference of potential substantially equivalent to that upon which the lamp is designed to operate, and at the same time a boosted electromotive force, to enable the regular current to pass. When, however, the starting material is used, the lamp may be started without preliminary heating by means of electric currents at an electromotive force usually higher than that upon which the lamp is normally intended to run. This may be conveniently done by placing in the circuit leading to the lamp the secondary coil of a transformer, the primary of which is connected with the supply circuit through a suitable circuit interruptor, or an alternating current from a suitable transformer may be used.

The principles laid down above are embodied in practical form in a lamp, in which the container is of glass having a bore ¾ in. diam., the length between the electrodes being 54 ins., and the chamber lying outside of the path of the current having a radiating surface equal to a spherical area 3 ins. diameter. The positive electrode will be constructed of pure iron held in place by a supporting pillar of glass, through which the platinum leading-in wire passes. The negative electrode may be a puddle of mercury, and a platinum leading-in wire extending through the walls of the vessel will connect the mercury with the external circuit. Such a lamp will run on a current of approximately 120 volts, and pass approximately 4 ampères when the surrounding temperature is that of an ordinary room—say 75 degs.; but the estimated candle-power under these conditions is not stated, although it is probably fully as high as that of an arc lamp consuming an equivalent current.

X-Ray Slot Machines

THE *x*-ray and the slot machine are modern utilities that have finally combined their energies to make a sidewalk show for the curious possessor of the nickel indispensable to operation. The apparatus includes a vertically mounted fluoroscope, which may be used when the tube is made active by dropping a nickel in the slot. The passer-by who desires to see the bones of his hand or wrist makes his contribution and places his hand in the proper position; the machine does the rest. With the exception of the fluoroscope, the necessary parts are enclosed, with suitable openings. The machine seems to be self-contained, and is of a convenient height for use by a man of average stature. One of these curious machines has been placed in a Chicago restaurant, and it excites much attention from its novelty. The apparatus is built to afford pastime, but it is also calculated to give the man-in-the-street a glimpse of natural phenomena that he might not otherwise obtain.—*Western Electrician.*

A Model Electric Light and Power Plant.

By W. J. Nicholas.

I ENCLOSE photographs of my model electric lighting and power plant for the model showground which appeared in The Model Engineer, under date October 1st last, and trust particulars of these will be of interest to your readers. The gas engine (seen in Fig. 1) will be recognised as one of Butler Bros.' ⅛ b.h.-p. motors, with an additional flywheel, which I have found necessary to obtain a good steady light. The engine and water tank for cooling the cylinder are fixed down to a heavy piece of timber, which is in turn bolted to a large box. This keeps the engine steady, and at the same time does not prevent me from being able to move the whole concern bodily. The idea of making it portable was adopted so that I might attend charity bazaars without the inconvenience of having to take down and fit together each time.

The dynamo (shown separately in Fig. 2) is of my own design and make, and was constructed at a very low cost. The field-magnets were cut out of a large sheet of iron by hand with a pair of tinman's snips or scissors; then, as the iron was of very poor quality (charcoal iron being unobtainable in Plymouth), I made up a big fire of wood, and put the "stampings" or laminations in, and left them there till the fire died out, which made them nice and soft. They were afterwards flattened, drilled, and bolted together, then filed up.

The bobbins were cut out of sheet brass, soldered up, insulated, and filled with No. 24 D.C. covered wire; they were then slipped into position on the F.M.'s, a little piece of the end stamping being bent out underneath to prevent them falling back again.

The armature was originally of "H" type, also cut out of sheet-iron, as before described; but at present there is a cogged-drum armature of eight cogs, which were cut out by hand with a hack saw; these stampings were then filled with No. 22 D.C. covered wire.

The commutator was made from a piece of thick brass tube, mounted on a hardwood core, screwed, and afterwards slit with fine saw into 8 sections or segments.

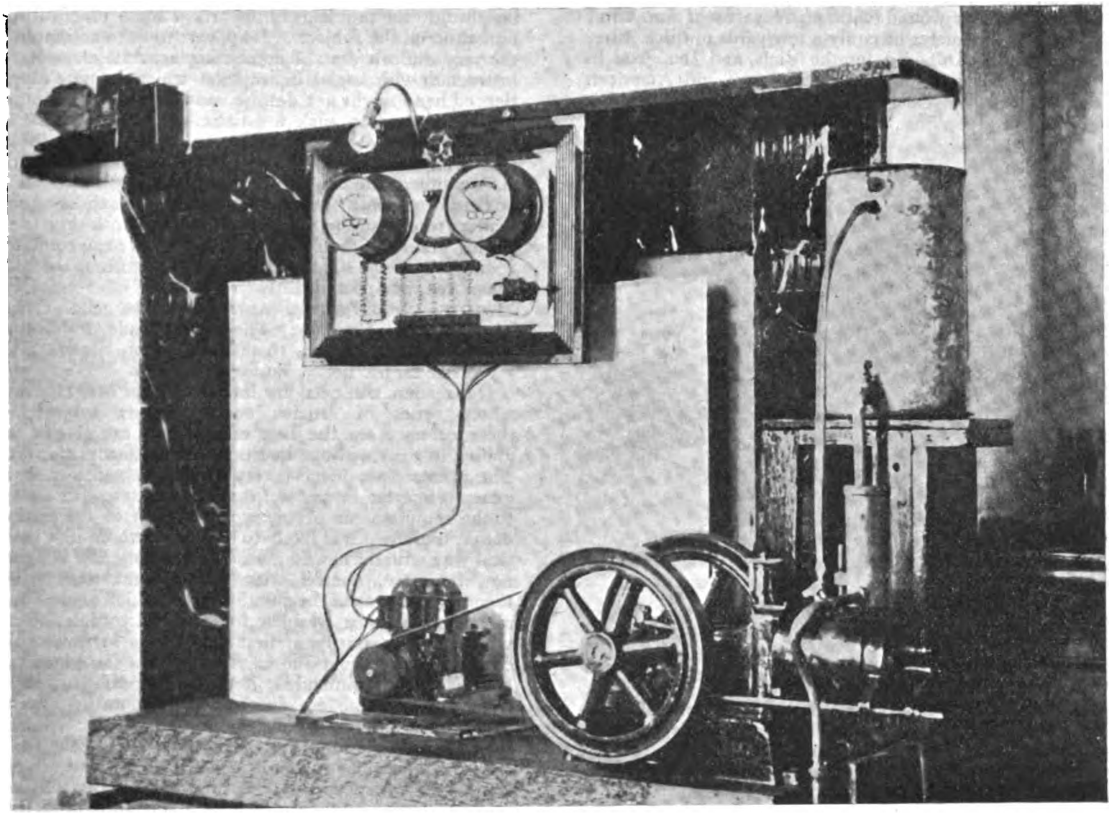


Fig. 1.—A Model Electric Light and Power Plant.

The brushes are made out of brass gauze, folded 3 or 4 times, and soldered at one end.

The bearings I made in the following way. Not being able to cast brass at home, I used type metal as a substitute, and cast it around a piece of brass tube, which forms the actual bearing. I can vouch for the strength of these bearings, as the dynamo has been in frequent use for several years, and I have never had to do any thing to them in the way of repair.

The base, on which everything is screwed, is of mahogany 1 in. thick. I might mention that the F.M.'s are let in brass shoes for support, and the bearings are oiled by little glass bulbs; also that the whole is painted and lined out.

The dynamo is capable of giving 4 ampères at 20 volts without heating up.

The switchboard (top of Fig. 1) is also of my own construction. To make it I obtained a piece of slab marble and made a frame out of picture moulding. This I strengthened with brass corner pieces.

The instruments were taken in hand, being made of large brass tube with polished mahogany bases. The internal mechanism is very simple, being two pieces of soft iron working into a paper cylinder, wound with wire, one of the pieces being attached to a pivot, on the extreme end of which is a pointer. When the current passes round the coil, it magnetises the two pieces of iron similarly, so that they repel one another according to the strength of the current. The difference in the two instruments is that the voltmeter is wound with many yards of fine wire, whereas the ammeter has only a few yards of thick wire. I used white cardboard for the dials, and the glass in front of each was obtained from some old American alarum clocks.

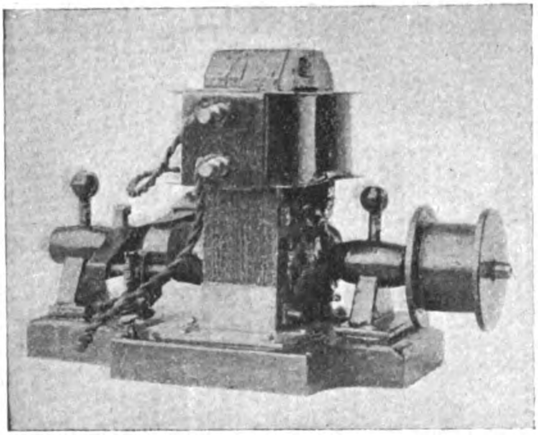


FIG. 2.—DYNAMO FOR MODEL ELECTRIC LIGHT PLANT.

In the centre of the switchboard are the resistance coils, with sliding switch, which govern the speed of electric motor on model showground, and are also of use in charging the accumulators. The switchboard is provided with pilot lamp and automatic cut-out, which is to prevent the accumulators discharging back through dynamo in case of engine slowing down or stopping.

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.]*

CENTRIFUGAL PUMPS, TURBINES, AND WATER-MOTORS. Third edition. By Charles H. Innes, M.A., Manchester: The Technical Publishing Company, 31, Whitworth Street. Price 4s. 6d. nett. Postage 4d. extra.

The fact that a volume such as this has gained its third edition is alone convincing proof of the position it has attained. This is due to the inherent excellency of the work quite as much as to the importance of the subject. To compress so much valuable information within the space occupied is a considerable feat, but it is not less surprising than the number and variety of practical examples which illustrate the very thorough theoretical considerations. The subject is, of course, one involving a vast amount of mathematical study, while at the same time, the practical results are very easily grasped, and form an extremely interesting subject for investigation. Doubtless many of our readers will be found in both classes, and to all of them we feel sure the volume will prove an extremely useful and standard work.

THE CONSTRUCTION OF FOUNDRY PATTERNS. By Herbert Aughtie, A.M.I.C.E. Manchester: The Scientific Publishing Company. Price 5s. net. Postage 4d. extra.

It is with no little pleasure we are able to state that Mr. Aughtie's volume on pattern making is an excellent one for those of our readers who wish to gain either an insight into the problems of the art, or some practical information on the subject. It appears to us to accomplish the very difficult feat of combining accurate elementary instruction with useful information which a quite experienced hand might not despise, and it covers the intermediate ground in such a satisfactory manner that the beginner does not feel the effects of a sudden transition from what he understands to what he cannot comprehend. As we hinted, the book will doubtless be useful to fairly advanced students; but our concern is with those of our readers who desire to make an incursion into a very interesting branch of their work, and to them we can cordially commend a volume, at once so clearly written, so fully illustrated, and so eminently practical.

MOTORS IN PRINCIPLE AND PRACTICE. By T. H. Hawley. London: The Cycle Trade Publishing Company, Limited, 19 and 21, Wilson Street, E.C. Price 2s. 6d. nett. Postage 4d. extra.

Our readers will need no introduction to Mr. Hawley, whose series of articles on a cognate subject in these columns are the best reference we can give of his ability to deal with the question he has made his own. The present volume has a very special, as well as a mere general, interest in the fact that it is written with a view to the requirements of the cycle trade, or of the section of that trade which is likely to have much to do in a practical way with the newest means of locomotion. We cannot, therefore, quarrel with the fact that the purely theoretical aspect of the question has been left alone, since all the more space was left for practical considerations, which are necessarily of first importance to those concerned. Apart from the class of readers for whom the book is primarily intended, it should appeal with every significance to the not inconsiderable number of our readers who are taking an interest in motor construction, whether from the point of an automobilist or otherwise. Electrical questions in connection with petrol motors are very carefully expounded, and this is especially valuable to those whose work has brought them very little into contact with this side. We are also glad to know that Mr. Hawley insists on the necessity of thoroughly understanding the various apparatus in use for the electrical ignition of explosive gas. The modern petrol motor largely owes its popularity to this feature, which cannot, therefore, be ignored by any aspirant to motor fame. The volume is very well illustrated throughout.

THE LOCOMOTIVES OF ALL NATIONS. F. Moore. London: Locomotive Publishing Company, 102A, Charing Cross Road. Price 6d. Postage 1½d extra.

The Locomotive Publishing Company have issued a separate Christmas number of the *Locomotive Magazine*, tastefully printed on art paper, entitled "The Locomotives of all Nations." It comprises, besides smaller illustrations, some nine full-page plates of locomotives of all nations. The photographs are supplemented with outline drawings, the dimensions being given throughout, for sake of comparison, in metres.

The Editor's Page.

AN interesting suggestion has been made to us by the Hon. Secretary of the Edinburgh Branch of the Society of Model Engineers, this, by the way, being one of the most enterprising of the numerous local sections which are now affiliated to the London Society. Mr. Kirkwood writes as follows:—"Speaking for my own branch, we have many members whose work is quite equal to, and in many cases surpasses, much that I have seen illustrated and described in the columns of THE MODEL ENGINEER; but obviously their work can only be seen by the members of our own branch and others residing in the immediate neighbourhood. Every branch will probably be in the same position as regards this, and I am of the opinion that it would greatly tend to increase the popularity of the *M.E.* among its readers, and bring them into closer touch with the members of the different branches if, apart from the usual brief reports of the branch meetings, a page or two were occasionally devoted to the actual work of the branches in turn, illustrated where possible by photographs of models made by the members. Readers other than members of the respective branches would then have an opportunity of judging of the merits of the work done in the provinces, and those readers residing in the neighbourhood of any of the branches would see for themselves the advantages to be derived from membership."

* * *

We quite agree with our correspondent that there is much work done by members of the various branches of the Society of Model Engineers which is too good to be kept only to a select few, and we have no doubt that our readers generally will be only too pleased to make acquaintance through our pages with as many examples of good model work as the members of the various branches can show them. We have invited the Edinburgh Branch to send us some photographs and descriptions for an opening article, and we take this opportunity of asking the other branches to follow suit.

* * *

We recently illustrated a particularly fine model of a modern Corliss engine made by Mr. Adam Gilbert. A number of readers, thinking they would like to make a similar model, wrote asking us to publish the working drawings from which this engine was made. We accordingly communicated with Mr. Gilbert, from whom we have received the following reply: "The only drawings I had for my engine were made on pieces of planed wood with chalk and pencil. These were rubbed out and others made as I went on with the engine. To make a full set of working drawings would require a vast amount of time, as there is such a lot of very small complicated gear. I cannot say if the engine is to scale, as I have had no practice in drawing, and have made it to my own design and fancy." We are sorry that Mr. Gilbert is not able to oblige our correspondents; but we think the fact that he has made so well proportioned a model with so little guidance in the way of drawings is one of which he may well be proud. It is not a method which we would recommend our readers to imitate however, for it can rarely be employed with success, or at least without the ultimate success being modified by a good deal of trouble and spoilt material by the way. It is, undoubtedly, the best plan to draw everything out in detail, and to scale, before any actual work is done.

* * *

"T. R. G." (Bristol) sends us the following kindly note: "I notice in your number of December 15th you speak of knowing one reader who has his advertisement pages bound up every year. I should also like to say I have taken your valued paper in since the *first* number, and have *always* had the advertisement pages bound up with the others at the end of the volume, and have, up to now, taken *two* numbers each time to give the paper a little encouragement; for though mechanics are not in my line of business, I can appreciate reading your articles and admiring the drawings of models." Our best thanks to "T. R. G." for his encouraging epistle, no less than for his regular and valued support.

* * *

Under the initials "A. D.," a correspondent, whose name is well known to our readers, sends us the following comments on a letter recently inserted in this page: "In reply to your correspondent 'A. S. L.' (Bournemouth) I should advise him, if he has no mechanical talent or enthusiasm, to let all model work alone, and if he is possessed of those qualities, to confine himself to making a sausage machine, and then, as he watches it revolving, he will be gratified by the reflection that it is of *real* use. I append a calculation of the amount of pleasure to be derived from the above as against the cost.
Let X equal the amount of pleasure at each revolution.
,, R ,, number of revolutions per minute.
,, C ,, cost machine.
Then $X \times R - C$ will be the total pleasure gained. Suppose the pleasure to be about that of an average stage play, and the machine to make 300 revolutions per minute. Thus we have for only one hour's watching the equal of 18,000 stage plays, and against, say, 8s. 6d., the cost of machine. I have not calculated the amount of pleasure to be derived from a model locomotive, as the value of R varies so greatly."

* * *

Referring to a query we recently mentioned as having been received from an ambitious correspondent who wished to build a 20 ft. boat to steam at eighteen to twenty miles per hour, another reader, "V. B. H. M.," sends the following:—"I think I can be of some assistance to 'H. B.' with regard to his 'flier.' At the Glasgow Exhibition I saw an engine exhibited by Messrs. Simpson, Strickland & Co., of Dartmouth, South Devon, which will fulfil his desire. The engine was of the quadruple expansion type, about 5 ft. long over all, and 3 ft. high as near as I could judge. This, with a Strickland tubular boiler of quite small dimensions for its power, indicated 140 h.-p., the working pressure being 375 lbs. per square inch, and drove a 30 ft. boat at twenty-two miles per hour."

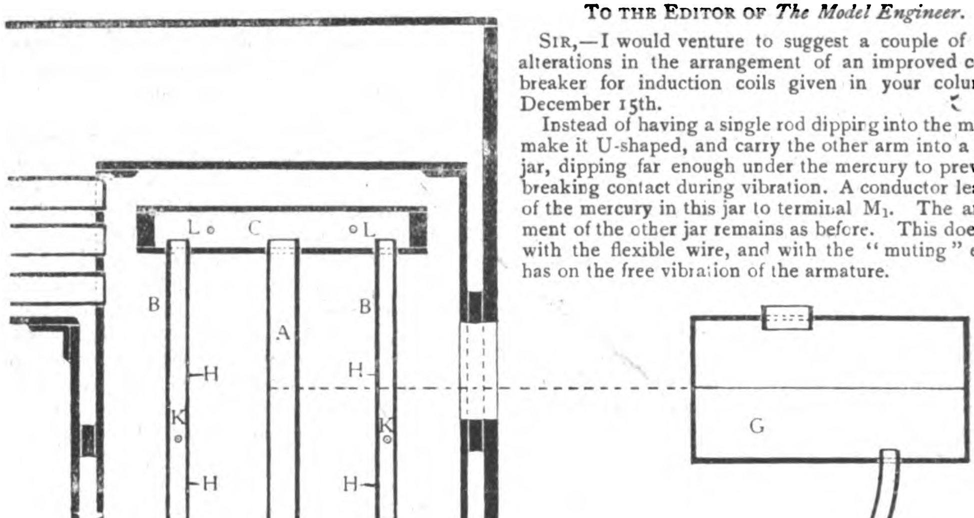
Practical Letters from Our Readers.

[*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.*]

On Firing Model Locomotive Boilers.

To the Editor of *The Model Engineer.*

Dear Sir,—I have sought in vain among the many suggestions of your correspondents for a simple and satisfactory method of heating small model locomotive boilers, and have at length been compelled to invent a method of my own. Perhaps you may think well to publish my idea in The Model Engineer, and, if so, it may be of service to some readers who have found themselves in a similar difficulty to mine; especially as this is the result of a successful experiment, and not the statement of untried theory—a difference which some of your correspondents occasionally fail to recognise.



A Methylated Spirit Burner for Model Locomotive.

My aim was, if possible, to use methylated spirit vapourised, and to dispense with a pump to keep up pressure, and still more to dispense with another lamp to produce the vapour. The tempestuous roaring of a Swedish burner made that method hopeless, apart from the fact that my model is ½ in. to the foot—too small for this plan.

I enclose a sketch of my arrangement. Three brass pipes, A, ¼ in., and B,B, ⅛ in., are brazed into a ⅜ in. pipe C; and the ends of pipes B, B, and C are then closed with brass plugs driven in. Small holes are drilled with a needle in the pipes B, B, and C at the points marked H,K,L; and the pipe A is connected by an elbow joint E (into which it is screwed or made a tight fit) to the pipe F, which conveys spirit from the tank G in the tender. The spirit, of course, rises in the pipe A to the same height as that in the tank, and is vapourised in A by the jets of flame proceeding from the holes H,H in the pipes B,B. The vapour also finds its way out from the holes L,L and K,K, and strikes in jets of flame against the sides of the firebox. The tank must be open to air, and the pipe A must contain a wick, or the boiling of the spirit will cause the flames to jump and finally go out. To start the apparatus, a small piece of cotton wool is wrapped round a wire and dipped in spirit, lighted, and held against the pipe A.

I shall be glad to hear if this arrangement is found successful by your readers, and can assure them that the experiment is well worth trying by any who find difficulty in heating their small boilers.—Yours truly,

Loughborough. Montague B. Bird.

How to Increase the Efficiency of a Spark Coil.

To the Editor of *The Model Engineer.*

Sir,—I would venture to suggest a couple of trifling alterations in the arrangement of an improved contact-breaker for induction coils given in your columns of December 15th.

Instead of having a single rod dipping into the mercury, make it U-shaped, and carry the other arm into a similar jar, dipping far enough under the mercury to prevent its breaking contact during vibration. A conductor leads out of the mercury in this jar to terminal M_1. The arrangement of the other jar remains as before. This does away with the flexible wire, and with the "muting" effect it has on the free vibration of the armature.

Also, instead of having an adjusting screw to keep the rod in position, solder it on, and have a glass rod dipping into the mercury in the contact-breaking jar, and capable of sliding stiffly up and down through some support such as cork. Raising or lowering this rod will affect the height of the mercury, and can be done while the coil is working.

I think it is very desirable that the armature should be removed from the front of an induction coil. Its action in this position is very complicated; but, roughly speaking, it tends, according to its rate of vibration, to lower the magnetism of the core prior to the break.

While discussing the subject of contact-breakers, it may not be out of place to refer to a type which is rather uncommon. The contact screw is placed on the near side of the armature, instead of in its usual position, so that contact takes place on the attraction of the armature. Connections are as follows:—From terminal to contact-screw, screw to coil, coil to spring, spring to terminal. It will be seen that at moment of contact a short-circuit exists along spring, and the current flows along this in preference to the higher resistance of coil. Consequently the core is demagnetised.

It will be apparent that the current freely circulates round the coil, except at the moment of contact, allowing the magnetism to attain its maximum, and also that sparking is done away with. At make, because it is only after contact has taken place that the magnetism ceases; and at break, because no magnetism exists in the core prior to this.

At first sight it might appear that this is an ideal method to use with an induction coil; but the very reverse is really the case, and if it is fitted, all induction effects in secondary as well as primary will disappear. It is quite efficacious with bells, however, and a number of these can be rung in series with this type of interruptor.—Yours truly, R. T. Hancock.

Cardiff.

How to Build a ¼-h.p. Water Motor.

To the Editor of *The Model Engineer*.

Dear Sir,—I have read your article in the December 15th Model Engineer upon the above subject with great interest, and beg leave to offer a few suggestions to those of your readers who think of building a water motor. Having manufactured these motors for the past ten years, I have had much experience in constructing them, so as to give the greatest efficiency with the least expenditure of water.

I hope you will excuse a little friendly criticism of the article. Nothing is said about *balancing the wheel* when finished, and as the motor runs at 3000 revolutions per minute, it must be admitted that this is a most important point. I recommend the wheel being placed with its shaft resting on the lathe bed, which must be perfectly level. The heavy side of the wheel may be reduced in weight by boring a hole, etc.

I consider that a shaft of ⅜ in. is rather small for the power developed, and that the bearings lined with brass tube will be unsatisfactory; they would be much better if cast solid in gunmetal, and not less than ½ in. diameter of shaft.

I have found from experiments that the best position for the jet is at the bottom of the motor, and not at the top. By placing the jet in the former position, an extra head or pressure of water is made available, and it permits instantaneous exit of the water when it has performed the work.

The buckets shown in the article throw the water outwards and sideways. In the improved bucket, which I supply, the water is thrown downwards into the exhaust,

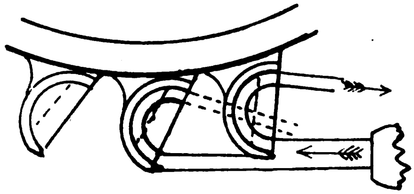


Fig. 2.

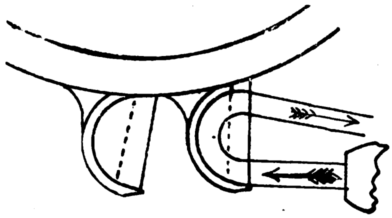


Fig. 3.

quite clear of the wheel and free from the succeeding buckets, as shown in sketches (Figs. 2 and 3).

I also enclose tracing of an improved jet or interchangeable nozzle (Fig. 4). By loosening the nut B the jet E may be removed, and one of more suitable size inserted, while the fibre washer A will make a perfectly water-tight joint. I can fit on a flange (C) to suit the motor described in your article at a moderate price.

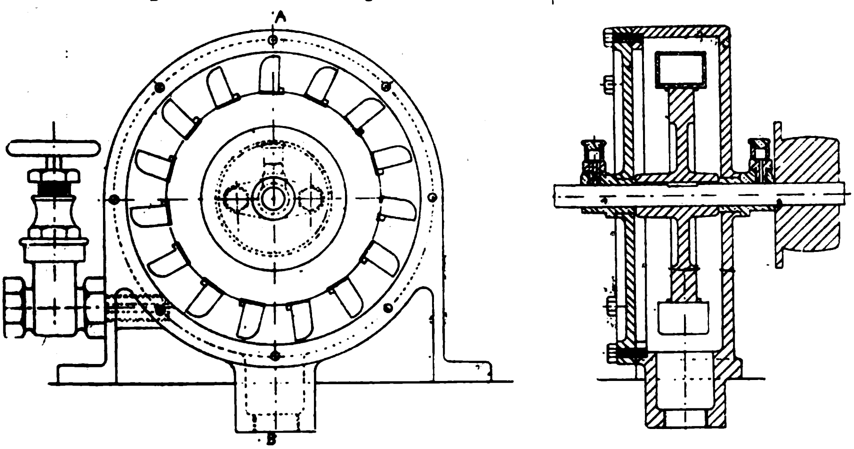


Fig. 1.—Section of ¼ h.-p. "Hector" Water Motor.

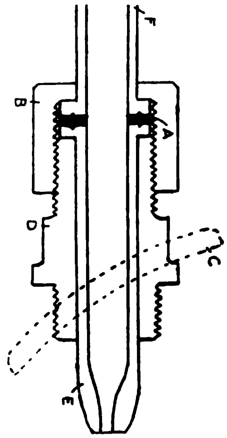


Fig. 4.

You will see from the sectional drawing (Fig. 1) of my motor that the Pelton wheel is fitted into a cast-iron case of neat design with a removable flange cover, and I can supply complete sets of parts to make ¼ h.-p. motor, and I guarantee satisfaction.

The writer of the article refers to the difficulty of making patterns for the buckets; and, apart from the shape of his bucket being old-fashioned, I think it would be impossible to construct it with a pocket knife. I am able to supply a complete set of fourteen buckets in phosphor bronze for the motor in the article.

Your article will probably elicit many enquiries from readers desiring further information. I shall be willing

to answer questions, either through your pages or by post, and supply any separate parts of motors that may be required. My address will be found in the advertising pages.—Yours truly, PERCY PITMAN.
Halifax.

A New Type of Storage Battery.

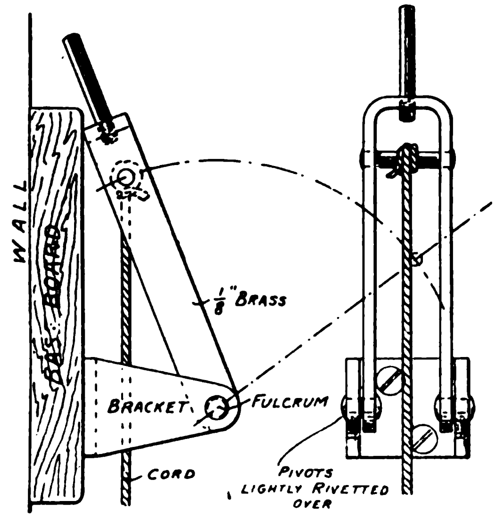
TO THE EDITOR OF *The Model Engineer*.

DEAR SIR,—The new type of storage battery, described by C. D. Martinetti in your December 1st issue, seems to be a kind which would suit the amateur for lighting, and might be used to advantage for sparking coils on motor cycles. The method of making up these cells is, however, a little vague. I understand the method of producing the spongy lead, but don't follow quite clearly the mixing and filling of the cells. Is it meant that the whole of the lead, both for inner porous and outer glass jars, is to be mixed with ⅕ in bulk of lead oxide before placing in jars? Also is the paste of read lead for porous pot and litharge for glass cell? Is any information available to say how many cells of this kind and size would be required to give from, say, 70 to 90 ampère hours capacity at 50 volts?—Yours truly,
Fife. "CYCLE ENGINEER."

An Improved Arrangement of Electric Night Light.

TO THE EDITOR OF *The Model Engineer*.

DEAR SIR,—I have constructed an electric night light set of the bichromate battery type, as described by Mr. Hunt in your September 1st issue, but with a few modifications, which help to make it handier. The result is



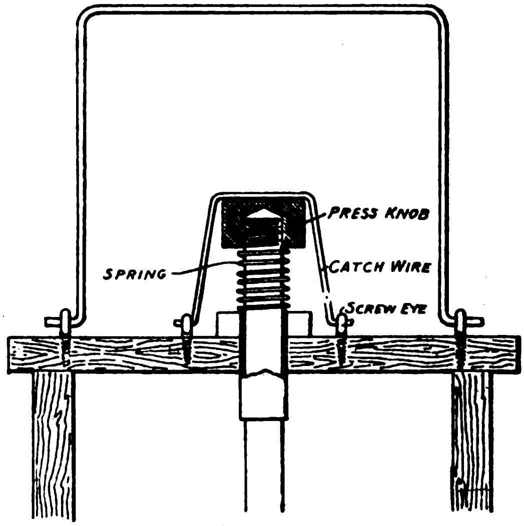
AN IMPROVED SWITCH FOR ELECTRIC NIGHT LIGHT.

very satisfactory. I have three bichromate cells instead of two, and I operate them in this way: Below the bed, at the head part, the battery stands on the floor, and on the wall above, within reach of the hand, I have a switch of my own design, which is here illustrated. It is simply pulled down, or pushed back, as the case may be, and the zincs remain in or out of solution.

The main point about this switch is that the cord attached to the zinc and switch handle passes *beyond* the centre, so that the weight of the zincs either keeps them out of or in the solution, as the case may be.—Yours truly, W. E. S.
Ilford.

TO THE EDITOR OF *The Model Engineer*.

DEAR SIR,—I have just completed the electric night-light set described in the issue for September 1st, 1901, and I am pleased to say it is a great success. I did not make the plunger rod to fold as described by a correspondent in a recent number, as I thought that the original design would not be so troublesome to manipulate in the dark; but I made one modification, which I think is an im-



CATCH FOR NIGHT LIGHT BATTERY.

provement. The catch to hold down the plates did not appear to me to be strong enough where it is screwed into the top, and besides, it spoils the symmetrical appearance of the box. The device I adopted is a miniature of the handle, as per sketch annexed. The knob is made square, and the wire catch, ordinarily lying down behind, is pulled over it when the light is required for some time.—Yours truly, HENRY HALL.
East Putney.

ACCORDING to a Canadian contemporary, a one-rail railway is to be tried in New York, and a very great rate of speed aimed at. The cars will be cigar-shaped, and run upon a central rail on an elevated structure. The electricity will be carried in outer rails on the under side of the structure, connecting with the car by clamp wheels. These are bound to the track in such a manner that accidents, it is asserted, are impossible.

* * *

IT is reported that a cat climbed a trolley pole near Lockport, and caused a lot of trouble to the International Traction Company and the Niagara Falls Power Company. Puss tried to walk on the feed wire, and her tail happened to touch the parallel wire that carried the current back to Niagara Falls. There was a flash that could be seen for miles as the 24,000 volts of electricity passed through her body. The cat was burned to a crisp. Her lifeless body fell across both wires, and did not drop to the ground. This short-circuited the current, caused a fuse to burn out at the Niagara Falls power-house, and cut off the power from all the lines centering there. It was two hours before the cause of the trouble could be found, and the charred remains of the cat removed from the wires. In the meantime, almost all the electric railways and street lighting plants in western New York were without power. We believe the cat was American.

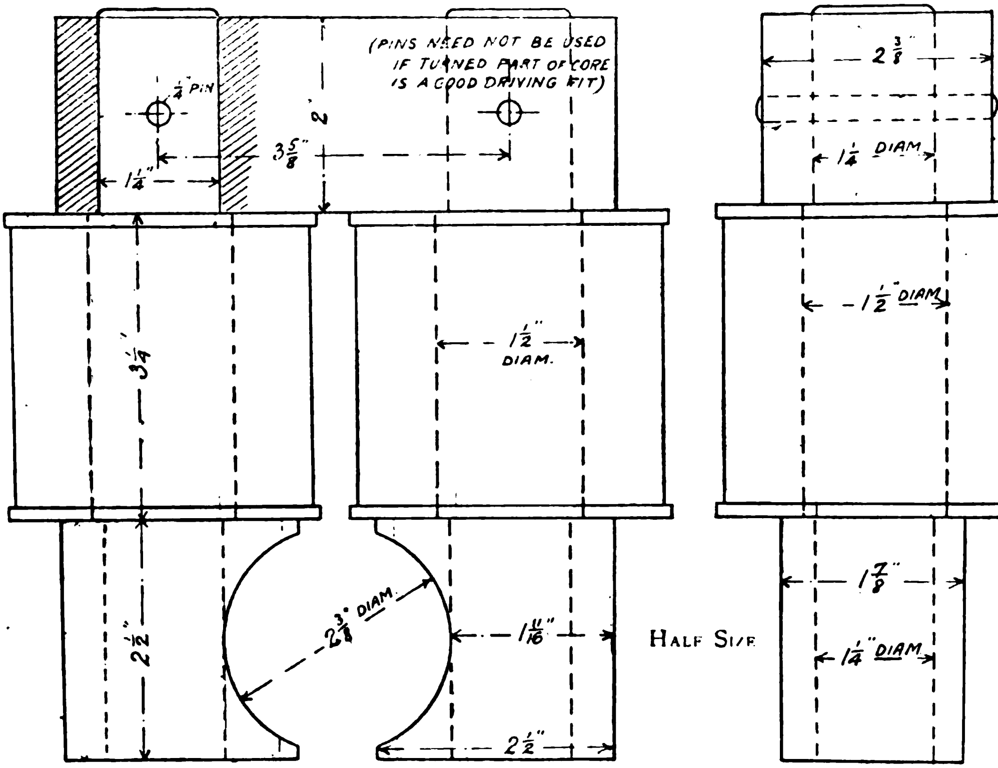
Queries and Replies.

[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.

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:—

[5193] **Edison-Type Dynamo.** H. R. (Ashton-on-Mersey) writes: I enclose sketches of an Edison-type dynamo which I am building, and I should be obliged if you would answer the following questions:—(1) Is it well proportioned? (2) What wire should I use on the magnets, and how much? (3) What sort of armature should I use, and what wire shall I wind with it? (4) How many bars should there be in the commutator? (5) How should I connect the armature to the commutator? (6) What will the output be? (7) What size of lamps is it advisable to use? (8) What power will it take to drive it at 3000 revolutions per minute? (9) What brushes shall I use? I thought of using carbon brushes as sketch (not reproduced). I wish to get as much out of it as I possibly can.



(1) The proportions of this machine are good, except with regard to the field-magnet cores. Presuming these are of good soft wrought-iron bar they should be 1½-in. diameter, and should be made a nice driving fit into yoke and polepieces; the ends being turned as large as possible. Our suggestions are embodied in the drawing herewith. (2) For the field-magnet winding, a total of 2¾ lb. to 3 lb. of 22 c.c. wire, connected in shunt. (3 and 4) Armature, drum-type, 2¼ ins. diameter, 1⅞-in. long, laminated, with 12 slots, ⅜ by ¼ in., wound with 9 to 10 ozs. No. 22 in twelve sections for a 12 part commutator. (5) Either by screws in commutator bar, or (better) by soldering the wire ends directly to the bars. (6) Output, 2 ampères at 30 volts = 60 watts. (7) The lamps should be of 30 volts, and if those of high efficiency (H.E.) type be used, about 30 c.p. may be expected. (8) About 1-6th h.-p. (9) We do not recommend carbon brushes for so small a dynamo. Your construction is right, except that all parts would need to be stronger, and the brush must be as wide as possible. Copper gauze brushes you will find excellent, and the construction of a proper brushholder can be seen in the "A.B.C. of Dynamo Design."

[5122] **Materials for Dry Cells.** E. A. B. (Leamington) writes: I wish to make up an electric night-light set similar to that described by Mr. Gawn in the October 15th issue of THE MODEL ENGINEER. I find the quantities of materials for dry cells are given in *parts*. Can you state approximately what *weights* of each material I should purchase to make a set to the sizes given?

For four cells of the dimensions stated in the article referred to, the quantities are approximately as follows:—Ammonium chloride, 3 lbs; carbon, 4 lbs.; manganese, 4½ lbs.; plaster of Paris, 4 lbs.; zinc chloride, 8½ ozs. Of glycerine and water, about ½ pint and 2½ pints respectively will be needed.

[5169] **Four-inch Spark Coil.** "SIGMA JUNIOR" (Boston) writes: In your March 1st issue, of last year, you give an article dealing with the construction of a 4-in. spark-coil. I have made a coil from those instructions, and should be glad if you would assist me in discovering why it is I am unable to get more than a 1-in. spark from it. I have followed the dimensions as closely as possible, but have made up the apparatus on a much more elaborate scale than Mr. Hunt suggests, *e.g.*, I have used ebonite wherever he mentions wood, except in the case of the base. Perhaps I had better give a few particulars regarding my coil. First, I used about 3½ lbs. (not 4½ lbs., as given), s.c.c. wire for secondary; I could not get on more in the space given. I have tested for continuity and insulation. Resistance of secondary = 3400 ohms. Secondary coil will hold static charges, given it by means of electrified ebonite rod—for at least three hours, and insulation between coil segments was most thoroughly carried out. The condenser will stand the same test even more satisfactorily, but does not make as much difference to the sparking at contact-breaker as I should expect; but without condenser I cannot get more than ⅛ in. spark from secondary coil. I have tried several condensers of various sizes, but am now using the one which gives the best results; it has 84 leaves of the size given in the instructions. The wires of the primary, outside the actual coil, are all insulated with rubber tube, in addition to the cotton covering. The resistance of the whole primary is under 1 ohm. I have tried several forms of contact-breaker. I am using three small secondary cells and a variable resistance. With 1 in. secondary spark the current through the primary is 2 to 4 amps.; I cannot get more than this amount through unless I screw contact springs up hard, which, of course, stops vibration. I have also tried running coil for several hours to see if there were any signs of breaking down, but spark was still the same length. May I draw your attention to the concluding sentence of this article on this coil in your paper? Your contributor estimates the current through secondary at 1-10th to 1-5th amp. I believe the E.M.F. required to spark across 4 ins. of air to be about 200,000 volts, which gives us 20,000 to 40,000 watts, and *supposing* we get all the energy out of secondary which we put in primary, at 6 volts (E.M.F. of 3 cells) 3333 to 6666 amps., or at 100 volts (ordinary lighting circuit) 200 to 400 amps. would have to be sent through primary to produce 1-10th to 1-5th amp. in secondary. Am I right in this? I am afraid I am putting you to a lot of trouble, but let me plead in extenuation that, although I have made up many pieces of apparatus from instructions given in your excellent little paper during the last two years, I have never had to apply to you for further assistance before.

(1) Be certain that secondary connections (section to section) are correct: one pair wrong will neutralise the induced current in the four adjacent sections. See that each outside wire is alternately right and left handed. (2) Is the core of primary thoroughly annealed? (3) Possibly your secondary is built up too far away from primary; get it as near as possible consistent with insulation. (4) Make a mercury interruptor, as described in the December 15th issue, to replace spring armature. (5) The fact that the secondary holds an electrostatic charge is not a proof that sparking from secondary to primary is not taking place; remember the higher pressure. (6) The statement *re* current in secondary being 1-5th to 1-10th ampère, of course, only applies when the Wehnelt interruptor is used on a 100 volt circuit. There must be something radically wrong in your construction, as the proportions of wire, etc., are ample for a 4-in. spark —considerably more so than allowed by the best makers. 3½ lb. of wire should give a 3-in. spark easily.

[5311] **Water Pressure.** "AMATEUR" (Northampton) writes: Will you please tell me how to obtain the necessary pressure of water to efficiently work the water motor described in your issue of the 15th December? Can this be effected in an ordinary dwelling where the water is laid on from main, with supply on first floor? Does the expression of "fall of 144 ft." signify that the water would have to be first raised to this elevation?

Unless there is already water pressure in the mains to the amount stated in the article you have no means of getting the power out of the water motor, as described. By the expression "fall of 144 ft." is understood the pressure due to that elevation of water. Of course, it is not necessary that the water should actually have a "head" of 144 ft., since if it is pumped under pressure to an equivalent amount you get the same effect.

[5133] **Electro-Magnetic Formulæ.** J.P O'H. (Catford) writes: In a book on dynamo design appear the following expressions:—

$$\text{Flux} = \frac{\text{Magneto-motive power}}{\text{Reluctance}}$$

and M.M.F. = strength of current × turns of wire × 4 π.

I should be much obliged if you will kindly point out to me, in as clear a manner as possible, the reason this quantity 4 π is used in this question. Continuing further in the book are given these formulæ, in C.G.S. notation:—

$$\text{M.M.F.} = \text{C.T.} \times 4\pi \text{ and } R = \frac{l}{A\,\mu}$$

$$\text{Flux} = \frac{\text{C.T.} \times 4\pi \times A\,\mu}{l} \text{ and C.T} = \frac{l}{4\pi \times A\,\mu}$$

Ampère turns A.T. = (C × 10) T.

The author goes on to say "transforming to English system of measurements, 1 in. = 2·54 c.m. and 1 sq. in. = 6·45 sq. c.m.

$$\text{A.T.} = \frac{10 \times (l \times 2{\cdot}54)}{4\pi \times \mu \times (A \times 6{\cdot}45)} = \text{A.T.} = \frac{l \times 2{\cdot}54}{A\,\mu \times 8{\cdot}10765}$$

$$= \text{A.T.} = \frac{l}{A\,\mu} \times 3{\cdot}132."$$

If above formulæ are in C.G.S. notation would not l = length in c.m. and A = area in sq. c.m. be transformed to English measurements by *dividing* respectively by 2·54 and 6·45 instead of multiplying by these quantities?

A really complete reply to your query would be outside the scope of the Query Department, as it involves the whole theory of electro-magnetic action. Without this, however, it is difficult to give any very clear idea of the reason for the terms of the formulæ, and it will therefore be necessary for yourself or any reader who desires a clear conception of the theory to study it in a good book such as those by Slingo and Brooker, or Silvanus P. Thompson. The expression, 4 π, is derived from the formula for the area of a sphere, which is $R^2 \times 4\pi$ (R being the radius). The unit of magnetic force is one line of force per square centimetre at a distance of one centimetre from the pole. But the pole is regarded as the centre of a sphere, and one line of force must proceed through *every* square centimetre on the surface of such a sphere (the radius being one centimetre) for the pole to have unit strength—since lines of force proceed in *every* direction from the pole. Now the surface area of a sphere of one centimetre radius = $(1)^2 \times 4\pi = 4\pi$. In other words, for every line of force required to be produced at unit distance (one centimetre) from the pole, 4 π lines of force must be generated in the magnet. With regard to the second part of your query the answer is "No." The number of square centimetres in square inches is 6·45. It is, therefore, necessary to multiply by this figure to obtain the value of ampère turns requisite to produce unit force in each square centimetre in a square inch.

[5186] **Motor for Bicycle.** E. C. W. (Hayling Island) writes: A 1¾ h.-p. petrol motor for cycle. (1) Can I use self-induction coil for simplicity of making? If so, what size and quantity of wire and length of coil? (2) Would a small dynamo do instead? If so, what size and proper price and advice as to make? (3) Is there any danger *at all* of back flash from engine to carburettor if I use one or more gauges in pipe; and if such a thing did occur what is the worst that could happen? (4) Would it be safer to have petrol tank quite removed from carburettor? If self-induction coil is no good, a rough sketch of coil and condenser suitable would greatly help me.

(1) As to self-induction coil and dimensions, it would be mere guess work to give winding for such a coil. Experiment only has proved efficient in guiding even the best makers, but for general guidance the following may be useful:—Most tricycle coils are constructed to work best with about 4 to 6 ampères at 6 to 8 volts, bicycles at 2 ampères and 4 volts, there being 4 cells in the former and 2 in the latter battery. The De Dion coil, made by Basse and Michael, of Paris, has a two-layer primary of about 16 gauge, and the secondary is about 36 gauge, but the number of turns in secondary cannot be stated. The outside measurements of a bicycle coil which gives a half-inch spark in air with a two cell accumulator, 2 amps. × 4 volts, are as follows:—Length over end plates 5 inches, diameter outside secondary winding 2¼ inches. (2) A dynamo of ordinary construction, either series, shunt, or compound wound, is almost useless for direct sparking purposes for several reasons, but chiefly because of the heat generated in the coils of the armature by the rapid make and break, the first essential being a permanent field by utilising permanent steel magnets in place of electro-magnets (study construction of Simms-Bosch magneto). Then again this system is useless with the ordinary sparking plug, it being necessary to produce the ignition spark by a mechanical make and break within the combustion chamber. The practical value of a small dynamo is in using it to charge accumulators, so making the machine independent of outside charging, and for this purpose you cannot do better than make a machine on the lines of that described in our December 1st issue. (3) There is absolutely no danger of back-fire from motor to carburettor if two superposed wire gauzes of sufficiently fine mesh be inserted in pipe leading from carburettor to engine; a similar precaution should also be observed at the air opening in the mixing valve at top of surface carburettor. In the event of back-fire passing the gauze screen, the explosive effect would be confined to the length of tube between motor and mixing valve; the bulk of the petrol and vapour contained in the carburettor or tank would not be explosive by reason of the vapour containing too little air to form an explosive mixture. An explosion under these circumstances would not be dangerous to any great extent so far as the rider was concerned, but none has as yet been reported from this particular cause. (4) If the above precautions be observed there is not the slightest necessity for widely separating the petrol tank and carburettor, but greater safety would certainly be insured by fitting a spray or float-feed carburettor, preferably the Longuemarre or similar type. We are sorry we are unable to give sketch and particulars of a suitable coil, but think you would be well advised to purchase this of best French make from one of the reputable motor firms, Motor Industries, Holborn Viaduct, E.C., or D. Citroeu, 45, Holborn Viaduct, E.C., could supply any requirement in this direction.

[5183] **Books for a Beginner in Model Making.** A. H. C. (Birkenhead) writes: I do not know anything about model engine making, but, having a desire to try my hand at it, and being of a practical turn in other directions, I thought that perhaps it might be possible for me to get the requisite knowledge from books on the subject to supplement instruction locally obtained in the use of the lathe, tools, etc. I am also anxious to know something in an elementary way of electric batteries, motors, etc., and how to make and apply them to models.

You do not say whether you have read any of them, but the books in our MODEL ENGINEER series are planned with a view to fulfilling the very requirements you specify. A complete list of these is as follows: "Small Accumulators," "Electric Batteries," "The Slide Valve, Simply Explained," "Telephones and Microphones," "Electric Bells," "Model Boiler Making," "Metal Working Tools and their uses." All these are 6d. each, postage being extra. A larger book, "Practical Lessons in Metal Turning," price 2s., will give you the requisite instruction in lathe work, and the "A.B.C. of

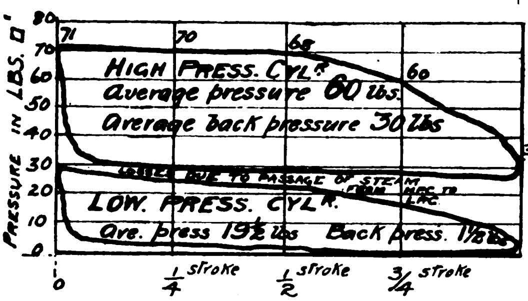
Dynamo Design," price 1s., will give you an insight into the designing of small dynamos. We have other books forthcoming on allied subjects, all of which will, we think, meet your case very well.

[5078] **Steam Motor Cars.** A. T. P. (Sydney) writes: (1) What kind of engine is used in steam automobiles? Is it compound or just simple high-pressure cylinders? (2) What would be the size of cylinders for a 4 or 5 h.-p. automobile? (3) What type of boiler is used, and is there any firm who manufactures such boilers with necessary fittings, such as burner, etc.?

A double cylinder non-compound vertical engine is used by the Locomobile Company. This engine is very lightly made, and is fitted with ball bearings both for the shaft and the big ends of the connecting-rod. The cylinders are 2½ ins. × 3½ ins. stroke, and develop about 4 h.p. Link motion and feed pumps are also fitted. The boiler is a vertical one, with a large number of thin flue tubes. We do not know if this company supply boilers and engines separately, but their London address is 52, Sussex Place, S. Kensington, S.W. Particulars, together with illustrations of these engines, may be found in Messrs. King & Co.'s "Automotor Pocket Book," obtainable at 62, St. Martin's Lane, W.C.

[5105] **Compound Engine.** F. D. D. (Leicester) writes: What is the correct size of cylinders for a compound engine to develope 1 h.-p. at 700 revolutions, boiler pressure 70 lbs. per square inch? Please also state, best cut-off and thickness of metal (cast iron) for cylinders.

Arrange cut-off at ¾ stroke. Thickness of cylinder walls—H.P.C., ⅛ in.; L.P.C., 5-32nds in. Theoretically, we find that an engine with a high pressure cylinder of 1½ ins. × 3 ins., and a low pressure cylinder of 2⅛ ins. × 3 ins., would give, at the prescribed pressure and speed, an i-h.p. of nearly 1¼, and that the H.P.C. alone would develope nearly 1 i.h.-p. The friction resultant with the use of the extra (L.P.) cylinder and its gear would very likely absorb the power gained by compounding, and it would be found that the H.P.C. alone would give nearly as much b.h.-p. per unit of steam consumed. We think you would do just as well with a simple high pressure cylinder of, say, 1⅝ ins. × 3 ins. diameter (the bore is supplemented to make up for probable losses and practical difficulties). To make compounding a success on such a small scale, means must be provided to prevent cylinder condensation, or it may be that the addition of a L.P.C to an ordinary engine would not present any real benefit, but the reverse. In small engines the surfaces of the cylinder (and, therefore, cooling surfaces if not perfectly lagged all over) are greater in proportion to the cubic capacity (and, therefore, total heat of the steam contained in the cylinder) than in larger engines. It has been found with large engines of 200 i.h.-p. that the effect of excessive expansion is marked by a great amount of initial condensation. In a simple engine, cutting off at 1-20th stroke, more than 42 per cent. of the steam admitted was condensed; with 50 per cent. cut-off (½ stroke), the condensation was reduced to 14 per cent. With compound engines this condensation was lowered some 15 to 20 per cent. of the above quantities. To calculate the i.h.p. of compound engine you must make sketches of probable indicator diagrams and arrive at average pressures, working out the i.h.-p. of each cylinder in the method given in issue of October 1, 1900, page 221. We append the approximate indicator diagrams we made for the purpose of this query. The capacity of L.P.C. is twice that of the H.P.C., the areas being—H.P.C. $\frac{7}{4} = 1\frac{3}{4}$ sq. ins., and L.P.C. $\frac{7}{2} = 3\frac{1}{2}$ sq. ins. To arrive at the mean pressure, add up the pressures at beginning, end, and at the intermediate points in stroke and strike an average, deducting the average back pressure.



APPROXIMATE INDICATOR DIAGRAM FOR COMPOUND ENGINE

$$\text{I.H.P of H.P.C} = \frac{30 \times 7 \times 1}{4 \times 4} \times \frac{700 \times 2}{33,000} = \frac{49}{88}\ \text{I.H.P}$$

$$\text{I.H.P of L.P.C} = \frac{18 \times 7 \times 1 \times 700 \times 2}{2 \times 4 \times 33,000} = \frac{59}{88}\ \text{I.H.P}$$

$$\text{TOTAL} = \frac{108}{88} = \text{nearly } 1\tfrac{1}{4}\ \text{I.H.P.}$$

[5713] **Boiler Failure.** W. H. C. (Poplar) writes: Will you kindly favour me by answering the following: I have a marine boiler, 8 ins. long and 7½ ins. diam., with two furnaces and 14 half-inch tubes. The boiler is made of copper, 1-16th in. thick. I made a two-cylinder launch engine with reversing gear, 1¼ ins. bore and 1¼ ins. stroke, with piston valves. I am in a fix with the boiler. When I start the engine, it goes first-class at a low speed; but when I put full steam on, the boiler primes and all the water is taken out of the boiler till it is a good way below the tubes; also there is no draught in the boiler. (1) How can I stop the priming? (2) How can I get a good draught to get steam up (3) Do you think the engine is too large for the boiler? I work a 25 lbs. pressure. The furnaces are 2 ins. diam., and run right through the boiler to a chamber, and the heated gases come back through the tubes to the uptake.

The boiler is rather too small, and we reckon, from the particulars sent, that it has barely 200 sq. ins. of heating surface. A boiler to properly drive this engine should be arranged with 500 sq. ins. The reason why it primes is, without taking into account the priming caused by the tubes being too high in the barrel (these leaving less than ¼ instead of ⅓ of the height of boiler as steam space), the discharge of the boiler at too great a rate, much faster than it can supply steam in a quiet manner. You have no doubt noticed—if not, try the experiment, with due precaution against scalding yourself—that when a large valve or cock is opened from the steam space of almost any boiler into the air the steam issues for a moment at great speed, and is immediately followed by most of the water. The whole of the water in the boiler is, by the sudden reduction of pressure, placed at a higher temperature than it should be for the corresponding pressure, and violently boils. Of course, in your case, the priming is aggravated by the provision of insufficient steam space. The only way to prevent priming in your boiler is to wiredraw the steam. Use a perforated collecting pipe instead of plain hole in top of boiler. Create a draught whilst steam is being raised in the manner described in the reply to Query No. 4450 on page 166 of THE MODEL ENGINEER for October 1st last, afterwards use a steam jet.

[5155] **Dynamo Driving.** E. S. (Pinxton) writes: Would you kindly suggest size of engine, boiler and dynamo, about 100 c.-p., suitable for lighting up a workshop, size 4 yds. × 4 yds. × 3 yds. high?

120 candle power requires 1 brake horse-power. For 1 b.h.p. with an efficient engine about 10 to 12 sq. ft. of heating surface must be provided. You will practically have to provide an engine and boiler capable of giving 1 b.h p., and we think that a neatly designed vertical engine, with one cylinder about 3 ins. × 4½ ins., running at about 300 revolutions per minute, with a boiler pressure of 30 to 50 lbs. per sq. inch. The boiler should be vertical, with a fair number of flue tubes of about 1¼ in. diam. The boiler shell should be of steel, ¼ in. thick, and be 3 ft. 6 ins. in height, by about 24 ins. diam. Messrs. Warsop & Co., of Launder Street, Nottingham, will supply engine or castings, and T. Goodhand, of New Brompton, Kent, will undertake construction of boiler.

[5140] **Bicycle Query.** J. W. F. (New Hirst) writes: Will you kindly give me some idea of detachable bar for joining two cycles together—one a lady's and a gentleman's? I wish to fix a motor, which, please also state the best for a double bar frame and cheapest, and also the best way to have motor, whether in front or at back. Please give a sketch, if possible.

We regret your query is altogether outside the scope of the "Query" Department.

[5171] **Design for Steam Car.** F. G. (Kidderminster) writes: Referring to the article in No. 35, THE MODEL ENGINEER, dated October 15, 1900, "The Ideal Motor Car," will you kindly give me specification for constructing one on the lines indicated in the article; also where I can obtain the parts ready for fitting together, also the probable cost?

We really cannot undertake to design and supply a specification for a motor car. Please consult an expert engineer on the subject. The article referred to merely gives a descriptive outline of an ideal car, upon the lines of which you may, if you agree with the writer, have one designed and built. You might apply to David J. Smith, of 5, Great Arthur Street, London, E.C., who designs and builds steam cars.

[5209] **Boiler and Engine Queries.** G. G. (Liverpool) writes: Will you please say if a water-tube boiler, made to enclosed sketch (not reproduced), would drive an engine, 1 in. bore ½ in. stroke, running about 800 to 1000 revs., steam pressure being 80 to 100 lbs.

per sq. in.? Would an ordinary spirit lamp do for firing, or should I use methylated spirit lamp? Please give size and speed of pump for same.

The engine will consume quite 3 cub. ins. of water per minute. We do not expect that the boiler will evaporate more than 2·1 cub. ins. p m., and also as the amount of steam and water space in the boiler is not very great, you will have to guard against priming by wiredrawing the steam a little. Use for this purpose a long perforated steam collecting pipe, the holes in the upper part being 24 in number, and about 1-32nd in. diam.—mere pinholes. You will have to be careful with the regulation of the feed; see *M.E.* for June 15th last. Silver-solder or braze all joints, and provide a fusible plug. Use a "Vesuvius" or "Hekla" burner (paraffin fuel, Swedish patent) in a horizontal position. We do not like the proportions of your cylinder, we should advise a longer stroke; as it stands, the cylinder will be rather wasteful of steam, owing to increased "clearance" practically necessary. Use one 13-16 in. diam. with ¾ in. stroke.

Amateurs' 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.*]

Small Steam and Gasoline Motors.

The accompanying illustration, Fig. 1, shows one of the small model engines supplied by the Morgan Motor Company of Brooklyn, N.Y., U.S.A., to those desirous of building their own engines either for pleasure or to illustrate the principle of the steam engine. The castings include everything required in the construction of the engine, such as cylinder, cylinder head, frame, base, piston, piston rings, valve box, eccentric strap, cross head, flywheel, &c. A set of working drawings is also furnished. The cylinder is 1¼ ins. bore by 1½ ins. stroke. Other types of model engines are also supplied, and castings for model trolley car motors, fan motors, telegraph instruments, &c. This company also supplies castings for those who desire to build larger motors such as is shown in Fig. 2 which represents their gasoline bicycle motor. This motor

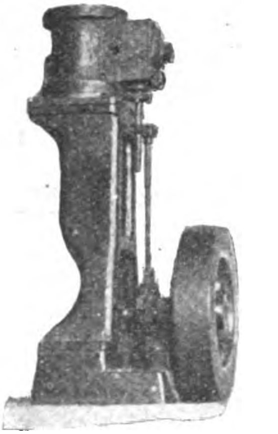


FIG. 1.

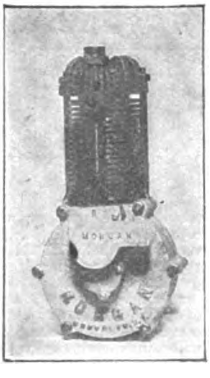


FIG. 2.

may be built on an 8-in. lathe, and will give excellent service on a bicycle. They also have castings for steam engines and gasoline motors up to 7 h.-p. for automobile, marine, and stationary use. All motors and engines are stated to be of simple design and easily constructed by amateur mechanics on a small lathe. This company has large facilities and will make any pattern or casting to order at very reasonable rates. Their full address is Morgan Motor Company, 50, Columbia Heights, Brooklyn, N.Y., U.S.A. Our readers in England must remember that the letter postage to the United States is 2½d., post-cards 1d. A firm, however obliging, cannot be expected to pay excess postage on letters insufficiently stamped, and to avoid the annoyance of having their letters refused (and consequently unanswered), readers should take care not to overlook this point.

A Steam Engine on "Easy Terms."

We are glad to be able to draw the attention of readers to the opportunity offered by Mr. Stuart-Turner for the purchase of his small high-speed steam engine on easy terms. We may refer readers to our advertising pages for particulars, and further details may be had by sending a penny stamp to the maker, at Shiplake, Henley-on-Thames.

A Model Electric Tramway.

We are asked by the Universal Electric Supply Co., 47, Crosscliffe Street, Moss Side, Manchester, to state that as a result of our notice of their model electric tramway (in the last issue of THE MODEL ENGINEER) the stock has been quite exhausted, but a further large number is being made up for delivery early in January, when all orders will be promptly executed in rotation.

Ball-Bearing Automobile Jacks.

Under this heading were described in our last issue some useful "jacks" of a new design which have been introduced by the Frasse Co. We learn from Messrs. Charles Churchill & Co., Ltd., 9 to 15, Leonard Street, Finsbury, London, E.C., that they are the agents in Great Britain for the above firm, so that all inquiries and orders in this country should be directed to Messrs. Churchill.

Catalogues Received.

Lowell Model Company, Lowell, Mass., U.S.A.—This firm makes a speciality of several sizes of gasoline motors for various purposes. They range from substantial 4 h. p. two-cylinder, vehicle or marine motors, down to light air-cooled bicycle motors of compact design, developing 1¼ h.-p. The various types are described in detail price lists, and English readers requiring particulars should remember that the letter postage to the United States is 2½d., post-cards 1d. The above firm makes a strong bid for popularity by supplying complete sets of castings, in the rough or partly finished, for bicycles and marine motors.

Edison-Bell Consolidated Phonograph Co., Ltd., 39, Charing Cross Road, London, W.C.—From this firm, or their authorised agents, may be obtained an interesting portrait souvenir of some favourite artistes in connection with the latest and most improved Edison's phonograph. The souvenir, which is well printed on art paper, contains particulars of all sizes of this machine, from the "Gem" to the "Concert Grand," and numerous illustrations from photographs elucidate the descriptive matter.

The Britannia Electrical Works, Tottenham, London, N. —A descriptive price list is to hand from this firm of electrical engineers, giving particulars and illustrations of electric bells, indicators, pushes, pulls, switches, alarms, batteries, telephones, and lighting arresters. Those interested may obtain the list, which is well illustrated, by enclosing a penny stamp and mentioning THE MODEL ENGINEER. A special discount is offered to members of the Society of Model Engineers.

A. G. Thornton, 68, St. Mary Street, Manchester.—Messrs. Thornton issue a very neat and well-produced little catalogue (post free) of their drawing instruments, pencils, pocket rules, etc., which every reader should possess. We have before remarked on the excellence of the goods we have examined from this firm, and we are glad to notice a speciality known as Thornton's "transparent skin drawing," suitable as a thin drawing or tracing paper, or even as a substitute for tracing cloth. The short days of winter also remind us that the quick-printing blue-print paper by the same firm is a blessing to those who require to reproduce tracings in a minimum of time.

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

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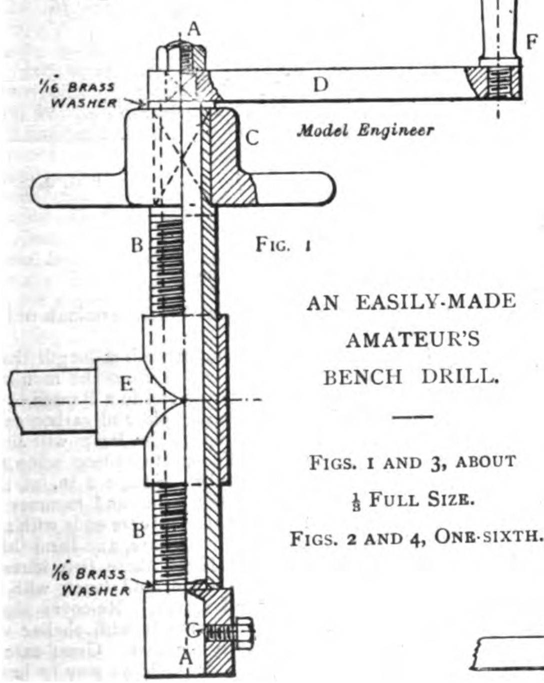
An Easily-Made Amateur's Bench Drill.

By A. P. DRAKE.

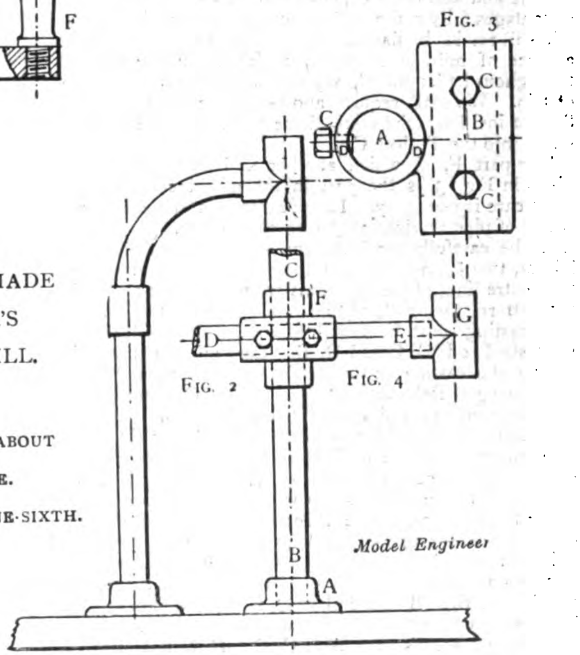
MOST amateurs — even if they are fortunate enough to possess a lathe — are at times troubled with their drilling. A job may be very awkward to set and drill in the lathe, but very easily manipulated under a vertical bench drill. The machine to be described is easily made, having no gearing, and, at the same time, need not cost more than a few shillings.



AN EASILY-MADE AMATEUR'S BENCH DRILL.

FIGS. 1 AND 3, ABOUT $\frac{1}{3}$ FULL SIZE.

FIGS. 2 AND 4, ONE-SIXTH.



The essential parts are the spindle A, A and the piece of gas pipe B, B. The gas pipe is about 1 in. diameter outside and 7 ins. long. Screw B, B for 5⅞ ins. with the ordinary gas thread to fit a T-piece E right through which the gas tap has been run. On the top end of B, B file four flats, square with each other, about ⅝ in. wide and 1¼ ins. long. A casting or forging (C) is then fitted on this end.

The feed motion of the drill is now completed. The two projections on C are placed at the bottom, so that when the handle B is revolved the fingers are not in danger of having the skin scraped off.

The spindle A, A is a forging, the head being turned up to 1⅜ ins. diameter and 1⅜ ins. long. The shank or spindle proper is 9¾ ins. long, and turned to fit very tightly in the gas pipe, which should have all the lumps, etc., in the inside trimmed out with a round file or rimer. Now drive the pipe on to the spindle, and turn each end and also the handle C to the proper length and a straight face.

Then remove the pipe, and ease the spindle to a running fit in the hole. Next, cut out of 1-16th in. sheet brass two washers to fit easily on the spindle, and have the same outside diameter as the pipe. The square for the handle D is now filed on the spindle and the end turned down ½ in. long and screwed to fit a ⅜-in. nut. We have now to drill in the spindle head a ½ in. hole to receive the drills or chucks. This is best done by fixing the spindle in the tool rest of the lathe, so that the centres of the spindle are the same height as the centres of the heads. Fix a ½ in. twist drill in the chuck, and give the required feed with the back or tail head. We now drill and tap a ¼ in. hole to receive the short screw G for holding the drills in position, and the spindle is finished.

The handle D is made from a piece of wrought iron, ⅜ or ½ in. thick, with a square hole to fit the spindle at one end and a ⅜-in. hole tapped out to receive the handle F. The ⅜-in. hole is countersunk a little, and the end of F riveted over, so as to prevent F screwing out in use.

Before putting the drill together, it is advisable to drill a small hole in the pipe B, B, near the head, for oiling purposes, and also to file a slight groove in the top of C and the tube for the same purpose.

We next take in hand the standard for the drill, for which two designs are given in Figs. 2 and 4. Fig. 2 scarcely needs any explanation, except to say that it is composed entirely of gas piping and a flange, the flange forming the foot. It is important that when the flange is bolted to the bench, the T-piece must be perfectly square up, or the holes drilled will not be true. The height of the standard may be regulated to the builder's own taste or requirements. Should the T-piece not be square up, heat the bend in the fire to a dull red. Then a few taps with the hammer will rectify matters.

The standard shown in Fig. 4 is at the same time more trouble and also more expensive to make, but the extra advantages fully make up for the extra time and expense. We still retain the flange A at the foot, and screw into it a piece of mild steel B, C, which is turned parallel throughout its length of, say 16 ins., and has a diameter of 1 in. We shall require another piece of mild steel, 8 or 12 ins. long, the same diameter, and also parallel, to screw into the T-piece C.

The part F, of which another and enlarged view is given in Fig. 3, is the part in the machinery of which some care is necessary. In appearance it resembles two pieces of pipe at right angles to each other. A pattern must be carefully made to the drawing, and to save labour, two ⅞-in. cores put through the two arms. If the centre lines of the two arms are not at right angles in the pattern, they will, of course, not be so in the casting. The casting must be bored to a good sliding fit on the mild steel rods B, C and D, E. Care must be taken in setting the casting in the chuck, so as to ensure the two holes being at right angles to each other. One face should also be turned up and a line (D, D, Fig. 3) the height of the centres drawn with a pointed tool. A line (D, E) is also drawn on the rod D, E square with the centre line of G, also the height of the centres. As this method entails some rather fine work, some workers would, no doubt, prefer the following plan: Place D, E in the centres and draw a line throughout its length with a V, or other pointed tool, held in the toolbox sideways. Drill and tap two ¼-in. holes; tap screws C in each arm; then fix arm B on upright B C and place D, E in position in arm C. Then with a square adjust G perfectly square up, and nip in place by means of screws C, C. If we now make a mark on the arm C opposite the line D, E, we can at any time turn the drill to bore an oblique hole, and afterwards adjust perfectly upright by bringing the line and mark together again. With the former method, the drill may be turned over so as to drill a hole straight up by bringing the marks D opposite the line D, E. The amateur will have in this machine a very handy drill—in fact, a small radial drill which has a very wide range, as it may be adjusted to various heights, lengths from pillar, and will drill at any angle either up or down.

The millwright and plumber will find the above drill very handy and useful, as by taking off the foot A and screwing on an elbow and short piece of pipe, a broken screw may be drilled out in a machine frame, or if a bend be screwed on in place of the elbow, a pipe or pillar drill is at once made.

A Small Electric Dark Room Lamp.

A SIMPLE form of electric dark room lamp which, as such, gives a soft reddish-yellow light, shadowless and equable, and, when necessary, is readily convertible for ordinary illumination, is here briefly described. The requirements are few:—A small 8-volt high efficiency incandescent lamp, a glass flask of about 2 pints capacity, a piece of ⅜-in. glass tubing, some shellac varnish, about 1 yard of No. 26 S.W.G. silk-covered copper wire, a small piece of box or mahogany 1 in. thick, and two very small brass terminals or binding-screws.

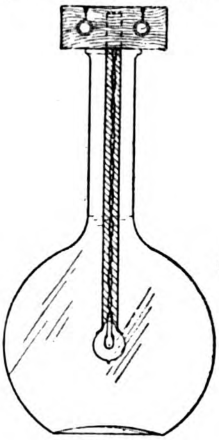


FIG. 1.

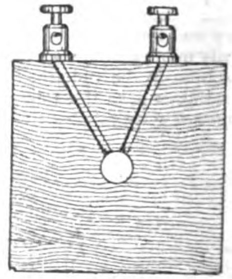


FIG. 2.

First cut the glass tubing of such a length that when inserted in the flask it reaches from the mouth to the centre of the bulb. Heat one end in a Bunsen or a spirit flame, and with a cone-shaped piece of carbon expand it slightly so that the bottom of the lamp will fit into it nicely. Next cut from the wire two pieces some 2 ins. or 3 ins. longer than the tube. Scrape 1 in. of the silk covering off one end of the wires and hammer the exposed copper flat. Then "tin" these ends with a soldering bit, clip the extreme tips square, and bend them into the form of tiny hooks. Hitch these two wires to the loops on the lamp, clinch them, and touch with the hot soldering-bit to make all secure. Re-cover the bared wire with silk or cotton, serve it with shellac varnish, and twist the wires loosely together. Great care should be observed in doing this, or the loops may be broken off the lamp.

Now, holding the glass tube in one hand, bell end upward, and the lamp in the other, let the wires hanging from the latter enter the tube. Lower the lamp into place and cement it therein with a plentiful application of shellac, and allow to set. When this is quite hard, the lamp will be held securely, and the tube may be turned with its other end upward and suspended vertically with cord upon a nail. Then, whilst the wire is kept in it centrally, fill the tube completely with shellac varnish and allow it, in turn, to set perfectly hard.

The piece of wood referred to should be cut 2½ ins. square and carefully smoothed. Bore a hole in its centre of such a diameter that the open end of the glass tube will fit into it tightly. Upon one side of the wood cut two grooves, ⅛ in. deep, radiating from the hole to one edge, and there screw in the two terminals, as shown in Fig. 2. From the opposite side the tube may be inserted, and cemented with shellac, in the hole to a depth of ¾ in. or ⅞ in. The two ends of wire will, of course, be projecting, and they must be scraped clean, laid in the grooves—one wire in each—and, finally, wound once round the terminals before these are screwed quite home. Fill in the grooves with the sealing-wax to protect the wires.

It now remains to prepare a strong solution of potassium bichromate wherewith nearly to fill the flask, and the lamp proper is finished. The tube with the lamp at its end is inserted in the neck of the flask, and so suspended by the piece of wood resting over the mouth, the lamp thus being in the centre of the solution. It is shown in Fig. 1. When a white light is required, merely withdraw the lamp from the flask, and stand the tube upright upon the wood, which thus forms the base.

To light up the lamp, two wires leading from a battery are connected by the binding screws. If an accumulator battery is employed a simple switch should be fitted so that the circuit may be easily broken and the light extinguished; but if a primary battery is used, it is better, for the sake of economy, to stop the current by lifting its electrodes.

For supplying energy to the lamp a small four-cell accumulator is strongly recommended. If, however, through lack of charging facilities, a primary battery is more convenient, four chromic acid cells, each of 1 qrt. capacity, will be found satisfactory. Where the lamp is used intermittently, and for a few minutes only, such as for plate changing, a dry battery of five cells will prove very useful.

A description of the construction of a suitable battery is obviously outside the scope of this note.—D. W. GAWN in *The Photogram*.

[Several batteries are described in THE MODEL ENGINEER handbook, "Electric Batteries," suitable for the above lamp.—ED. *M.E. and A.E.*]

"Flying."

THE above is the title of a new quarterly publication, the first number of which has reached us for review, from the publishers, Messrs. Iliffe & Sons, Ltd., 3, St. Bride Street, E.C. The nature of its contents is obvious and we welcome so enterprising a production. Too many inventors are working in the dark—they know little of the work done by others, and consequently much time is wasted by the same ideas being worked out independently. The new journal promises well and its first number is absorbingly interesting. There are portraits of Professor Langley, Signor Santos-Dumont, and other aeronautical worthies. The text includes articles on the Maxim aeroplane, trials of flying machines, a new flying machine, motor-aviation of to-day, the doings of the Aero Club, and a host of similar matters, and we are pleased to note that the subject is strictly adhered to. The printing and illustration is excellent, art paper being used, and the price is half-a-crown.

The Society of Model Engineers.

London.

FUTURE MEETINGS.

THE following are the dates which have been fixed for the ensuing ordinary meetings:—Tuesday, February 4th, paper by Mr. D. C. Glen on his "Recent Model Engineering Experiences"; March 12th, a series of short papers by Messrs. Boorman, Riddle, Hildersley, Greenly, and other members; April 10th, Rev. W. J. Scott, B.A., on "Modern N.E.R. Locomotives"; and May 5th, when the models entered for the forthcoming competition will be exhibited.

The usual monthly meeting for January was held at the Memorial Hall, Farringdon Street, on the 6th ult. Mr. Percival Marshall took the chair at 7.15 p.m., and after the formal business was over, the subject of the proposed Model Making Competition, open to members of the Society not professionally engaged in model making, was discussed. The members agreed that the entries should, if a sufficient number of models were brought forward, be divided into the following classes: Locomotive, marine, stationary, and other engines, model ships and boats, electrical machines and apparatus, best home-made tool, best model made by a member under 21 years of age, best model made by a member of a Provincial branch society. Silver and bronze medals will be awarded at the discretion of the judges; and in accordance with a resolution passed, on the motion of Mr. H. Sanderson, the members instructed the judges to give special attention to originality in design and construction (*i.e.*, methods of constructing). The question of handicapping the professional engineer or metal worker against the amateur was brought forward. It was decided that the committee fix the number of marks "start" the member who is entirely self-taught should have over those who have had professional training in engineering or whose occupation includes the use of metal working tools.

It must be noted that, in accordance with a resolution made at the annual general meeting for 1900, no member who has joined within three months of the last date for entering the competition will be allowed to compete.

The Chairman then called upon Mr. W. T. Bashford to deliver his paper on the construction of a ¾ in. scale model, "Dunalastair 2nd," which lay on the table, together with some of the patterns, frames, &c., for his new model G.W.R. engine, "Atbara."

Mr. Bashford very clearly described the method of constructing the model. He laid stress upon the advisability of making one's own patterns, and also upon the ease with which the crankshaft — the bugbear of the locomotive builder — could be made by building it up from separate pieces, pinning them together, and afterwards brazing. The completed crankshaft for the model "Atbara" was exhibited.

The boiler for model C.R. engine is provided with nine ½-in. flue tubes, several water-tubes in the firebox, superheater in the smokebox, and is constructed to stand safely 80 lbs. per square inch. The engine is fired by one "Primus" oil burner of the silent type.

The paper concluded with a trial trip on the Society's model railway track, which was performed with great success. The model, which steamed admirably, showed its powers by pulling 100 lbs. of lead weights placed in a box laid upon the tender.

A unanimous and hearty vote of thanks, moved by the Chairman, was accorded to Mr. W. T. Bashford.

Among the other exhibits was a neatly wound armature by Mr. Yetts.

HENRY GREENLY, Hon. Sec.,
4, Bond Street, W.C.

Provincial Branches.

Cardiff.—The usual meeting of this branch was held at 7 and 8, Working Street, on January 7th, at 8 p.m. There was a good attendance of members and friends. Several models and parts under construction were exhibited, including a travelling crane by Dr. Parsons, a gun, and the cylinder and shafting of a twin-screw model steamer, the latter of an unusual, but very promising type. Mr. Ashford undertook to get out drawings for the pattern work of Trevithick's loco. One new member was elected. Owing to the absence of Mr. Eastabrook, his new loco was not available for inspection, but it is hoped to have it on view at the next meeting on February 4th.—R. T. HANCOCK, Hon. Sec., 168, Newport Road, Cardiff.

Edinburgh.—On Saturday, December 21st, about thirty of the members of this branch, with their friends, visited the Tollcross Cable Power Station of the Edinburgh District Tramway Company, and were shown over the station by one of the assistant engineers. About an hour and a half was spent in a very thorough inspection of the machinery and equipment of this, the most important of the four Edinburgh cable power houses. The "pit" under the busy Tollcross junction was also inspected, and the operation of the gripper in changing from one cable to another was noted. The engine room, however, was the centre of interest. Three pairs of horizontal compound non-condensing engines are installed, with cylinders placed to work side by side. Each pair is of 500 h.-p., with a pressure of 160 lbs., and a speed of forty-five revolutions per minute. The high pressure cylinders are 23 ins. in diameter, the low pressure 40 ins., the stroke being 5 ft. Automatic variable cut-off admission valves are used on the high-pressure cylinders, the exhaust valves being of the Corliss type. In connection with the engines an ingenious provision has been made whereby the power can be increased should any extension of the tramways be made. By placing smaller-grooved pulleys on the main shaft, and increasing the speed to 65 revolutions, it will be possible to double the horse-power of each engine without increasing the speed of the cable, a point in which every engineer, who has to look to increased output at a future date, will be interested. The tension races for the cables also possess many features of interest.

The next visit will be to the McDonald Road Electric Lighting Station on the date to be subsequently fixed. —W. B. KIRKWOOD, Hon. Sec., 5, North Charlotte Street, Edinburgh.

Glasgow.—The monthly meeting of this branch was held in the Grand National Halls on January 8th, Mr. Rogers in the chair. After the minutes of the previous meeting had been read and adopted, and two new members had been admitted, the Secretary intimated that Mr. Pitman had kindly offered to send a complete set of ¼-h.-p. motor castings and sectional working drawings to the Society. Mr. Dunnett exhibited his patent rotary engine, which was much admired by the members. It was a compound rotary engine with high and low pressure cylinders; the valve motion has positive action through the medium of two cams—one for each cylinder—revolving with engine shaft. The Chairman called upon Mr. Dunnett to give a description of his engine, which he did in a very practical manner. Mr. Rogers proposed a vote of thanks to Mr. Dunnett, which was heartily seconded, and the meeting adjourned at 10 p.m. The next meeting will be held on February 5th. The Secretary would be glad if those who supply tools, castings, and fittings, etc., for model engineering would kindly send a copy of their catalogue. Full particulars of membership of this branch can be had from JOHN ROGERS, Hon. Sec., 79, Dundas Street, S.S., Glasgow.

An Inch Scale Model L.T. and S.R. Locomotive.

(*Continued from page 30.*)

HAVING completed the description of the arrangement of the engine proper, attention may now be given to the generator. The diameter of the boiler of the original engine is 4 ft. 6 ins., and outside the cleading a trifle short of 5 ft. When settling the outside diameter of the shell this latter figure was taken as the limiting dimension; the absence of telescopic rings, separate firebox sheet, butt strips, and other details which vary the diameter at different points in the length of a large locomotive boiler, enabled the model to have a barrel which is appreciably larger than the scale size. Allowing ⅛ in. all round for total thickness of cleading sheet and lagging, for which asbestos paper covered with a layer of flannel soaked in alum is suggested, the diameter of the barrel may be 4¾ ins. outside. The next item decided upon was the height of the crown of the firebox. This part needs careful consideration, as upon it depends, more or less, the success of the model.

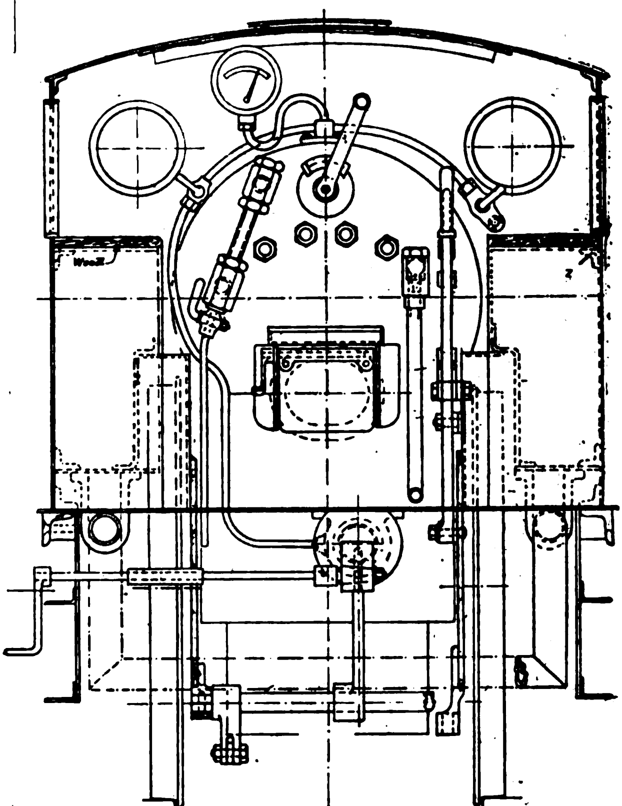
A model locomotive boiler in which the crown is high is a constant source of worry and bother. Sufficient range of water, necessary when running a model locomotive, cannot be given in such a boiler without priming on the one hand, or leaving the crown of the firebox high and dry on the other, to prevent which, at very frequent intervals, "pumping up" must be resorted to. However, the heating surface must not be reduced below a certain limit, and the designer finds himself between two stools; but he must not fail. The crown of the firebox in this model is placed about ⅝ in. above the centre line of the boiler, which is about ¼ in. less in scale dimensions than that given to the real. This, together with the ⅛ in. increased radius of barrel, gives about 1 13-16ths ins. of steam and water space, or some ⅜ in. more than could be allowed if the boiler were built in exact miniature. It must be noted what this ⅜ in. accomplishes. Calculating the number of cubic inches contained by a layer of water of this thickness in the boiler, it will be found, taking the speed to be seven miles per hour, and the consumption of water consequent upon this about 5 cubic ins. per minute, that the engine will be able to run continuously some six minutes longer without water than otherwise would be the case. About 1 in. seems to be the maximum range of water allowable with this engine, which at the above speed would enable the engine to cover just over a mile without water.

Turning to practical considerations of construction, the shell is bent up from one sheet of copper 1-16th in. thick. The longitudinal seam should be chain-riveted at ⅜ in. pitch, with copper rivets about 3-32nds in. diameter. The wrapper of the firebox will need to be pinched in to pass between the frames, which are 4 ins. apart. A clearance of 1-16th in. must be allowed at this point, which limits the width of the firebox to 3⅞ ins. It must be remembered that the two bottom rows of side stays will have to have countersunk heads. The back plate should be of same thickness of sheet copper, and be flanged over a block in the usual way. A firedoor may be arranged in the usual position; but this, it is stated, is not an absolute necessity. Such would be essential if the engine were ever to be fired by charcoal, and it is worth while arranging for use with oil fuel also. The door should have side cheeks, as shown, otherwise, when the door is slightly open, the heated gases will have an easier exit and make a dirty mess, to say nothing else, of the boiler fittings. The firehole would be found very useful when lighting the oil burners and the subsequent steam raising; until the steam blower was ready the firedoor could be opened wide, and a temporary sheet iron funnel, with a horizontal elbow at the bottom could be inserted. This funnel should issue through the roof of the cab, and would provide an easy means of getting rid of the products of combustion, which, until the boiler and the water contained therein are warmed, only sluggishly pass through small flue tubes. The firehole and door have another advantage, as a modicum of air may be allowed to pass in over the burners, and complete the combustion. This is an important point, as although the burners may not be smoking through insufficient oxygen being supplied, they will not, unless the full amount be given, burn in an efficient manner, and give out the heat they would do if working in the open air.

The inside firebox is shown on the drawings with the upper part swelled out so that the maximum number of tubes may be arranged. The crown is elliptical, and is stayed by a peculiar arrangement of girders and direct stays. The girders which are inside should first, after filing to a proper shape, be riveted and sweated to the firebox. They, or the firebox sheet, should then be correctly marked out and be drilled in the proper directions for a 5-32nds screwed stay. A special tap should be made, if those to hand will not do, which will pass right through the holes in the outside firebox, and screw the holes in the inside firebox in such a way that the stays will enter without trouble, and not force the holes or strip the threads, which would be their tendency if the thread was not tapped truly. It will be noted that the central stay of all has for its support at the head the safety-valve boiler seating. This should be turned up solid, and holes drilled around the stay bolt hole, to allow steam to pass by to the safety-valve columns. These stays are strong enough to take from two to three times the weight which would be placed upon them, which is ample, considering the resistance to collapse afforded to the crown by its shape and also by the girders.

The throat-plate is shown coming inside the barrel. This greatly simplifies the joint at the part of the shell where the firebox leaves the barrel. The front tubeplate of the boiler is a casting in gunmetal, and has flanges to take the barrel and the smokebox wrapper-plate. The barrel may be fixed to the tubeplate with ⅛-in. screwpins, which should be driven right home and afterwards well sweated with soft solder. It will be noted that the flue tubes have a slight rise of 3-32nds in., and when marking out the front tubeplate this must be taken into account. The branch for steam pipes should be screwed to face on tubeplate, with a little red lead as jointing material.

The tubes, nine of which are ⅜ in. outside diameter, the remaining two being ¼ in. outside, are best fixed in the firebox tubeplate, which should be made from *good* brass plate ⅛ in. in thickness, reduced at the lower part and flanges to 3-32nds in. by screwing. The firebox ends of the tube should be chased with a fine taper thread of about 19 to 32 threads to the inch, and the other end provided with a slot, so that, with a special screwdriver, the tubes may be screwed home tight. They may be either coated with some red lead preparatory to fixing or with tinning acid, the tubeplate having been tinned previously, before placing in position. With the latter method, the application of a blowlamp will thoroughly sweat the tubes to the plate. The screwing will effectually prevent the red lead or solder blowing out in event of the water being let down too low. The other ends of the tubes may be treated in various manners. The tubes may be cut nearly flush, riveted over and sweated, or may be simply fitted with a ring of wire or tubing driven on to the end and the whole well sweated, leaving a good fillet of soft solder around each tube. The rings mentioned allow of this being done more easily. Four longitudinal stays of phosphor bronze, 5-32nds in. in diameter, should be fitted to tie the front tubeplate and backplate together. Their exact position is shown on the drawings. Nothing need be further said about the firebox, except as regards the arrangement of the water-tubes. These are six in number, and are placed so that they will, with the help of a small plate attached to the tubeplate (*see* Longitudinal Section, The Model Engineer, p. 13, January 1st), form an excellent baffle for the flames. They are inclined, 3-16ths in., all in the same direction, and should be silver-soldered to the firebox. Stays, ⅛th in. diameter, of bronze should pass through them, the upper ones having wedge-shaped washers under the nuts. The ordinary firebox stays should have nuts on the inside only. All stays should be well sweated with soft solder after fixing. The smokebox

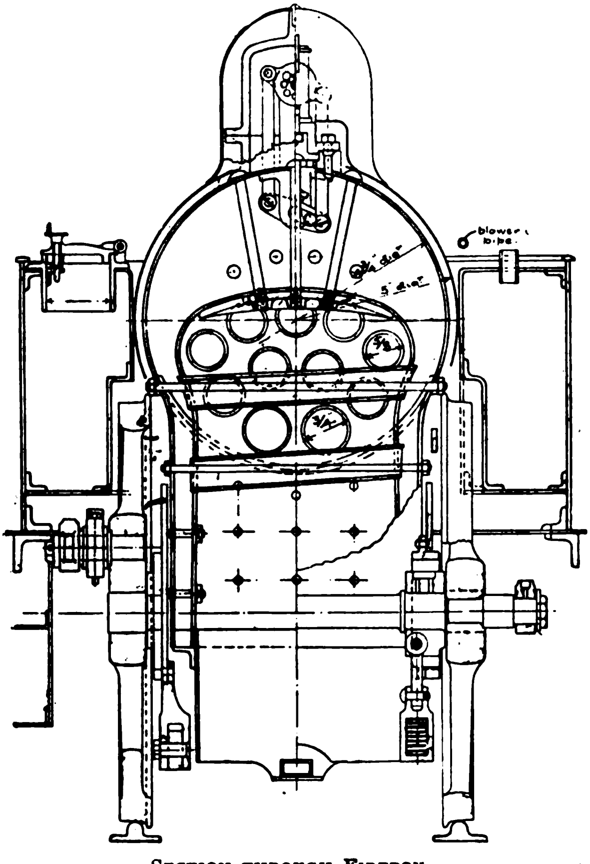


Boiler Mountings Inside the Cab.

presents little difficulty in construction, and needs no detailed description. The joints of the drag plate, front tubeplate and wrapper-plate should be carefully made, so that the smokebox shall be airtight. The front plate of smokebox should be countersunk screwed to an angle riveted to the wrapper, a red lead joint being used. The door and handles are of an orthodox pattern.

The regulator in dome is of the "Pearce" type, the regulator rod being of bronze, and requiring to be set off over firebox, so that it may clear the central stays. The dome needs no special reference; for the outer dome a casting is supplied.

The side tanks and cab require a little forethought before proceeding to the construction. To reduce the difficulty of handling a large sheet of awkward shape, the side tank and cab side sheets should be out of one piece. The joint with the back tank should be at the rearmost handrail a butt joint, with a thick strip behind, in a line with the top of the back tank. The section of the side tanks can be obtained readily from the drawings; the recesses for the driving and coupled wheels should be noted, and extra splashers to hide the trailing wheels in the cab will have to be provided. To the right-hand one of the latter the rack for the reversing lever is attached. The reversing rod has also to be set here, so that it will clear the splasher. To affix the tanks, which should, when communication pipe, &c., are cut adrift, be able to be lifted with the cab bodily from the frames, stout angle



SECTION THROUGH FIREBOX.

brass should be riveted at the bottom of the side sheets, so that the screws may be driven upward through the angle edging into them.

In the real engine the back tank is provided with water as well as coal space. This could not have been arranged in the model without some trouble being necessitated when erecting the engine; and to enable the oil tank to be made as capacious as possible, the water space at this part was dispensed with. The two side tanks are connected by a ½ in. brass pipe, which joins the side tank by a special cast junction screwed by two set-screws to the underside of tanks. The pipe is hidden by the angle edging, and is elbowed behind the step plate turning vertical. At a convenient place it is elbowed again transversely to the frames, and on the opposite the joints are again repeated until it connects with the opposite tank. The pipe may be made from one piece, cutting at the proper points right-angled wedge-shaped pieces from the pipe, and filing until it is nearly severed. The tube should be soft, when it may be then bent to form the elbow and the joint easily silver soldered. If the tube were severed some difficulty would be experienced in keeping its position when soldering. A short branch of 5-16ths in. pipe should be inserted in the communication pipe under the footplate, as shewn with a union at the end, and a pipe from the suction valve of pump can then be connected to it. The pump, of a well-known type, is a very good and reliable one, and the position has been found in practice to be very convenient.

The oil fuel fittings are arranged in a usual way for model locomotives. The tank should contain enough oil for over an hour's run. One No. 5 burner may be used; but although there is some little difficulty in getting at two, owing to the equaliser and brake hangers, their use will give the best results, as, besides increasing the amount of fire, they spread it more evenly over the firebox. Two 3 in. (No. 5) might be arranged instead of the two No. 4 (2½ ins.) with a little ingenuity if a smart performance is aimed at. They will require a little pinching in, and, it is suggested, may, to accomplish this end in a workmanlike manner, be placed in the lathe and have the flame-spreading flanges spun in a little so that they appear like a tulip; this, however, must not be carried to any great extent, or the efficiency of the burner will not be enhanced. Another trifling adjustment may have to be made to enable the burners to work at their best, and that is the height of the blast pipe and blower. The blast pipe is shown at its maximum height on the drawings, and may require lowering a little when testing-time arrives. Some ½ in. may be taken off if necessary. With the blast-pipe the blower should be also lowered. The drawings are reproduced one-third full size.

The Photographic and Optical Trades' Exhibition.

THE following particulars of the forthcoming Photographic and Optical Trades' Exhibition will interest many of our readers. The exhibition will be held in the Spring of 1902, from April 11th to April 19th inclusive, in the Portman Rooms, Baker Street, W. A section will be devoted to the optical trade, and further details can be had from the Secretary, Mr. Arthur C. Brookes, Harp Alley, Farringdon Street, London, E.C.

To Remove Verdigris from Brass and Copper.—In an earthenware jar pour 1 part commercial sulphuric acid and 2 parts commercial nitric acid. Dip the articles into the mixture, and immediately wash in clear water; then rub in sawdust. The metal is polished bright by this process. If the metal is greasy, wash previously in a solution of caustic potash in hot water. It is best to perform this operation out of doors, as the fumes are poisonous.—*Jewelers' Review.*

Marking Out.—Instead of using chalk on steel or iron when marking out, try bluestone (copper sulphate). Wet the part you wish to mark (taking care not to grease it) and rub the bluestone over this; it will leave it a copper-coloured film, which shows the scriber marks up well. Of course, this is no use for rough castings.—A. ASTON.

Motor Cycles and How to Construct Them.

By T. H. Hawley.

(Continued from page 33.)

XVI.—Motor Manipulation (*continued*).

We may now proceed to investigate the causes of stoppage, and in the first place it may be said that in the absence of overheating through hard driving, the principal causes will be traceable to some fault in the *contact breaker* or the *ignition plug*, though, of course, the *carburation* must always be accounted the prime factor, and before searching elsewhere, it should be decided whether the carburation is at fault, and if the motor should slow up in running, a slight movement to and fro of the mixture lever will quickly tell whether the fault lies in this direction, for if it does, the motor will instantly alter its speed in one direction or the other; but if no change in the carburation has the desired effect, then the petrol should be first investigated, and it may save further loss of time to take the specific gravity by means of the densimeter—an instrument which can be purchased for a shilling or so.

If the reading is ·680, or near it, then the petrol is not at fault; but if the specific gravity has dropped to ·700 the petrol is accounted "stale," and although it may be made to work at this specific gravity in warm weather or by coaxing, it is quite likely that this alone might cause non-working, in which case—if a reserve supply tank is fitted—the old petrol should be run off and the carburettor re-filled with "fresh" petrol; failing this, the only remedy is to shake up the stale petrol by working the tube J of the carburettor quickly up and down, and, if possible, add a little new petrol to assist starting, though it should be noted that fresh and stale petrol will not thoroughly mix, as the fresh or lighter spirit will come to the top and be used up first; but by the time this had occurred the heating properties of the coil passing from the engine exhaust through the carburettor would probably have the effect of vapourising the stale petrol.

Failing faulty carburation, the ignition system must next be investigated, and this may be divided into three sections—(1) the battery, (2) the contact-breaker, (3) the sparking plug. The induction coil I have not included, as it will rarely give trouble if originally well made, except in extremely wet weather, or when loaded with wet mud.

In order of probability the contact-breaker should first be inspected, though the rider's knowledge of his battery will be a guide as to where to start, and, assuming that there is no reason to suspect the battery, the fault will, in almost every case, rest between the contact-breaker and the sparking plug.

Fig. 79 shows the complete De Dion contact-breaker and advance spark device, with the outer cover removed. The current from the induction coil primary enters by terminal M, which is electrically connected with the pillar Q carrying the contact screw B, the circuit being completed when the platinum tipped end of B comes in contact with the platinum-tipped surface of the trembler T, leading the current away by the pillar P and the terminal N, which is earthed to the body of the motor. R is a locking screw for holding the contact screw B in position after adjustment, and S is a screw attaching the trembler blade T to the pillar P, whilst C is the cam mounted on the half-speed or two-to-one shaft of the motor. The action of the contact-breaker is as follows: When the shoe on the trembler T falls into the notch in the cam C as shown, contact is temporarily made between B and T, and so the battery current finds a closed circuit through the primary of the induction coil, and during this period a spark should be produced at the ignition plug points, though, theoretically, this contact-breaker, when properly adjusted, should produce a stream of sparks by reason of the vibratory action of the spring blade. Much doubt exists, however, as to whether this repetition spark ever really occurs, and also as to its value if it does, for it is clear that one spark well defined will explode the charge, and added to this doubt is the fact that few users of the device appreciate the necessity for the fine adjustment called for to ensure the vibratory action, or at any rate do not make such adjustment.

The trembler blade will sometimes snap off at the junction with the pillar P, or the shoe end may break away from the blade, either occurrence being easily detected and comparatively rare, the most common fault being in the adjustment or in the fouling by corrosion of the contact surfaces.

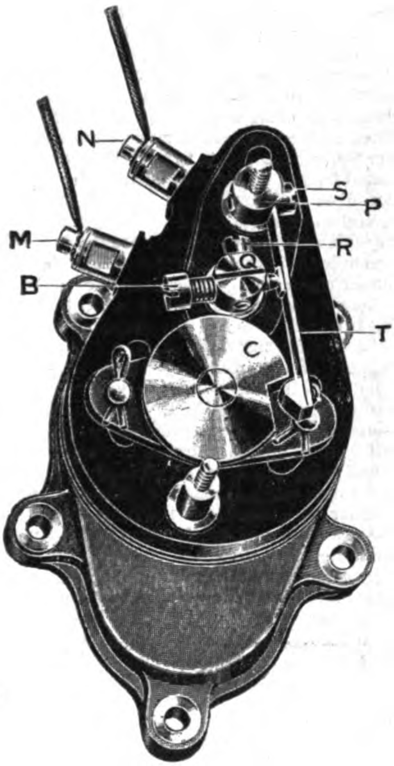


Fig. 79.—De Dion Contact-Breaker and Advance Sparking Device.

To make the adjustment, the cam should be moved to the position shown in the illustration, and the trembler shoe, when clear of the pressure of the contact screw, should sit about half-way down the notch of the cam, as shown.

The setscrew B should then be fed up until it is seen to *just move* the trembler blade T, thus making contact and closing the primary circuit; further revolution of the cam C will separate the contact points, and the circuit will remain open until the trembler shoe again falls into the notch in the cam.

It is usual to test the working of the spring trembler by giving it a sharp lift with the finger end, and noticing whether sparks are produced at the sparking plug, or the same test is applied to prove the spark producing powers of the plug; but it is obvious that in the case of the contact-breaker this test is not reliable, for the motion thus imparted to the blade is more vigorous than in ordinary working, and it is better to move the cam by pushing the machine and note whether a spark is produced when contact is broken.

The contact-breaker is subject to many minor disorders of an insidious nature, which may be briefly referred to. The gripping screw Q will sometimes fail to perform its duty, thus allowing the setscrew B to work out of adjustment; the wear of the platinum surfaces by continual pounding together will upset fine adjustment by failing to make contact; the piece of platinum on the trembler blade is riveted and then soldered, and the solder occasionally breaks away, causing a loosening of the platinum with consequent imperfect contact and corrosion; too much battery current or imperfect coil construction may cause sparking between the contact screw and the trembler with consequent burning away, corrosion, or imperfect contact; in replacing new contact blades or screws, the platinum surfaces may not coincide, in which case the unprotected surface of steel would be quickly burnt away or corroded; in all cases of renewal of the trembler blade it is necessary to make a fresh adjustment of the contact screw, because the slightest variation from a straight line will cause the contact points to be brought closer together or separated further apart; oil may leak through from the crank chamber and get to the contact points, become charred, and so form imperfect contact.

Faults which are more apparent are the breaking away of the eyes or loops of the conducting wires at M and N, and other similar connections throughout the electric circuit, though these breakages are at times rather troublesome to discover, because, although the stranded wire may be severed, and either imperfect or no contact is made, the outer support of the insulating material holds up the broken loop, so that it is necessary to test for this by touch rather than by sight. In adjusting this type of contact-breaker, some drivers prefer to ignore the vibratory theory altogether, and so screw up the adjusting screw B another half turn, simply making certain of definite contact and a single spark, though in this case the contact-breaker under discussion is not the best form to adopt, for a commutator form with brush contact and wiping action would be more satisfactory.

If in the event of interruption of working, and after a cursory examination of the contact-breaker has failed to disclose the cause, the sparking plug should next be examined; indeed, the sparking plug being the terminal point of the electrical system, it may be said that in most cases where no special symptoms are shown, that it is best to commence with the plug and trace the faults backward, though the mere fact of obtaining a spark at the plug with the machine at a standstill by no means proves that either plug or contact-breaker are in proper order, for we have already seen how hand vibration of the trembling blade of the contact-breaker may prove misleading; and the spark plug may be equally so by reason of the fact that if the cement fixing the platinum wire to the porcelain body of the plug becomes cracked or works loose, then, although a spark may be produced with the machine at rest, the vibration of the machine when running may, by reason of the broken cement, cause a variation in the distance apart of the plug terminals sufficient to cause misfire.

Lubrication of the motor cylinder and crank chamber is of the utmost importance, not only in the matter of regular application, but especially in regard to the nature and quality of the oil used, the high temperature attained in small air-cooled motors being such that all ordinary oils are quickly burnt up into a charred mass, which not only leaves the piston and the other working parts dry and unlubricated, but otherwise seriously affects the working by deposits formed on the valves, etc.

A lengthy experience of various lubricants prompts me to specially emphasise the importance of obtaining absolutely the best cylinder oil for the purpose, regardless of cost, for in many cases I have found a distressed motor to suddenly revive with a dose of the right oil in most magical manner. If asked what was the *best* oil, I should answer that although there may be other oils equally good, it would be best policy to go for a tested article which is certainly not to be beaten, and this is a French oil known as "Huile D," specially prepared for the De Dion machines, and procurable from the United Motor Industries, of Holborn Viaduct, E.C., costing in bulk about 4s. or less per gallon, or in small tins at the rate of about 6s. per gallon.

This oil can be burnt up only at extremely high temperatures; it increases compression, and, being very thick, does not become sufficiently liquid to pass through the valves to burn in the silencer.

For lubricating the gear box enclosing the engine pinion and driving gear, a paste will answer much better than any oil, and I have found the most successful lubricant for this and the differential gear to be a mixture of fine graphite powder (Dixon's) with Russian tallow and benzoline or paraffin. It is prepared by melting the tallow over a Bunsen burner, and stirring into this the graphite, which has previously been made into a thin paste by mixing with paraffin, until the resulting mixture is of the consistency of very thick cream, and the lower part of the gear-box should be fully charged with this.

A chapter on motor manipulation would be incomplete without some reference to tyres, and whether dealing with a motor tricycle or a full-sized car, it may be said at once that the motor pneumatic tyre is the least satisfactory item, from the user's point of view, of the whole machine equipment, and the most expensive in removal.

If the tyres are to be made to do good service they must be watched at every turn and humoured in every way possible, especially on starting; for if the mixture be wrong, or the advance lever in the wrong position, the sudden jerks at starting will be ruinous to the best of tyres, and especially pronounced where the rubber outer cover is merely solutioned to the fabric. The balance gear or differential should also be watched in this connection; for unless the gear is working well, there is an unequal tension on the rubber surface, which tends to tear it away from the foundation, and also increases the liability to sideslip with difficulty in steering. The tyres selected should be of the interwoven or "Palmer" fabric type, as no solution on rubber will stick very long; immediately a cut in the outer cover is observed it should be cleansed with petrol, dosed with solution, or the new Westwood cover stopping, which is self-vulcanising in a few moments, but is preferably allowed a rest of six hours or so.

The equipment of the tool bag of a motor tricycle, or any motor vehicle, is quite an elaborate affair compared with the ordinary cycle kit. It should contain the following:

A spare exhaust valve, complete with spring and washer, and with the valve already ground in a fit to the motor.

A complete inlet valve and seating, with spring, etc., at least one spare ignition plug (examined and tested). A densimeter, an ampère meter (reading to 10 ampères), a few odd lengths of insulated flexible wire, and some bare copper wire, about 16 gauge (the latter being for beating out into washers, &c.). Some ordinary solution and general tyre outfit, with outer cover stopping; some stout brown tape for binding up badly damaged tyres, some emery flour or "Wellington" knife polish for grinding in valves, some gutta-percha tissue or rubber strips for wrapping terminals, a large can of lubricating oil, another can of petrol, some spare nuts, screws, and washers, a few wiping cloths, a tyre remover or two, and if the machine is not fitted with a reserve lubricating tank, about a pint can of best engine oil, with a regulation dose measure.

Of actual tools, a small and large screwdriver, two sizes of adjustable spanners, a pair of cutting pliers, scissors, knife, small smooth file, a pair of parallel jaw pliers, and special box and pin spanners to fit intricate parts will all be required at one time and another.

A piece of emery cloth, some cotton waste, asbestos twine or cord, and perhaps a small tin can of graphite paste and another of vaseline will fairly cover ordinary requirements.

On short runs, of course, the bulk of the articles mentioned may be left at home; but the above list is given as a fairly complete tourist outfit, which will enable the rider to tackle most of the small things which are likely to go wrong.

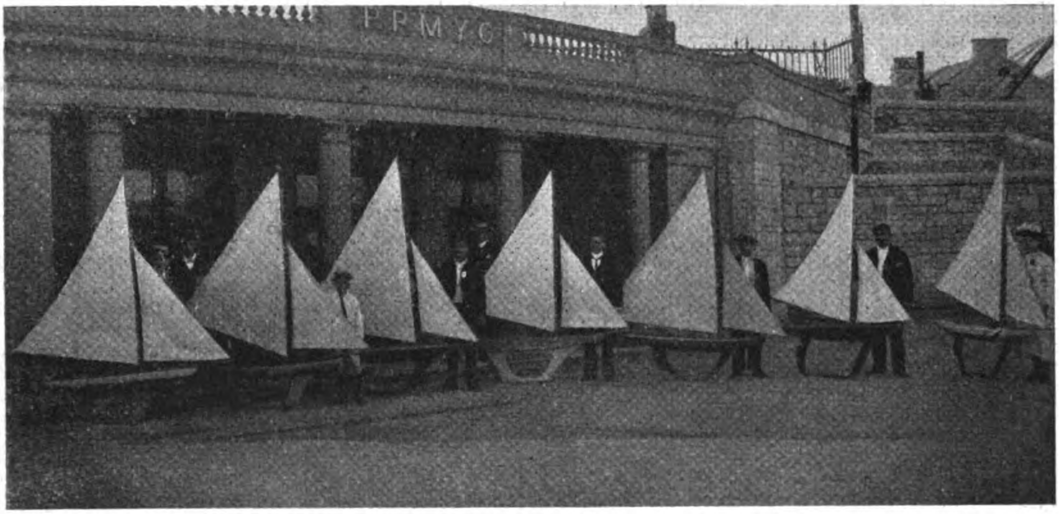
(To be continued.)

The third is the *Ailsa* (owned by Mr. W. Vickers)—Length O.A. 69 ins., L.W.L. 47 ins., beam 16½ ins., draught 15 ins. Is a very good all-round boat, having won two silver cups, presented by Sir J. Jackson, and several other prizes.

The fourth, the *Trixie* (owned by myself)—Length O.A. 66 ins., L.W.L. 49 ins., beam 15 ½ins., draught 16 ins. (carrying 17 lbs. of lead). She is a different form from any of the others, having an angle bilge (or better known as the *Sharpie* type), and is an exceptionally good boat in choppy seas, which are frequent in Plymouth Sound.

The fifth is the *Terrier* (owned by Mr. G. Saunders)—Beam 17 ins., draught 16 ins. A peculiarly shaped boat, having a round bilge from aft to mast, then forming into a box-shaped bow; she is a very fast boat off the wind in smooth water, and is the winner of the West of England Challenge Cup, sailed for at Brixham, the *Ailsa* running her very closely, being only a few seconds behind. Twelve boats competed in this race, each of the following clubs sending three boats—viz., Brixham, Dartmouth, Fowey, and Plymouth.

The sixth boat is the *Fern* (owned by Mr. W. Pool, standing behind the boat)—Beam 17 ins., draught 15 ins.



A few of the Boats of the Port of Plymouth Model Yacht Club.

She is nearer the model of the actual racing yacht than the others, having more rise of floor and more rocker or reel; is a good boat, but, being a little tricky, has not been sailed as she should have been, and is one of the oldest 20-raters of the club.

The seventh (extreme left-hand) boat is the *Britisher* (owned by Mr. G. Swiggs), with 10-in. beam, L.W.L. 50 ins. This was a pretty little keel boat at first, but making too much leeway, was fitted with a fin and bulb, which improved her somewhat.

Our beautiful little club rooms, of which we are very proud, form the background. They are very conveniently situated on the West Hoe, its frontage facing The Sound, with a boat camber on the left and only about 50 ft. from the water.

In concluding, I may say that we sail under the Y.R.A. 6000 Rule (scale: 1 in. to 1 ft.), and that with one exception the models are built and sailed by their owners.
—Yours truly, C. G. Ferguson, Hon. Sec.
17, Herbert Place, Morice Town, Devonport.

Model Yachting Correspondence.

The Port of Plymouth Model Yacht Club.

To the Editor of *The Model Engineer*.

Dear Sir,—The illustration on this page shows a group of some of the members of the Port of Plymouth Model Yacht Club, together with their boats, taken in front of the clubhouse. A few details of the boats will be of interest.

Starting from the right hand corner, the first boat is the *Magpie* (owned by Mr. Mitchelmore)—L.W.L. 47 ins., beam 16½ ins., draught 18 ins. She has not sailed in many races, owing to her owner being away most of the racing season, but has given a very good account of herself when racing.

The second boat is the *Althea* (owned by Mr. J. Hodge), of very light displacement—Long W.L., 18 ins. beam, 18 ins. draught, with 12 lb. of lead. A fine weather boat.

Automatic Electric Signalling.

THE directors of the North Eastern Railway, says the *Mechanical Engineer*, have just placed an order with the Hall Signal Company, New York, for the installation on the main line of the North Eastern Railway, near York, of the electric automatic track circuit block signal system. This system, it may be stated, is designed to enable the services of signalmen to be dispensed with, except at points of junction. It is purely automatic, and is operated by electricity by means of connections set up by the trains themselves. When a train has passed a signal, the electric current is diverted from an electro-magnet in the signal case, so that the signal automatically falls to "danger" through the force of gravity, and there it remains so long as a pair of wheels are on the track. For the automatic signalling, it is claimed that it presents the "block" system in perfection, without the risk of human error. In addition to reducing the wages bill, by the abolition of many of the "intermediate" cabins, it is maintained that the adoption of the system is calculated to increase the carrying capacity of a railway by enabling the block sections to be shortened without the expense of erecting and "manning" additional signal boxes. Another and very important feature of the system is that the apparatus is not affected by changes in the temperature, and is not liable to get out of order. It is calculated that no less than ninety-one trains can be worked over one track in the course of an hour.

It appears to us, however, that the value of having men stationed at frequent intervals along a railway, should not be overlooked, since breakdowns of the most trifling character may be much more annoying when communication can only be had at considerable distance.

A Sparking Dynamo for Gas-Engine Service.

ALTHOUGH the majority of dynamos and motors of recent design are of the circular-yoke type, with radial poles, the Manchester type of field-magnet has many points of merit, particularly in machines designed for amateur construction. The patterns are more easily made, and although there is more actual machine work to be done, it is of a character more easily performed than that on the circular-yoke type, taking into consideration the facilities possessed by most amateurs for this sort of work. An interesting little machine of this type has recently been built by Mr. B. F. M. Weaver, of Wilmington, Del., and is illustrated herewith. We are indebted to our contemporary, the *American Electrician*, for this description.

Fig. 1 is a partly sectional side elevation of the field-magnet frame, base and journal pedestals; the dimensions are all indicated on the sketch. Fig. 2 is a transverse sectional view of the field-magnet pole pieces and the wood base. The magnet pole-pieces were made of a good grade of cast-iron, and the magnet cores consist of ordinary ⅝-in. wrought-iron bolts, machined just enough to make them fit snugly in the holes of the pole-piece flanges. The distance from centre to centre of the magnet cores is 6 ins. There are no shoulders on the magnet cores, the pole-pieces being held apart by the magnet coil spools, which may be made of either composition-metal, or cast-iron. These spools are each 3 ins. long over all, and the barrel is bored out to fit the magnet core snugly. The outside of the barrel is turned down to 1⅛ ins. diameter. The heads of the spools are 2⅜ ins. in diameter.

Fig. 5 is a sketch of the armature, commutator, shaft, and pulley. The armature core is of the usual laminated

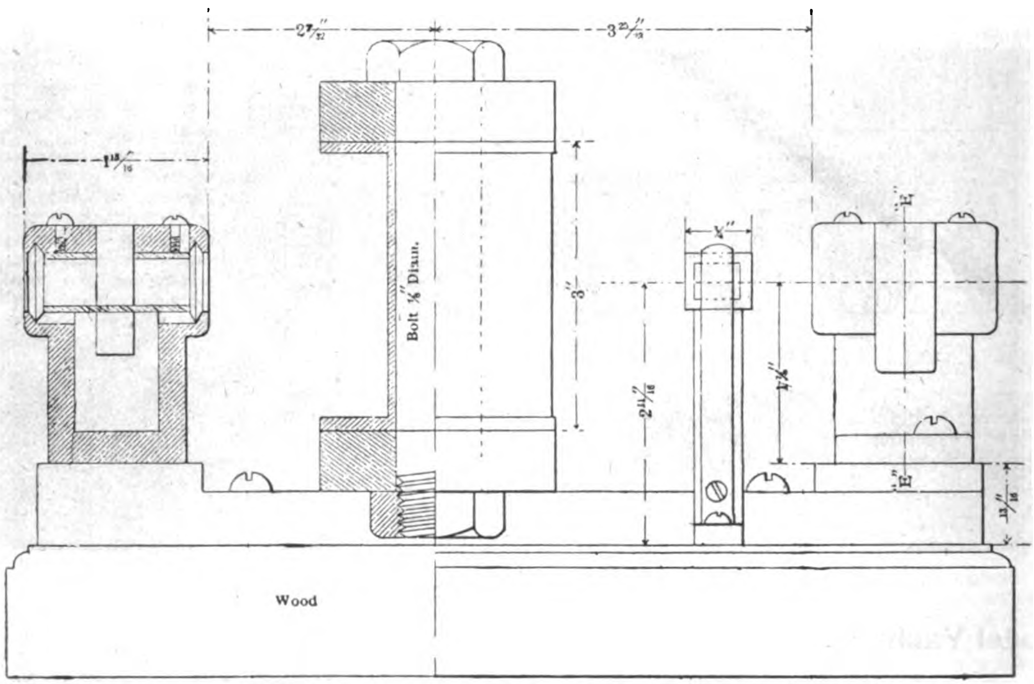


FIG. 1.—A SPARKING DYNAMO FOR GAS ENGINE SERVICE. (Semi-sectional Side Elevation.)

type, made of discs 2⅝ ins. in diameter, and of the shape shown by Fig. 4. The coil holes in the armature disc are 5-16ths ins. in diameter, and flared out toward the periphery of the disc, so as to leave a communicating slot through the edge to each hole. It will be noticed that the central hole in the armature disc, which is ⅝ in. in diameter, is not a complete circle, but is flattened on one side in order to form a feather for communicating positively the rotation of the shaft to the discs. The shaft has a corresponding flatted side, of course, so as to fit snugly in the central hole of the disc. The discs are clamped between two brass flanged collars, the flanged

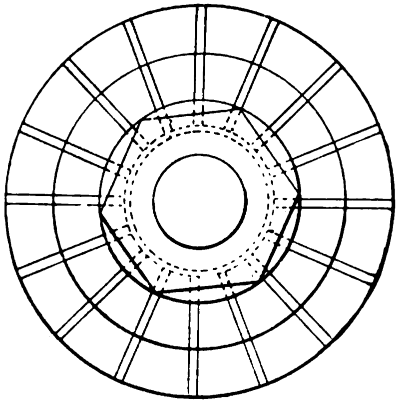


Fig. 3.—End of Commutator

portion of the collars being 1¾ ins. in diameter, and the barrel 1 in. These are screwed on the shaft, as shown in Fig. 5, and one of them is provided with an additional outer flange, which serves to prevent oil from finding its way over to the armature core, should any of it creep out

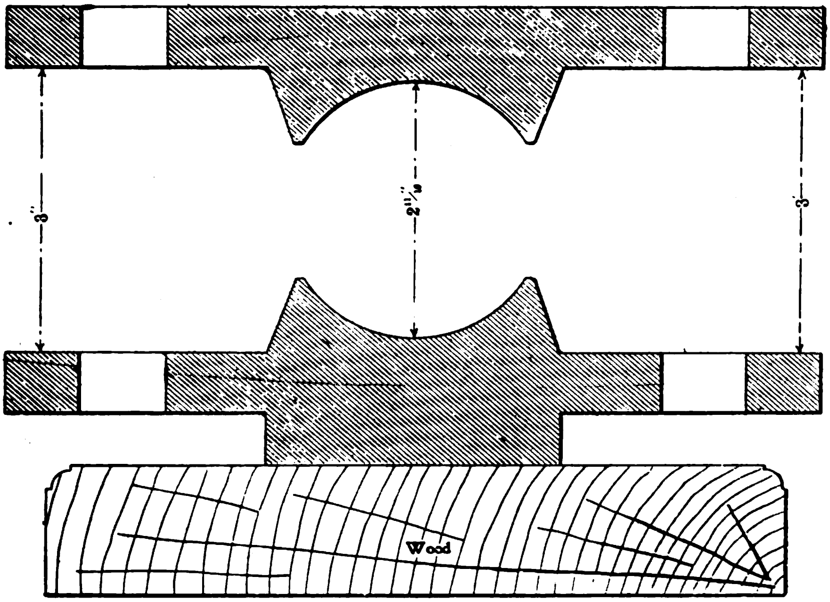


Fig. 2.—Transverse Section of Field-magnet Yokes and Pole-pieces.

along the shaft. The magnetic portion of the armature core is 2¼ ins. long, and the length over all, including clamping collars, is 4⅜ ins.

The pulley is of brass, cast with a solid central web instead of spokes, on account of the smallness of its diameter. It is 2½ ins. in diameter and 1⅛ ins. wide on the face.

The commutator is of the usual type, with the segments bevelled at each end for drawing together. The segment is undercut at only one end, however, where the connecting lug extends over the rear bevelled collar. The clamping collar at the front end of the commutator fits smoothly over the core, but is not threaded; it is forced into place by an auxiliary nut on the core back of it. Fig. 3 is a front view of the commutator, which is 1½ ins. in diameter at the brush tread by ¾ in. axial length, and 2 ins. in diameter over the connecting lugs, which are 5-16ths in. thick axially.

The brush holders, one of which is shown in Fig. 7, are very simple in construction, consisting of a brass standard carrying at its upper end a rectangular box for the carbon brush and provided with a flat phosphor bronze or brass spring screwed

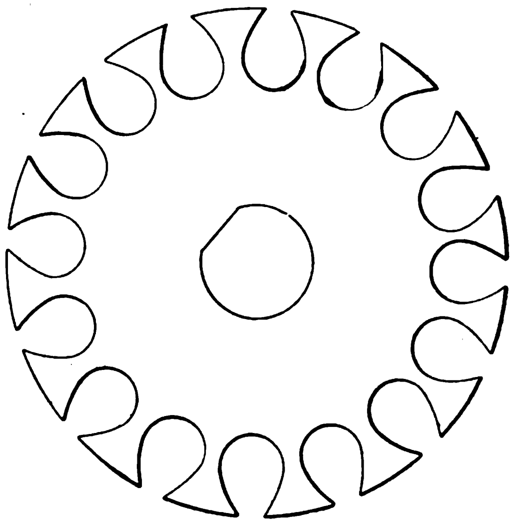


Fig. 4.—Armature Disc.

to the standard near its base and bent to such a shape as to enable the upper end to press against the back end of the brush. The brushes are ⅛ in. wide, 7-16ths in. thick, and 1 in. long.

The journal pedestals are clearly shown in Fig. 1 and by Fig. 6. They are of the self-oiling pattern, having oil rings 1 in. in diameter outside and 13-16ths in. diameter inside; they are ¼ in. wide parallel with the shaft. The oil reservoir is made with parallel sides above the centre in order to facilitate the construction of the box by amateurs. The width is 11-16ths in. transversely and ⅞ in. axially. The boxes are provided with bushings of ½-in. bore and ⅝-in. outer diameter; they are 1½ ins. long each. These bushings are held in place by small machine screws set into the top of the journal box casting.

The machine has been built with two armature windings, one for 14 volts and 3 ampères, and the other for 32 volts and 1¼ ampères. The 14-volt winding consists of sixteen coils of No. 20 double cotton-covered magnet wire, each coil containing sixteen turns of wire. The armature winding for 32 volts consists of sixteen coils of No. 22 wire, each coil containing forty turns of wire. Each field-coil contains twenty-six layers of No. 25 double cotton-covered wire, each layer containing ninety-two turns, so that there are 2,392 turns of wire on each coil. The two field-coils are connected in multiple when used in connection with the 14-volt armature, and in series when used with the 32-volt armature, the fields being connected in shunt with the armature.

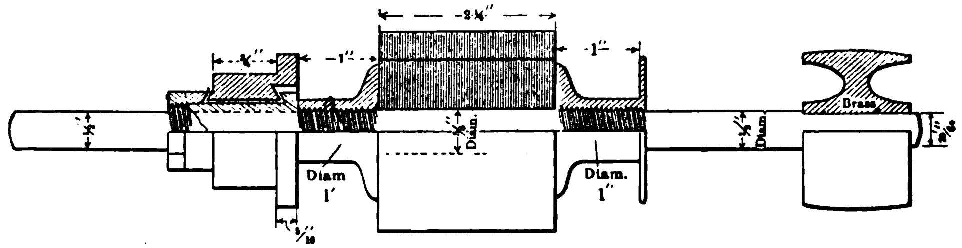


Fig. 5.—Armature, Shaft, Commutator and Pulley.

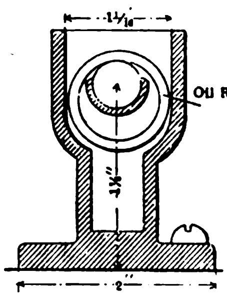


Fig. 6.

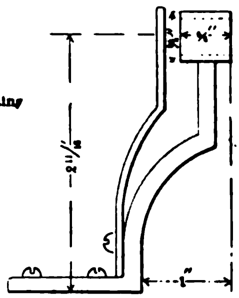


Fig. 7.

The speed of the machine for 14 volts is 2,400 revolutions per minute; for 32 volts it can run a trifle slower than this. Fig. 8 shows the completed machine, as built by Mr. Weaver, with a socket for a pilot lamp on the terminal board. This machine is of the simplest possible construction, consistent with practical results, all of the fitting, with the exception of that on the brush-holders, consisting of plain lathe work.

The present comparative cost in America for *equal volumes* of the following metals are:—Aluminium (⅓ lb.) 11 cents; brass (1 lb.) 15 cents; copper (1 lb.) 17 cents; tin 30 cents. Thirty firms in the U.S.A., about forty-five in Europe, and several in Australia, are already using aluminium for lithographic printing, chiefly on rotary presses. Leaf of about 1·70,000th in. thickness is largely replacing silver in decorative work.—*Lightning*.

Metal Finding by Electricity.

THE possibility of discovering metallic lodes in this way, recalling one of the attributes assigned to the divining rod, has long been foreshadowed, and something similar was actually accomplished on a small scale by Hughes's induction balance. It seems now to be in course of practical application in America. The Electric Metal Locating Company originates from Chicago, and has a powerful board. According to the *Western Electrician*, the president of the company has just returned from Northern Idaho and Oregon, where five gold locations have been made by the method and proved by excavation. The deepest work done with the method up to this time has been 600 ft., but it is hoped that even greater depths may be tested for metal. The above journal, of November 16th, gives a description of the process, with a photograph of a field party, and a plan of resistances showing the situation of a lode. Two suitable steel rods are driven into the earth and their upper ends connected by a wire with a set of dry batteries in circuit, so that a current passes along the wire and returns through the ground. The electrodes are moved regularly over a given area, and the resistances from point to point measured by a Wheatstone bridge and coils and plotted. It is necessary that the length of wire should be more than twice the depth to be surveyed: a coil of 3000 ft. has easily been managed. Examples given are: normal earth resistances, ohms 10,000, 54,000, 15,000, 20,000; resistances over metal veins 800, 56 (copper, near surface), 1000, 1,100 respectively. Questions not touched upon are (1) as to the relative value of the discoveries when made, as lead, zinc, copper, iron and gold, some of them poor ores, are mentioned to have been alike indicated; (2) whether, considering the varying resistances of these ores, any conclusion can be come to as to the depth.

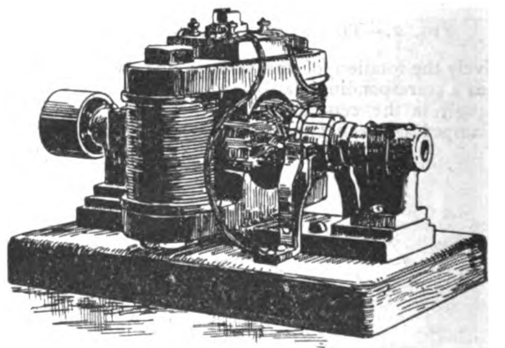


Fig. 8.—The Complete Machine.

Tools for Small Engineering Work.

By W. H. Dearden.

(*Continued from page 4.*)

THE Pin Drill is so called because it has a turned pin or guide projecting below the cutting edges, which, in this case, are flat, or at right angles with the drill. This form of drill is used when holes are required of considerable diameter, a small or leading hole being drilled accurately first, so that the turned pin just fits it freely, the hole being then enlarged to the required size by means of the flat cutting edges. They may also be used where it is desirable to recess a piece of metal—to take, for instance, a cheese-headed screw, or to let a nut in flush with the face. If a hole is required a dead size, you will find it advisable to try your drill when it is ready for use in a similar piece of metal in order to test the size of it. To ensure a drill running true through a piece of metal, first drill a small hole, say about ⅛ in., not forgetting to turn the job about while drilling it, so as to allow for any inequalities of the face upon which it is laying; then follow with the required size. In drilling tapping holes, it should be borne in mind that the metal swells in tapping, and therefore the holes must not be too small, or you will have trouble in tapping, especially in cast iron, when they should be drilled a trifle large, or the thread will break away. In addition to the aforesaid drills, I might mention the Countersink Drill, of which there are several kinds, some of which may be seen among the tools I have brought with me, including also samples of each of the drills I have described, which will be better understood when seen. In drilling small holes, which especially applies to model work, the drills should be run at a high speed, and, where possible, get machine power (small lathe or drilling machine), for the process of drilling metal by hand is a tedious one, because it is impossible to give the proper cutting speed to the edges on account of the small diameter of the circle upon which the edge operates. The angles of the cutting edges of a drill should be about 110 degs., and for a countersink for general work 80 degs. to 90 degs. After a hole has been drilled, its sides frequently require smoothing, or it may have to be made a little larger. For these purposes rimers or broaches are the tools generally used, their forms, as also their sizes, varying according to the purpose for which they are required. Of the various forms, the half-round and three fluted are about the most effective, and are more favourably placed for cutting rather than scraping.

In using rimers of this kind, a very little downward pressure is required, for their fine tapered form in this case constitutes the true feeding pressure. For a guide as to amount of taper, I should recommend ¼ in. to 1 ft. Another kind of rimer is made by filing a series of flats upon a piece of round steel, varying in number according to size, it being always advisable to use three, five, or seven flats, and not an even number, because they do not cut so well. For leaving a hole parallel instead of making it taper, rimers are often made of equal diameter for the greater part of their length, the whole of the cutting being then done by the tapered extremity with which they are provided, the upper portion serving as a guide, and so making the hole parallel. Rimers are made on a large scale, and used, for instance, in locomotive work, where the strap of the connecting-rod is fastened on by bolts, these holes being "rimered" out taper and accurately turned bolts made to fit and then driven home tight, and so securing the straps to the rod.

Now with regard to Taps. If a rimer be made from a piece of steel on whose surface a screw-thread has been cut, it is evident that if its advance at each revolution be equal to the pitch of the screw, it will produce a thread in the hole through which it is passed. Internal screws or threads are produced by screw-taps exactly on this principle.

The old method of making taps consisted of a tapered screw of hardened steel, upon whose surface a number of flats had been filed; but the obtuse angles which they presented were quite incapable of cutting, and could only remove the metal by a scraping action; under the most favourable circumstances, the process was a slow one, the tap having to be worked backward and forward considerably, as each advance was made, the thread only being perfect when the entire screwed portion of the tap had passed through the hole. Considerable force was necessary to cause the tap to advance at all, and great difficulty experienced in starting a thread. A small tap may sometimes be made in this way, but its efficiency will not be so great as it otherwise would be if properly fluted; in short, a tap is like a rimer, and will be found much effective if fluted instead of flats thereon. If flats are filed, they should be three in number, and the thread backed off behind the cutting edges for clearance. A set of Taps should consist of three—*viz.*, a Taper Tap, an Intermediate or Second Tap, and a Plug Tap. The threads upon the taps themselves are cut parallel throughout, the top of the thread being removed in the taper tap for nearly the whole distance up, and in the second for a short distance only, so that the end of the taper tap enters the hole when drilled, thus allowing it gradually to start a thread. This is followed until completed by the second and plug tap, the plug having a full thread on its entire length. Where possible the threads upon taps should always be cut in the lathe, thereby obtaining a correct form of thread, and producing a better tool when finished. In milling taps, the flute should be cut so as to allow the face of the cutting edge to come lineable across the centre of the tap in section. The surface of metal remaining after the tap is milled, should be considerably less than that portion which has been taken away, otherwise the tap will have too great a bearing surface, and bind, instead of cutting. When the tap is milled, great care should be taken in filing it up, so as not to interfere in any way with the shape of the thread. Each thread should be backed off both top and bottom to within reasonable distance of the cutting edges, otherwise it will have a tendency to cut or drag when being withdrawn from a hole. On carefully examining any well-made taps, it will be seen that the threads (more especially in taper taps, by which the greater bulk of the work is done) are filed off to a much greater extent upon their following than upon the cutting edges. Like rimers of similar section, they can only be cut whilst revolving in one direction, and should always have an uneven number of cutting edges.

The steel from which taps should be made may differ from that of other tools, it usually being what is known as tap steel. It is not so short or hard, tool steel possessing about three parts per thousand more carbon than tap steel. In making tools of any description, indeed, in general work, especially that of model making, you will do well to adopt the use of a Vernier or micrometer gauge, this being the finest form of measurement and the best way of obtaining accuracy. In this I speak from personal experience, having made them and constantly worked to them for a number of years.

Among the tools I have with me are several small cutters, die nuts and dies, drifts, &c.; also different forms of taps. But upon these I will not dwell, hoping you will avail yourselves of the opportunity of seeing them.

I will now pass on to the hardening and tempering of tools. Both in the forging and hardening of edge tools, great care should be taken that the steel does not become overheated, or the result will be that the tool will be of very little use when finished. It should be heated to a bright red, which will be sufficient (providing the steel is of good quality) to harden it when plunged into water. In heating in a fire or furnace, watch carefully until the desired heat is obtained, and do not allow the tool to remain any longer in the fire. For hardening small drills, taps, &c., such as used for model work, the best method will be to heat them in the gas by means of a blowpipe, being better able to watch the degree of heat, and also to get them hot just where necessary. In hardening a tool of any description, be quite sure that it is clean and free from grease before placing it in the fire, and also that the water is free from all greasy substance, otherwise it will not have that action upon the steel which it should have, and may necessitate having to harden it again. Difficulty is often experienced in the hardening of cutters and other tools, where there is great possibility of them cracking when plunged into water. These cracks often make their appearance when quenching hot steel, and entail the loss of all the labour which has been bestowed upon it. To avoid this, it is essential that a uniform heat should be obtained, so that the action of the water may be the same throughout, constantly keeping the tool in motion whilst in the water. It is advisable with reference to cutters (or any other tools which may have holes through them), to fill these up with fireclay, so that the water may not reach them, thereby keeping the interior soft. For cutters or similar tools, lukewarm water is often used.

The hardening of twist drills is a matter which requires very great care, so that they may be kept straight. For this purpose molten lead is often used instead of water, the drill being carefully heated in an oven adapted for the purpose. Its position is often changed, so that it may not become bent while being heated. It is then plunged, point downwards, into the molten lead.

Twist drills, after being tempered, are ground by means of emery wheels, exactly in the same manner as they are cut in the milling machine. A degree of hardness, almost equal to that of a diamond, may be obtained by plunging a tool, when nearly white hot, into sealing-wax, repeating the operation until the steel is too cold to enter the wax. Engravers' tools are hardened in this way, being afterwards just touched with oil of turpentine. The cause of hardening and tempering is intimately connected with changes in the condition in which the carbon exists in the metal. The hardness which can be imparted to steel depends upon the amount of carbon present, and the degree to which the temperature falls. The most rapid cooling agent is mercury, and in addition to molten lead and water, oil is extensively used where the degree of hardness required is not very great. Salt is also often used in water to enable tools to be made harder for turning chilled castings, etc.

The tempering, or letting down the temper of tools, is a delicate process, but is made quite simple by the fact that when brightened steel is heated, it is accompanied by a constantly varying colouration of the surface as the temperature rises. It becomes possible, therefore, by observing these colours to arrest the heating at the proper point, and so to bring the tool exactly to the desired temper. In practice, the above process is often shortened by hardening the end of a tool right out, after which it is polished, and the colours begin to travel towards the cutting edges, when as soon as the desired temper appears, the entire tool may be cooled out. This method strengthens a tool considerably, leaving it soft behind the cutting edge. In tempering, see that sufficient time is taken, for the slower and more uniformly the colours appear, the better is the result likely to be. Quenching, after tempering, is unnecessary if the heat is raised only to a sufficient point to give the desired colour. In the case of small tools this may be better accomplished by placing them on a piece of hot iron. The pale straw colour which appears first cannot be easily seen except by comparison with a piece of bright steel unheated. Where very great hardness is required this colour would let down the temper too low, and a bath of oil or tallow will afford a ready means of tempering. The smoke which arises by placing the tool in this will be found convenient in enabling the degree of heat to be intimated, the first slight smoke corresponding with the light straw, an abundant dark smoke to dark straw or brown, and a very abundant black smoke to purple. By continuing the heat till the grease inflames and continues to burn, a lower temper is given. This method is known as blazing off, and is much used for tempering springs. The colour most suitable for tools and cutters for metal is a light straw, this temperature being about 440 degs. F.; for taps, &c., dark straw (470 degs. F.); for springs, etc., dark blue or purple (560 degs. F.).

In closing my remarks upon tools, I should like to speak briefly upon the process of hardening files, which is somewhat interesting, although a delicate operation, requiring several precautions. This is done by heating them to a full red and quenching them in cold water. If the steel is exposed to the air at red heat (even if only for a short time) oxygen combines with it, rapidly destroying the sharpness of the teeth by covering them with oxide. The surface of the file is, therefore, protected from the air by dipping it into a solution of common salt stiffened with flour. When the file is heated to redness, this composition forms a kind of varnish, which protects the teeth from the air. Should any bends or twists take place in heating, these are corrected by a blow with a small leaden hammer upon an anvil of the same material, the file being also inserted between a couple of plates fixed parallel and a little distance apart, and bent in an opposite direction to the one which it is intended to correct. It is brought again to a cherry-red heat, holding it by the tang and turning it over in the fire or oven. The method of plunging into the water is important, to prevent warping. All files, except the half-round, are immersed slowly in a vertical direction. The half-round is quenched by keeping it perpendicular to the surface of the water, moving it through the water in the direction of the round side; but as the convex side contracts much more than the flat surface, there is a tendency in these files to curl back. This is overcome by bending the file in the opposite direction when hot, and then plunging it into the water horizontally. Each file is carefully watched, and should any bending be observed after being once plunged into the water, it may be corrected before it is quite cold by inserting it between the plates above-mentioned, pressing upon it with slight force, at the same time cooling it by pouring water upon it. By this method, considerable curves may be corrected. The tang is afterwards tempered by immersing it into molten lead. After hardening, the files are well scoured with scrubbing brushes dipped into water and sand, and are next put into lime-water and left for some hours in order to completely get rid of the salt, which, should any remain, would soon rust and destroy the files. After being thoroughly dried, they are rubbed with olive oil containing turpentine, and then finished, and are ready for use.

ACETYLENE GAS, says the *Canadian Engineer*, because of the brilliant whiteness and great steadiness of its light, combined with the simplicity of manufacture, is being carefully tested for lighthouse purposes. The tests have proved satisfactory. Italy has been giving special attention to the subject.

A Model Industrial Exhibition.

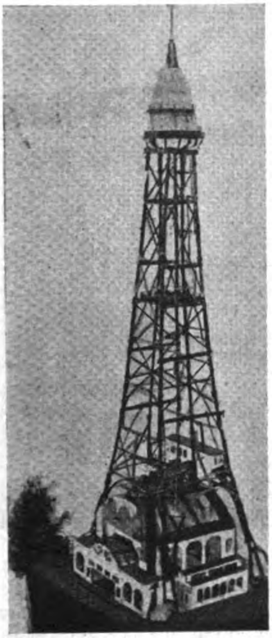
By G. T. Farrar.

A CONTRIBUTOR, who sends a description of his model show ground, has certainly hit upon an original idea for a model, and it induces me to send particulars of the model on which I have been engaged all my spare time for the last fifteen years, am still working at, and hope to do so for many years to come. It is a miniature industrial exhibition, containing a large and most varied collection of tiny models, all of which have been entirely made by my own hands, without any machinery or glasses. The exhibition comprises nearly 11,000 articles, made of many thousand pieces.

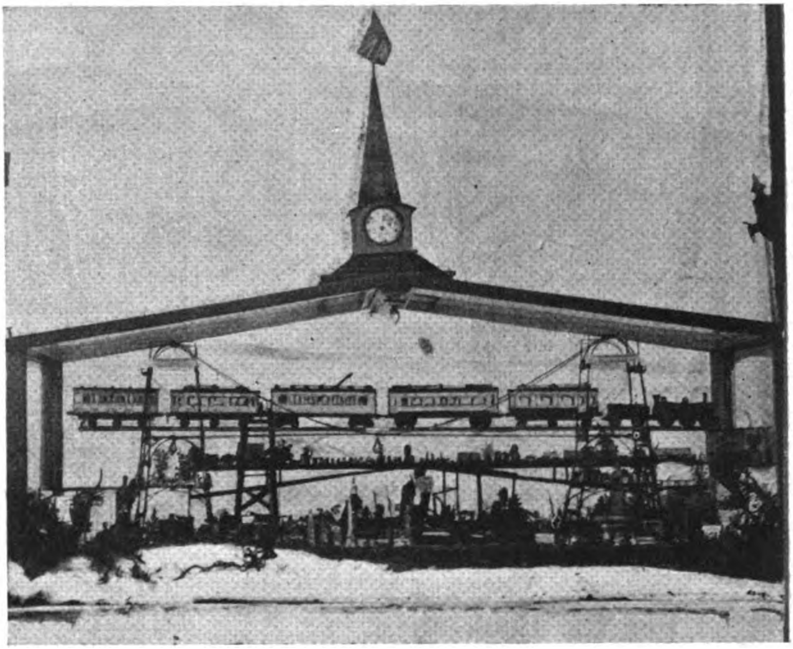
The entire collection is at present contained in three buildings, the largest being 3 ft. long by 1 ft. wide, and taken through a window, as arranged for Christmas, 1899: this will explain the snow (cotton wool) seen around it. As now exhibited, the photograph on page 64 will make matters clear, and it will be noticed that another bridge takes the place of those in the photograph below. The space required for the entire exhibition at present is 10 ft. by 2 ft., with an height of 4 ft., from standing level of tower to top of flagstaff.

The second building is 2 ft. long, 1 ft. wide, and 9 ins. high, and is the manufactures' building. Most of the exhibits it contains are in small glass cases, about 3000 of them are plates and dishes, &c., stamped out of gold, silver, aluminium, copper, zinc, brass, celluloid, paper, etc., all the punches for which I made myself by hand.

There are about 1000 other articles in this building, and 1,060 pieces of glass are used in its construction. All my stock of artillery are to be found here—the largest,



Model Eiffel Tower.



The Machinery Hall—Winter Scene.

A Model Industrial Exhibition.

1 ft. high inside measurement. It is my machinery hall, and below are some particulars of its contents.

There are on an iron suspension bridge four railway cars (passenger), one horse-box, and a fourteen-wheeled locomotive. You will notice on the photo that there are five carriages and a ten-wheeled locomotive on it. One car and the engine are now below. There are also two electric railway cars on another bridge, an electric locomotive and narrow-gauge railway loco and tip waggons; also new steam crane, steam lorry, steam tip waggon, waggonette, closed and open carriages, steam and chemical fire-engines, and a large number of other exhibits; also a new restaurant and offices. All moving machinery is worked by four clockwork motors (my own make) underneath building. The photographs which I send you are both of this building at different dates; that showing the tower is two years old.

This photograph (with the buildings and tower) was a 25-ton gun, is mounted on a revolving carriage, and a smaller one is fixed as a disappearing gun; both of these are in motion. There are also the last steamships that I have built, namely, the *Oceanic*, *Deutschland*, and a Cunard boat. In this case will be found the smallest suite of wood furniture in the world, all of which will go into a nut shell: it consists of 100 pieces; perhaps if I say it can all go into the smallest child's thimble, it will be better understood. There are also glass jugs, six of which would go into a cherry-stone; also a gross of iron, brass and copper nails and tacks, which would also go into a cherry-stone.

The third building is 1 ft. by 1 ft. 8 ins. high, which does not appear in the photograph. It is what you might call an overflow for all the other cases, and contains all the older exhibits, ships, railway trucks, trams, &c., all of which I hope to replace shortly.

The next item is the wrought-iron Eiffel Tower, which is 3 ft. high from ground level, with three automatic lifts to take passengers to the top. Two of the cars can just be seen between the centre station and the top and bottom. These lifts are worked by a clockwork motor. I send photograph of tower before it was fixed in its place.

After this comes the Magic Lake, which forms part of the grounds, and on which three small steam launches are sailing round, calling now and again at the landing stage for fresh passengers.

Then there is the "Happy Valley," with a cliff railway up one side and an ærial flight across; also windmill, fort, cottages, etc.

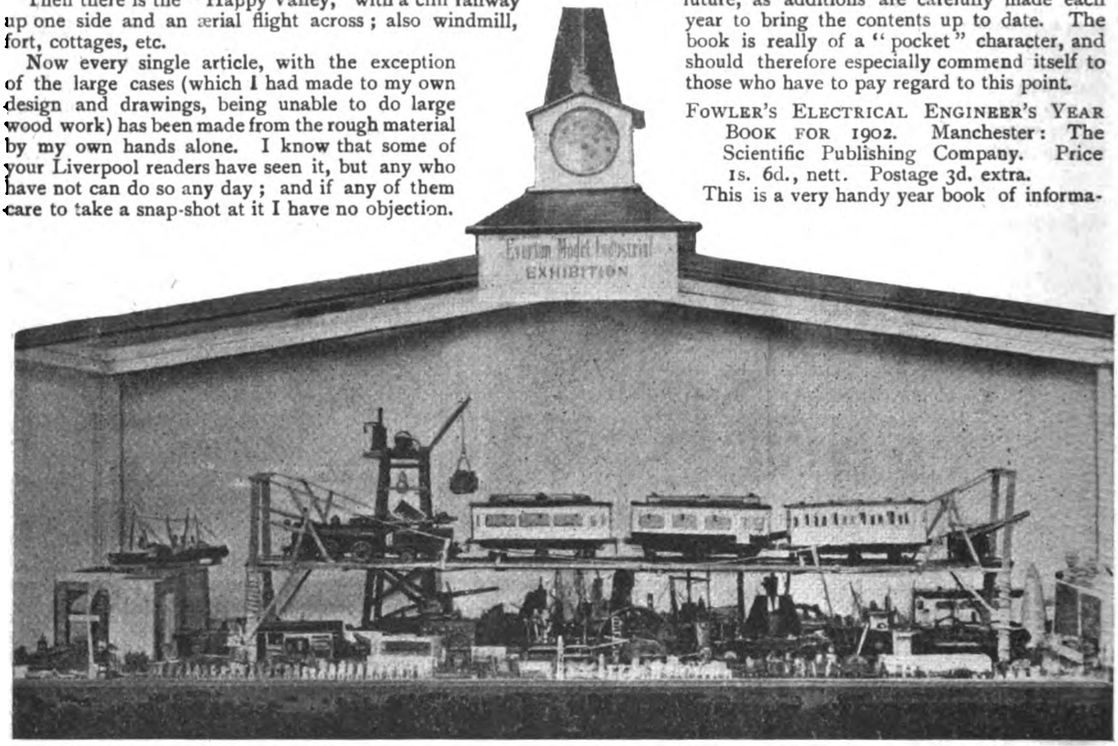
Now every single article, with the exception of the large cases (which I had made to my own design and drawings, being unable to do large wood work) has been made from the rough material by my own hands alone. I know that some of your Liverpool readers have seen it, but any who have not can do so any day; and if any of them care to take a snap-shot at it I have no objection.

THE PRACTICAL ELECTRICIAN'S POCKET-BOOK FOR 1902. London: S. Rentell & Co., Limited (*Electricity*), 2, Exeter Street, Strand, W.C. Price 1s. Postage 2d. extra.

We have always liked the neat "get-up" of this annual pocket-book, with its good printing and convenient size. These would not, of course, compensate for anything lacking in the text, but this has never been a fault in the past editions, and is not likely to occur in the future, as additions are carefully made each year to bring the contents up to date. The book is really of a "pocket" character, and should therefore especially commend itself to those who have to pay regard to this point.

FOWLER'S ELECTRICAL ENGINEER'S YEAR BOOK FOR 1902. Manchester: The Scientific Publishing Company. Price 1s. 6d., nett. Postage 3d. extra.

This is a very handy year book of information, tables, etc., for the electrical engineer, and we are glad to note that several improvements have been made since its first appearance last year. The directory of technical information respecting the equipment of the various central electric light and power stations in the United Kingdom is of the greatest value and appears to be carefully compiled. We note, with pleasure, that it is the aim of the Editor to keep abreast with the times and to take full advantage of the opportunity for revision afforded by the annual publication of the work. This policy is sure to result in success.



A MODEL INDUSTRIAL EXHIBITION—THE MACHINERY HALL.

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.)*

WIRELESS TELEGRAPHY. By G. W. de Tunzelmann, B.Sc. London: The office of *Knowledge*, 326, High Holborn. Price 1s. 6d. Postage 3d. extra.

There is a fascination about the very words used to denote the subject of this book, and it is, perhaps, difficult for any author with a practical knowledge of this subject to make it uninteresting. As treated in the present volume it is very far from such an objection, the development being almost "like a story," and a very good one at that. Any reader who desires to gain a really practical insight into the history and present position of "wireless" telegraphy can rest assured that this is the book to meet his requirements. It is practical, in the sense that the difficulties and the methods of the subject are clearly and pretty fully explained, and we imagine it will prove an excellent aid to the experimentalist, as well as a careful record of the world's progress in one of the most modern branches of science.

A TRAIN TELEPHONE.—A special train, which was used recently by President Cassatt, of the Pennsylvania Railroad, for the purpose of inspecting the lines west of Pittsburgh, is equipped with a telephone service. This service is so arranged that it is possible to communicate with each car on the train, and thus avoid the necessity of going from one car to another. With electric lights on railway trains, and intercommunicating telephones, says the *Electrical Review* (N.Y.), we need only electric motors on the locomotive to complete the conquest of the railroad.

The Editor's Page.

THE New Year's resolutions for model makers, which we suggested in our issue for January 1st, have apparently made an impression on at least one of those to whom they were addressed, and this reader, who selects "A Novice" as his *nom de plume*, has thought the opportunity a favourable one for returning the compliment. We welcome his vigorous and breezy epistle, which we print below, as a sign that his model making intentions are at least sincere, although we regret that we cannot admit the accuracy or the justice of his impeachment. However, his letter will speak for itself. Here it is:

* * *

"As a reader of your paper for a year or so, I take the liberty to write you on the subject of your remarks in the 'Editor's Page.' You recommend us to turn over a new leaf, and, as a New Year's resolution, to make better models this year than last, and to clear the rubbish out of our workshops, &c. Now, I think I will do as you say. I will make better models this year. I think, of course, the best way is to work according to THE MODEL ENGINEER. I am not a millionaire; neither can I give all my time to the work, so I cannot think of starting on a model that will cost me £40. I want something cheaper, yet good. Well, what can I start? A small gas engine, either as a model or to drive my lathe. Looking through THE MODEL ENGINEER, I fail to find a description of either, that is, in the last two years—so I must find something else. A model torpedo boat destroyer? Well, I find two or three designs—all different, and one like a barge. Which is right? I don't know, so will give this up. Well, I will build a boat of some sort, steam preferred. I look at engines for same. Here is a design that looks good—but in next week's paper three or four people pull it to pieces. Here is another—still the same; boilers are worse still. Again, with regard to the screws, are they fitted to revolve the same way? Then, what is the good of two; if they revolve in reverse directions, I can't see how this acts. I will look at my *M.E.*, that ought to tell me; I can't find it anywhere. Then, again, there are the deck fittings of a T.B.D. I can't find out what they are like, and I must come to the concluson that THE MODEL ENGINEER is not a fit paper for a novice like me—it is only suitable for some one capable of tackling a job like a model of H.M.S. *Majestic*, as big as a house, or a railway train that wants a park to lay down the lines for. If I wanted anything of this sort, I should get enough to sicken me, as I could build a fresh engine every week, and then would soon fall behind my mentor. Could you not, as a New Year's resolution, make up your mind to give us, say, a good model of a T.B.D. that would be as perfect, when finished, as some of your engines, or a small gas engine, or, again, a small dynamo? Wishing you every good wish for the New Year."

* * *

The above letter prompts us to suggest another New Year resolution to our correspondent—viz., that he should read his MODEL ENGINEER a little more closely and a little more intelligently. With the exception of a small gas engine (which was described three years ago), all the subjects he mentions have been amply dealt with during the past two years. A brief inspection of the issues since the commencement of 1900 shows that a good design for a model torpedo boat destroyer appeared in the issue for November 1st, 1900, and designs for suitable engines for model launches appeared in June, 1900, August 15th, September 1st, and September 15th, 1901; complete designs for dynamos appeared January 1st and December 1st, 1901, and also in the series of articles on the "ABC of Dynamo Design"; while a large number of designs and instructions for making model dynamos have appeared in our Queries and Replies Column. In addition to these, which have been selected at random, a number of other articles on making interesting and fairly simple models, have appeared, from which "A Novice" ought surely to have no difficulty in making a satisfactory selection. It is quite true that some of the models described in our pages have their faults in design, and have been criticised accordingly in our correspondence columns; but because a model may have some bad points, that is no reason why its good points should not be given publicity. Moreover, the criticism in such cases should be most valuable in guiding other readers what to avoid in their own work. There are few, if any, models built which are absolutely perfect when finished, and many a model is altered, and altered again, by its builder in the endeavour to improve its appearance or its working. The most successful model-maker is the one who, in addition to his own knowledge, has the intelligence to profit by the successes or the failures of others, and nowhere can he gain access to such a fund of experience of this kind as through the pages of THE MODEL ENGINEER. If "A Novice" will look again through the volumes he quotes, and select a model which is something like what he wishes to build, he will doubtless be able, by bringing his own ideas into play, and by taking due note of the experiences of other readers, as recorded in the paper, to produce a model which will be an improvement on the one selected as a starting point, and will be vastly more satisfactory and creditable to him than a mere slavish copy of another man's design.

* * *

On the subject of perfect scale models, which has recently been discussed in these pages, "J. E. J." (Clapham) writes:—"I see no reason why a perfect scale model should not be an actual and efficient working model, excepting, of course, the locomotive type, owing to the inability of the boiler to make steam fast enough; but in a model where the boiler is separate from the engine, you have unlimited scope for obtaining that which conduces more than anything else to the efficiency of a model—a good supply of steam at a good pressure. I cannot agree with 'D. McN.' (Glasgow) in your 'Practical Letters' column of your issue for December 15th, where he says:—'If the model had every detail to scale, I doubt if it would be an *actual* working model—an *efficient* working model it would not be.' In my opinion, the efficiency and actual working of a model is determined by the workmanship, and the steam pressure available for driving it; if these are good, the performance of the model will be good. The more perfect in detail the model is made, the greater the amount of skill required in fashioning and assembling the parts. Therefore, to those anticipating building a perfect model, I would suggest a simple type—such as a single cylinder, vertical or horizontal engine, fitted complete with governor, acting on an equilibrium valve. The model may look simple; but the maker will be sure of it withstanding the close scrutiny of his professional engineering friends, which certainly cannot be said of the majority of so-called models I have seen."

* * *

The lathe is so useful an adjunct to the amateur mechanic's workshop, that an opportunity for obtaining a useful tool of this kind in return for an hour or two's spare time employment may appeal to those of our readers whose outfit is not yet complete. Messrs. S. Holmes and Co., of Bradford, have kindly placed at our disposal one of their Anglo lathes listed at £3 10s., to be offered as a prize for an article on any subject set by ourselves; and they also offer one of their 17s. 6d. lathes as a consolation prize in the same competition. As this is a matter which chiefly concerns those readers not already possessed of a lathe, we have accordingly decided to award the above prizes to the best and second best articles describing a model made by the competitor without using a lathe. The reader who can make the best model without a lathe will probably be the one to make the best use of a lathe when he gets it. The model described may be anything of a mechanical or electrical nature, and should preferably, but not necessarily, be a working model. More credit will be given to a model in which the parts which are usually produced in a lathe have been worked up in some other way than to a model so designed as to avoid the necessity for any cylindrical parts. The description should be sufficiently full to enable any other reader to make a similar model, and working drawings showing clearly the details of construction should be given. All entries should be marked "Competition No. 20," and should be received by us not later than March 15th. The general competition rules appearing on this page should be observed.

Prize Competitions.

Competition No. 18.—Two prizes, value respectively, £5 5s. and £3 3s. (by Messrs. Swete and Lyster, of Pietermaritzburg, Natal), are offered for the best and second best original designs for a small modern type direct-coupled steam engine and continuous-current dynamo. The donors of these prizes make the following stipulations:—The output of the dynamo to be not less than 500 watts, and the voltage to be not less than 50. The competitor may make it more if he likes, but due regard must be paid to the tools at the disposal of amateurs who are not beginners. The engine may be of any type preferred by the competitor, either single or double cylinder, single or double acting, simple or compound, enclosed or open. The boiler pressure is to be taken as 60 lbs. on the sq. inch. A design is required that will represent something more than a toy, and yet within the power of a good amateur mechanic to build, and capable of giving satisfaction when made. Complete scale working drawings, with dimensions of both engine and dynamo, must be given, as well as all necessary mechanical and electrical calculations. There should, in addition, be a full written description of the set, explaining the methods to be adopted in its construction. The usual general rules will also apply to this Competition. The closing date for receiving entries is March 31st, 1902.

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.

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.

Sand Moulds for Brass.—A plain sand mould is not advisable for small brass castings, for when hot metal comes in contact with fresh sand, the latter partially melts, and a rough casting is the result. To obviate this, finely pulverised charcoal is dusted upon the mould, or the mould is smoked with cork shavings or pitch torches, by which a very fine coat of carbon is deposited, and a smooth surface obtained on the casting. Carbon does not adhere well to old sand; when it is used, it is necessary to first dust the mould with pease-meal, and then add the carbon. Avoid excess of both, otherwise the casting will come out faint instead of sharp, the carbon collecting in the hollows and preventing the metal from running up.—*Jewelers' Review.*

Practical Letters from Our Readers.

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

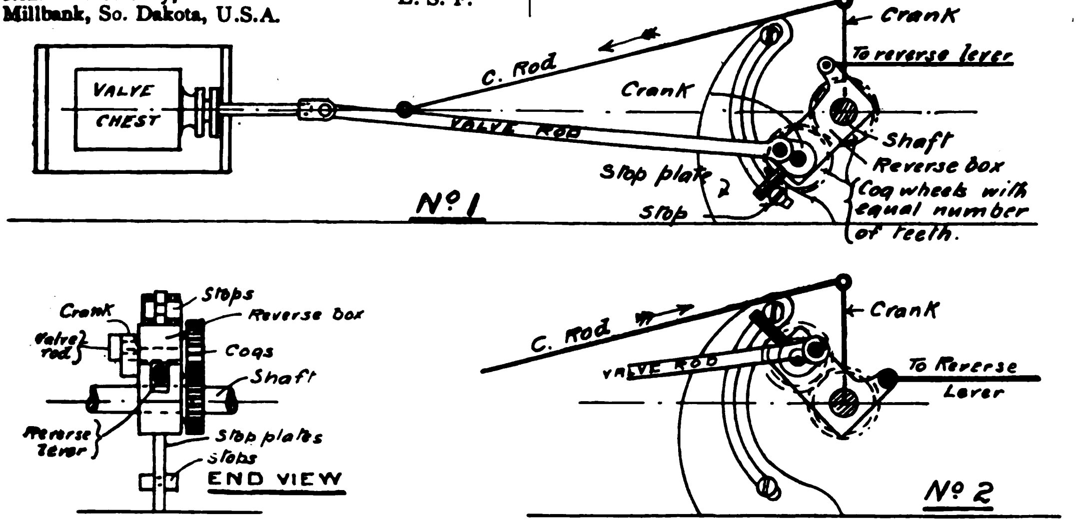
A Novel Reversing Gear.

To the Editor of *The Model Engineer*.

Dear Sir,—I enclose a rough sketch of a pinion reverse gear for a steam engine. This gear is very easily made on a very small scale. I think it can be made easier than a simple eccentric, as a small crank can be used instead of an eccentric. There must be arranged movable stops, so as to adjust for lead. The smaller the amount of throw of the reverse box, the more lead. This reverse is harder to describe, at least for me, than to make. I think you can see the principle by studying the sketch.—Yours truly,

E. S. F.

Millbank, So. Dakota, U.S.A.



A Novel Reversing Gear.

Some Electrical Terms Explained.

To the Editor of *The Model Engineer*.

Dear Sir,—The whole question of electrical distribution may be popularly illustrated by its analogy to hydraulics. The dynamo essentially is a rotary pump; but pumping electricity instead of water. It the discharge pipe of a rotary pump be carried around through a given circuit and connected with a suction, both pump and pipes being full of water, the movement of the pump will, obviously, cause the water to flow in one direction, producing a continuous current of water. Substitute dynamo for pump, wire for pipe, and electricity for water, and conception of electrical transmission by the continuous current is at once clear as to its elementary phenomena. We will bracket the analogous electrical terms; then we may say that a certain number of pounds (volts) of pressure are required to overcome the friction (resistance) of the pipe (wire) in order that the water (current) may flow at the rate of so many gallons (ampères) per minute. The larger the pipe (wire) the more water (current) can be carried, and the less will be the friction (resistance); the smaller the pipe (wire) the less the quantity (ampères) per minute and the greater the friction (resistance). Apparently the pipe (wire) might be so small that the friction (resistance) would absorb a very large proportion of the power of the pump (dynamo), leaving but little remaining for useful effect. Therefore, if the pipe (wire) be too large, it will cost too much; if too small, the loss will be too great. The electrical appliances are also analogous to engineering appliances. The contacts are the pipe fittings; and the fusible wires are the safety valves. The voltmeter is the pressure gauge; the ammeter is the same as the water or gasmeter, the recorder of quantity consumed.—Yours truly,

W. J. W. Quick.

Hull.

Galvanic Colouring of Metals.

A large number of recipes for the colouration and protection of metals are given in *L'Electrochemie*. Gilding on steel is imitated by galvanically coating with copper from a cyanide bath, then with a thin film of zinc. After drying and polishing, the article is heated in linseed oil to 160 degs. centigrade, when it is stated that the surface becomes of a red-brass colour, as if there had been a real alloying of the copper and the zinc. Iron can be protected from rust by a layer of molybdenum, deposited from a bath containing one gramme of ammonium molybdate and fifteen to twenty grammes of ammonium nitrate per litre, with a current of two to five ampères per sq. decimetre. All varieties of iron can be covered with an adherent and unalterable deposit of peroxide of maganese by making them anodes in a bath containing about 0·50 per cent. of manganous chloride or sulphate with five to twenty-five per cent. of ammonium nitrate, the bath being cold, the cathodes of carbon, using a weak current of one or two ampères. Selenite of copper is recommended for colouring iron and steel brilliant black or blue-black, according to strength; the layer, after firing is very permanent. The bath is made with selenious acid six to ten, copper sulphate ten, nitric acid four to six, to the litre of water. It can also be used for copper and brass with feeble currents. Mathey colours watch-hands and other small metal articles with gold or platinum, but not with silver, by placing them on an anode plate under about three cm. of solution, and dipping the cathode into the liquid over them until the required tint is produced.

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.

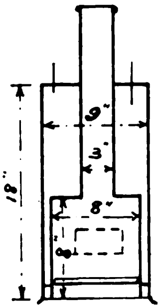
Queries on subjects within the scope of this journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied, 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, *97 & 98, Temple House, Tallis Street, London, E.C.]*

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

[4830] **Cores for Small Castings.** T. L. (Penydarren) writes: Will you kindly give me particulars for forming cores in small brass castings up to 2 ins. diameter, as I do not uite understand how it is done?

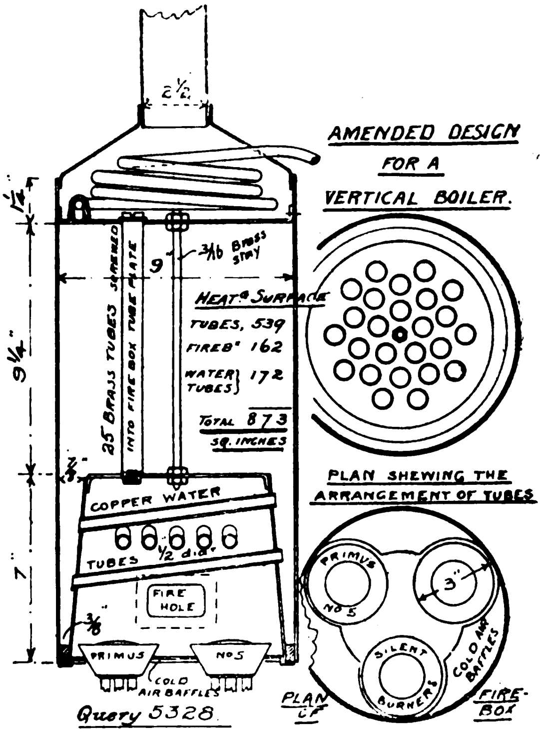
Cores if of simple character, able to be easily removed from finished castings, may be cut with a penknife from a piece of ordinary bathbrick. Below is an abstract from a series of articles in the first volume of THE MODEL ENGINEER, which will show you the principal points to be observed:—"The composition of cores for models is fine brickdust and a small quantity of bullock's hair cut fine, and made into a paste with a little water. The core thus prepared, which must have the consistency of a piece of clay after it has received its proper shape, must be prodded thoroughly through its length with ventilating holes, and is considerably improved by receiving an outer coating of a mixture of weak molasses and charcoal dust. A core box may be made for ramming the core material into and making it to shape, but the model maker will find no trouble in rolling out this compound to the form he requires by hand, and finishing up with an ordinary penknife. Bake the core thus made in a kitchen oven until the coating has a lavender colour."

[5328] A. D. B. (Leigh), writes: Will you kindly let me know if a boiler similar to annexed rough diagrammatic sketch would be



suitable for driving an engine with two cylinders 1½ ins. diam. 2 ins. stroke—what pressure should be kept up? What power would be developed? What is the best composition to put in steel boiler to prevent corrosion? If this boiler would not be suitable, please say what size would be

The consumption of steam for the two cylinders at the moderate speed of 300 revs. per minute and pressure of 30 lbs., would be about 7·2 cubic inches per minute. The boiler, which has only 300 sq. ins. of heating surface, would only supply about half (4 cubic ins.) of this quantity. At the above pressure and speed the engine would develop about ¼ indicated horse power; therefore, the boiler, as it will evaporate only sufficient for one cylinder, may be called an ⅛ h.-p. generator. You may easily double the output without increasing the size of the shell or firebox. We indicate on sketch below the method of augmenting the heating surface. For details of construction see "Model Boiler-Making," price 7½d., post free. The flue-tubes may have a taper thread cut on lower end and be slotted at upper end so that they may be turned with a special screw-driver; a collar of wire or tubing may be hard soldered on to top, which, when sweated to the tubeplate, will make the tubes resist the bulging of the tubeplates. The copper cross tubes will require careful fixing, and may be fitted to holes accurately drilled in the firebox, expanded, and well sweated with soft solder. The shell of the boiler may be of steel at least 5-32nds in. in thickness, and to prevent rusting you might have it galvanized inside and out. To prevent the cold air coming immediately in contact with firebox sides baffle plates may be placed as indicated. Every good fireman knows that if the air is allowed to come in through gaps in the fire



at the sides the steam production will be considerably reduced, and it is, therefore, best if any holes appear that they should be in the middle. You may, of course, use a coal charcoal fire, and, in that case, the bottom set of water tubes might be left out and the fire-hole arranged higher to allow a thicker fire. A superheater coil is very desirable

[5327] **Accumulator Installation.** H. H. (East Putney) writes: I am thinking of making a small accumulator installation similar to that described in Vol. IV, page 225. Unfortunately, the article is not explicit in several important particulars, and I shall be glad of your assistance. (1) The installation is stated to light *several* 8-volt lamps. But how many and what candle-power? (2) How many ampères would 8-volt 5 c.p. lamp take? and how many would 12-volt 5 c.p.? Such lamps being obtainable. (3) The diagram on page 225, Vol. IV, shows two lights only, one of which is a night-light. All the trouble of this installation would not be incurred to light these only, so I suppose the extra lamps are joined to the terminals at the bottom of the resistance board. Is this so? (4) Again referring to diagram. To charge accumulators the battery switch must be moved over, and if, as stated, the battery is always in circuit, it must not be moved back except when battery is disconnected for cleaning. To send current through the lamps the accumulator switch must be moved over. But battery and accumulators are then in parallel *with different voltages.* Of course, reversal of weaker E.M.F. (*i.e.*, accumulator) does not matter as it would charge, but would any current go to external circuit from it, and, if so, would battery and accumulator contribute equally to current through lamps, and would voltage be 8 (accumulator) or 12·948 (battery)? It will be noticed that battery cannot be separately connected to lamps. (5) What happens as between battery and accumulators, if (*a*) too many lamps are accidentally put on at once; (*b*) exact number to take all current available are on; (*c*) too few lamps are on and resistance board is not adjusted? (6) Capacity of accumulator. This is stated in the first edition of "Small Accumulators" to be 6 ampères per square foot of positive plate, but in Vol. V, page 213, this is corrected to read 16. I should have accepted the correction without misgiving, but Cassell's "Popular Educator" also says 6. I should be glad to know definitely that it is 16.

(1) This may be calculated from the capacity of the accumulators. The maximum discharge rate must not exceed 3½ ampères, so that

the maximum current (in watts) available is 8 × 3½ = 28. This is equal to from 7 to 10 c.p., according to the efficiency of the lamps selected. (2) Lamps of ordinary efficiency require from 3½ to 4 watts per candle power. High efficiency (H.E.) lamps require from 2·5 to 3 watts per candle power. This will enable you to work out the the answer to this query at once. (3) Extra lamps may be connected as you suggest, or a motor may be joined up if required. (4) The difference of potential does not matter in practice. The higher voltage is on the side of the primary battery, which tends to charge the accumulators. The fact that the voltage may be 12 is immaterial: the internal resistance of battery is too great to allow more than a minute current to flow. As a matter of fact, this installation might be considerably simplified. (5) (*a*) The plates of accumulator might be buckled. (*b*) We do not grasp the meaning of this query. (*c*) It would depend: have you any particular mistake in view? (6) The capacity *may* be much greater than 16 ampère hours per foot of positive *surface*. It may be as much as 30, easily. At the same time, plenty of amateur-made accumulators will not carry 6 ampère hours per square foot. If an average must be fixed it can be put at 16, but many readers quarrel with the figure because they personally cannot reach it or find it much too low. It must be understood that we are quite unable in the case of accumulators to gauge with any degree of accuracy just what any particular individual can get as a result. Putting the capacity at 6 is to put it very low.

[5343] **Electro Motor.** "MOTOR" (Notting Hill) writes: Can you tell me which is the smallest motor for working with a bichromate battery, and the price? Can you recommend a good set of fret-work and tell price?

Yours is a very curious query, and it is a sample of many we receive. Doubtless you know to what use you wish to put the motor, but you give *us* no information on that point! Possibly a preliminary study of our advertisement pages, followed by a perusal of price lists issued by some of the electrical firms whose names you will meet, will enable you to choose a motor to suit your purpose. Will you please read through your queries again as printed above, and ask yourself whether you could possibly have put more indefinite questions? Will you also notice that you trangress Rule I of our conditions for answering queries, an omission in which you are not alone, and which will account to several others for non-appearance of replies to their letters.

[5261] **Engine Queries.** E. J. P. (Hackney) writes: (1) Would a slide-valve cylinder, ½ in. bore × 1 in. stroke, give as much power, with a steam pressure of 60 or 70 lbs per sq. inch, as a cylinder ⅝ in. × 1 in. with a pressure of 30 or 40 lbs. per sq. inch? (2) What size slide-valve cylinders (using two) would a boiler exactly similar to that in Mr. Smithies' single-cylinder tank engine supply steam to? (3) How many, and what diameter of, burners has the above-mentioned engine, and how is the cylinder fixed to the frames? (4) What is the correct diameter of steam pipe for ⅝ in. × 1 in cylinder?

(1) The pressure on a ½ in. piston, with a steam pressure of 65 lbs., would be 13 lbs. barely; on a ⅝ in. piston, at pressure of 45 lbs., = 13¾ lbs. (2) Two cylinders 7-16ths in. × 1 in. stroke, or one cylinder ⅝ in. × 1 in. stroke. (3) About six spirit wicks ½ in. diam.; cylinders are connected to the foot-plating. (4) About 3-16ths in. diam. outside—thin tubing.

[5284] **Engine to Drive Dynamo.** R. S. P. (Durham) writes: Am thinking of building a small boiler and engine for driving a dynamo. Will you kindly answer the following questions: (1) What would be the best type of engine to use? (2) What would be the required stroke and bore for this engine to make it about ½ h.-p.? (3) What sized boiler would be needed for to work this engine? (4) What pressure would you have the boiler tested to? (5) Would you have an injector or a pump on the boiler? (6) How much water would have to be pumped into the boiler a minute?

(1) A vertical high-speed engine. (2) About 2 ins. × 2½ ins. stroke. (3) A boiler with some 750 sq. ins. to 1000 sq. ins. of heating surface. A boiler such as that given in reply to Query No. 5328 would suit your purpose well. (4) About 1½ times the working pressure by hydraulic means, and at a slightly less than 1½ times by steam; say, for working pressure of 50 lbs. about 80 lbs. hydraulic and 70 lbs. steam. (5) Either. Injector would have to be worked intermittently, whereas the pump could be kept continuously at work. (6) Make the pump large enough for most urgent needs of boiler, and reduce its throw of water by alteration of speed, stroke or by a pet cock on delivery pipe. Reckon, for purposes of pump design, that 16 cubic inches of water per minute is required.

[5345] **Engine and Dynamo.** J. C. (Glasgow) writes: (1) I have a vertical engine of 1½ ins. bore, 3 ins. stroke. Will it develop ½ h.-p. at 50 lbs. pressure? (2) What size vertical boiler would be required, central flue only? (3) Having only one free night I should wish to charge secondary cells from the dynamo sufficient to supply four 16 c.-p. lamps for 12 hours. How many cells would it require?

(1) See THE MODEL ENGINEER for October 1st, 1900, for method of calculating horse power. Your engine would develop about 7-12ths i.h.-p. at 400 revs. per minute if it is a double-acting engine. (2) Please refer to Answer to Query No. 5328. We deprecate use of single central flue; but if you insist, a boiler about 3 ft. high by 17 ins. diameter will have to be used. A ½ horse generator is shown on page 35 of "Model Boiler Making" (price 7½d., post free, from our publishers). The size of shell is 2 ft. 6 ins. by 15 ins.; it is intended for solid fuel. (3) You do not state output or voltage of dynamo or give any data from which we could answer your query.

[5317] **Electric Night Light.** J. W. B. (near Accrington) writes: (1) I have constructed one of the electric night lights. I have done all according to the information given, but find it loses its power in a week's time when not in use. Is there something wrong with it? Would you please explain? (2) I saw in THE MODEL ENGINEER a few weeks back you were going to describe how to build a ¼ h.-p. oil engine. When are you going to start?

(1) There *is* something wrong, but it is quite impossible to say exactly what without seeing the battery. The probability is that you have a short-circuit somewhere, or are using a lamp which consumes too great a current. Possibly the zinc does not lift quite clear of the solution. If you want us to say at all definitely, you must state exactly in what way the battery was made, what departures were made from the original design, and the manner of work you have put the apparatus to. (2) We regret we cannot say definitely.

[5338] **Carburetter for Petrol Motor.** C. H. writes: I am making a small petrol motor and should like to know about the position of the carburettor. The carburettor which is of the spray type would suit my plans best, if attached to the inlet valve with only 3 ins. of piping between them. Would this be a safe and practical position for it, if I have a plentiful interception of wire gauze in the connecting pipe?

A spray type carburettor would be safe enough at 3 ins. from the motor, if two superposed wire gauze discs of fine mesh be inserted in the connecting pipe and providing the body of the carburettor does not come in contact with the motor cylinder. Up to a certain point, it is desirable that the carburettor of this type be placed near to the motor so as to warm it, and a pipe with a bell mouth end (also protected by gauze) is usually fitted to the pure air inlet of carburettor so that the bell mouth being close to the motor the air is heated on entering the bell. A heating pipe is also brought from the exhaust silencer through the body of the carburettor for the purpose of warming the incoming petrol, this pipe being fitted with a tap or cock for shutting off the heat when not required. The only fear is that in the event of over-heating of the engine the whole carburettor might get so hot as to interfere with the quantity of the supply of gaseous vapour. The Longuemare carburettor as fitted to the De Dion tricycle is about 8 ins. away from the motor.

[5363] **Manchester Dynamo, 20 Watts.** P. D. (Brighton) writes: I have castings of a small Manchester type motor, the two field cores of which are ¾ in. diam. by 2 ins. long, and 3¾ ins. apart; poles are 1¾ ins. wide. I have wound the cores with No. 26 wire to 1½ ins. diam. Kindly state whether this is right, and what kind of armature would be best and what wire for same? I have a small ring armature core, which is just the right size over all but is too difficult to wind. I have tried all ways, but cannot manage it; the hole is ⅞ in., outside diam. 1¾ ins., with 8 slots each ⅜ in. wide. Could I convert this into a drum armature with four coils?

Several important details are lacking or are ambiguous in your letter. Under the circumstances, we are obliged to say our answer depends for its correctness on the assumption that we have rightly interpreted your letter. The slotted armature will be much easier and much better to wind as a drum, and you may refer to Fig. 1, page 262, December 1st issue, for diagram of winding. About 4 ozs. No. 22 will be required, and should be connected in shunt. The output might be as much as 2 amps. at 12 volts, but will probably hardly reach that amount.

[5437] **Boiler Queries.** C. J. E. (Manchester) writes: I shall be obliged if you will give me the chief dimensions for a water-tube boiler similar to the one on page 46 in "Model Boiler Making," suitable for an engine of 1½ ins. bore, 1¾ ins. stroke, running at about 300 revs., with a boiler pressure of 50 lbs. per sq. inch?

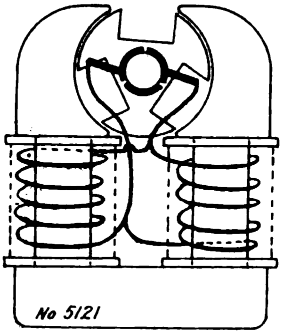
The boiler should be made at least half as large again as that shown in "Model Boiler Making." Care must be taken to prevent priming, and the superheater coil may be somewhat enlarged with advantage. The hole in steam junction should, therefore, not be larger than, say, ⅛ in. Use ¼ in. copper solid drawn tube for the water tubes, and silver solder them into the pans.

[5393] **Wimshurst Machine.** A. H. (Shaw) writes: I wish to make a Wimshurst machine with 12-in. discs, but instead of using glass or ebonite for plates, I propose using papyroxyline or gun paper discs, made of millboard about 1-16th in. thick. What is the proper plan to follow in preparing the discs from ordinary millboard? Should the discs be varnished, and what is the best varnish to use?

We have never tried using any such material for Wimshurst machine construction, and do not recommend it. Ebonite is bad enough for its warping propensities, and we imagine millboard would be infinitely worse. Doubtless the varnishing would prevent this getting very bad, but would itself tend to warp the plates slightly. It must not be supposed that the difficulties attending the making of a piece of apparatus like the Wimshurst machine can be readily overcome. The fact that so many experimenters have devoted their attention to these particular machines is sufficient proof that an obvious material like millboard is not of much use for the purpose. If you try, shellac varnish should be used, and we should be glad to hear the result. Possibly other readers who may have experimented in this direction would assist with their views.

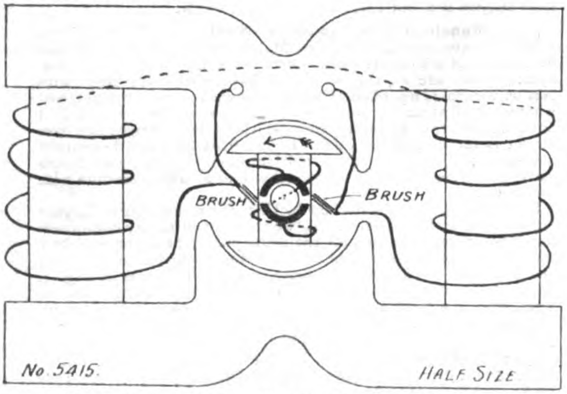
[5121] **Tripolar Motor.** M. G. (Bolton-le-Moor) writes: Will you kindly tell me what amount of No. 24 wire will be required to wind a motor having an armature 2 ins. × 2 ins. (tripolar), with field-magnets, having a core 13-16ths in. diameter, and 2 ins. long?

Wind the tripolar armature with 2 ozs. of No. 24 wire, and the field-magnets with 4 ozs. of the same wire, 2 ozs. on each limb. The



field-magnet windings must be connected up in parallel as shown in the sketch, and the parallel windings in series with the armature.

[5415] **Manchester Dynamo, 16-Watt.** F. C. H. (Victoria Park) writes: I enclose herewith half-size drawings of some castings of a small dynamo. Kindly inform me of the following: (1) Size and amount of wire to wind on armature. (2) Size and amount of wire on each field limb. (3) Voltage (4) Ampèrage. (5) What power should I require to excite field-coils? (6) Kind of battery recommended for exciting fields. (7) Is there any special direction in which to revolve armature? (8) Method for determining N. and S. poles of machine. (9) How many revolutions per minute should armature work at?



(1) About 3 ozs. No. 20. With careful winding this should be got on easily. (2) 6 ozs. of No. 22 on each limb, ¾ lb. in all. (3 and 4) The output may be as much as 2 ampères at 8 volts. (5 and 6) A battery of two good bichromate cells will do very well to impart the permanent magnetisation necessary in the field-magnets. (7 and 8) The direction of rotation is important, but can soon be found by experiment. The method of *calculating* it is one involving a certain amount of explanation which is too long for this column. (See the "A.B.C. of Dynamo Design.") (9) The speed should be about 3000 revs. per minute.

[5417] **Fuller Bichromate Batteries.** O. M. M. (London, W.) writes: (1) Do Fuller's mercury bichromate cells make a smell when charged? (2) Can you give me a formula for the chromic and sulphuric acid solution for Fuller's mercury bichromate cells? (3) Will three Fuller's mercury bichromate cells work an "Ediswan" 6-volt lamp?

(1) No. (2) Correct proportions for the solution are given on page 46 of our little handbook, "Electric Batteries," price 7d., post free, from our Book Department, 6, Farringdon Avenue, London, E.C. (3) Yes.

Model Six-Pole Tramway Generator.

In the course of a reply to a query on this subject (see p. 281, December 15th issue), it is stated that if the commutator bars are cross-connected, only *three* brushes need be employed. This is, of course, an error. All bars lying at an angle of 120° to one another should be connected together, and *two* brushes used, bearing on points of the commutator separated by 120°.

A Model Steamer Explosion in Hyde Park.

On Sunday morning, January 5th, a model steamer, which is reported to be about 10 ft. long, exploded on the Serpentine, in Hyde Park, seriously injuring the owner, Mr. Brooks, and another man. It was stated that the vessel was "driven by petroleum," but our own information, derived from a reliable source, is to the effect that this is a mistake. As a result of the explosion the model was blown to pieces. Should any readers of The Model Engineer know further particulars of the accident, the Editor will be glad to hear from them on the subject.

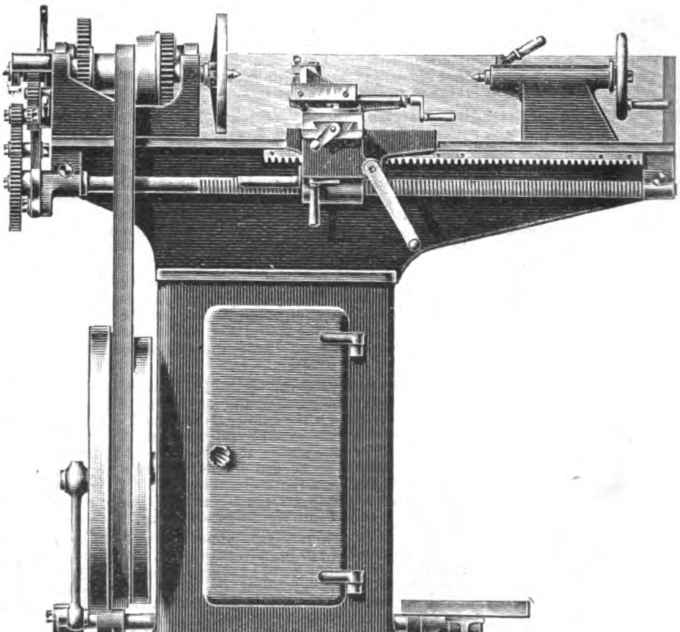
Amateurs' Supplies.

A Model Traction Engine.

We have received from Messrs. George Goodman & Co., East Hayes, Bath, a set of full-size working drawings (blue prints), of a ¾-in. scale traction engine, castings for which they are placing on the market. The design is that illustrated in The Model Engineer, December 1st, 1901, slightly simplified. Readers requiring further particulars should write to the firm, enclosing a penny stamp for reply.

A New Lathe for Model Makers.

We show in the accompanying illustration a new design of lathe recently introduced by Mr. W. H. Astbury, of Brougham Chambers, Wheeler Gate, Nottingham. It is specially intended for the requirements of model makers, amateurs, motor and cycle firms instrument makers, and other people engaged in light mechanical work. The most noticeable departure from ordinary practice is in the form of support for the bed, this being a substantial cast-iron column in place of the usual pair of standards. The form and weight of this column tends to secure great steadiness and enables a convenient cupboard to be provided for the reception of tools and accessories. The maker states that owing to the peculiarity of the design stiffer jobs can be dealt with than is usual on lathes of this size, whilst due regard has been given to convenience in manipulation. The dimensions of this tool are as follows: — Height of centres, 4 ins.; length of work admitted between centres, 22 ins.; length of bed, 3 ft. 6 ins.; width of bed, 5½ ins.; diameter of faceplate, 7½ ins.; leading screw, 1 in. diam. cut four threads per inch.



A New Lathe for Model Makers.

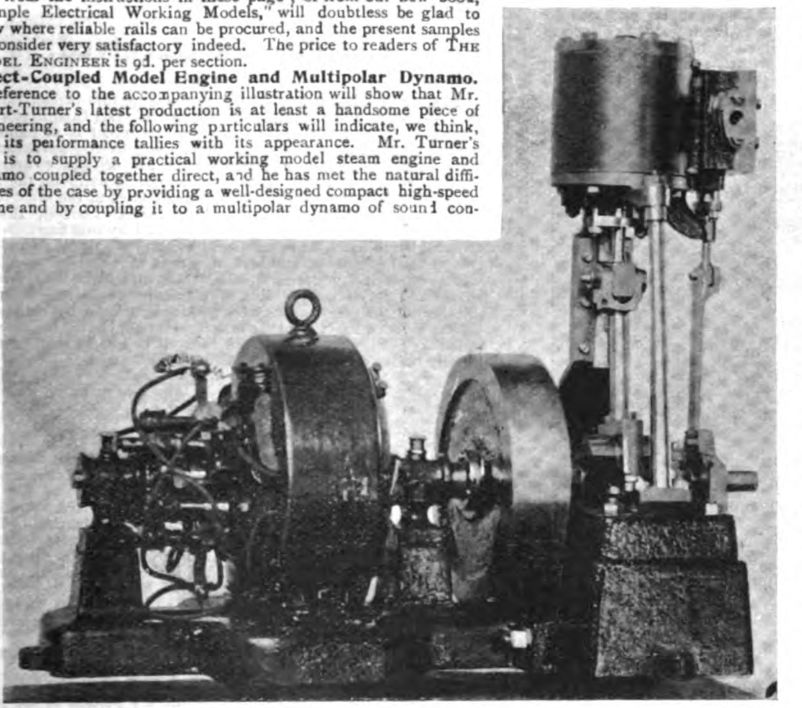
The driving is by means of a 1¼-in. flat belt, with three speeds, the largest diameter on the headstock cone being 4¾ ins. The approximate weight of the lathe as illustrated is 7½ cwt., while its overall measurements are—length, 45 ins.; height, 43 ins.; width, 26 ins. It can be arranged for power driving if preferred, or can be supplied complete with an electric motor. The gearing throughout, including change wheels and rack, is machine cut from the solid, though cast wheels can be fitted at proportionately lower price if desired. A careful examination of the working drawings which Mr. Astbury has sent for our inspection shows us that this is a carefully designed tool, well adapted for the class of work for which it is intended. An interesting feature in connection with this lathe is that Mr. Astbury has decided to supply amateurs and others wishing to build their own lathes with complete sets of castings and parts, either in the rough, or machined ready for fitting together. Further than this, he is prepared to supply the castings in instalments, if necessary, so that those to whom initial outlay is a consideration will only require to spend their money gradually, as the work of construction progresses. Full particulars of these lathes, together with particulars of this method of supplying castings, may be had from the above address by any reader mentioning this paper, and enclosing a stamp for postage.

Model Railway Track for Electric Locomotive

We have received for inspection a sample length of tin railway track for model electric rail or tramways. It has an insulated central rail, and this and the two outer rails are mounted firmly on metal sleepers complete. The track is supplied by the Universal Electric Supply Co., 47, Crosscliffe Street, Moss Side, Manchester, who send it out in either curved or straight lengths. At each end of each section is an ingenious locking device, which not only locks together the separate sections, but ensures perfect electrical contact and smooth running. Eight sections of curved rails make a 40-in. diameter circular track, and by the addition of straight rails a track of any length may be laid out. The rails are 1¾ ins gauge, and the track is, of course, suitable for steam locomotives, the central rail in this case being idle. Those who are making model electric cars from the instructions in these pages, or from our new book, "Simple Electrical Working Models," will doubtless be glad to know where reliable rails can be procured, and the present samples we consider very satisfactory indeed. The price to readers of THE MODEL ENGINEER is 9d. per section.

Direct-Coupled Model Engine and Multipolar Dynamo.

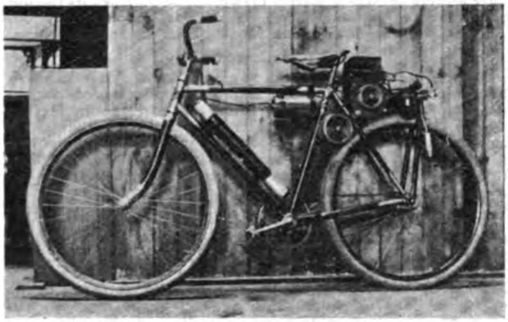
Reference to the accompanying illustration will show that Mr. Stuart-Turner's latest production is at least a handsome piece of engineering, and the following particulars will indicate, we think, that its performance tallies with its appearance. Mr. Turner's aim is to supply a practical working model steam engine and dynamo coupled together direct, and he has met the natural difficulties of the case by providing a well-designed compact high-speed engine and by coupling it to a multipolar dynamo of sound construction, running at a moderately slow speed, designed by Mr. A. H. Avery, of Fulmen Works, Tunbridge Wells. The engine (a No. 2 type) has a cylinder 2 ins. bore by 1½ ins. stroke, and runs at 1,500 revs. per minute. It is highly finished, special attention being paid to working parts; all machined surfaces are polished and the rest enamelled neatly in green. The dynamo gives an output of 3 ampères 15 volts. It has drum armature, radial bearing seats, and the insulation throughout is of mica and vulcanised fibre. The bright parts are polished and the carcase finished in green enamel. Parts or finished machines and engines are supplied, and the fact that the details of the engine can be manipulated on a 3-in. lathe should prove an important point. Enquiries, in which THE MODEL ENGINEER should be mentioned, should be directed to Mr. Stuart-Turner, Shiplake, Henley-on-Thames, a penny stamp being enclosed for reply.



DIRECT-COUPLED MODEL ENGINE AND MULTIPOLAR DYNAMO.

An Amateur's Motor Bicycle.

F. B. Widmayer, of 2312, Broadway, New York City, agent of the P-T Motor Co., whose advertisement appears elsewhere, sends us the following description of a motor bicycle which was built by one of their customers:—"I herein send you photograph and a description of a motor bicycle which I have built, the same being used for over a year; and I have ridden the same over 2000 miles. The photograph shows a regular Iver Johnson road wheel, equipped with a type B, 1 h.-p. P-T motor driving the rear wheel by a friction wheel; also a P-T automatic gasifier, muffler, &c., a Dow jump spark coil, and a set of four Excelsior dry batteries. The tank over the motor holds two quarts of gasolene, which I have found sufficient for a run of from 50 to 60 miles. I built the motor all on a 9-in. Star lathe, without the use of any special tools, from a set of castings obtained from the P-T Motor Co. While my method of driving may be crude and open to criticism, but as I used the same to secure a simple flexible drive without any alterations to the wheels, I may mention the rear wheel has a coaster and brake in the rear hub. The friction wheel is pivoted in the clamp that holds the motor in the rear stays, and it is held against the tyre by a helical spring the other end of which is fastened to a clamp around the bottom bracket. A lever, with a Bowden wire, serves to bring it against or draw it away from the tyre. The friction wheel has also a little lateral play to permit a good bearing in the tyre of the wheel if the wheel is not true, a flanged pulley driven by a 1-in. flat belt connects it with a similar pulley in the motor shaft. The motor is controlled by a single lever which holds the exhaust valve open; this lever also shifts the spark and regulates the speed. The machine can be started two ways, either by pedalling a few yards and then dropping the friction wheel, or with a crank direct in the motor shaft, like all gasolene automobiles are started. In a crowded city street, when in a tight place, I can raise the friction wheel and allow the motor to run idly and pedal slowly, and when I see my way clear I can drop the friction wheel and away I go. I can climb a 6 ft. grade without any slip in the tyre, and on a level road can run from 12 to 15 miles per hour. I use the above machine every day



AN AMATEUR'S MOTOR BICYCLE.

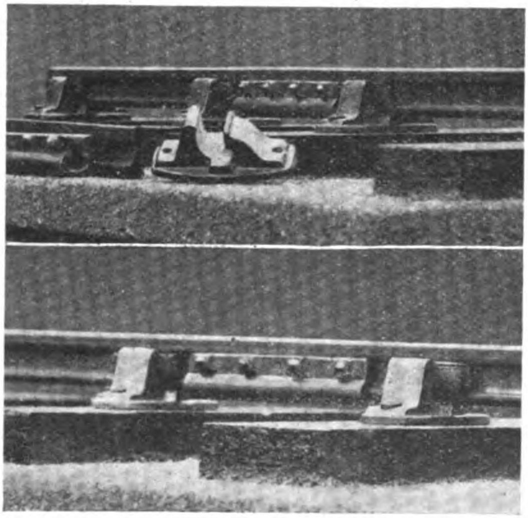
(weather permitting) and it has given entire satisfaction to me in every respect. I hope the above will be of interest to your many amateurs like myself."

Seamless Flexible Metal Tubing.

A flexible metallic tubing, capable of standing very considerable pressures, and quite steam tight, is a desideratum. That supplied by Messrs. George Schultz & Co., 80, Cannon Street, London, E.C appears to have all these good qualities and is made from solid-drawn tube. It is manufactured in stock lengths of 8 ft. each, and from ¼ in. to 2¾ ins. inside diameters. The list issued by the firm mentioned illustrates a variety of couplings for use with this tubing, and contains illustrations and full details of prices. Owing to the peculiar construction, the tubing is specially suitable for providing greater heating or cooling surface than could be obtained by the use of plain tubing of the same length. Particulars and lists can be obtained as above, mentioning The Model Engineer when writing.

Model Permanent Way.

The model railway engineer will be glad to know that he can now obtain at comparatively low cost scale model permanent way, the materials for which have just been placed on the market by Messrs. George & Co., Hamble, Hants. The scale adopted is that of the standard gauge of the Society of Model Engineers, viz., ¾ in. to a foot; the rails are of solid hard brass and are an exact reproduction, both in section and length, of the latest type of bullheaded rails as used on the main lines of railway carrying heavy express traffic and which weigh 100 lbs. per yard. The chairs are after an 1896 pattern of the Midland Railway, having outside keys and weighing 54 lbs. each. Only two holding down spikes are employed in place of four as in the real chair. These model chairs, owing to the special way they are constructed, are a perfect fit on the rail, and are sent out finished ready for laying, which can be readily accomplished by the merest tyro. The fishplates which are ingeniously arranged and entirely new, ought to give every satisfaction, as they have the exact appearance of being fitted with real nuts and bolts. Each pair of plates are made in one piece, and are a perfect fit on the rails. They are very strong, and will be found to hold the ends of the rail truly together, as is clearly shown in the accompanying photograph. The metal employed in the construction of these goods is a special mixture, having a sufficiently high tensile strength for the purpose and will not rust. The sleepers are made correctly to scale and tarred or creosoted, and are all exactly the same thickness. We are informed that special chairs, etc., necessary for points and crossings, of which



A Realistic Model Permanent Way.

there will be about eight different types, are in preparation, and will be ready shortly. Messrs. George & Co. say this permanent way will be found strong enough for the heaviest 1-in. scale model as for ¾ in., and when laid forms an exceptionally firm track, and from what we can judge from the sample supplied to us, would be suitable, both in strength and appearance, for all models from ⅝ in. to 1 in. scales. Prices may be obtained for 1d. stamp, and a small sample, comprising a piece of rail, chair, fishplate and sleeper, will be sent post free for 6d. The rails, if not used for the whole of the track, are eminently suitable for a show piece, and for this purpose Messrs. George & Co. are listing complete a piece of track, 4 ft. long, at a very reasonable price. We can recommend all readers interested in model railway construction to secure samples of these exceptionally well-designed goods.

A Simple Die Chuck.

We illustrate below one of the simple die chucks supplied by the Britannia Co., Colchester. This type of chuck has certain good qualities which will recommend it to the amateur, to whom moderate price, durability, and range of work are important. It can be used either concentric with or eccentric to the lathe centre, and from its simplicity of construction is not liable to get out of order. The

retail price of a chuck to take in from 3-16ths in. to ½ in. is 20s., and a larger size, to take from ¼ in. to 1 in., retails at 25s. If the buyer is unable to tap the hole for screwing to mandrel, this can be done by the firm at an extra cost of 2s. 6d.

Catalogues Received.

Fraser & Chalmers, Ltd., 43, Threadneedle Street, London, E.C.—This firm manufactures the Reidler Air Gas Compressors and Blowing Engines, and a well-produced pamphlet is to hand describing and illustrating at some length the uses and advantages of these machines. Those interested in air or gas compressing machinery for chemical or mining works should write for the above pamphlet, The Model Engineer being quoted at the same time.

F. Darton & Co., 132, St. John Street, London, E.C.—A large variety of electrical goods is supplied by this firm. A well-printed list to hand shows numerous motors and dynamos specially made by them, whilst numbers of pieces of electrical apparatus, batteries, lamps, voltmeters, bells, coils, and night-light sets, are illustrated and priced. Most of these are, of course, of special interest to the trade, as they are good selling lines, but readers can obtain articles direct from the makers, Messrs. Darton & Co., themselves. The illustrated list here referred to will be sent, post-free, to any reader mentioning 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.

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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.

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The Steam Turbine.*

THE earliest records of steam engineering are to be found among the relics of ancient Egypt. About 120 B.C. Alexandria was at the zenith of her civilisation. At this time Hero, probably contemporary with Euclid and Archimedes, wrote his celebrated work —"Spiritalia Seu Pneumatica." In it he described several forms of mechanical apparatus. The use of the steam jet for accelerating combustion; the expansion of air when heated in a closed vessel; several forms of steam boilers; various hydraulic apparatus for opening and closing temple doors. The most interesting among all these is a description of a re-action steam turbine. It consisted of a boiler, above which is a sphere mounted upon two trunnions. By means of these, steam is admitted to the interior of the sphere. On the equator were attached two bent pipes, such that the issuing steam re-acted upon the sphere and caused it to revolve about its trunnions.

The next turbine capable of any practical improvement, and which may be regarded as the forerunner of the de Laval turbine, was invented by Bianca in 1629. It consisted simply of a jet of steam impinging upon the vanes of a paddle wheel and blowing it around. A century later (1705) the reciprocating engine appeared, and from that time until the last few years practically nothing was done in the development of steam turbines.

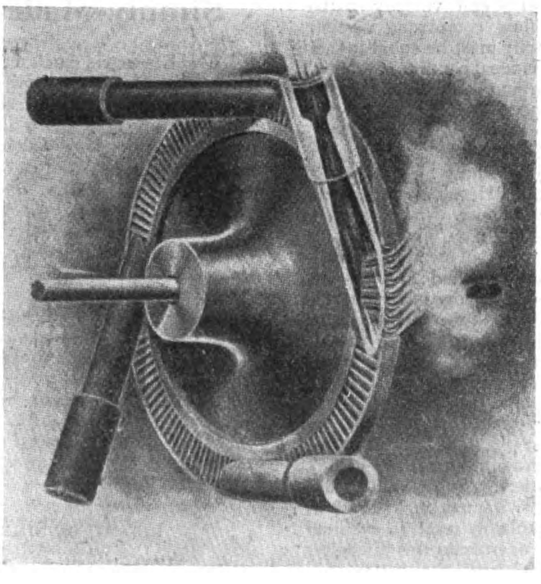


FIG. 1.—THE DE LAVAL TURBINE.

Before leaving this brief historical review, it is interesting to record that Mr. Parsons, with a view of exploring the possibilities of a re-action steam turbine, constructed one on the lines of Hero's engine. The sphere was replaced by two hollow oval sectional arms, mounted upon a hollow shaft, with jets at the outer ends, through which the steam issued tangentially to the plane of motion. The whole was enclosed with a cast-iron case and connected to a condenser. With 100 lbs. per square inch at the jets and 26 in. vacuum in the exhaust casing, a speed of 5000 revolutions per minute was attained and 20 h.-p. developed. The consumption of steam was 40 lbs. per brake horse-power.*

It is not a little remarkable that the latest development of steam engineering should be returning to the earliest form of engines of which we have record. It is still more remarkable that the engine as described by Hero had greater economy than any steam engine produced for eighteen, or even twenty, centuries later. The fundamental principle of the steam turbine, in contradistinction to the reciprocating steam engine, lies in the fact that the latter does work by reason of the static expansive force of the steam acting behind a piston, while in the former case the work is developed by the kinetic energy of particles of steam, which are given a high velocity by reason of the steam expanding from one pressure to a lower.

Steam turbines may be divided into three classes: (1)

* Abstract of paper read by Francis Hodgkinson before the Engineers' Society of Western Pennsylvania, November 20th, 1900, and published in the *Mechanical Engineer* (Manchester).

*STEAM CONSUMPTION OF RECIPROCATING ENGINES.

Ordinary horizontal engine	...	37 lbs. per i.h.-p.
Passenger locomotives ...	...	25 ,, ,,
Simple Corliss condensing engine		20 ,, ,,
Willan's compound condensing	...	15 ,, ,,

Impact, of which Bianca's is an example; (2) reaction, of which Hero's is an example; (3) a combination of both of these, of which Parsons' is an example.

It is proposed in this paper to deal only with the two forms which have attained some degree of commercial success—viz., the Parsons and the de Laval, particularly the former.

The general principles made use of in water turbines also apply to steam turbines. The buckets and guides must have as little skin friction as possible, and so arranged that the acting fluid may strike without sudden shock, and have its direction of motion changed without sharp angular deflections. One difficulty, however, presents itself, and is due to the tremendous velocity of steam as compared with that of water under ordinary heads.

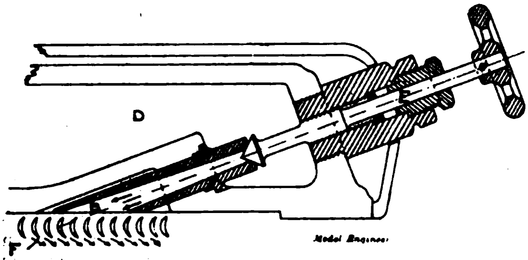


FIG. 2.—CONTROLLING VALVE AND NOZZLE OF DE LAVAL TURBINE.

The laws governing the best velocity of buckets are the same as for water wheels. In the impact turbine the ideal condition is when the peripheral velocity of the buckets is one-half that of the fluid comprising the jet. In the reaction turbine this velocity must be equal to that of the jet, in order to give us this ideal condition. Now, with high-pressure steam discharging into a vacuum, the velocities obtained are from 3000 ft. to 5000 ft. per second, as calculated by Zeuner's formula. A turbine, therefore, built on the lines just enumerated, would have peripheral velocities far beyond the limits of strength of material. As an example, a 10-in. Hero's engine would revolve at 75,000 revolutions per minute.

The de Laval turbine (shown in Fig. 1*) consists of a divergent nozzle, which directs the jet of steam upon suitably-formed buckets, which are attached to the periphery of a revolving wheel. The outer edge of the buckets is shrouded by a steel ring, which prevents the centrifugal escape of the steam. The unique features of this turbine are the nozzle and the means by which the wheel is enabled to revolve upon its axis of gravity.

With regard to this latter point, a difficulty always arises in attempting to revolve a body at a high rotative speed. It is essential in the first place that the body be accurately balanced; but, in spite of all care, this cannot be attained with absolute accuracy. The result is that, with ordinary shaft and bearings, tremendous vibrations would be set up that would probably result in eventual rupture of the shaft. De Laval overcomes this difficulty, however, by mounting his wheel near the centre of a long, light shaft, capable of being considerably bent and returning to its original form. The shaft is mounted upon bearings of ordinary construction. This flexibility enables the forces set up by the revolving wheel to deflect the shaft and enable the former to revolve about its axis of gravity. The wheel case and the wheel case cover are so shaped as to form "safety bearings" around the hub of the wheel for the purpose of catching and checking its speed in case of an accident to the shaft.

* From the *Railway Digest*, U.S.A.

The nozzle is divergent. In it the whole expansion of the steam is carried out. The steam at the mouth of the nozzle has the same pressure as the exhaust. In other words, the steam has its energy completely transformed into mass and velocity by the time it comes in contact with the buckets.

The steam, after passing through the governor valve, enters the steam chamber D, Fig. 2, where it is distributed to the various nozzles. These, according to the size of machine, range in number from 1 to 12. They are generally fitted with shutting-off valves E, by which one or more nozzles can be cut out when the turbine is not loaded to its full capacity. This allows steam of boiler pressure to be almost always used, and adds to the economy on light loads. After performing its work, the steam passes into a chamber and out through the exhaust opening.

These turbines are essentially of very high speed. The smaller sizes run about 30,000 revolutions per minute, and are geared down to about 3000; the larger sizes about 10,000 revolutions per minute. The peripheral speed of the wheel is usually from 600 to 1,200 ft. per second. The reduction of speed is accomplished by means of a pair of helical spur gears with the angle of helix 45 degs.

These gears form by far the biggest part of the whole outfit. The remaining portions of these turbines have no remarkable features. The regulation is effected by means of a flywheel governor, which is on the slower-running shaft, and wire-draws the steam at the admission.

(To be continued.)

Simply-Made Electric Clocks.

THE electric clock usually consists of two hands that are caused to move around by means of an electro-magnet, which receives its impulses over a wire circuit from a standard clock provided with a contact maker and breaker. The hands advance by what is called a

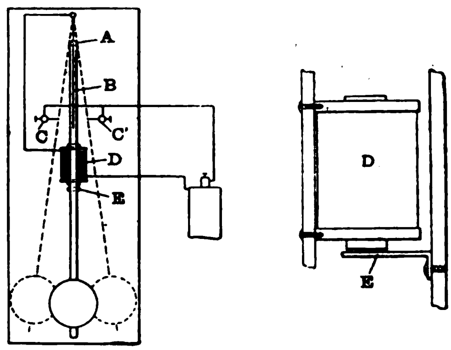


FIG. 1.—A SIMPLE ELECTRIC CLOCK.

"step by step" motion each time an impulse is sent through the electro-magnet, at intervals of one second. An interposed master clock may operate a number of electric clocks placed at different points on the same circuit. It is in this way that standard time is sent all over the United States from the observatory at Washington and other astronomical observatories.

A very novel and inexpensive application of electro-magnetism to move the pendulum of a clock is shown in Fig. 1. Near the top of the pendulum, at *A*, is fastened a fine steel spring *B* with two platinum contact end points, opposite which two platinum-tipped contact screws *C C'* (electrically connected together), are attached to the clock case, some distance apart, so as to allow the pendulum free swing.

Somewhere below the contact-points, and also attached to the clock-case, is located a single magnet spool *D*, and fastened to the back of the pendulum rod, just short of frictional contact with the projecting iron core of the magnet spool, is secured a piece of angle iron *E*, which is attracted by the former whenever contact is made between either one of the screw contact-points *C C'* and the contact spring *B*. The magnet spool is, of course, stationary, so that the small piece of angle iron, in being attracted, moves with the pendulum. A single gravity cell is sufficient to keep the pendulum swinging for many months.

The connections, as outlined, show that the contact *C'* makes contact whenever pendulum has swung to the right side, and contact is broken when the pendulum is in a vertical position. Another, but more complicated electric pendulum clock is shown in Fig. 2.

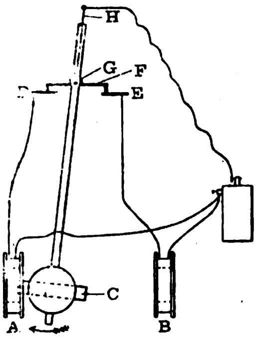


FIG. 2.—ELECTRIC CLOCK ACTUATED BY SOLENOIDS.

Two rectangular shaped solenoids, *A* and *B*, wound with comparatively fine wire, are fastened to the case of the clock, and allow the bob of the pendulum, which carries a piece of soft iron, *C*, through its centre, to swing free within them. Contact is alternately made at *D* and *E* by means of a sliding bar, *F*, which is moved sideways by a pin, *G*, fastened to the pendulum and electrically connected by a wire to the spring, *H*, and in turn to the battery. The other pole of the battery is connected, as shown, to solenoids and to the platinum contact plates *D* and *E*. Supposing contact is made between *D* and *F*, the solenoid *A* will become magnetised, and will draw the piece of iron, *C*, within it; the momentum of the pendulum on its return swing will carry it past the vertical position, the pin *G* will move the contact bar *F* to the right, and thus establish a contact between *F* and *E*, and consequently the solenoid *B* will attract *C*. This arrangement, however, requires more battery power than the former.—*Jewelers' Review, N. Y.*

IT seems as though there were at last some prospect of a reform of our Patent Law, for among the forthcoming measures announced in the King's speech at the recent opening of Parliament is one "for amending the Patent Law." Those of our readers who are inventors and who want to know wherein our Patent Law is defective, and in what directions it needs reform, will find this subject dealt with in "British Patent Law and Patentees' Wrongs and Rights," by Hubert Haes, which is, perhaps, the only book dealing with the subject from the point of view of inventors and patentees. It is obtainable from Messrs. E. & F. N. Spon, Ltd., 125, Strand, W.C., and costs 1s., or, post free, 1s. 3d.

The Utilisation of Exhaust Steam.

AT the meeting of the Institution of Junior Engineers held on January 3rd at the Westminster Palace Hotel, the Chairman, Mr. Percival Marshall, presiding, a paper on "The Utilisation of Exhaust Steam" was read by Mr. John Buloy. In introducing the subject the author criticised the several methods adopted with the view to disposing of the lime scale deposit on the tubes of evaporative condensers, and suggested that in many cases it would be feasible to overcome the difficulty by periodically circulating a dilute solution of hydrochloric acid over the fouled surfaces. Special attention was directed to the employment of exhaust steam for heating circulations, and for hot water supplies for hospitals and asylums, and also its utilisation for raising the temperature of the water delivered to public baths and wash-houses.

An interesting illustration was given in which the exhaust steam from a 7½-in. by 6-in. duplex pump was utilised for heating the day rooms of an asylum where the cubical content was 54,864 ft. With an external temperature of 37 degs. F., with ample provision for ventilation, an internal mean temperature of 63 degs. was maintained.

Reference was made to the relative merits of direct heating, and inducing the flow of exhaust steam throughout a main circuit by means of an air-pump, as against the adoption of a central heater through which low-pressure water would have an accelerated circulation derived from an ordinary plunger pump. Where a complex system over a widespread area was a necessity, the latter system was advisable on the score of efficiency, first cost and the general upkeep. Where exhaust steam was utilised for the concentration of liquors, the writer advocated the "Lille" system as the one from which perhaps the most favourable results had been obtained; with it an efficiency so high had been reached as to evaporate 40 lbs. of liquid per lb. of coal.

The direct return of condensation water to steam boilers was not commended, on account of the liability of intermittent shocks occurring. The writer considered that in practice trapping was the most satisfactory arrangement, and in spite of the disadvantages that sometimes attended the working of steam-traps, it was best to adopt this method of drainage, and to depend upon the concentration being returned to the boilers from a central hot-well, into which all the discharges should be led. The trap that relied for its action upon the concentration of the vapours of surplus heat was the one commended, rather than that on the expansion principle, by reason of the extreme fluctuations of pressure and consequent temperature where steam was employed in such a way as to bring about heavy spasmodic demands.

A discussion on the paper followed, and after a vote of thanks had been passed to the author, the proceedings terminated.

The Centenary of the Locomotive.

TO celebrate the hundredth anniversary of the first successful locomotive run, which was accomplished in the streets of Camborne, Cornwall, on Christmas Eve, 1801, a number of Cambornians assembled in procession through the streets of that town on Tuesday, December 31st last. Speeches, suitable to the occasion, were made, and the two builders of the engine in question—Richard Trevithick and Andrew Vivian—commemorated in the heartiest way. In the evening a public lantern exhibition in Commercial Square was given, and incidents and places in connection with these notable inventors were depicted upon the screen. Unfortunately the weather was anything but propitious.

The Society of Model Engineers.

London.

THE following are the dates which have been fixed for the ensuing ordinary meetings:—Wednesday, March 12th, a series of short papers on various model engineering subjects—electrical and mechanical—by Messrs. Boorman, Crebbin, Bowling, Riddle, Hildersley, Greenly, and other members; April 10th, Rev. W. J. Scott, B.A., on "Modern N.E.R. Locomotives." The meetings commence at 7 p.m. in the Board Room, Memorial Hall, Farringdon Street, E.C.

MODEL MAKING COMPETITION, 1902.

As announced at the January meeting of the Society, a model making competition, open to all members of the Society, will be held in May next. The date of the exhibition has been fixed for May 22nd, instead of the 5th. The entries for the competition, accompanied by one shilling entrance-fee, must be sent to the Hon Secretary, Mr. HENRY GREENLY, on or before May 5th, upon forms which will be posted to all members. The models for exhibition should be despatched in proper packing-cases, addressed to The Society of Model Engineers, Memorial Hall, Farringdon Street, London, E.C., so that they reach the hall by the morning of Thursday, the 22nd. The carriage should be paid both ways.

The prizes will consist of silver and bronze medals, and will be awarded in the following classes at the discretion of the judges: 1, Locomotives; 2, Marine, Stationary, and other Engines; 3, Electrical Apparatus; 4, Ships and Boats; 5, Best Model made by a member under 21 years of age; 6, Best Model exhibited by a Provincial member; 7, Best home-made Tool; 8, Miscellaneous models.

The prizes will be awarded according to the number and quality of the exhibits in each class; and the judges, in allotting marks, will pay especial attention to originality in design and construction—*i.e.*, methods of constructing. Members who are users of metal-working tools in ordinary business, or who have had professional instruction in mechanical work, will be handicapped according to the nature and extent of their experience. Members who are professional model makers, cannot be entered for Classes 1, 2, 4, 5, 6, 7, and 8, and those who are engaged in electrical apparatus making as a livelihood will not be allowed to enter for Class 3. Only *bona fide* members of the Society are eligible. By a resolution of the Society, dated November 7th, 1900: "No person shall be allowed to compete in any of the Society's competitions . . . . unless the said person has been a member of the Society at least three months prior to the closing date of the competition, and his subscription has been paid up to date or in advance."

Models which have gained prizes in the previous competition (1900) cannot be allowed to compete in the present one, and no model shall take more than one prize.

The competition entry form will contain all further particulars as to prizes, rules, and form of declarations as to the extent of the work done by the competitor, and his occupation and training.—HENRY GREENLY, Hon. Sec., 4, Bond Street, Holford Square, W.C.

Provincial Branches.

Dublin.—The annual general meeting of this branch was held at 3, Burgh Quay, on Tuesday, January 28th, Mr. J. Holliday, A.M.I.C.E., M.I.M.E., Vice-President, in the Chair. The Treasurer's statement of accounts was presented, showing the Society to be in a flourishing financial condition. The following gentlemen were elected to act for the coming year:—President, John G. Purser; Vice-Presidents: R. P. T. Logan, J.P., M.I.C.E., M.I.M.E., John Holliday, A.M.I.C.E., M.I.M.E; Hon. Secretary, T. E. Winckworth, 149, South Circular Road, Dolphin's Barn; Hon. Treasurer, John Holliday, A.M.I.C.E., M.I.M.E., 5, Brooklyn Terrace, South Circular Road; Committee: Leonard Murphy, J. Kelly, S. H. Ackland. Arrangements were made for an attractive series of lectures and papers on engineering and allied subjects to be read at the forthcoming meetings of the Society, which will be held, as a rule, at the above address on the third Tuesday in each month.

Edinburgh.—A meeting of the Edinburgh Branch of the Society of Model Engineers was held at No. 13, South Charlotte Street, on Thursday, January 23rd, twenty-two members being present. After the minutes of the previous meeting had been read and approved, and seven new members had been admitted, Mr. James Hunter gave a lecture on "Lantern Illuminants," showing both the limelight and acetylene gas in operation. Mr. Hunter went pretty fully into the chemistry of the limelight, and had intended to show several experiments to illustrate his lecture; but owing to the lateness of the hour, was compelled to postpone them until Friday, February 7th. Mr. Hunter, who had brought a large amount of valuable apparatus down, was cordially thanked for his interesting lecture.

On Wednesday, January 29th, the Branch met at 13, South Charlotte Street, when the Hon. Sec. read Mr. Henry Greenly's lecture on "Model Locomotive Design." There was an attendance of fourteen members. The lecture, which was well illustrated with lantern slides, was listened to with great interest, and at the end a very hearty vote of thanks was awarded to Mr. Greenly for his kindness in sending the lecture, and to Mr. Hunter for manipulating the lantern.

Mr. Anderson also received the thanks of the meeting for supplying and fitting up a two-burner incandescent gas-bracket, a gift which will be thoroughly appreciated by members when using the reading room.

Future arrangements are as follows:—

Wednesday, February 26th.—General Meeting. Mr. Duncan's Model Engine. Lecture on "Model Boilers," by Mr. J. C. Crebbin.

Saturday, March 1st.—Visit to Coal Pit.

Thursday, March 13th.—General Meeting. Lecture by Mr. Dodds on "Steam and the Steam Engine." Mr. Miller's Carburettor, etc.

—W. B. KIRKWOOD, Hon. Sec., 5, Charlotte Street.

Leeds.—The Leeds branch of the Society of Model Engineers held a meeting on Wednesday, January 22nd, there being a good attendance of members. Mr. Rhodes, of Armley, gave us a lantern lecture on "The Rise and Progress of the Locomotive," and it proved a very interesting and instructive lecture. The lecturer put on to the sheet very clear pictures of locomotives, showing the development from its earliest stages from the year 1813 up to the present time, including Continental, American, English, Irish, and Scotch locomotives. At the close of the lecture, Dr. Wear, with a few suitable remarks, proposed a vote of thanks to Mr. Rhodes, which was passed unanimously, the meeting terminating at 10.40 p.m.—W. H. BROUGHTON, Hon. Secretary, 262, Carlton Terrace, York Road, Leeds.

WHAT is said to be the largest locomotive ever built was turned out recently by the American Locomotive Company from the Schenectady plant. It is of the decapod type, and weighs nearly 123 tons. It has ten driving wheels, and will be used in the freight service in the mountain districts on the Atchison, Topeka, and Santa Fé Railroad.

Motor Cycles and How to Construct Them.

By T. H. Hawley.

(Continued from page 57.)

XVII.—Motor Manipulation (*continued*).

We may now consider the sparking or ignition plug, and the various diseases to which it is liable. The sparking plug is an apparently simple construction, and consists essentially of two platinum terminals, insulated from each other, and placed within the combustion chamber of the motor, the two ends being separated about 1-32nd of an inch, and the air space between forming the gap where the spark is produced.

It is unnecessary to enter into the more minute details of spark producing mechanism, suffice it to say that in the system we are now dealing with, the low tension battery current is transformed by means of the induction coil into a high tension current capable of overcoming considerable resistance, the resistance to overcome being the air space between the plug terminals, and in overcoming this resistance the spark is produced.

The construction of the sparking plug may vary considerably. In the genuine De Dion plug the central conductor is a platinum wire carried through the centre of the plug in a porcelain insulating stem, a similar wire being connected to the metal body of the plug and bent

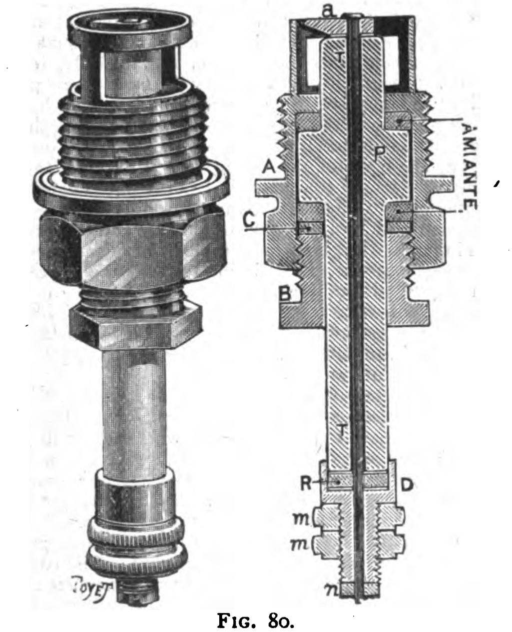


Fig. 80.

over at right angles to within about 1 mm. of the other wire, the circuit being completed, of course, through the body of the motor, which, with the tricycle frame, forms the return or "earth" conductor for both primary and secondary circuit.

Nothing will prove of greater value to the driver of a motor cycle or other vehicle than a thorough knowledge of the construction and peculiarities of the sparking plug, for the ailments are many and of an insidious nature, and it is the time employed in locating faults rather than actually remedying them that proves so irritating to the rider who wants to get on.

Figs. 80 and 81 illustrate two different types of sparking plug, which will sufficiently explain the general construction of all. Fig. 80 is a type of plug largely used on "Benz" cars; but is equally admissible on De Dion motors, and is here described in order to show variation from the ordinary De Dion plug. Referring to the sectional view—*a* is the sparking needle formed of platinum, and held in position by the steel conducting-rod T, the spark being produced between the point of *a* and the cage-like wall of the plug body, which is of steel; A is the body of plug screwing into the combus-

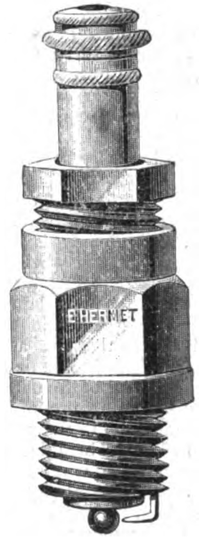


Fig. 81.

tion chamber; P is the porcelain insulating stem which is held in position in the plug body by the nut B, which screws against the washer C, the enlarged portion of the porcelain stem being supported top and bottom by asbestos washers marked "Amiante," so that on unscrewing the nut B the porcelain stem is removable from the body of the plug; the conductor T is secured in position by the small nut *n* and D is a metal cap fitting over the end of the porcelain stem, and on to this cap the terminal nuts *m*,*m*, are screwed, R being simply a washer on the end of porcelain. In the case of this particular plug the gap, or sparking space, is fixed, and the pointed terminal *a* does not burn away; but the surface of the ring surrounding it will become pitted in time, when a fresh surface is quickly presented by rotating the terminal piece *a*. In Fig. 81, the central conductor terminates in a ball which may be rotated to present new surfaces to the sparking needle, and the space between the two is regulated by slightly bending the sparking point. In the ordinary De Dion plug the terminals consist of two wires bent at right angles, with their points close to and in line with each other; and in adjusting this form of plug it is necessary not only that the terminal points should be the proper distance apart, but in a straight line with each other, and the end faces square to each other. Cheap plugs should be carefully avoided; it is the worst form of penny-wise-and pound-foolish policy to purchase what appears to be the same construction at 6d. less than the real thing; but plugs bearing the following names may be relied on as being carefully made, though the best is none too good:

The "Reclus" (needle point and conical centre), the "Demontable" (cheese-head centre and needle point, fitted with spring allowing for expansion of porcelain), the "Cementless" (in which the cheese-head centre terminal is a nut with a conical seating in the porcelain), and the genuine "De Dion," which is a carefully-made plug with cemented central conductor—all the plugs named being threaded the standard De Dion size.

One of the most common mishaps to sparking plugs is the cracking of the porcelain stem, thus causing a short circuit, this cracking being attributed to the intense heat, and although this is no doubt the ultimate reason for the fracture of the stem, the reason is unequal expansion in combination with defective manufacture in the porcelain stem.

Some makers have sought to remedy the matter by inserting springs or spring washers, to allow of elongation of the porcelain when heated; but it is probable better results would obtain if greater care was exercised in the manufacture of the stems in combination with equalisation and increase of bulk. In the cheap plugs sold at tempting prices it will usually be found that the porcelains are warped, and not in a straight line, and the least tendency in this direction will surely result in fracture, for the stem when cold is tightly held up between the nuts and washers, and already is subjected to stresses which tend to break it, so that when the expansion due to heat in working is added, such a stem is sure to go. In the best made plugs the porcelain stems are ground true in a lathe, after being baked in the ordinary way of manufacture, and in addition are afterwards heated to redness in a furnace, when if there be any permanent set or weakness due to removal of the outer skin by grinding, it will be disclosed by the fracture of the stem.

The next important point in the case of a cemented-in conductor is the cracking or breaking away of the cement between the platinum centre wire and the porcelain, and this will frequently cause confusion to the novice, for the plug, when tested in a stationary position, may spark beautifully, but fail altogether when the machine is being propelled over the road, the explanation being that the platinum wire being but loosely supported by the cement, the distance between the sparking points is constantly varying, on account of the vibration, with consequent mis-fires.

To revert to actual practice, the above remarks will, in the first place, show the importance of purchasing only first-class materials, especially in the case of sparking plugs. The motorist should never leave home without at least one extra sparking plug in reserve, and this plug should be thoroughly tested before being passed on duty. If a furnace or gas forge is not at hand, the porcelain stem should be removed from the plug body and held in the flame of a Bunsen burner until it becomes red; and if it does not crack under this treatment, it is not likely to crack when in use, though it is also necessary to see that it is straight and that the asbestos packing takes an equal bearing on the shoulders of the stem. With these few remarks on plug construction, we may proceed to testing for faults when on the road. In the event of misfire or other cause for which the plug is suspected, the plug should be bodily removed from the motor, the position of the sparking points first noted, then an examination made for loose cement or broken porcelain. If all these points appear right, it may be that a sooty deposit due to bad mixture and resulting imperfect combustion has spread over the end face of the plug, thus forming a conducting medium which short-circuits the current and prevents the formation of the spark. In this case the remedy is to wash the plug end with petrol, and clean the terminal surfaces with emery cloth or a knife blade. Then, if nothing further can be discovered, the plug may be tested in two or three ways. First remove the cap of the contact-breaker and push the machine until the cam and the trembler shoe is in the position shown in Fig. 79—*i.e.*, with the battery circuit closed through the primary of the induction coil; then with the connection wire firmly screwed up to the central conductor of the spark plug, and the plug in position in the motor, but with the ignition valve mounting removed so that the sparking terminals are visible, proceed to cause a make and break by lifting the trembler T (Fig. 79) with the finger end, and if all is correct a stream of sparks should show between the plug terminals, though a safer method is to wheel the machine slowly to and fro so that the cam itself causes the make and break.

Another method, which avoids the trouble of disconnecting the supply pipe from carburettor and the inlet valve from motor, is to place the plug itself in contact with any metallic part of the motor or the machine frame, and repeat the former instructions, when, the return circuit being through the framing, a spark will appear as before between the plug terminals if the whole of the apparatus is in order. But suppose that under either of the tests named the plug fails to spark, then the plug may be detached from the wire conductor leading from the coil secondary, and the vibration of the trembler repeated whilst holding the end of the conductor within about ¼ in. of the frame or motor, because if under this test a good spark jumps from the conducting wire to the motor body or machine framework, we know that it is the plug that is at fault; but if this test fails to produce a spark the fault may be looked for either in the battery current having run down, or a breakage in the conductors of the primary circuit; another, but extremely unlikely, cause being breakdown of the induction coil.

When making tests like this on the roadside, if the plug fails to work it is always best to insert a new plug, leaving the faulty one to be corrected at leisure at home. In fixing a plug to the motor care should be taken that a copper washer is inserted between the shoulder on the plug and the body of the motor, otherwise there may be leakage and loss of compression. Other points about the sparking plug to which attention may be drawn are:—The equal distribution of the asbestos packing and the proper screwing up of the gland nut, so that the pressure, without being excessive, is sufficient to hold the porcelain stem firmly in position and the attachment of the secondary wire from the induction coil, for in many cases the connecting screws or nuts on these plugs are none too sound, and if, in addition, the wire loop is badly formed, there may be intermittent contact.

The dry battery should be frequently tested at home, and if well looked after there should be no trouble with it on the road. A 4-cell battery, when new, will give 10 ampères at over 6 volts, and its range of life may be tested and estimated either by voltmeter or ampère-meter; but when testing by ampère-meter the connection should never be made directly with the battery terminals, but so as to include the coil primary, otherwise the short circuit will uselessly run down the battery current. The battery will continue to operate the coil down to 4 ampères; but when once a dry battery drops below this, it is unsafe to trust to for long journeys, though, under favourable conditions, a battery may remain normal at this point for some time. It would be difficult to bestow too much care on the dry battery, and it should be remembered that from the moment the new battery is unpacked it will tend to lose power if exposed to a damp atmosphere. Every effort should be made to conserve the battery power by thoroughly protecting the individual cells one from another, and an india-rubber envelope or casing should enclose the whole; it is also a good plan to ensure conductivity between cell and cell by a touch of solder, and the connections to the outer circuit may also be soldered, because a new battery once fixed seldom requires breaking up until quite spent, so that the first condition is to ensure good conductivity, then thorough insulation. The conductivity and immunity from short-circuiting throughout the entire primary and secondary circuit is of vital importance, and will well repay any extra trouble, for, of course, in the event of a leakage, the battery current quickly runs away to waste, and dry cells once run down cannot be re-charged. I find that after soldering certain of the connections as suggested, it is a good plan to wrap most of the terminals and connecting points with gutta-percha tissue, partly melting in position or sealing it with a hot iron rod; all the battery connections should be so treated, and also the following connections in the outer circuit—both ends of the thickly-insulated wire from coil secondary to spark plug, both connections on the contact-breaker, and the two terminals on the handlebar insulating block.

The reason why this is advisable is that in riding in wet weather the rain is apt to form a connecting film at certain points, so running down the battery, and, at the same time, stopping the sparking. The secondary circuit, of course, being the more susceptible, worse however than mere rain is the accumulation of wet mud, and in this manner trouble is most likely to arise from the position of the induction coil, so that in anticipation of a long wet ride, many riders completely encase the induction coil and its terminals in some waterproof material, whilst in their latest pattern machines Messrs. De Dion Bouton place the induction coil within the reserve petrol tank, where it is completely protected from the wet.

(To be continued.)

THE INSTITUTION OF JUNIOR ENGINEERS.—A large number of members of this Institution availed themselves of the permission, kindly accorded by the directors of the Mazawattee Tea Company, for visiting their extensive and up-to-date factories at New Cross, on January 9th. The works manager (Mr. Sidney Densham), the superintending engineer (Mr. J. C. Wallace), and other gentlemen, showed the members over, and an extremely instructive afternoon was spent. The electric generating and distributing plant, tea leadfoil rolling plant, sprinkler installation, condensing plant, automatic tea-packing and weighing machinery, tin-box making machinery, printing machinery, cocoa and chocolate machinery, &c., were all seen, the many ingenious devices in connection therewith receiving appreciative recognition. At the conclusion of the visit Mr. Percival Marshall, chairman of the Institution, heartily expressed the members' acknowledgments for the privileges which had been extended to them, Mr. Densham responding.

How to Make Experimental Electrical Apparatus.

By T. G. J.

(Continued from page 205, Vol. V.)

MISCELLANEOUS ELECTROSTATIC APPARATUS.

IN addition to the electroscopes, electrometers, statical electricity generators, etc., etc., which have already been described, the electrical student will require quite a number of smaller pieces to help demonstrate the many theories put forward in his text-books. The more important apparatus only will be treated, but it may be added that the student who will take the trouble to construct all the pieces here described will be amply recouped for his pains by the amount of pleasure and profit derived, and from the observations of electrical phenomena under various conditions. Perhaps it will be better,

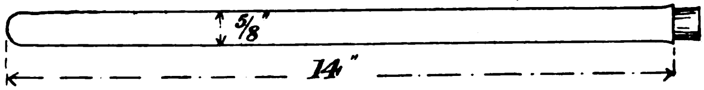


FIG. 1.—FRICTIONAL TUBE FOR ELECTROSTATIC EXPERIMENTS.

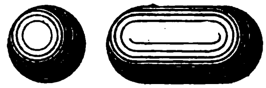


FIG. 5.

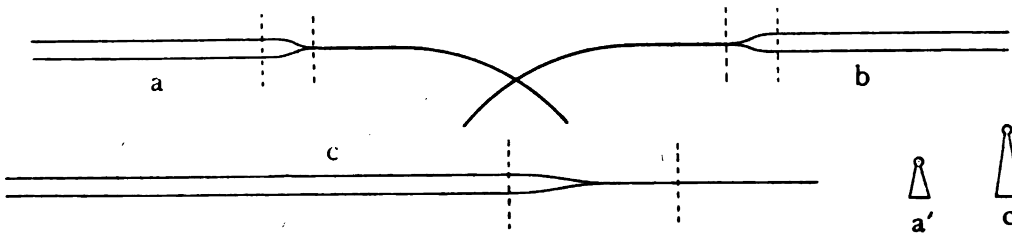
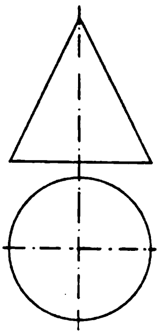
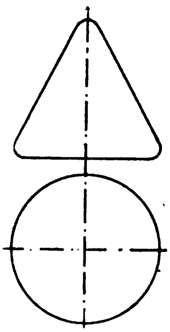


FIG. 2.—MAKING GLASS THREADS AND PIVOTS.





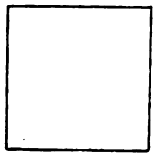


FIG. 4.

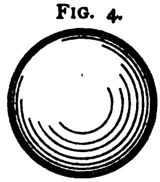


FIG. 3. FIG. 6. FIG. 7.

first, to describe the manipulation of some of the materials used daily by the experimentalist. Of these there are none which require to be of the right quality more than glass.

In making sealed glass tubes for friction insist upon having the best Bohemian glass, about 5/8 in. diameter. A very good length is 14 ins., and the end is sealed, or fused, by holding the tube vertical in the flame of a spirit lamp or Bunsen burner, and continually turning the tube in the fingers until the end has closed up. It will assist to make the sealed end more uniform if the tube be lightly blown into at intervals as the fusing proceeds. The tube should not be blown until the hole has completely closed up, else the end will be blown open again. The only precautions which are necessary in order to do this successfully are to hold the tube vertical, keep turning round in the fingers, and when blowing do so very lightly. Care should also be taken to heat the tube very gradually at first to avoid cracking. For the same reason cool very gradually. The open end of the tube is slightly widened. To do this heat the tube at this end, holding vertical as before, and when nearly soft press the heated tube upon a conical iron or steel spike. Heat the spike to the same temperature as the glass, and let the pressure be very slight. The tube should now be thoroughly cleaned inside, and all dust, etc., removed; then heat the tube along its whole length by moving it back and forth about 2 ins. above the flame. When hot enough to be uncomfortable to the hand, fit a good new

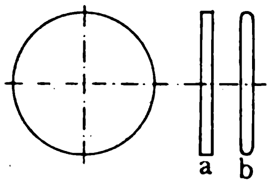


FIG. 8.

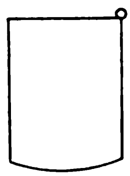


FIG. 11.

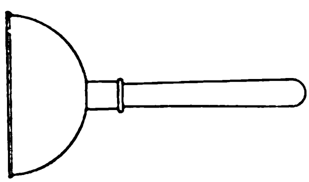


FIG. 9.

cork to the open end and the tube is complete. The interior of the tube will always be free from moisture, provided the cork is fitted fairly tight; but of course if the cork be afterwards removed, re-cleaning and re-heating will be necessary before again inserting the cork. A little sealing-wax or electrical cement applied to the cork will assist to keep the tube dust and moisture proof. Fig. 1 gives an idea of the appearance of a frictional tube.

Glass Pivots and Threads.—Pivots are made by heating a piece of 1/8 in. diameter glass tube near the centre, and when a little soft pulling asunder. To make a long pivot (Fig. 2, *c'*), give the tube a quick jerk, and for a short pivot (Fig 2, *a'*), a slow, steady pull. A hair-like piece will be found to project at each end; this is cut off near the pivot and fused into a small bead by holding in the flame of the lamp for a few seconds. To detach the pivots, make a sharp nick about half-way around the tube at the base of the pivot by means of a small triangular file, insert in the flame, and when fairly hot apply a slight pressure, and the pivot will come off. Threads are made in much the same way as pivots, using 1/8 in. diameter glass rod instead of tube. A quick jerk gives a fine thread, and a slow pull a thicker one. Threads are useful for insulating purposes. Shellac threads, fine rods, etc., are made like glass ones. Brown or orange shellac will be found easiest to manipulate. Avoid "dead" shellac—caused by exposure to the atmosphere—as it will not make threads. Always keep shellac in an air-tight box, or it will lose strength.

Conductors.—A very efficient set consists of cone, cube, cylinder with rounded ends, pear, sphere, and discs with round and square edges (Figs. 3 to 8.) They should all be about 4 ins. high, and the cone, pear, and cube are 4 ins. diam. at the base. Walnut will be found most satisfactory for making conductors. The tinfoil, with which the conductors are covered, is fastened to the wood with very thin glue and smoothed out with an old hat brush. The piece for the cone is a geometrical development of a cone, and should be cut about 1/8 in. deeper than the slant height of the cone. This small margin is turned down over the edge of the base before fixing the circular piece with which the base is covered. The pear is covered in much the same way as the cone, but the covering of the sides should completely turn the rounded edge of the base. As the apex of the pear is rounded off, a small piece of tinfoil should be fastened down over this part and well brushed. In covering the cube, let every one of the six pieces of tinfoil, with which the faces of the cube are covered, overlap the edges about 1/8 in.

The sphere is best covered with foil in longitudinal sections, and a little cap fixed down where the pieces meet at top and bottom. The cylinder is 2 ins. diam. and should have rounded ends and be covered with three pieces of foil, one on each end and a piece for the body. This latter piece should overlap the end pieces about 1/8 in. The discs had better be made of metal, as they may be required for many purposes. They could, with advantage, be made of copper and zinc respectively, and be 4 ins. diam. and 1/4 in. thick. Great care must be exercised when making the above conductors to avoid wrinkles in the tinfoil covering, and to fix the pieces very evenly and smoothly on the wood. The brushing should give a very neat and even surface, and cause the conductors to have the appearance of white metal.

Insulated hemispheres are easily made from the copper hemispheres used by sanitary engineers for making cistern balls. These hemispheres have usually rounded rims, so it will only be necessary to sweat an insulating handle socket in the centre of the convex side. (See Fig. 9.) The sockets are pieces of copper tubing, 1 1/2 ins. long, 3/4 in. diameter, with rings soldered to their upper end. The handles are of walnut, treated as described in article on

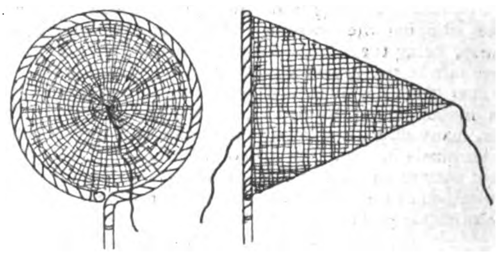


FIG. 10.—FARADAY'S CONICAL LINEN BAG.

Wimshurst machine. Faraday's Conical Linen Bag (Fig. 10) is made from linen gauze, and bound to a glass rod bent into a circle. About three inches of the glass rod should be allowed to project from the circle in the form of an axis. About 1/4 in. diameter will be heavy enough to have the rod. The bag is bound to the glass circle with very fine silk cord, and a piece of the same material is passed through the end or apex of the bag. The projecting straight piece on the glass circle is fitted with a good cork, and the whole can then be easily fitted to an insulating stem. (See page 199, Vol. III.) The Ice Pail (Fig. 11), another of Faraday's instruments, is simply a tin can about 6 ins. high, and 4 ins. diameter. The brass ball generally used in conjunction with the Ice Pail has a small hook screwed into one side for the attachment of insulating thread. A similar hook may, with advantage, be soldered to the Pail to facilitate the attachment of wires.

The Electric Chimes (Fig. 12), used in conjunction with the Wimshurst machine, are interesting and useful, and the close observation of their action will serve to fix in mind the laws of attraction and repulsion. The cross-bar is a piece of ½ in. diameter brass tubing, about 13½ ins. long, fitted at both ends with a ⅝ in. brass ball. Into one side of the tube are screwed five small screw eyes. The outside hooks are fitted first, about ⅝ in. from the balls at either end; then fix the others between the two already fitted. A space of 2¼ ins. should intervene between the hooks. In the centre of the tube, and diametrically opposite the screw eyes, is fitted a 1¼-in. hook, made from ¼-in. brass rod, and terminating in a ½-in. brass ball. From the hooks, on the extreme right and left of the cross-bar, are suspended by means of fine brass chains about 9 ins. long, 2-in. diameter gongs. A similar gong is suspended by means of a fine silk cord

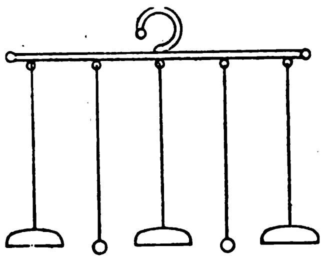


FIG. 12.—ELECTRIC CHIMES.

from the central hook. A piece of chain similar to that used to suspend the outside gongs is fitted to the inside of the central one, and must be of sufficient length to reach the table upon which the Wimshurst will be operated. Two clappers, made from ⅜ in. brass beads, are suspended from the hooks between the gongs by means of silk fibre twisted so as to form a fine cord. The gongs must hang quite level, and the clappers be suspended in such a manner that they will strike the chamfered sides of the gongs, when the former are caused to vibrate. These chimes are suspended from the prime conductor of the influence machine by means of the large hook in the centre of the cross-bar, and if properly constructed should chime continuously when the machine is worked. To obtain the best effect the gongs must be different in tone.

Hamilton's Mill (Fig. 13) consists of a brass ball, ½-in. diam., into which are fitted, at four diametrically opposite points, brass wires about 5 ins. long and ⅛-in. diam. The end of each arm or wire is filed to a fine point, and a hole is drilled in the ball at right angles to the arms. This hole, which is about 3-32nds in. diam., is drilled about 13-32nds in. deep. The end of each arm is now bent at right angles about 1¼ ins. from the points. All the points must be bent in the same direction. The mill is pivoted on a piece of knitting needle of such diameter that when placed in the hole made in the ball it will be free to turn in any direction with a minimum of friction. The needle can be screwed into the attachment ball of the prime conductor of the influence machine, and it should be remembered that the pointed end must always be used as the pivot bearing. This mill will revolve in the direction opposite that in which the arms point and will fully demonstrate the theory of density at points.

The Proof Plane (Fig. 14) is used in conjunction with the electrometer for the purpose of ascertaining if a body is "charged." It is specially useful when testing hollow conductors, as by its means the interior of the conductors can be examined with ease. It can be conveniently made by soldering about 1¼ ins. of ⅜-in.

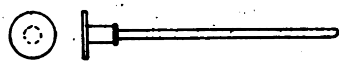


FIG. 14.—PROOF PLANE.

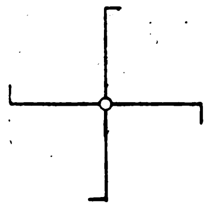
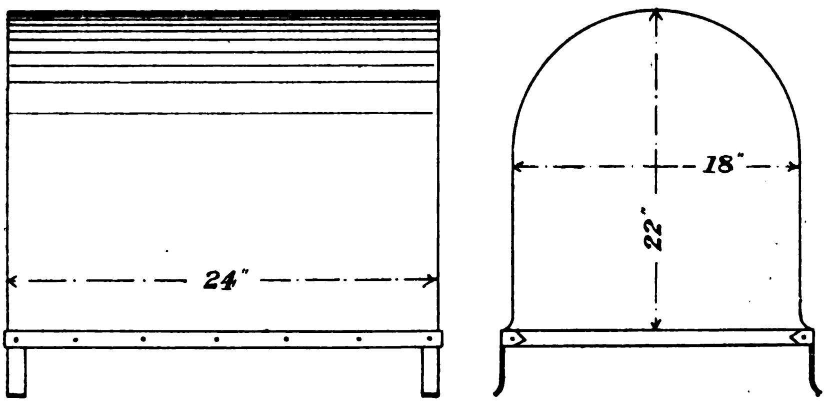


FIG. 13.—HAMILTON'S MILL.



FIGS. 15 AND 16.—SIDE AND END VIEWS OF DRYING OVEN OR AIR BATH.

FIG. 17.

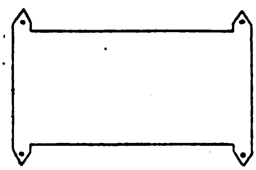


FIG. 18.

diam. brass tube to the centre of a halfpenny. A ⅛-in. brass ring terminates the piece of tubing to prevent dissipation of electricity at the edges. Previous to fixing the socket, the halfpenny must have its both sides filed smooth and the edge nicely rounded. The handle is 7 ins. of ebonite rod large enough to fit the socket without shake. Fix in socket with a little electrical current.

Pith Balls and figures are made from the pith of the elder tree. The balls should be cut as nearly round as possible with a penknife, and then placed on a perfectly flat surface and rolled with a circular motion, using a flat smooth board for the purpose. If the board is pressed too tightly, the result will be ovals instead of spheres. The figures may be made in parts and then glued together. The arms, legs, bodies, heads, etc., will prove difficult to carve at first; but with a little patience and perseverance it will be found possible to succeed.

Perhaps one of the most useful things in the student's laboratory is the Air Bath or Drying Oven (Figs. 15 to 18), for by its aid statical experiments may be carried out in the dampest weather. The many substances to be subjected to friction as well as the rubbers themselves and also the testing, measuring, and detecting apparatus, can all be placed in the bath and the troublesome moisture dissipated. Very often the electroscopes and electrometers may be allowed to remain in the bath during the experiment, and thus prevent the hydroscopic surface of the glass attracting moisture. The frame of the bath is made from strip iron, 1 in. broad, ⅛ in. thick. The legs are made from the same material and are 7 ins. long previous to being bent at the ends. The bend is made about 1½ ins. from the end, and almost at right angles to form the feet. The legs should be fitted to the inside of the frame by means of rivets passing through both. A sieve or gauze bottom is now made from wire gauze of close mesh and the ends bent as shown in Fig. 17, so that it can be hooked upon the ends of the iron frame. The sides are of tinned iron or copper sheet, and should be cut as shown at Fig. 18, and bent to shape shown at Figs. 15 and 16. The projecting lugs are bent round the corners of the frame and a small rivet passed through them and the frame to keep them in position. The cover should be riveted to the sides of the frame to keep both together. A second bottom is now made to fit over the ends of the frame in the same manner as the first, but this one should be of perforated copper. The first bottom should be let down about one inch lower than the second. The sheet copper is perforated by drilling ⅛-in. holes 1 in. apart all over its surface. The oven is now complete, but a Fletcher's burner will be required to provide the necessary heat. The burner is placed on a slate underneath the oven, and connected with the nearest gas jet by a few feet of rubber gas tubing. Regulate the flame and avoid too much heat.

How to Make a Watch Screw-driver.

By F. C. Reis.

We extract the following from the pages of our contemporary, the *Jewelers' Review*, believing that many of our readers will find a use for an excellent little tool, which should not therefore be found in the workshop of the clock-maker only.

A screwdriver of this design can easily be made by any workman. It takes four or five for a complete set. I find steel pinion wire, with as many leaves as possible, the best for the body portion, as shown at *c* in the illustration; the diameter can be 2, 3, 4, or 5 mm., or about those sizes. Steel pinion wire is desirable because it leaves no odious deposit on the fingers as brass does. They do not need nickel plating. The roller or swivel *b* can be made square or hexagonal, so it will not roll; it can also be made of different material, by which the size can be *quickly* distinguished. I always put emphasis on the word "quickly." For instance, we can use copper for the largest, silver for the next, brass, blue steel, and ivory. Four sides can be flattened in the filing fixture on the roller, so the corners will round, as shown at b^1, which is a top view of *b*.

Needles can be used for the blades. I find them very good. Temper the blades. To soft-solder them in neatly, lay a small bit of solder on the hole *a*, and you will see the solder run in nicely. Of course, the blades must fit snug so there will be no truing necessary after soldering. The sides of the blades can then be ground on a carborundum wheel, or a coarse oil stone, or the blades can be ground before inserting, with the slide rest and grinder, or gear cutter. The blade can easily be replaced, even if it should break off accidently, by holding it over the lamp and pushing it out. The bolt *d* is driven in like a roller is driven on a staff. The head of the bolt should be sunk into the roller so it will be flush when in its place. The swivel or roller should vary a little in thickness in the different sizes; also the diameters. The bolt is to be slightly tapering and turned smooth, so the the roller will turn free. The corner on the body where the swivel rests should be turned off so as to reduce friction. The smoother the roller and its seat are, the better it will roll; in fact, it will turn as though it were oiled, yet I never oil them. The hole in the swivel should be flat under the bolt head, and the bolt should be oiled on driving it into the body, to prevent its rusting or sticking, should it become necessary to draw it out in the future. It is a little more work to make the bolt than to simply turn a pivot on the body and then rivet it on, but the bolt with the smooth head runs or turns better, and never sticks when the swivel is pushed upward as the "bought trash" does. There is no friction on the bottom of the head of the bolt, when in use, and only a minimum amount against the finger on the top of the bolt.

As to the exact proportions of the parts, the workman can use his own judgment. I shall give the approximate proportions, which need not be adhered to. The body part can be 80 mm. long for all the sizes; the swivel can be 2 to 3 mm. thick, and 6 to 10 mm. in diameter; as to the blades, they should be made for use on an 18 size American full plate, down to four smaller sizes.

I have also made several good screwdrivers, using a plain piece of steel for the body, and then covering the body portion to the dotted lines on the sketch, with a piece of ebony wood; filling the hole with dissolved shellac, then turning the wood down and inserting two brass pegs to prevent the wood from turning. This I do for the large sizes 6 to 7 mm. in diameter for larger work or screws than in watches.

I shall say a little more as to the temper. Where the needles are not procurable, get Stubbs steel wire, and after cutting the lengths lay them on a charcoal block; blow the flame on them, and drop in oil when cherry or dark red. Clean them off well with fine emery paper; have them dry and bright, and blue them carefully over the lamp. Now drop them into muriatic acid, and wash them off and dry them. This is a good temper; even a dark brown is good. Remember now, if they are a little too hard at the socket, catch them with the pliers, and blue them to about 4 mm. outside of the socket. Now our temper is perfect. This blue, remember, should be removed, so when finished the tool will look workmanlike, bright and neat, pleasing to the eye, and agreeable to the touch.

The power for the electrification of the London underground, says the *Mechanical Engineer*, will be developed by steam turbines at the central power station at Chelsea. The total power will be 70,000 h.p., and it is proposed to use ten turbines each of 7000 h.-p. by Parsons & Co. These will be the largest motors of this kind ever built. The largest hitherto made was for the Elberfeld Corporation in Germany.

Fittings for Model Yachts.

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

(*Continued from page 233, Vol. V*)

II.—Spars.

SPARS must be made of very carefully selected pieces of either red or yellow pine; the grain must run clean and straight from end to end, and there must be no vestige of a knot throughout the entire length.

The most important spar is, of course, the mast; its diameter at deck should be $\frac{1}{4}$ in. for every foot length of water-line; thus, for a 10-rater the diameter should be about $\frac{3}{4}$ in.

In giving proportions for the other spars this diameter of the mast will be taken as the unit. Therefore, when two-thirds of mast is mentioned it means, in the case of a 10-rater, $\frac{2}{3} \times \frac{3}{4}$ or $\frac{1}{2}$ in; and when the spar in question is said to taper from $\frac{2}{3}$ to $\frac{1}{3}$, it will mean $\frac{2}{3} \times \frac{3}{4}$ (or $\frac{1}{2}$ in.) tapering to $\frac{1}{3} \times \frac{3}{4}$ (or $\frac{1}{4}$ in.); *not* tapering to one-third of the spar's greatest diameter, but to one-third of the mast's diameter. The drawings are not to scale, but are given only to explain the text.

If it is intended to use a topmast the diameter should be the same for the whole length of the mainmast; but for a polemast it should be tapered, starting about two-thirds of its length from deck, and finishing at top with a diameter of two-thirds of that at deck.

A mast should never be longer than is absolutely necessary, and for calculating this "least length" proceed as follows:—Divide the length of gaff on the sail plan into two equal parts; from the centre draw a line parallel to the water-line, and where this line cuts the mast is the lowest point where the peak halyard ring can be placed. Add another $\frac{1}{2}$ in. above this and you have the height of mast which is absolutely necessary.

Having measured the length of mast below deck, select a suitable piece of wood, and cut it an inch or two longer than required, plane it up square, and make quite sure that it is sound. A flaw may be found (which is otherwise invisible) by taking the two ends and twisting the wood as if to make it into a screw. Don't, however, overdo this twisting, or the wood will split. If satisfactory, start planing the four corners off in turn until the spar assumes a fairly round appearance. If a polemast, mark the position where the tapering will commence, and continue planing away a little more from that mark to the end until the diameter at the top is about the required size.

Should it be intended to use a mast tube through the deck, the diameter of mast below deck must, of course, be equal to the diameter of the inside of the tube. If it is merely let through the deck, the extreme end should be cut square to fit into a square recess fitted on the bottom of the boat.

After the planing process, use a coarse sandpaper, drawing the spar through the paper from end to end, finishing it with a fine paper until perfectly smooth.

The appearance of a polemast is much improved if the top is finished off in the manner shown in Fig. 2 A and in Fig. 5; this allows of a ledge on which the shrouds or a brass ring (to be described later) can rest.

The extra piece must be added, in addition to the actual length of mast required, and the small round cap on top is fitted separately.

The simplest, and, at the same time, most efficient, method of fixing a topmast is by means of a light brass tube, about 4 ins. in length for a 10-rater, and shorter in proportion for the smaller classes (Fig. 1). This tube is sunk on the mainmast for half its length, the latter being made smaller at the head, so that the outside diameters of mast and tube are equal.

It is better to obtain the tube before cutting the mast, so as to guarantee a nice fit.

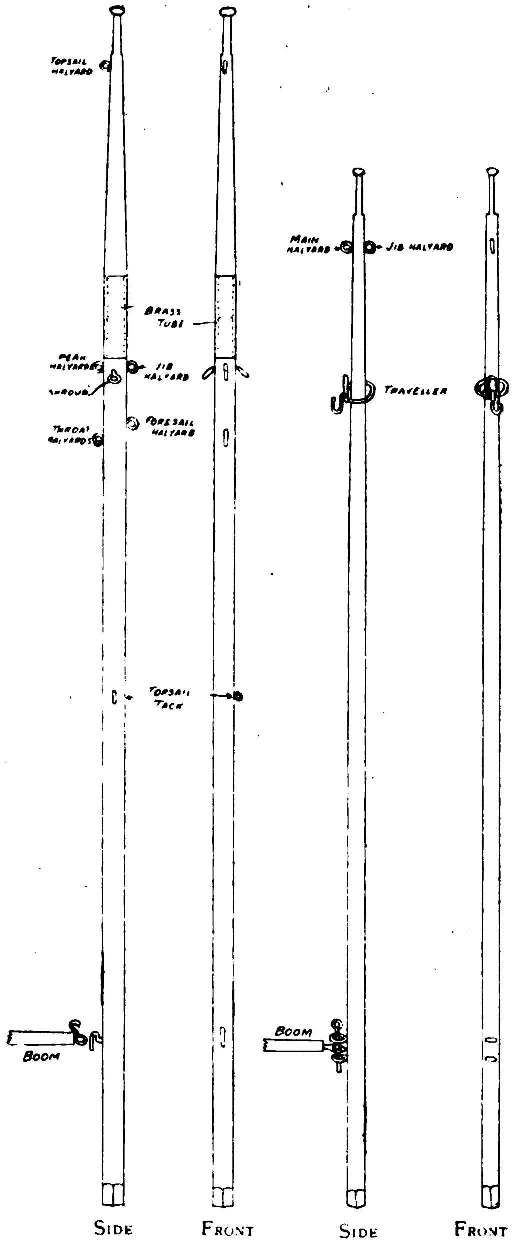


Fig. 1. Fig. 2a.

The topmast tapers its entire length, and at the top should be about half of its diameter at the brass tube; it can be finished off in the same manner as the head of the polemast. Its length is obtained by the same rule as that used for the mainmast, using the yard of the topsail instead of the main-gaff.

The main boom has its greatest diameter one-third of its length from the clew of the mainsail, where it should be as large as the mast. It tapers each end, to about ¾ at the clew and ⅝ or ½ at the tack.

The gaff should be about two-thirds of the mast, tapering from the jaws (where it is largest) to about half of the mast at the peak. Wooden jaws on gaffs are unsatisfactory; those made of wire are recommended, and will be described later.

The diameter and strength of bowsprit depends, to a large extent, on its length; for an up-to-date craft with a reasonable length of overhang forward (which takes the place of bowsprit), the same proportions can be used as those given for the gaff, excepting that it should not taper quite so much.

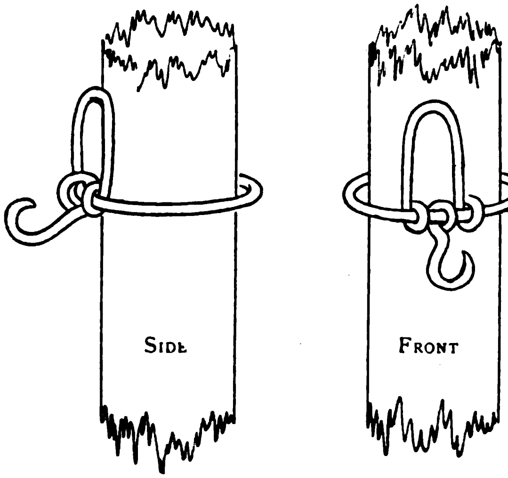


Fig. 2b.

The length of bowsprit "inboard"—viz., on deck, should be about 6 ins. for a 10-rater. In some cases this part is "flat" on its under side, but make it round to start with, as it can be altered afterwards, if necessary.

The topsail yard is one-third of the mast with the slightest of tapers at each end, and this size will be suitable also for the spars along the foot of the headsails.

The yards for the standing lug should be two-thirds of mast at centre, tapering to half at each end.

The small spar, called the jack yard, usually fitted at the foot of the topsail, may be a quarter of the mast, and not tapered.

The spinnaker boom should be two-thirds of mast, with a slight taper at the mast end.

To strengthen the ends of the spars (masts excepted), where it is necessary to place screw-eyes or to bore holes, small brass rings can be fitted; the wood should be cut away so that the rings will be flush with the surface of the spar. They are not absolutely necessary, but give a smart appearance to the finish of the rigging. In their absence the ends of the spars must be whipped with fine twine. At the clew end of boom and fore end of bowsprit the brass rings should be sunk on to allow a projection of about ½ in. of spar, through which projection the hole for outhaul on traveller should be bored (see Figs. 6 and 9).

If the rings are to be used, they are fitted before the spars are varnished; but the twine can be put on after.

The varnish must be rubbed in with cotton wool or a piece of soft flannel; a brush is useless for such small work, as it is impossible to get any pressure to ensure the varnish being well rubbed in.

Each spar should have at least two coats of varnish, allowing the first to thoroughly dry, and, before applying the second coat, smoothed down with *very* fine emery paper, and afterwards with a clean piece of cloth.

The spars can now be fitted with the necessary appliances for attaching to the sails, and the mast for the standing and running rigging.

The mast will require a strong hook just above the deck to receive the screw-eye in the end of the boom. There is a very neat mast tube on the market with this hook combined, a rough sketch of which is shown in

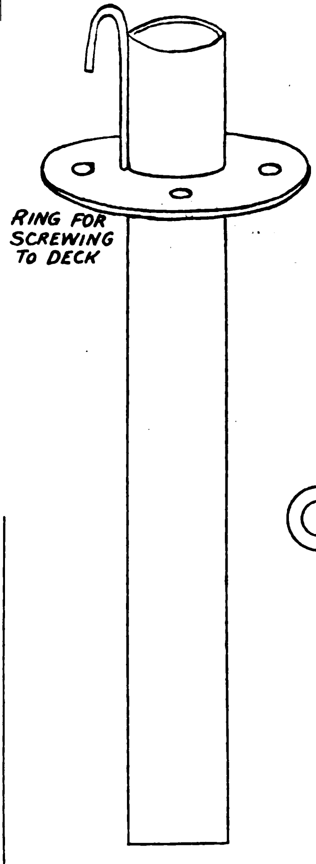


Fig. 3.—Mast Tube.

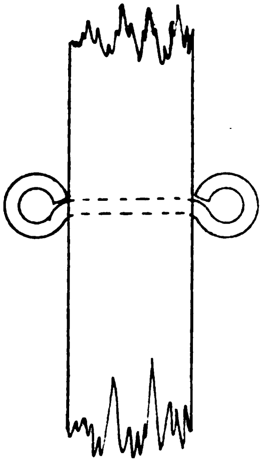


Fig. 4.

Fig. 3. An alternative plan is to have two screw-eyes on the mast, between which the screw-eye on boom is placed and held together by a pin dropped through all three. This method is shown in Fig. 2 A. At head of mast there must be a ring for the peak halyard, and another lower down for the throat halyard, on the fore side of mast one for jib halyard and another for foresail halyard (if both head sails are used). Two more rings—one on each side of mast—are required for the shrouds. These last two are not required if a polemast with a ledge is used as shown in Fig. 2.

All these rings may be screw-eyes, but when there are two on opposite sides it is practically impossible to place them at the same height, and if one is a trifle lower, the mast or spar is weakened considerably by the double hole. To remedy this, a pair of rings, such as the shroud rings, should be made in one piece of brass wire. Turn one end into a ring, bore a hole through the mast, place the wire through, and turn the other end into a ring of similar size, taking care to have the join of the ring on the upper side as shown in Fig. 4. This plan should be adopted whenever possible.

If the "rigger" is clever at small brass work, a very neat masthead ring can be made of a piece of brass tube, as shown in Fig. 5. This can be slipped over the mast and held in its place by a couple of small screws. The mast should be cut away to make a flush joint. If a topmast is being used, the lower end of the brass tube can be fashioned in the same way. It will be remembered

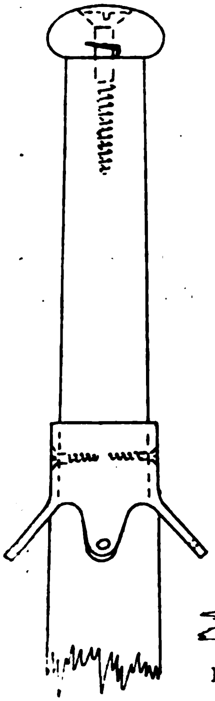


FIG. 5.

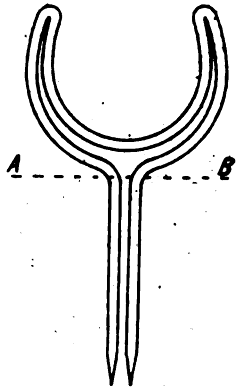


FIG 7.—GAFF JAW.

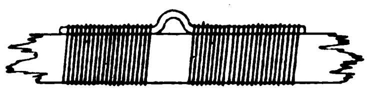


FIG. 10.—METHOD OF LACING TEMPORARY LUG TO YARD

The boom has a screw-eye fitted in forward end, to which is attached a hook for receiving the eyelet in tack of sail, and at the after end is the outhaul and traveller. This latter is on the same principle as that used for hoisting the yard of a balance lug. The ring fitted in the clew of the mainsail is hooked on to the traveller, and the latter is drawn to the end of the boom by the outhaul, which will require a hole bored through the extreme end of boom *from top to underside*. Holes through spars, if intended for cord to run through, should be made with a piece of red-hot wire. A ring is placed on underside of boom for the outhaul to be attached to. This traveller is only used in the case of a loose-footed mainsail; if intended to be laced to boom, a hole is necessary at end of boom *from side to side*. The differences are shown in Fig. 6. The other fittings for boom are shown in these diagrams.

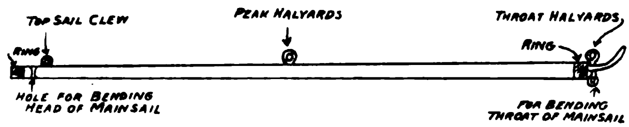


FIG. 8.—FITTINGS FOR GAFF.

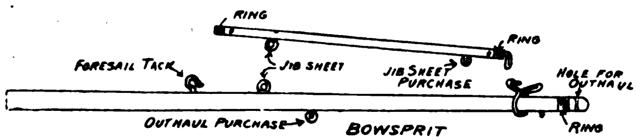


FIG. 9.—FITTINGS FOR BOWSPRIT.

As before stated, the gaff jaws are made of wire, and are shown in Fig. 7; they should be bent at B, so that when the sail is properly hoisted, the jaws lie at right angles to the mast.

The gaff requires rings on top and bottom as near the jaws as possible—the mainsail will set better if these rings are worked on to the jaws through B in Fig. 7; a smaller ring is also necessary at the peak for the topsail outhaul, if this latter sail is used. A hole from side to side for the peak of mainsail and a ring, about the centre of spar for the peak halyards (Fig. 8). The bowsprit is fitted as

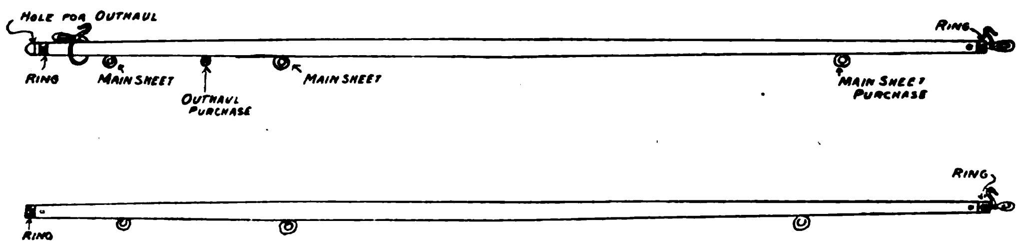


FIG. 6.—FITTINGS FOR BOOMS.

that small rings were sewn on the luff of the mainsail for lacing to mast. The cord for the lacing may be wound round the mast, or very small screw-eyes may be fitted down the after side of mast, through which the cord can be alternately threaded with the rings on the sails.

For the lug sails, which have no gaff jaws, the mast must be fitted with a traveller, as shown in Fig. 2 A, and also enlarged in Fig. 2 B.

Provision must be made for holding down the tack of the topsail, and for this purpose a small screw-eye should be placed on side of mast about half way down.

When setting up the sails, it may be found convenient to have further rings here and there; but those mentioned are the only necessary ones at present.

shown in Fig. 9. Shroud rings need not be used unless the bowsprit is of any great length outboard; as an alternative, the bowsprit end may be fitted with a cap of brass tubing similar to the masthead shown in Fig. 5. The traveller on the bowsprit is very useful, as by means of it the jib can be shifted fore and aft, and experiments made as to its best position in various strengths of wind.

In the case of the lugs on yards which have no jaws, it is better not to put in screw-eyes for the halyards, as it is seldom that the position first tried is satisfactory. A better plan is to bend a piece of wire and lace it to the sail, so that, if necessary, the ring can be shifted until the best position is found (see Fig. 10). This plan can with advantage be carried out on all the other spars, and save weakening them by boring holes. When the correct position has been found, a small groove can be made in the wood, into which the wire will sink. The topsail yards have the halyards and outhaul attached direct to the spars, to avoid any projection which would prevent them being close up to topmast and main gaff. All these latter-mentioned spars have holes at the ends from side to side.

The spars for a schooner and yawl are made in exactly the same way as for a cutter or sloop, excepting that the sails of the two former rigs being proportionately smaller (viz., if the same total sail area is used), the spars may be made a trifle lighter.

Fig. 11 shows a skeleton outline of the spars on a cutter with their names.

The battens for the gunter are best made from hickory

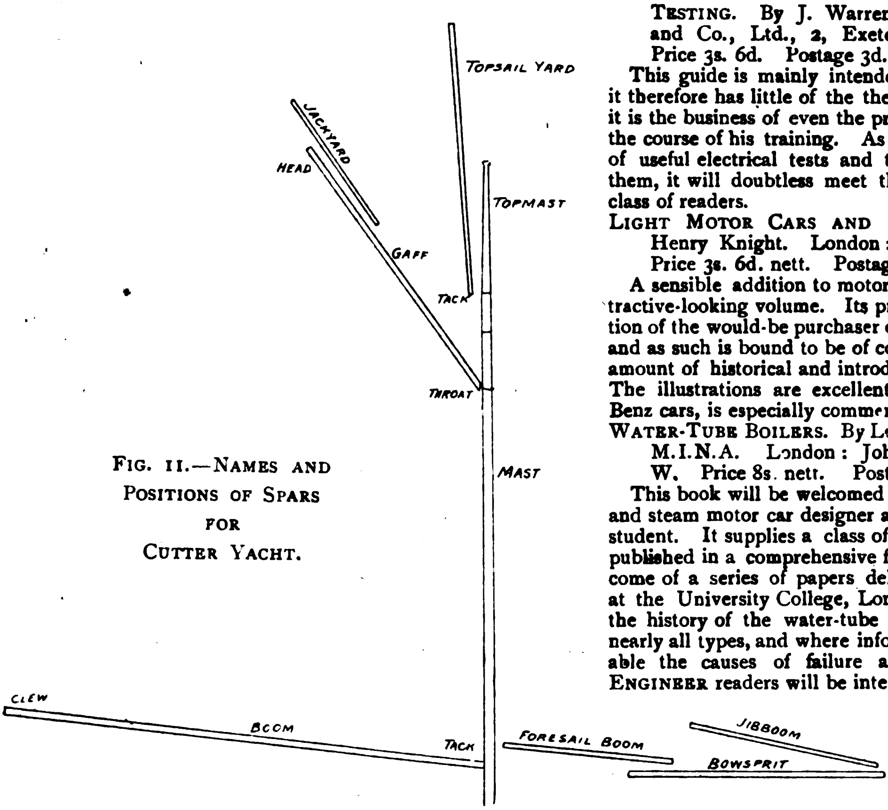


FIG. 11.—NAMES AND POSITIONS OF SPARS FOR CUTTER YACHT.

or other springy wood, but pine makes a very good job. They should be ¼ in. wide by 1-16th in. thick, and need not necessarily be varnished. The spars should be now ready for attaching to the sails, and the mast and bowsprit for setting up on the hull, a procedure known as "fitting out."

It is stated that a patent has been taken out for an arrangement to reduce the noise caused by exhaust gases issuing from internal combustion engines into the atmosphere. A valve which can completely close the exit passage from the exhaust box to the atmosphere during each cycle of the engine, is provided, and at that period at which noise tends to occur, it is caused to close, and opens again to allow the exhaust gases to escape as soon as their state of disturbance in the box has subsided.

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.)*

PROSPECTING FOR GOLD. By Daniel J. Rankin, F.R.S.G.S. London: Crosby Lockwood & Son, 7, Stationers' Hall Court, Ludgate Hill. Price 7s. 6d. nett. Postage 3d. extra.

This is a very handy pocket-book for the gold seeker, containing a vast amount of information in a very portable form, and only dealing with such subjects as are of direct interest to the prospector. The volume is especially well bound and carefully printed.

GUIDE TO THE PRACTICAL ELEMENTS OF ELECTRICAL TESTING. By J. Warren. London: S. Rentell and Co., Ltd., 2, Exeter Street, Strand, W.C. Price 3s. 6d. Postage 3d. extra.

This guide is mainly intended for the practical man; it therefore has little of the theoretical in its pages, since it is the business of even the practical man to get this in the course of his training. As a compilation, however, of useful electrical tests and the manner of conducting them, it will doubtless meet the needs of a very large class of readers.

LIGHT MOTOR CARS AND VOITURETTES. By John Henry Knight. London: Iliffe & Sons, Limited. Price 3s. 6d. nett. Postage 3d. extra.

A sensible addition to motor car literature is this attractive-looking volume. Its prime motive is the instruction of the would-be purchaser of a light car or voiturette, and as such is bound to be of considerable use. A certain amount of historical and introductory matter is included. The illustrations are excellent, and the information *re* Benz cars, is especially commendable.

WATER-TUBE BOILERS. By Leslie Robertson, M.I.C.E., M.I.N.A. London: John Murray, Albemarle St., W. Price 8s. nett. Postage 4d. extra.

This book will be welcomed by the model boiler maker and steam motor car designer as well as the engineering student. It supplies a class of information never before published in a comprehensive form; and is really the outcome of a series of papers delivered by Mr. Robertson at the University College, London. The work reviews the history of the water-tube boiler, giving drawings of nearly all types, and where information has been obtainable the causes of failure are noted. Its MODEL ENGINEER readers will be interested to find that many of the schemes put forward by them and others as new are, in fact, very old, and how, as time goes on, the inventors of various engineering details are forgotten. Thus, the "Field" tube was invented in 1831 by a Jacob Perkins, the present name having become associated with it by its use in a boiler designed subsequently by a Mr. Field. The work also includes description of the early developments of the water-tube boiler in connection with road locomotion. The chapter on "Circulation" should prove interesting and instructive. The young marine engineer will find the information given in the parts devoted to feed water regulation, the advantages and disadvantages of the water-tube boiler, of great service to him in his preparation for qualifying examinations. Considering the magnitude of the subject, the book, with its 200 pages and 171 illustrations, deals with the subject minutely; but it does not seem to lessen the want of a complete treatise upon the design and construction of the "tubulous" boiler; perhaps the time is not quite ripe for such at present.

The Editor's Page.

CONSIDERING the ability and ingenuity displayed by many readers of THE MODEL ENGINEER, as exemplified in their contributions and in many "Practical Letters," it is a little surprising that the drawings submitted rarely reach a high level. It happens that the requirements in this matter are fairly simple—good outline drawings in really *black* ink being all that is necessary—yet very few appear to bear this in mind. Sometimes a fairly capable draughtsman makes a show of good work, but he often discounts it all by adding shade in pale washes, colouring, or even red and blue centre and dimension lines, which, however useful on ordinary working drawings, are quite unsuited for reproduction by process engraving. Sometimes good drawings are spoilt by careless lettering or figures, or because the letters and figures would be too small when the drawing is reduced to the requisite size for our pages. When the contributor is able to produce a good drawing, but does not feel equal to sufficiently neat lettering, &c., the figures and descriptive words should be written on in pencil, so that they can be properly inserted in ink by one of our own staff.

* * *

We can safely say that dating from the first contribution ever sent to this journal, up to the present moment, but few drawings have been received in a form ready for reproduction in our pages without some alteration or touching-up being required. Of course, these alterations are sometimes trifling enough, but such are the exceptions. Now, there is little reason for this state of affairs. Every reader who takes an interest in his work hits upon some clever "dodge" at one time or another, and he is usually generous enough to give his fellows the benefit of his experience. The excellent "Practical Letter" he sends us, however, does not appear in the "next issue" (which was probably printed when he wrote), nor even in the next. He blames us, and loses interest in his idea; but if he only knew the truth, it is simply that his "rough sketches" required a large amount of overhauling or redrawing at a time when our staff was particularly busy. The moral is that those who desire to see their ideas in print at the earliest moment, should send a good plain drawing—not a fancy sketch. Of course, many of our readers have not had sufficient experience in draughtsmanship to enable them to produce a properly-finished drawing, and we need hardly say in such cases a clear sketch, however rough, is acceptable if the idea described is good.

* * *

"R. G." (Paris) writes: "I have read with great interest your articles on the building of a motor tricycle, but I should advise the readers (if they will allow me to do so) who intend building one to wait till you have given the instructions to build a motor bicycle, if they want a bicycle of that class, as I am quite sure they would be entirely disappointed with a tricycle. Not that there is any defect in the explanations given in your columns, but a motor tricycle in itself is not a desirable machine at all, and I can speak from my own experience, even with some of the newer types than the one described. This is amply proved by the fact that in France—the fatherland of motor cycles or motor cars—there is now scarcely any tricycle to be seen about, whereas, only two years back, there were thousands of them on the roads or in the cities. I do not think it necessary to give here any other explanation to this fact, as I cannot take up too much of your valuable space and time; but anyone who will reflect and compare the motor tricycle and the motor bicycle, will certainly not hesitate one instant to decide in favour of the latter. I hope these few lines may be of use to your readers, who will keep their skill to devote it to the bicycle, when you give them the necessary instructions, and should same be as clearly explained as in the case of the bicycle, I am quite sure they will be fully satisfied." Perhaps some of our readers, who have had actual riding experiences with motor cycles, may favour us with their views as to the relative advantages of the two types of machines.

* * *

"R. W. B." (Liverpool) writes:—"I am pleased to read, in your issue of January 15th, that at least one maker has offered his models on easy terms. I am sure there are many of your readers who will be glad of such an arrangement, and I am surprised that some of the leading model makers have not offered such terms before to-day. There is no doubt there are many 'would-be modelites' who have to be content with mere reading of your esteemed journal, owing to the lack of ready capital. I am sure if one or two more firms would come forward, and trade on the same lines, it would help the amateur a great deal. Perhaps, if you would kindly publish this letter, Messrs. Whitney, MacMillan & Co., Stevens' Model Dockyard, the Clyde Model Dockyard, and several others, may give a thought to this."

* * *

It will be noticed that we devote on this page some space to brief replies to correspondents whose communications have not been otherwise acknowledged. We hope to make a regular feature of this, so that those readers who write us on any matter which does not require a reply by post, or through our Queries and Replies column, may know that their communications have not been overlooked.

Answers to Correspondents.

"W. C." (Glasgow).—You do not state the type of machine. Send *full* particulars and we will be glad to assist.

"VOLT-AMP" (Guernsey).—Many thanks for your good wishes, which we much appreciate. It is early yet to think of a weekly issue of the *M.E.*, but the matter is not being lost sight of.

"H. L. K." (Egerton).—Suggestions for article on hydraulic models duly noted. You will find an interesting description of a model hydraulic press in our issues for October 15th and November 15th, 1901. Also article on hydraulic ram for raising a window blind in issue for December 15th, 1901.

Prize Competitions.

Competition No. 18.—Two prizes, value respectively, £5 5s. and £3 3s., are offered for the best and second best original designs for a small modern type direct-coupled steam engine and continuous-current dynamo. The donors of these prizes make the following stipulations:—The output of the dynamo to be not less than 500 watts, and the voltage to be not less than 50. The competitor may make it more if he likes, but due regard must be paid to the tools at the disposal of amateurs who are not beginners. The engine may be of any type preferred by the competitor, either single or double cylinder, single or double acting, simple or compound, enclosed or open. The boiler pressure is to be taken as 60 lbs. on the sq. inch. A design is required that will represent something more than a toy, and yet within the power of a good amateur mechanic to build, and capable of giving satisfaction when made. Complete scale working drawings, with dimensions of both engine and dynamo, must be given, as well as all necessary mechanical and electrical calculations. There should, in addition, be a full written description of the set, explaining the methods to be adopted in its construction. The usual general rules will also apply to this Competition. The closing date for receiving entries is March 31st, 1902.

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. 20.—Prizes, consisting of an "Anglo" Lathe (list price, £3 10s.) and another Lathe (list price, 17s. 6d.), both presented by Messrs. S. Holmes & Co., of Bradford, are offered for the best and second best articles describing a model made by the competitor without using a lathe. The model described may be anything of a mechanical or electrical nature, and should preferably, but not necessarily, be a working model. More credit will be given to a model in which the parts which are usually produced in a lathe have been worked up in some other way than to a model so designed as to avoid the necessity for any cylindrical parts. The description should be sufficiently full to enable any other reader to make a similar model, and working drawings showing clearly the details of construction should be given. All entries should be received by us not later than March 15th. The general competition rules should be observed.

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.

Competition No. 17.

We append below some comments on the principal entries for our recent competition for a design for a model portable steam crane.

(1) DAVID SHANNON, 161, Broomloan Road, Govan, Glasgow.—The drawings sent in by this competitor are very clear and workmanlike. The crane is of unusual design and has very little gearing, the various motions being obtained by separate cylinders, of which there are five. On this score the design is open to criticism, especially as the boiler is of rather small proportions. The fuel arrangements are not shown. The description is clear, but might have been extended in places.

(2) ALEXANDER MACLAREN, Carridon, Motherwell, N.B.—This competitor has shown a very complete design, practically a copy of a large loco crane, modified in essential points to make it efficient as a model. The only fault which can be found is that the drawings are not as clear as should be, and before reproduction can be attempted, new ones must be made. Too much has been crowded on to a given amount of paper. The crane has two cylinders with link motion. The slewing and travelling motions are reversible, independently of the engines. High and low gear are arranged for the lifting, and can be thrown in according to the weight to be hoisted. The description is very good. The drawings should have been made to a larger scale.

(3) H. H. (Forest Hill).—The general design of crane is good, and no doubt it would make an efficient working model, but the entry is not the best sent in. The drawings are only fair, and are not complete. A good longitudinal section should have been made. The details are not worked out in a proper manner.

(4) E. F. (New Barnet).—The drawings are not capable of reproduction. Description is full, but is not as clear as it might be. Gearing arranged in a rather disproportionate manner, and it is doubtful if several details as shown are practicable. Pattern making necessary for carrying out the design would be difficult, and the patterns are numerous. Engine not designed or arranged in quite the best way; one cylinder only is used.

(5) J. B. H. (Portland).—No attempt is made at explaining the details of construction, and the drawings as they stand do not admit of reproduction. Longitudinal section not made—such a drawing in this case seems essential. The boiler would not evaporate sufficient water to work engines satisfactorily, and the design of the cylinders might be improved.

(6) F. J. K. (Birkenhead).—The drawings are not at all clear, and, contrary to rules, coloured inks are used. Details not well designed, and use of two sets of double-cylinder engines with link motion is deprecated. Boiler not arranged in the best manner possible.

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 New Type of Small Storage Battery.

TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—I hope you will publish this additional information about my storage batteries. "Cycle Engineer" asks how the cells are made up. There is nothing difficult about it that I can see.

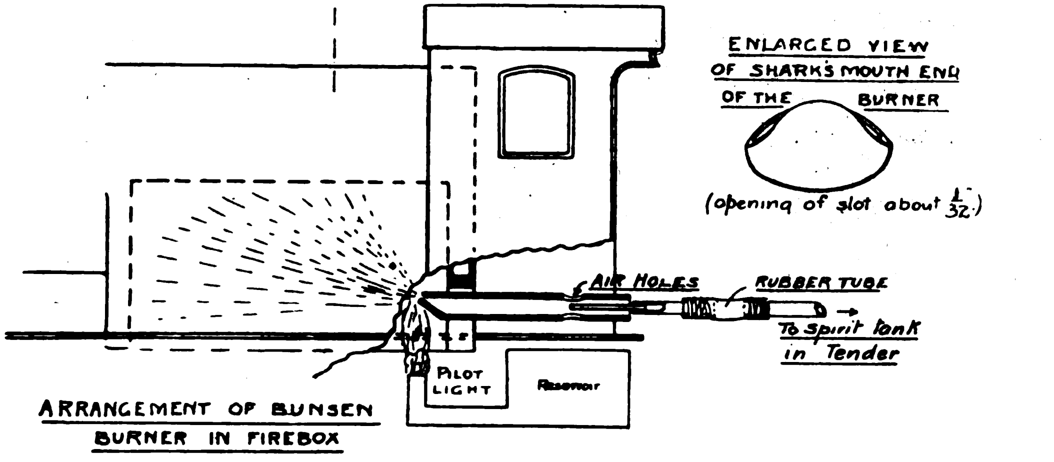
Part of the lead is first mixed with the litharge paste and rammed down in the space between outer glass and inner porous cell. This is the negative.

Then more lead is mixed with the *minium* paste, and placed inside the porous pot. The lead wire electrodes are, of course, put in place before ramming down the mass.

I stated in my article that the size of cells I use gives about ten ampère-hours. It stands to reason that larger ones, containing, say, 25 lbs. of lead instead of 2½ lbs., would probably store the 70-90 ampères "Cycle Engineer" wishes to obtain. As the voltage is normally 2·00, it is easy to calculate the number of cells required for a given E.M.F.

The only defects I find in these batteries are the considerable weight and the low rate of discharge, which averages two ampères. I should be grateful for any suggestions concerning improvements.—Yours truly,

Florence, Italy. C. D. MARTINETTI.



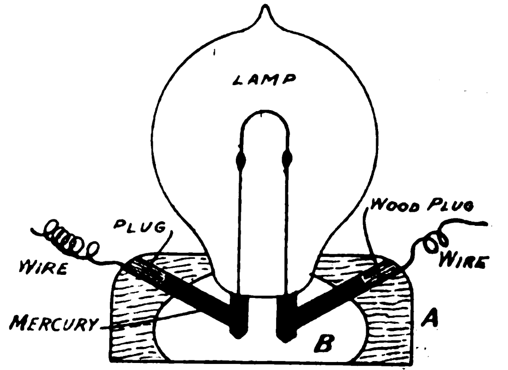
SPIRIT VAPOUR BURNER FOR MODEL LOCOMOTIVE.

How to Repair Electric Loop Lamps.

TO THE EDITOR OF *The Model Engineer.*

SIR,—I have noticed in THE MODEL ENGINEER various methods of repairing loop lamps. I tried these, but with unsatisfactory results, and I have come to the conclusion that the following method is the best:—

First turn up out of hard wood a ring (A, Fig. 1), fitting the lamp in as shown. Next fill up with plaster-of-Paris, made to a liquid (B). Remove the lamp, which should have had a little oil rubbed over where the plaster comes; drill very carefully two holes down the plaster exactly the same width apart as the wires in the lamp, and two more diagonally to meet same, as shown per sketch. Next carefully glue the lamp in with its wires opposite the holes in the plaster, and fill these holes with mercury, plugging two wires to meet the mercury, which



REPAIRING AN ELECTRIC LOOP LAMP.

completes the lamp. The sketch is in section.—Yours truly, W. E. COLES.

Chippenham.

On Firing Model Locomotive Boilers.

TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—As I have been making further experiments in firing with spirit vapour with decided success, I think your readers would be interested in a few details of the method I employed. My original design was to generate the vapour in the usual method—by a small lamp under a spirit tank in the tender, taking care to lead the supply pipe from a dome with splash plate or well separated chamber to ensure that no liquid spirit passes over. An eighth pipe was used, and connection made with the locomotive by the ordinary black rubber tube, which will be found to stand the vapour best. The metal pipe was continued in the cab, and led into the firebox, where it ended in a "shark's mouth" burner.

A small "pilot" lamp was attached to the locomotive with the top of the wick slightly in front of and below the burner. I found that this burnt steadily, and did not "pop out," as in Mr. Greenly's experiments; but although I left the firebox as open as possible, the vapour did not get a sufficient supply of air, especially when standing, and escape of unburnt spirit at the funnel was very marked.

I have now altered my burner, by leading the eighth pipe into a three-eighth pipe in the cab, leaving the end of the larger pipe open, and also making holes opposite the vapour jet, as in a Bunsen burner, and then led the larger pipe into the firebox ending in a burner as before. I now find the flame flows evenly over the whole firebox, with no cushion of gas, while the escape of unburnt spirit is very slight, and would probably be nothing with a rather larger outer tube. I enclose sketches of the arrangement.

The following is another hint that may be of use to your readers:—I find that after taking pains in making a model, much of the work is disfigured by after experiments, especially in boiler design. I find it now much better to buy one of the cheaper models with fairly realistic outlines, and experiment with it until I have come to a satisfactory decision. In fact, one of the type, a "Pilot," from Messrs. Basset-Lowke, would form the basis of quite a respectable little model. It is very powerful, and with boiler modifications would enable anyone to add to their rolling-stock at very little expense, especially when a workshop is not at hand.

I would certainly advise beginners to try this method, as it will save them many disappointments, inseparable from commencing on a more ambitious model, and the experience gained will be useful in future attempts.—Yours truly,

W. W. H.

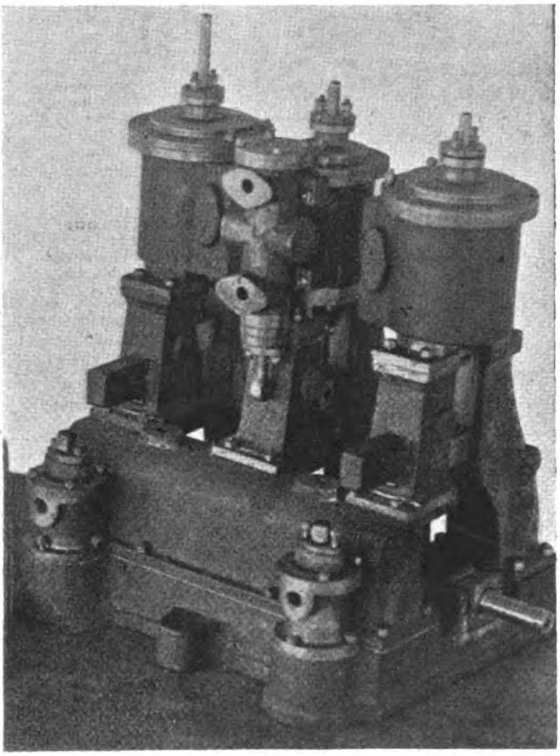
Sheerness.

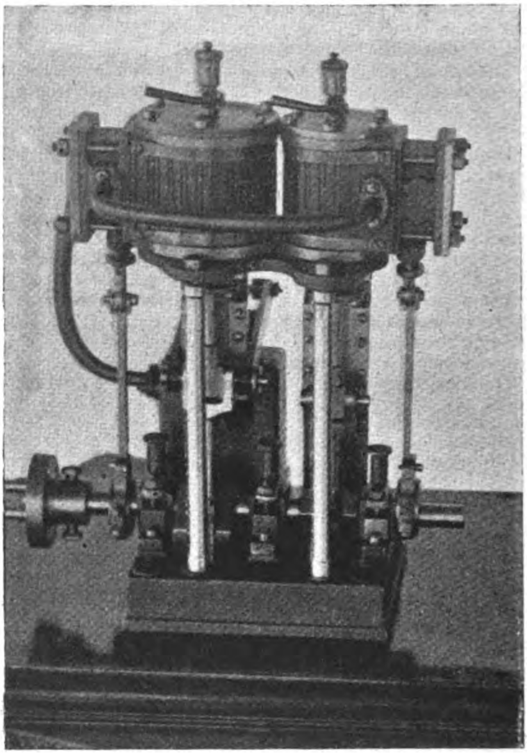
Two Workmanlike Models.

To the Editor of *The Model Engineer*.

Dear Sir,—I am sending you a couple of photographs of engines I have built lately. One is, as you see, complete, and the other in progress. The completed one drives a light boat, with two people in it, on a lake quite nicely. I find The Model Engineer most useful and instructing.—Yours truly,

Amraoti, Berar. W. H.





Two Excellent Steam Launch Engine Models.

How to Build a ¼-h.-p. Water Motor.

To the Editor of *The Model Engineer*.

Dear Sir,—I must thank Mr. Pitman for his friendly criticism of my design of a water motor, in The Model Engineer of December 15th.

I thought it best not to make any allusions with regard to the balancing of the wheel, assuring myself that if the patterns were well made, and good castings obtained, the only portion out of balance would be the one directly opposite to key, and as this is very near the axis of rotation, it appeared to me that it could be overlooked. I certainly agree with Mr. Pitman that the balancing would be an improvement.

Referring to the shaft, I think it could be increased with advantage to 7-16ths in. or ½ in. diameter.

I do not think making the patterns for the cups with a pocket-knife an utter impossibility, as I have made several myself of various shapes, and after trying many ways, I found the knife the best, though it demands some labour and careful work.

As to the statement that my buckets are "old-fashioned": owing to the jet being placed at the top, I had resort to the said shape, which are quicker in ridding themselves of the spent water after it has performed its work. I would certainly not have adopted them, had I placed the jet at the bottom as in Mr. Pitman's design.

With regard to the lining of bearings, the idea was to facilitate the removal of worn-out bearings, and the replacing of new ones, thereby obviating knocking and unsteady running. I must again thank Mr. Pitman, and assure him that any criticism from him would not only be very acceptable to me, but would also be a great help to "Ours."—Yours truly, G. SOLIS.

Glasgow.

Queries and Replies.

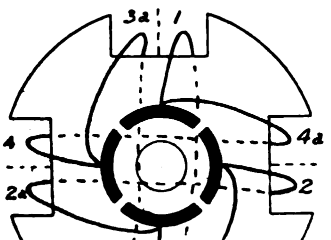
Attention is especially directed to the first condition given below, and no notice will be taken of Queries not complying with the directions therein stated.

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:—

[5371] **Winding a 4-part Armature.** F. E. (Hartlepool) writes: I have a four section armature, and I cannot find out how to wind it. It is a drum armature, laminated. Diam., 1 1-16th ins.; width of slot, 5-16ths in.; length, 1⅝ ins. What amount of wire will be required? I have a 4-part commutator.

A 4-slot armature should be wound in four sections for a 4-part commutator. A diagram of the best way to do this is here given.



You do not state anything about the field magnets, the output required, nor the use to which the machine is to be put, so that a reply to the last portion of your letter is hardly possible. About 2 ozs. of wire would be required to wind it.

[5396] **Telephone Installation without Induction Coil.** A. S. E. (Hampstead) writes: I am making a telephone station as described by Mr. Colville Barrington in Nos. 12 and 13 of THE MODEL ENGINEER. I have made the automatic switches as directed, but I wish to avoid using an induction coil, the distances being very short. In Fig. 9, page 3, No. 13, Vol. II, the connections are shown with induction coil. Will you please show me what alterations are necessary so as to use transmitter and receivers in simple series? The transmitters are G.P.O. Hunnings, granulated carbon type, and receivers are bells, having rather low resistance. Having made all the switch work, I should like to have connections which would work without having to make new switches. Please do not refer me to expensive books, as editors of contemporaries often do.

A similar query to this was answered in our April 1st issue, 1901, page 166. If you refer to this, you will find a sketch of suitable connections for your case.

[5416] **Edison-Lalande Battery.** "SIGMA" (Devonport) writes: (1) Will seven Edison-Lalande battery cells in series charge a small 4-volt accumulator? (2) Would this be a handy battery to use for this purpose, and would the first cost and up-keep be appreciably greater than "Gravity Daniells"? I am using at present three double fluid chromic acid cells, which appear to work alright until the solution begins to creep over the bolts in the carbon plates. (3) Is the Edison-Lalande cell a patent, or may anyone make it up if he can obtain the materials? (4) Where can I obtain the copper oxide plates, and can you tell me the approximate cost of same? I have read your books on Electric Batteries and Small Accumulators. (5) Where could I obtain tables showing the resistances of wire on the S.W.G. notation?

(1) Yes, seven Edison-Lalande cells would just comfortably charge a 4-volt accumulator. (2) We think that if the first cost is not too much against it, you could not get a better battery for the purpose. This first cost is certainly more than Gravity Daniells, and possibly the up-keep would be a little greater. If, however, you can dispose of the reduced copper at all profitably, this would not be the case, and they would actually cost less than Gravity cells. They have every advantage over the latter. You would save the trouble of creeping, which you mention, if the top of the carbons were carefully treated, as described in "Electric Batteries." (3) The Edison-Lalande battery is not patent. (4) We do not know whether the copper oxide plates can be obtained, but copper oxide itself can be purchased from a manufacturing chemist, and could be compressed into cakes sufficiently hard to secure good results. By altering the position of the elements, having a copper plate at the bottom of the jar, as in a Gravity cell, the copper oxide might be simply rammed down on top of it. (5) A fairly complete table was published for the benefit of amateur electricians in our January 1st number, 1901. We do not know of any better table than this, which was carefully compiled from a number of reliable sources

[5418] **Failure of Shocking Coil; Electric Lighting from Batteries.** H. K. (Jesmond) writes: (1) I have made the shocking coil described in your September 15th issue, in exact accordance therewith. I use a No. 2 Leclanché battery, and have brass handles, 6 ins. long. It will not give a shock at all. Is the battery sufficient, or would the regularity of the winding of the coil matter? Please advise me how to remedy the above coil. (2) I intend lighting a room, 16 ft. long by 13 ft. wide by 7 ft. 8 ins. high, by electric light. What kind of lamp would be most suitable, also what kind of battery or dry cell would supply the necessary current? What would be the best wire for connecting cell to lamp?

(1) Have you connected up the handles and battery correctly? These connections are as follows: The battery wires to be connected to terminals A and B, and the handle wires to C and D. You must have made some difference, either in building or connecting the coil, in spite of your assertion to the contrary. We are well aware of numbers of readers who have made the coil as specified, and find it gives a very respectable shock indeed. The best plan in cases like this, where it is impossible to guess at the cause of the trouble, is to send the apparatus to us, when we can very quickly give you definite information to remedy the trouble. The only cost is that of postage, which you must arrange to pay both ways. (2) You may take it as perfectly definite that we discourage any attempt to practise electric lighting on what may be called a practical scale, from primary batteries at all. You should read the article on "Some Primary Battery Inventions," published in our September 15th issue last year. The consumption of zinc, and the attendance required to get anything like satisfactory results, is so out of proportion to that result that no one would keep the installation going for a month who had any regard to the value of his time and money. We say nothing as to the trouble and messiness involved, both of which are very considerable

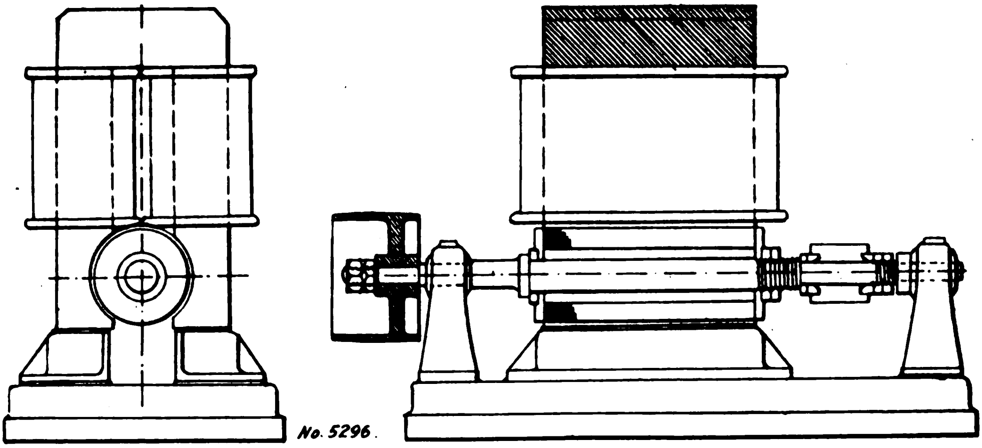
[5419] **Entering the Electrical Profession.** S. R. (London, W.C.) writes: I am nearly 16 years old, and am very anxious to become an electrical engineer. This is not merely a passing fancy, for I have cherished this idea for a long time. Could you tell me the best way of becoming one? I have looked through the papers for advertisements, but the premiums are so high, about £80 per year for three years seems the lowest.

The best course you can pursue—put briefly—is to look down the advertisement columns of one of the important electrical journals, say the *Electrical Review*, and choose a few of the firms whose manufactures appear to be those in which you take particular interest. Then call or write to each firm offering your services as an apprentice, and stating whether you have any special qualifications, such as evening class work, whether theoretical or practical, and whether you have studied the subject at all at a technical college. We cannot give you the names of firms who will take apprentices without requiring a premium. We hope shortly to be able to publish a series of articles on the subject of entering the electrical profession, and you will doubtless find these useful, even if you have by that time secured an appointment.

[5420] **Electric Telegraph.** S. T. L. (Bourne) writes: (1) I am anxious to make a nearly full size P.O. single needle telegraph instrument on the lines of my sketch (not reproduced). My difficulty is: There are two ends to each bobbin, and I cannot connect up right. I made the pair of model telegraphs which appeared in the *M.E.* about last April. They worked well, except that the needles would not leave the electro-magnets sometimes. I have wrapped the ends with paper, but they still stick. (2) If I had a small dynamo, say a 15 c.p. and four 1½-hour accumulators, how long should lamp burn if accumulators were charged one hour from dynamo?

(1) We cannot make out from your sketch sufficient details to enable us to give you definite information. Please send a dimensioned drawing showing the apparatus in elevation and plan. With regard to the model telegraph, possibly the action was a little too energetic, and the removal of a few turns of wire from the electro-magnet would get over the difficulty. Four accumulators in series require current at about 10 volts to charge them. If the dynamo is built to give this, amount of current stored by the cells depends upon the rate at which it is done. You should state the size of plates in the accumulators, because there is a definite charging current which depends on this size. Probably, in the present case, it ought not to exceed ½ ampère. Thus, when charged from the dynamo at this rate, the cells would have ½ ampère-hour capacity for lighting The length of time a lamp supplied from the accumulators would burn depends on the current it takes, and this again depends upon the candle power, &c. You will see that your query only states a few of the conditions which govern the answer, and, therefore, we can really say nothing definite.

[5296] **Undertype Dynamo, 120 Watts.** J. S. (Coatbridge) writes: Enclosed you will find tracing of a dynamo I am making The proportions are taken from a large machine to a scale of 3 ins. to the foot, this drawing being a quarter the size of the model. The armature is mounted on spindle ready for the wire, and I would like your opinion on what size and quantity of wire would be required to give what you consider a suitable voltage for a machine this size, also at what speed it would be required to run and the probable output.



No. 5296.

We do not quite like the plain drum armature, although if the proportions are closely kept in making the machine it should work well, provided a good powerful field be employed. This is fortunately easy with a forged carcase, and the following windings ought to provide an output of 4 to 5 ampères at 30 volts at 2 800 revolutions per minute without difficulty. The armature will be easier to wind if provided at each end with a toothed fibre disc, having 16 teeth (each about 1-32nd to 3-64ths in. wide). The winding should be done in two layers and 8 sections, each section requiring 14 turns (7 in each layer), or a total of 224 conductors. Altogether about 10 ozs. nett of *No. 20* will be required for armature. The field-magnets may be wound with 5½ lbs. No. 20 wire, half on each core. They must be connected in shunt with the brushes. The speed, as mentioned above, should be 2,800 (perhaps a little higher), and about ⅓ h.-p. will be needed to run the machine.

[5421] **Wimshurst Machine for X-Ray Work.** E. B. S. (Leeds) writes: The following are particulars of a Wimshurst I have built. There are two glass plates, 15 ins. diam., each having 18 brass sectors with embossed centres (length of sectors = 3 ins.). For Leyden jars I use two glass gas jars, 8 ins. high and 2 ins. diam., coated outside with tinfoil 2 ins. deep, and to same height inside with small shot. I have been able to get a 5-in. spark in air occurring once every 1½ secs. with plates revolving about 200 revs. per minute. In conjunction with above, I use a 3-in. Jackson's focus tube, and find I have to give an exposure of from 10 to 15 minutes to produce a distinct image of bones of the hand. The photo enclosed was exposed for 15 minutes, with tube 6 ins. from plate. (1) I should like to know if it is possible to get good results with an exposure of 2 minutes, and, if so, what alterations you advise me to make to above machine? I only want to use the machine for *x*-ray work. (2) I am thinking of making another machine with 24-in. plates. Is there any great advantage in putting 4 plates, and, if so, how are neutralising brushes, etc., arranged? (3) Will the 24-in. two-plate machine work a 6-inch focus tube? (4) Does the following rule hold: Length of exposure varies as square of thickness of object treated; and also what is the relation between thickness of object and distance of tube from plate?

(1) Obviously you cannot expect so good a result with the same machine and not a quarter of the exposure. It can only be done by "altering" the machine to the extent of supplying three more pairs of plates. The Wimshurst is doing exceedingly well if 5-in. sparks can be obtained, the plates being only 15 ins. diameter. (2) The advantage gained by extra pairs of plates is considerable. Little or nothing may be added to the spark *length*, but the *fatness* is much increased, a very desirable feature in *x*-ray work, whereby the exposure is greatly shortened. The neutralising rods, etc., are arranged as though two machines were being used, except that as the two inside plates should revolve together on a common boss, the same neutralising rod will do for both. It may be made T-shaped at each end, each end of the top part of the T bearing a brush. (3) Yes, but first get the machine to work. If the spark is shorter than might be expected, a lower power tube would be needed. (4) We have not come across any such "rules." The first looks probable. The second point seems a little obscure. In any case, the tube should be far enough away from the object to reduce as much as possible the spreading of the rays of light, and, for a similar reason, the object should be as near the sensitive plate as possible. The thicker the object, the greater will be the required distance between it and the tube, but this must not be excessive, as the penetrative power is rapidly diminished with the distance.

[5423] **Half Horse-power Engine.** H. W. (Bellshill) writes: I would be much obliged if you would advise me in the following. I want an engine to develope ½ h.-p.—(1) Which one of these three would you recommend—a steam engine; a gas engine; or a hot-air engine? (2) Which would be easiest to construct? (3) Which would be the cheapest to construct? (4) Which would be the cheapest to maintain?

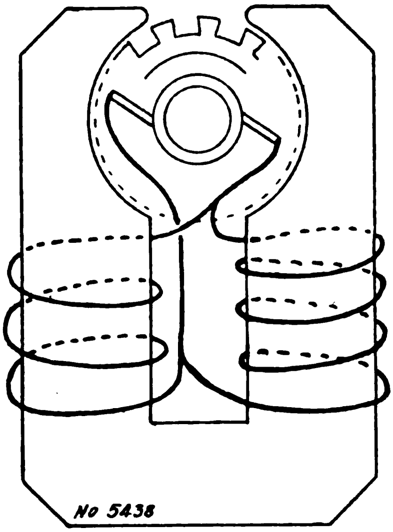
(1) A gas engine would be the best for the following reasons:—(2) To maintain, because it has fewer parts than a steam engine and boiler, and would require less attention. In the matter of attention, perhaps, it is not quite so desirable as a hot-air engine, but a gas engine would certainly prove much more economical in fuel. (3) A gas engine is the cheapest engine. (4) A steam engine would present more difficulties. It requires some skill and experience to construct a good boiler. A hot-air engine must be *much larger* than either a steam or gas engine, and therefore will require larger tools to construct. The pressure in the power cylinder of a hot-air engine is very small, and to give the same output its diameter must be increased proportionately.

[5440] **Model Loco.** W. C. T. (Sheerness) writes: I am making model loco about twice the size of Mr. Pearce's single wheeled locomotive. I shall be greatly obliged if you would answer me the following: What diameter, also number of tubes to use to get as much effective heating surface as I can? Diameter of steam pipe, exhaust pipe, feed pipe, and steam blower pipe (inside diameters). Do you think I can burn coal? grate—3½ ins. by 5⅝ ins. Best working pressure. Do you think the boiler suitable for the engine? What distance from fulcrum should centre of safety-valve press for the said pressure of steam with a spring equal to 4 lbs.?

About 400 to 450 sq. ins. of heating surface should be provided. Use ⅝ or ¾-in. flue tubes. Use some ⅜-in. cross tubes in firebox. Steam pipe, ¼ in. inside; exhaust pipe, 5-16ths in.; feed pipe, 3-16ths in. inside diameter; blower, 1-20th to 1-15th of an inch, according as experiment determines. Yes; use small coal intermixed with coke and charcoal. Oil fuel might be used with advantage. About 50 lbs. most suitable pressure. If the boiler is made satisfactory and above heating surface is provided, the engine will be able to steam two cylinders 1½ by 2½ ins. Make the leverage of safety-valve two to one, that is fulcrum 1 in. from valve-centre and the latter 2 ins. from the vertical centre line of spring.

[5438] **Ring Armature.** A. J. H. (Northwich) writes: Would you oblige by giving me particulars of amount of wire to put on field, also of a ring armature for the dynamo shown in this sketch?

If a ring armature is imperative it should have 12 slots, 5-16ths × 3-16ths in. each, and should be 2⅛ ins. diam. outside and 1⅜-ins.



inside. Commutator will be in 12 parts, and the wire required will be 9 ozs. (48 yds.) No. 20. The wire for field-magnets should be 1½ lb., No. 24, wound as in the diagram. The output may possibly be 4 amps. at 15 volts. Speed, 3000 revolutions per minute.

[5442] **Steam Turbines.** C. C. B. (Stourport) writes: Could you kindly inform me whether there are any fairly elementary books published about the theory and construction of model steam turbines? Also, whether the Hon. C. A. Parsons has published any pamphlet or description of the *Turbinia*?

The first part of an article on the subject appears in the present issue. There is a book called "Centrifugal Pumps and Turbines" (price 4s. 10d., post free, from Dawbarn and Ward, Ltd., 6, Farringdon Avenue, E.C.), by Chas. H. Innes, which contains a chapter upon steam turbines. Please refer to THE MODEL ENGINEER for February and March issues of 1900, for a paper by the Hon. C. A. Parsons on "The Development of the Steam Turbine." Please refer to back numbers of the *Engineer* and *Engineering* for a detailed description of the *Turbinia*.

[5452] **Charging Small Accumulators.** A. H. J. (Blackmill) writes: As I have no other source of electricity here, I should like to know how many quart Leclanché cells would be required to charge a 4-volt accumulator, and how long would it take to charge it.

Leclanché batteries cannot be used to charge accumulators. You should read "Small Accumulators" and "Electric Batteries," two of THE MODEL ENGINEER handbooks. It is impossible to say how long a 4-volt accumulator will take to charge without knowing both the maximum charging current allowable, and the capacity of cells.

[5464] **Armature.** T. W. (Manchester) writes: (1) Can you print me a sketch showing how to build a *small* drum armature? (2) In which number of THE MODEL ENGINEER is there an article on how to make an oil engine suitable for a small launch; when will your promised article on an oil engine appear?

(1) Small drum armatures can be made with any number of slots in reason, and you do not state what number you require. The winding of a 4-part drum armature is given in a reply to another query (No. 5371 in this issue). Of course, you cannot have a proper drum armature with a smaller number of slots than this. (2) No such article has been published in THE MODEL ENGINEER, and we are unable to assign a definite date for the appearance of the article you refer to.

[5457] **Electric Night Light.** T. W. (Barnsley) writes: I am making the night-light set described in *M.E.*, September 1st, 1901, and should like a reply to the following questions concerning same. (1) Is there anything I can paint the inside of the case with, to make it acid proof? I do not wish to use paraffin wax, if possible. (2) If paraffin wax is necessary, how can it be evenly applied? (3) Where shall I be able to get a suitable lamp? I see it has to be 3½ volts, taking ½ ampère.

(1) Any good varnish, if two or three coats are applied, will make a perfectly acid-proof covering to the wood, and sealing-wax varnish would be perfectly suitable. Paraffin wax is certainly the best material for this purpose. (2) The wax should be melted and poured into the box, and spread as much as possible while still soft. When this is done it may be made even by ironing with a hot iron, which will make it soak into the wood. (3) You will get a suitable lamp from any dealer in electrical sundries advertising in THE MODEL ENGINEER.

[5424] **Charging Accumulators.** H. L. (Kingston-on-Thames) writes: Some time ago I made three carporous cells to charge a 4-volt pocket accumulator. I connected the carbon to the + terminal, and the zinc to the other. I left the accumulator on for 19 hours, and as at the end of that time I could get no current from the accumulator I reversed the connections, and after leaving on for some hours could only get current for about five minutes. Could you tell me why this is? Have I got sufficient cells, or have I damaged the accumulator? If I have, how can I put it right? How much current ought I to be getting from the carporous cells, using sulphuric and bichromate? I am thinking of making a 3-in. spark coil. Will you please give me full dimensions: number of sections, ⅛ in. × 3⅞ins. and how many accumulators will it take to work it? I have been using an accumulator to work a 3-16ths-in. spark coil, and it takes a heavy current. Should I put a resistance in the circuit?

There is evidently some mistake. Carporous cells are not charged with bichromate and sulphuric acid, but you probably mean double fluid bichromate batteries. Of course, if you charge the accumulator in the wrong direction you were liable to spoil it altogether; but we should think the most likely trouble is in regard to the fact that the battery would be exhausted before charging had finished, and quite possibly the accumulators discharged themselves back through the exhausted battery. Three bichromate cells are sufficient for charging the 4-volt accumulator, and carporous cells proper should not be used for this work. If you recharge bichromate cells and connect them up to accumulator in the same way as you did the second time, you should then see whether all was in order after two or three hours' charging. With regard to the spark coil, you might read through our description of a 4-in. Spark Coil, in the March 1st, 1901, issue of THE MODEL ENGINEER, and you should read Norrie's book on "Induction Coils," price 2s. 2d. post free from our Book Department, as it is not possible in a brief reply to give you constructional advice at sufficient length. A 3-16ths-in. spark coil ought not to take a great deal of current if things are in order, and possibly you are over driving it. We note you do not state many particulars of the coil, nor the voltage of the accumulator, and without details it is impossible for us to guess whether there is any fault or not.

[5489] **Wire Gauges.** "RHUMKOFF" writes: Will you please state the meaning of the expressions "B.W.G." and "S.W.G."?

"B.W.G." stands for "Birmingham wire gauge," and "S.W.G." for "Standard wire gauge." Further particulars of these can be found in any engineer's text-book. *Will you please read through the conditions given at the head of these columns, and with any future communications give us your name and address as a sign of good faith.* Will you also note that we specifically state our inability to give an answer in 'our next.'

[5501] **Electrical Queries.** "VOLT-AMP." (Guernsey) writes: Could you please give in detail the action of a Wimshurst machine in generating static electricity? Are there any laws telling how to make a certain size Leyden jar to hold a certain quantity of static electricity? Is it possible by means of many jars to get ampèrage and not only voltage from accumulated electricity? Can you fuse wires by means of a Wimshurst and jars? I only want a few words of general information from one who knows.

Unfortunately all the subjects you broach are of the class which require a fairly considerable amount of electrical knowledge to understand, and are such that simple explanations are almost useless, or even misleading. Taking the first question, namely, with regard to the action of a Wimshurst machine, the broad facts even are not yet thoroughly understood. Putting it in the simplest way, it may be safely stated that each of the tinfoil sectors acts by reason of its charge upon the sectors of the other plate in the same way that one plate of an electrophorus acts upon the other from which the charge is taken. As both plates have many sectors, and each one of these acts in the same way on the others, a very rapid electrification will take place. Of course, the charges at the top and at the bottom of a Wimshurst plate are of opposite kinds, and neutralising brushes are necessary to neutralise residual charges left on the sectors, and to enable them to acquire opposite polarity by the time the same sectors reach the collecting combs. Obviously, beyond a general idea that the action is that of an electrophorus on a continuous scale, not very much can be said definitely with regard to that action. Your second question argues an indefiniteness of knowledge of static electricity, and merely to answer "No" to the question would help you very little. You can only get the proper conception of what is implied in this and the next question by carefully reading and experimenting from an ordinary good text-book on the subject. We regret that it is simply not possible to give in a few words of general information much that could be of use in so complex a subject.

[5448] **Engine to Drive Dynamo.** L. O. C. (Malta) writes: I have a 30-watt dynamo, Avery-Lahmeyer type, taking 1-12th h.-p., which I want to drive by a steam engine. Will you kindly give me size of engine and boiler to develop this horse-power? I have the book on Model Boiler Making, if you wish to refer me thereto.

An engine with a cylinder, $1\frac{1}{8}$ ins. by $1\frac{1}{2}$ ins., with a boiler pressure of about 40 lbs., running at 400 to 500 revs. per minute will be suitable. A vertical boiler, about 8 ins. by 16 ins., provided with several $\frac{3}{8}$ in. flue tubes, and two or three tiers of cross tubes, $\frac{1}{4}$ in. or 5-16ths in. inside diam. in the firebox, each row containing three or four tubes, and placed over each other at right angles. The water tubes should be inclined. For further particulars please refer to Query 5328, which appeared in the February 1st issue. The boiler should have at least 300 sq. ins. of heating surface. The details of construction given in the handbook, "Model Boiler Making," should be followed. The flue tubes may be screwed into the lower tube-plate with a taper thread.

[5458] **G.W.R. Locos; Safety Valve.** C. J. C. H. (Bourne End) writes: Would you kindly inform me how the safety valve of an engine of the "Cornish" class is controlled from the cap while the engine is running, as I have thought it over, but cannot arrive at any satisfactory conclusion.

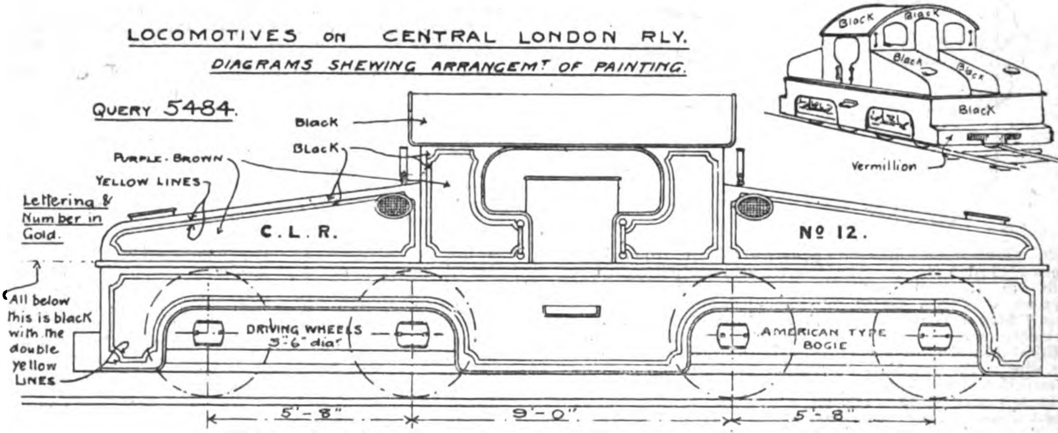
The safety valves are ordinary spring-loaded valves and do not require any attention by the driver. We also believe that two such valves are used

[5571] **Model Yarrow Boiler Queries.** A. M. B. (Edinburgh) writes: I am anxious to make a water-tube boiler as per Fig. 16 in your handbook, "Model Boiler Making," but the letterpress descriptive of that boiler is rather brief. I therefore venture to request the favour of replies to the following queries: — (1) Size of baffle plates, and how should they be fixed in steam drum. (2) How should a "Vic" injector be fitted on such a boiler? (3) Where should water level be? (4) What style of water gauge would be most suitable and best way to fix it to boiler? (5) What style of oil burner would be most suitable for furnace?

(1) See Model Engineer for Dec. 15, 1900, page 354, for arrangement of baffles in a "Yarrow" type boiler. The upper ones are fixed to barrel by several Z-shaped stays placed at convenient points. (2) We do not think an injector only is suitable for this type of boiler. You should have a pump running continuously and an injector for use in emergencies. The feed should be distributed along upper drum by a pipe. (3) About centre line of boiler should be lowest level. Water level should not vary three-eighths of an inch. (4) The simplest type with largest bore possible. (5) Three No. 4 Primus oil burners, arranged two on one pipe and one on the other. Have screw-down valves on supply pipes.

[5484] **Model C.L.R. Electric Locomotive.** C. H. T. (Liscard) writes: Kindly reply to the following queries *re* electric locomotive described in December 15th, 1901, Model Engineer: (1) What are the correct colours of the cab frame, etc.? (2) Is the original lined; if so, where and in what colour? Is it a single line or a double one? (3) Is it a model of the locomotives used on the Central London Railway? (4) What is the position of the lettering, if any? Allow me to point out what I consider a great drawback to the use of worm-gearing as supplied with the motor mentioned, one of which I have. Say the locomotive is running on the track at full speed, if the current is cut off from the motors they will stop after a few revolutions of the armature, but the wheels of the locomotive will still tend to revolve, owing to the momentum which the locomotive has gained while travelling at full speed. Now, the fact that the wheels tend to revolve also tends to make the armature revolve also, but it cannot do this, because the worm-gearing will not work backwards, (*i.e.*, the revolution of the worm causes the cog wheel to revolve but the revolution of the cogwheel will not cause the worm to revolve), and in most cases will bind the spindle of the motor, as was the result with my own motor.

We append a sketch of the locomotives on the Central London Railway, more especially showing the painting; the whole of the loco is painted black, except the "buffer beams," which are vermilion, and the four panels on each side above the foot-plate line. The colour of these panels is variously described as "an invisible purple brown," and "a dirty-coloured chocolate." These panels are surrounded by the black ground, edged with two yellow lines, which were probably gilt at the outset. The lettering is in gold, laid upon a yellow ground. The positions of the letters C.L.R. and the number are indicated upon the drawing. As you will see, the model illustrated in the issue of December 15th last is not a copy of the electric locomotives of the C.L.R. It is true that worm gearing has the disadvantage you remark, and it is, therefore, a matter for the maker to decide whether this is too serious in this case. The difficulty can be partly overcome by fitting a ratchet wheel to the axle so that the worm wheel drives the axle through this by means of a pawl. Thus the wheels of the locomotive will be driven positively as long as the current is on, but will run free in the given direction as soon as this is cut off, and the motor stops. This could not very well be fitted to a reversing locomotive, as it implies a double ratchet arrangement, one part of which would have to be thrown in or out when reversing the engine, and so much complication is very undesirable. Of course, the other alternative, viz., the use of plain cog gearing, as shewn in Dr. Hovenden's locomotive (January 1st issue) would entirely eliminate the trouble.



[5487] **Locomotive Smokebox.** E. B. (Ambleside) writes: Will you say whether the bottom of the smokebox of a loco boiler is left open or closed in. I have nearly finished a model of a G.N.R. loco, including boiler, and it certainly appears to me that unless the smokebox is closed in all round there will be very little draught through the tubes to the firebox; but the drawings which I got with the castings do not show any plate at the bottom of smokebox. I have never made a locomotive before, and have never had an opportunity of seeing a locomotive boiler, or would not trouble you with so simple a question.

The bottom of the smokebox should have an horizontal plate fixed making the whole completely air-tight. Some method of packing or stopping the holes at steam pipes must be adopted so that they do not leak air, otherwise the draught through the tubes will be lessened. In a locomotive boiler the draught is an induced one, and is caused by making a partial vacuum in the chimney and smokebox —with the blower (a *small* jet of steam well below the base of the chimney and as nearly concentric with it as possible) and with the blast from the exhaust pipe when the engine is running. Nothing will make a loco boiler fail like the stoppage (partial or complete) of the induced draught. Keep the blast pipe low down in the smokebox and contract the nozzle sufficiently to give a sharp exhaust.

[5488] **Motor Cars.** R. S. (Boyle) writes: Would you kindly let me know which kind of motor is best the steam or the De Dion? By comparing one with the other in price and durability, which would you recommend for a small carriage to carry two people, at the most twenty miles an hour? But I would be satisfied at ten miles.

The choice will depend somewhat upon the point of view taken. The question is really beyond the scope of this Department. The difficulties with steam cars are many, chiefly water carrying, steam condensing and generator, difficulties. We think you would do better to adopt the petrol engine as the motive power. About 4 h.-p. will be required. With the petrol motor the only real objection is the noise and the wear and tear of gearing. The petrol power would most likely cost considerably less than the steam car and also last longer, but, of course, this depends upon the type and build of the respective cars.

[5492] **Steam Motor Car.** A. H. (Birmingham) writes: (1) What horse-power and pressure of steam is required for a steam car to carry four persons? (2) Would a boiler as described in your issue of July 1, 1901, page 15, be suitable, or could you suggest one of easier construction—that is, of fewer parts? (3) What fuel to use; if spirit or oil, what burners? (4) Would a compound engine as described by "Eos," Sept. 15, 1901 (using two valves), be suitable; if so, what stroke of engine and what bore of H.-P. and L.-P. cylinders? (5) What size steam ports and pipes?

(1) 4 to 6 h.-p.; 100 lbs. steam pressure. (2) The evaporation of this boiler is about the average obtained with a good fire, but it is somewhat lighter in proportion than many types for the same output. We think you could not do better than adopt either a vertical boiler with innumerable small flue tubes (say ⅝-in.) and water tubes in the firebox of the same diameter, or one based on the Yarrow type, see "Model Boiler Making." The shell of the former type should be of steel, and galvanised inside and out. The heating surface

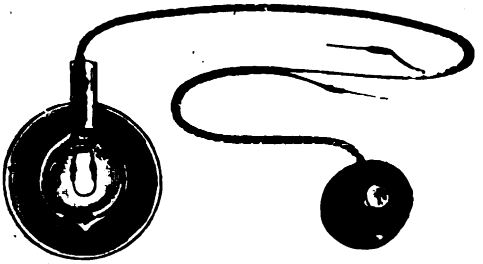


FIG. 1.—THE "GEM" BUTTON-HOLE LAMP.

should be at least 10,000 to 12,000 sq. ins (3) Petroleum. Clarkson and Capel burner. (4) See issue of Jan. 15, p. 47, for design of compound engines. Use link motion, and provide superheated steam. (5) See some engineer's "Pocket-Book."

[5497] **Boiler Queries.** A. T. (Deptford) writes: I have a boiler—a plain cylindrical vessel, laid horizontally—and want it to drive an engine with cylinder, ⅝ in. by 1¼ ins. Will you kindly oblige me with sketch of how to fix boiler down to a board, so that it can supply the required amount of steam by burning methylated spirit or charcoal (the latter being preferred)? The boiler has no tubes.

The boiler will steam if given unlimited fire, but cannot be called in any way an economical one. For modifications advisable see reply to Query 4587, page 215, issue of November 1st last. The boiler, if fired externally, with charcoal, should have a grate and combustion chamber, protected from radiation. This method of firing, however, is not advisable.

[5617] **Soldering Flux.** W. J. C. (Tottenham) writes: Will you kindly inform me what flux is used when soldering iron?

Chloride of zinc is used for general purposes. To make this, obtain some commercial quality hydrochloric acid (spirits of salts), place in an open vessel in open air or on the hob of a grate and drop into it a few pieces of zinc. A violent ebullition will result, which will last for about half-an-hour. Give the acid as much zinc as it requires. When the chemical action has stopped, add water and let the mixture settle; strain off into the utensil in which you will keep and use it. Some artizans add a little salammoniac to the chloride of zinc before using it. You can, of course, obtain from any ironmonger soldering fluids already made, which will work on iron or steel as well as brass or copper.

THE YŌST TYPEWRITER.—Messrs. Callender's Cable and Construction Company, Limited, write to the company owning this excellent machine, that they have thirty-five Yōsts at work in their offices, works, and depôts, and in no instance have they had cause to complain of the manner in which they have fulfilled the heavy duties imposed upon them. The whole of the work, which necessitates an immense amount of tabulating, is done upon the Yōst.

* *

THE Technical Education Board of the London County Council announce a course of ten free lectures on Electric Power and Lighting, illustrated by lantern-slides and experiments, to be given by E. Halford Strange, Esq., M.Sc., in the William Ellis School, Allcroft Road, Gospel Oak, N.W., on Wednesday evenings, commencing on January 22nd at 8.30 o'clock. Admission will be by ticket, to be obtained free on application at the school, and a detailed syllabus of the course can also be had, price 2d. Communications should be directed to the Hon. Secretary to the Local Committee, Mr. E. B. Cumberland, at the above address.

Amateurs' 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.*]

Small Lamps and Other Electrical Goods.

The new edition of the "Novelty" list issued by Archibald J. Wright, Islington Electrical Works, 318, Upper Street, London, N., has been considerably enlarged, and many new items are consequently included and illustrated. We are pleased to be able to illustrate one or two of the many electrical features, Fig. 1, for instance, showing the "Gem" button-hole lamp. It comprises an electric lamp fitted to a reflector, with hook at back for attaching to coat, and is complete with flexible cord, switch, and tags. In Fig. 3 are shown three types of handy electric lamp stands, which ought to prove popular, as they are neat and very low in price. Fig. 2 is an illustration of a useful small accumulator, with ready-formed plates in a glass containing vessel, supplied ready for the acid to be run in. The price varies according to size of cell, and a slightly higher charge is made for sealed cells. Fuller particulars of these and other novelties can be obtained by a perusal of Mr. Wright's list, which is sent to MODEL ENGINEER readers on receipt of two penny stamps.

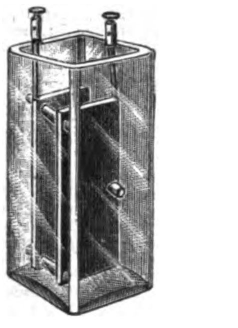


FIG. 2.—SMALL ACCUMULATOR IN GLASS CONTAINING VESSEL.

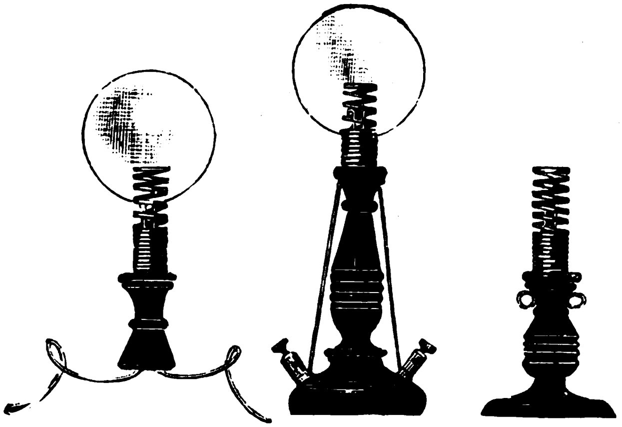


FIG. 3.—ELECTRIC LAMP STANDS.

*A Cheap Shocking Coil.

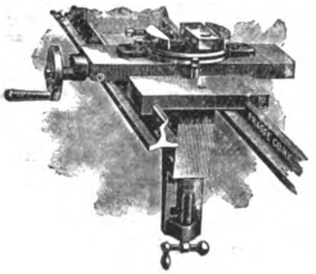
A pleasant quarter of an hour has been spent by some of our staff, testing the powers of a neat little shocking coil, sent for inspection by the Electrical Sundries Manufacturing Co., 152, Grey Mare Lane, Manchester. A single bichromate cell serves to give a very respectable shock to one person, as we quickly discovered. The coil is fitted with regulating tube, and we are particularly pleased with the finish of the little instrument, which is supplied with neat flexible cords and nickel-plated handles. The coil is priced at 3s. 6d., and suitable bichromate cells at 1od. A price list (2d. post free) is issued by the firm, as well as a supplementary "electrical novelty" list, which will be sent to readers mentioning THE MODEL ENGINEER.

*Rails for Model Locomotives.

We have inspected a sample length of rail which is being introduced by the Baldwin Engine Co., 10, Greyhound Lane, Streatham Common, London, S.W. It is stated that the rail is of cast steel, but is of so mild a character as to be readily bent to a slight degree, for curves, &c., and can be straightened, if necessary, with equal ease. The sample we received was a little rough on the wearing surface, but the makers state that this will not be so in future. The rail will be supplied in 18-in. lengths, and its dimensions suit it for use with locomotives of ¾-in. scale and upwards. The price is 3d. per rail, and chairs, which will be in malleable cast iron, will be supplied at 3d. per dozen.

A New Milling Attachment.

The Frasse Company, 38, Cortlandt Street, New York City, U.S.A., are putting on the market a useful milling attachment of which they send us the following particulars. It can be fitted to any lathe, either of the screw-cutting or ordinary pattern. It can be instantly adjusted by placing on the bed, between the head and tail stock (as shown in illustration), and *does not require gearing* to operate it. The movable vice holds the work while the cutter



works between the centres. Vertical adjustment is obtained by the lower crank raising or lowering the work, to bring it in contact with cutter. The crank shown on the left moves the vice back and forward. The turn-table vice which holds the work permits of milling diagonally, if desired, by so placing, and is practically adapted for facetting, bevelling or for slotting screws, and will perform various classes of intricate work, which will suggest themselves to the operator. There is a vertical adjustment of 3 ins.; across vice 7 ins. The vice will hold 2 ins. between the jaws, or 3¼ ins. when the jaw is removed. The bed is planed to the Universal bed V, but to ensure exact fit, the Frasse Company suggests sending a template with order, so that the planing can be tested accurately. This firm also sells castings at 6.00 dollars per set. They would be pleased to mail a circular descriptive of this attachment to any reader on receipt of two penny stamps.

*A Protractor for Nothing.

We have received from the Liverpool Castings Supply Co., 5, Church Lane, Liverpool, a few samples of a protractor which is being given free to any applicant who sends a halfpenny stamp to cover postage. Of course, this protractor is an advertisement, but as it combines English and metric rules, scales, Whitworth thread table, English and American centre gauges, whilst the advertisement is confined to the fact that the name of the firm is printed on the face, we can well recommend our readers to write for one without delay. They should mention THE MODEL ENGINEER when so doing.

*A Steel Hardening Compound.

The novel title "Essence of Temper" has been given by the makers to a compound intended for hardening small tools for cutting cast steel, marble, and other trying materials. A sample box of this substance has been sent to us for trial, and a test was made with it on an ordinary drill-bit fitted in an Archimedian drill. Whether the result was better than could be obtained by a careful toolsmith, we cannot say; but it is certain that the bit was very readily hardened, and that the temper was such that holes were easily drilled in pieces of steel of varying degrees of hardness without damage to the cutting edge of the bit. We should consider it an excellent substance for the purpose, and if used according to the directions given will doubtless prove satisfactory in any hands. Sample boxes, at 1od. each, can be obtained from Messrs. Taylor & Welch, Falmouth. THE MODEL ENGINEER should be mentioned.

A Lathe Milling Attachment.

Messrs. F. and H. Shaw and Brother, Hebden Bridge, send us a photograph of their milling attachment for lathes from 3½ ins. to 8-in. centres. It is arranged to bolt on to the top slide of the slide-rest by means of the existing studs. By means of this attachment, articles can be milled in any position at one fixing. The swivel is indexed and will swing right round. The clamps used are made from solid steel and are casehardened.

Catalogues Received.

Britannia Electrical Works Company, 43, St. Martin's Lane, Charing Cross W.C.—This firm is sole agent for an insulating material, "Amberax," which is described as a substitute for shellac, paraffin wax, and the like, in the manufacture of coils, condensers, transformers, frictional machines, and other high tension apparatus. The material is made in the form of "wafer", tape, and ribband, and is also sold in tins, a sample being supplied post free for three stamps. The same firm makes a speciality of "Excelsior" high-efficiency lamps, of powers up to 100 c.-p., and voltages to 250. A stamp should be sent by those interested, and THE MODEL ENGINEER quoted when corresponding.

C. L. Ford, Stalybridge. — The seventeenth edition of Mr. Ford's illustrated list is to hand. It contains particulars, prices, and illustrations of medical and other coils, a very large selection of accumulators, portable lamps, battery lamps, cycle lamps, water motors, gas and oil engines, dynamos, electric bells, galvanometers and phonographs. It will be posted to any reader of THE MODEL ENGINEER on receipt of two stamps.

T. Tamblyn-Watts, Settle, Yorks.—The "Geeko" Telephone is particularised in an illustrated price list sent to us by this firm. These telephones are moderate in price, very easily fitted up, and Mr. Tamblyn-Watts is prepared to supply, gratis, competent instruction to enable amateurs and others to instal them according to requirements. Self-contained instruments such as these are much in request now, and we recommend MODEL ENGINEER readers to secure the above list without delay. A stamp should be sent to cover postage.

C. Manning & Sons, Ltd., 8, Bevis Marks, London, E.C.—The Automobile Encyclopædia, issued yearly by this firm, may rightly claim to be something more than a catalogue, as indeed its title suggests. It is a very comprehensive and fully illustrated list of automobile goods, and, although the firm states that it has been made as concise as possible, it covers more than 80 large pages. The various articles have been classified under their respective headings, including components section, electrical, accessory, rubber, oil, tool, and spare parts sections. As a list of agents stocking spare parts, petrol, and undertaking repairs, and furnishing storage accommodation, is included, this list will be found very useful by the motorist. The system adopted is that of placing all the illustrations, with their reference numbers and descriptive titles, together, near the end of the book. Two shillings is charged for the list, and cannot be considered an excessive price in exchange for the information contained therein.

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.

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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. VI. No. 68. MARCH 1, 1902. PUBLISHED TWICE MONTHLY.

How to Build a Model Steam Launch Hull.

WE are indebted to a valued contributor, Mr. Geo. W. Halpin, for the accompanying drawings and a description of the method he has adopted to build the hull of a model steam launch. This is a subject in which a large number of readers will be interested, especially as in the present instance the particulars have been tested by actually carrying out the construction of a model which has excellent "lines" yet is comparatively simple and inexpensive in making. To those who may be unfamiliar with such work, a perusal of an excellent article—"The Construction of Built-up Model Yachts" (THE MODEL ENGINEER, August 1st and 15th, 1901)—may be recommended, as some familiarity with the technical names of various sections and plans employed in ship drawings is very desirable.

The present model, drawings of which are here given, is copied—as far as general form is concerned—from a type of boat very common on the Thames as a pleasure launch; a comfortable roomy boat, broad in the stern sheets, does not draw down by the stern when under way, and a good sea boat, with a light draught. The model is built of tin-plate and the original, from which this description is taken, has four strakes each side. It is advisable, however, for the average builder, who may not have had experience in working tin-plate, to make five strakes each side, and this number is shown in the sections. This will simplify the bending of the strakes, and they will require less "drawing" to make them take the moulded shape correctly.

The dimensions of the hull are: length over all, 52 ins.;

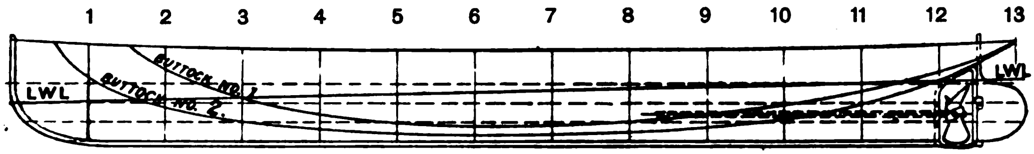


FIG. 1.—SHEER PLAN OF MODEL LAUNCH HULL.

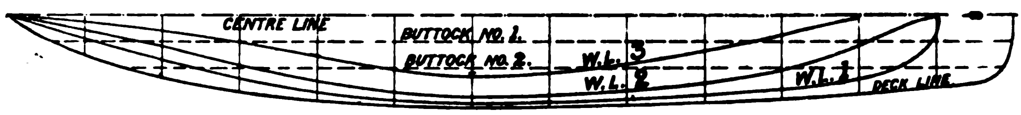
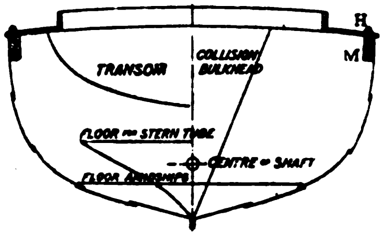


FIG. 2.—HALF BREADTH PLAN.



AFT. FORWARD.

FIG. 3.—MIDSHIP SECTION.

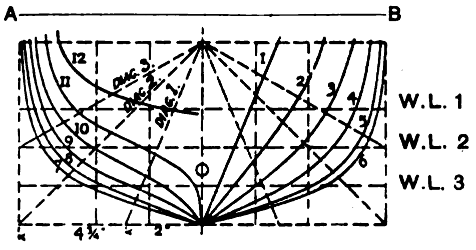


FIG. 4.—BODY PLAN.

beam, 9½ ins.; depth amidships, 4⅝ ins. Obviously, any proportionate size may be made from the lines given, additional strength being essential if made larger, and thinner metal being employed if a reduction in size is the object. The drawings on the preceding page are one-tenth the size of the boat in question, the further sketches, Figs 5, 6, and 7, not being to scale.

The vessel should be built upside-down on a stiff board longer and wider than the deck plan. On this board a centre line is drawn and lines crossing this at right angles, 4 ins. apart, are also accurately set out. Moulds or "shadows" are cut out of ¼-in. pine or other wood, from No. 1 to No. 12, the shapes being taken from body plan, the right-hand side of which gives sections forward

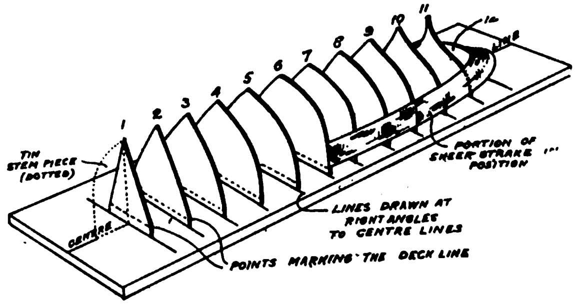


FIG. 5.—DIAGRAM TO SHOW METHOD OF BUILDING.

and left-hand aft. The moulds are not, however, to be made exactly to the form shown on body plan, but must each have an additional depth to bring them all to an equal depth, a datum line like AB (Body Plan) being chosen and all moulds made to that. They are then fixed centrally and in correct order along the centre line marked on the building board, and the correct position of deck line marked on each mould. All moulds must stand quite square with the building board and with the centre line, and one edge should touch the squared line in each case. A diagram, Fig. 5, will emphasise the important points, and shows in skeleton form the general arrangement. As a guide to cutting the strips of tin-plate, the length from deck to keel (AB, CD, and EF, Fig. 6) should be taken and divided into five parts each.

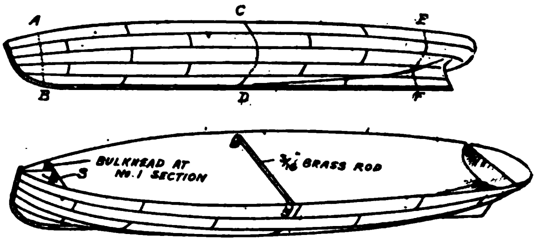
The original model has no keel, but is fitted with a stem-piece (S, Fig. 7, of tin-plate) reaching to the first frame. The stern post is of brass wire, flattened by hammering. The garboard strakes are first fitted, being previously flanged down to form a keel, as shown in midship section (Fig. 3), a flange ½ in. wide being ample. These strakes are worked down till they fit the moulds from end to end. They should overlap the first of the 1-5th marks on sections 1, 6 and 11, by about ⅛ in., and may be tacked down to moulds in three or four places by means of pins driven through small holes which can afterwards be soldered. The two keel flanges may be clamped and neatly soldered, this being afterwards reinforced by running solder along the joint inside when the hull is taken off the moulds. Note that there should be little or no "spring" in the strakes when they have been "drawn" into position; if they are well-fitted, the hull will have no tendency to bulge or become malformed when taken off.

The sheer strakes on each side are next cut and fitted. These also should overlap the 1-5th marks about ⅛ in., but care should be taken that the other edge (the deck line) comes just lineable with the deck line marks on each mould, the tin-plate being carefully cut away until it is right.

Tin-plate is unobtainable in lengths sufficient to make a whole strake in one piece. At the best, for a boat of this size, each strake must consist of four pieces, and these can just be cut from sheets measuring 13¾ ins. × 10 ins.—a common size. Appearances, as well as strength, can be regarded by setting out the strakes in a systematic manner, and the best arrangement is possibly that shown in Fig. 6, where garboard and sheer strakes are each in four pieces, of as nearly equal length each as possible, the intermediate strakes "breaking joint" in the manner shown. The overlap of one section to the next (in each strake) may be about ¼ in., and the underneath piece should first be tinned. The end of the next section can then be laid on the tinned part in correct position, and the application of the hot soldering bit on top will effect a perfect junction. Needless to say, all these joints should be made one way, so that the outside lapping looks towards the stern of boat. This is done by starting at the stern when soldering up the sections.

The middle strake of the five is next fitted to the moulds on each side. This strake overlaps both ways the 1-5th marks. It should be tacked down like the others. The remaining strakes are then to be cut and fitted; they should overlap the edge of each of the other strakes by about 3-16ths in. If care is taken to work each section to shape, starting at stern, these filling-in strakes could all be put on and soldered into position without tacking them to the moulds at all. At the stem all should be tightly clamped together, the solder sweated in, and the stem itself finished off neatly afterwards. The pins can next be removed and the hull lifted well off the moulds.

The next point is the question of strengthening the hull, which at present is merely a skin. A tin bulkhead should be fitted at No. 1 mould, being soldered to sides and to stem piece, which of course reaches to it (see S, Fig. 7). Amidships, a beam of 3-16ths in. round brass wire, with the ends flattened and turned down, may be riveted to the sheer strake on each side. To stiffen the top edge of this strake, and also to provide a ready means of fastening the deck, a strip of wood should be fixed inside the edge. A suitable strip was cut from a child's hoop for



FIGS. 6 AND 7.

the original hull, and as this was long enough to be fitted in one piece, it is to be recommended. The section is about ½ in. moulded by 5-16ths in. sided, and is shown at M, Fig. 3. If too springy, this strip may be steamed, or soaked in boiling water for a quarter of an hour.

Provision is made for bedding the engine and boiler by means of floors at suitable heights. These necessarily depend on the machinery chosen, but a good method of fixing is to arrange a wood floor, sandwiched between tin-plate sheets which are soldered to the vessel's sides. Screws can then be passed from the engine bedplate through the top piece of tin into the wooden floor. Additional stiffness may be given to the hull wherever necessary; but if well made to the instructions given the decking, &c., will give sufficient strength.

The deck, or rather waterway, may be of teak, 3-16ths or ½ in. thick, and it should project, as shown in Fig. 3, to form a narrow bead over the top edge of sheer strake. There should be a half-deck forward and the same aft, covered in as far as may be without making it difficult to get to the machinery. The waterway may be 1⅛ ins. wide, and should have a coaming inside, standing above the deck ⅛ in. all round. Another narrow half-round strip, pinned along outside edge of deck at H, finishes off that part. The rudder head comes up through a well fitted brass tube with brass plate on deck, and is fitted with an ordinary tiller. Other fittings are two brass fairleads forward and two aft, and a double bollard in centre of half-deck.

The hull, completed so far, and for a boat of the given dimensions, should weigh about 7⅛ lbs., and should float about the level of centre line of shaft. When fitted with engine and boiler, and with correct supply of water and fuel aboard, she ought just to ride at the calculated water line, drawing 2 ins. forward and 3⅛ ins. aft. The drawings are made as though the model floated on an "even keel," drawing the same depth fore and aft. The real L.W.L. is shown on sheer plan (Fig. 1), and as will be seen is not parallel to the construction lines. This is simply a matter of convenience in drawing, and will not practically affect the "water lines" of the boat when afloat.

The Society of Model Engineers.

London.

THE following are the dates which have been fixed for the ensuing ordinary meetings:—Wednesday, March 12th, a series of short papers on various model engineering subjects—electrical and mechanical—by Messrs. Boorman, Crebbin, Bowling, Riddle, Hildersley, Greenly, and other members; April 10th, Rev. W. J. Scott, B.A., on "Modern N.E.R. Locomotives." The meetings commence at 7 p.m. in the Board Room, Memorial Hall, Farringdon Street, E.C.

Model Making Competition, 1902.

As announced at the January meeting of the Society, a model making competition, open to all members of the Society, will be held in May next. The date of the exhibition has been fixed for May 22nd, instead of the 5th. The entries for the competition, accompanied by one shilling entrance-fee, must be sent to the Hon Secretary, Mr. Henry Greenly, on or before May 5th, upon forms which will be posted to all members. Full instructions will be given to each competitor as to the dispatch of his model for exhibition.

The prizes will consist of silver and bronze medals, and will be awarded in the following classes at the discretion of the judges: 1, Locomotives; 2, Marine, Stationary, and other Engines; 3, Electrical Apparatus; 4, Ships and Boats; 5, Best Model made by a member under 21 years of age; 6, Best Model exhibited by a Provincial member; 7, Best home-made Tool; 8, Miscellaneous models.

The prizes will be awarded according to the number and quality of the exhibits in each class; and the judges, in allotting marks, will pay especial attention to originality in design and construction—*i.e.*, methods of constructing. Members who are users of metal-working tools in ordinary business, or who have had professional instruction in mechanical work, will be handicapped according to the nature and extent of their experience. Members who are professional model makers, cannot be entered for Classes 1, 2, 4, 5, 6, 7, and 8, and those who are engaged in electrical apparatus making as a livelihood will not be allowed to enter for Class 3. Only *bona fide* members of the Society are eligible.

Models which have gained prizes in the previous competition (1900) cannot be allowed to compete in the present one, and no model shall take more than one prize.

The competition entry form will contain all further particulars as to prizes, rules, and form of declarations as to the extent of the work done by the competitor, and his occupation and training.

On Tuesday, February 4th, the ordinary meeting of the Society was held at the Memorial Hall, Farringdon Street, E.C., Mr. Percival Marshall taking the chair at 7.45 p.m.

LAYING-OFF TABLE.

Frame Nos.	1	2	3	4	5	6	7	8	9	10	11	12
Beam Heights ...	5	4⅞	4 13-16	4¾	4¾b	4 11-16	4¾	4¾	4 13-16	4⅞	4 15-16	5
Half Breadth	2	3 3-16	3 15-16	4 7-16	4 11-16	4¾	4¾	4⅝	4½	4⅜	4 1-16	3¾
Diagonals 3	1¾	2⅞	3 11-16	4 5-16	4¾	5	4 15-16	4 11-16	4 7-16	4⅛	3⅝	2 11-16
Diagonals 2	1 15-16	2 15-16	3 11-16	4 5-16	4¾	5	4⅞	4⅝	4⅜	3⅞	3 5-16	2¾
Diagonals 1	2½	3⅜	3 15-16	4 5-16	4½	4⅝	4½	4⅜	4⅛	3¾	3⅛	1 15-16

Diagonals, 4¾ up stem; No. 1, 2 ins. out; No. 2, 4¾ ins. out; and No. 3, 2 ins. up. Rise of floor midship, 1⅜. Stations, 4 ins. apart, beginning from fore side of stem. Heights measured from top of keel.

With regard to the original model, Mr. Halpin remarks that as fitted at present the vessel is not very fast. This would doubtless be matter of improvement with engines and boilers, and as he has kindly promised to send a description of the present engine, readers of The Model Engineer will have an opportunity of studying more of this gentleman's work. The boat travels well in fairly rough water, and can keep a long while under weigh. Her moderate beam should enable her to carry her machinery easily and allow room for comfortable manipulation.

As it is impossible to measure off accurately from reduced drawings, which cannot be reproduced large enough to be of use in that way, a "laying-off" table is appended from which the necessary dimensions can be taken. Readers unfamiliar with the method of using this, should refer to the articles on model yacht construction already mentioned, in which the use is explained, and although this is not on precisely the same lines, it will serve to illustrate the above table.

To Readers in Nottingham.

A movement is on foot to start a branch of the Society of Model Engineers in Nottingham. We are glad to draw the attention of readers of The Model Engineer to the advantages to be gained by joining such a Society. Mr. R. P. Reader, 4, Wellington Square, Park Side, Nottingham, has the preliminary arrangements in hand.

The minutes of the previous meeting were read and approved, and several new members elected. A letter was read from the secretary of the Birmingham branch asking for the loan of models at a forthcoming exhibition. All those members who can lend models are requested to communicate with Mr. A. C. Knipe, 119, Lodge Road, Birmingham.

The Chairman then called upon Mr. D. C. Glen to read his paper. Mr. Glen gave the members a *résumé* of his model engineering experience. He was strong in condemning the unlimited use of soft solder in model making, stating that although it was a valuable adjunct to model work, it was unknown in mechanical engineering, and, therefore, its use should be restricted as much as possible.

At the conclusion of the paper, a hearty vote of thanks was accorded to Mr. Glen, on the motion of the Chairman, seconded by Mr. Crebbin.

The lecturer having to leave early, the formal business of the evening was resumed. The draft entry form for the Model Making Competition was submitted to the members and approved.

Among the exhibits may be mentioned a *very fine* partly made model of the "Dunalastair," and also the frames and boiler of Mr. Bashford's splendid model G.W.R. locomotive, "Atbara." A cylinder of model high-speed engine and drawings, together with a model electric river launch, were exhibited by Mr. Stuart-Turner. Messrs. Willis, Read, and others exhibited small parts of model locomotives.—HENRY GREENLY, Hon. Secretary, 4, Bond Street, W.C.

Provincial Branches.

Bradford.—The fortnightly meeting of the Bradford Branch was held at the Coffee Tavern, Tyrrell Street, on Monday evening, February 3rd, 1902, Mr. A. P. Drake presiding. The minutes of the previous meeting were read over and passed, and the meeting then proceeded. Mr. White exhibited a vertical steam engine, 1¼ ins. bore by 2 ins. stroke, and Mr. Rhodes showed a glazing machine for model work. All the workmanship was of the best. There will be an exhibition night of all members' models on March 3rd, which we hope will be a great success. This night only will be open to visitors who are interested in model work. The exhibition will be held at the usual meeting room at 7 p.m.—J. H. LAMB, Hon. Secretary, Holly Bank, Rushton Road, Thornbury, Bradford.

Cardiff.—The usual monthly meeting of this branch took place at 7 and 8, Working Street, at 8 p.m., on February 4th. After the formal business had been transacted, Mr. Loveridge suggested that members having books which they were willing to lend, but not disposed to place in the reference library, should hand in lists of them, that they might be made available for the use of their fellow-members. The feature of the evening was the exhibition by Mr. Eastabrook of his new ¾-in. scale model loco, standard gauge, built after the designs of Mr. H. Greenly, of the London Society. The power developed by this model was a revelation to those present, and shows the importance of the principles insisted upon in Mr. Greenly's lecture read at a recent meeting. Further detailed drawings of Trevithick's loco were handed in by Mr. Ashford, and entrusted to the president for reproduction.

The next meeting will take place on March 4th, by which time it is expected that a lecture having electricity as its subject may be arranged for.—R. T. HANCOCK, Hon. Sec., 168, Newport Road, Cardiff.

Glasgow.—The monthly meeting of this branch was held in the Grand National Halls on Wednesday, February 5th, Mr. Lang in the chair. After the minutes of the previous meeting had been read and adopted and two new members elected, the Secretary exhibited Mr. Pitman's water motor castings, which were much admired by the members. This was followed by a discussion on the general construction and efficiency of water motors, also the water pressure available in Glasgow for driving same. The benefits the Society would derive in having permanent rooms and a workshop were also discussed by the members, and a resolution was carried unanimously empowering Mr. Beith and the Secretary to make the necessary arrangements if the rooms were suitable. Mr. Thomson kindly offered his 4-in. centre screw-cutting lathe to the Society, and a number of the members have offered various tools for the workshop. A library was also formed in connection with this branch. A vote of thanks was accorded to the members for their presents of tools and books. The meeting adjourned at 10 p.m. The next meeting will be held on March 5th.—JOHN ROGERS, Hon. Sec., 79, Dundas Street, S.S., Glasgow.

Leeds.—On Tuesday evening, February 4th, the Leeds Branch of the Society of Model Engineers held a meeting in St. Andrew's Church Schools, when Mr. Broughton put before the meeting a very neat set of castings for a water motor ½ h. p., by Mr. Pitman, of Halifax. Mr. Wilkinson brought a 5-in. Cushman chuck, and Mr. Collingwood a very neatly designed beam engine about ¼ h.-p. and a small boiler, so that steam was got up and the engine run satisfactorily for some time, the meeting terminating at 10 p.m.—W. H. BROUGHTON, Hon. Sec., 262, Carlton Terrace, York Road, Leeds.

Liverpool.—A meeting of the members of this branch of the Society was held at the Balfour Institute, on Wednesday, January 15th, the chair being occupied by Mr. Dawson.

After the minutes of the previous meeting had been read over and passed, the Chairman informed the members that it would be necessary for him to resign his position, this statement being received with much regret. Unfortunately, circumstances prevented Mr. Croker giving his lecture as arranged, and this had consequently to be held over until a future meeting.

A new member was elected, and the remainder of the evening was taken up by discussion on various subjects, the meeting terminating at about 9.30 p.m.

The following meeting of the members of this branch was held on Wednesday, January 29th, at the Balfour Institute. After the minutes of the previous meeting had been read over and passed, the hon. auditors for the year were elected—viz., Mr. S. Jackson (proposed by Mr. Kirby, seconded by Mr. Thorp) and Mr. J. Kirby (proposed by Mr. Thorp, seconded by Mr. Staveley). The Chairman (Mr. Dawson) then made a short farewel address, expressing his good wishes for the future prosperity of the Society. Mr. Croker afterwards proposed a hearty vote of thanks to Mr. Dawson for his services as chairman during the past two years, and wished him every success in the future. This was seconded by Mr. Thorp, and carried unanimously.

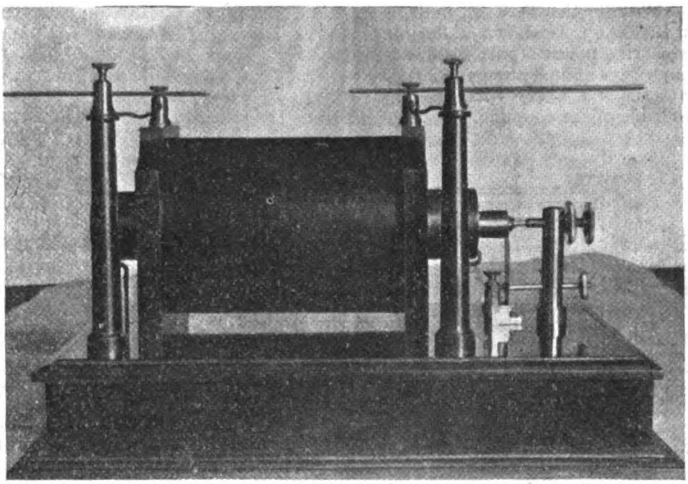
The next meeting will be held at the Balfour Institute, on Wednesday, March 5th, at 7.45 p.m., and will be the third annual general meeting of the Society, when the officers and committee for the ensuing year will be elected.—FRED. T. STEWART, Hon. Sec., 14, Adelaide Road, Kensington, Liverpool.

IN reference to gaslight mantles, it is reported by the *Electrical Review* (N.Y.) that an Austrian engineer has discovered and perfected a chemical compound which, when added to the thoriacera mantle, converts it from a loose, fragile structure into an elastic glass, where the chemical constituents are chemically combined, and not merely mechanically held together.

A 4-in. Spark Coil.

By E. H. Leonardt.

THE following is a short description of a 4-in. spark coil which I have made by following fairly near to the article which appeared in THE MODEL ENGINEER, Vol. IV, No. 44. The slight alterations which I made were: by using 1½ lbs. of No. 14 D.S.C. wire instead of S.C.C., and 4½ lbs. of No. 36 S.S.C. wire instead of 4½ lb. S.C.C. wire. By using silk-covered wire on the secondary, the sections can be made more compact, thus getting more turns into the strongest field with a corresponding better result in the discharge. The contact-breaker is of the type used by Mr. Apps on his famous coils, the spring being of the stoutest ⅝-in. clock spring obtainable; I have also used slightly thicker platinum than is suggested. The condenser I have made more compact than is usual, by running a hot iron over each sheet of paraffined paper as it was placed in position, melting the wax and pressing out all the air bubbles, thus making the whole thing quite solid when finished. I have also added two ebonite discharge pillars, which, though not absolutely necessary, considerably add to the appearance of the coil and are handy when using a Crooks' tube. With three cells the coil works quietly and gives a continuous flow of sparks 4¼ ins. long. The photograph which I have taken gives a fair idea of the finished coil mounted on its polished mahogany base.



Mr. E. H. Leonardt's 4-in. Spark Coil.

An Electro-Magnetic Gun.

EXPERIMENTS have recently been made in Christiania, says the *Daily Mail*, with the new electro-magnetic gun invented by Professor Birkeland. The electric connection between the battery and the gun was made in less than a second by the aid of a current-breaker. The electric spark was seen, and then there was a loud report, which was not, however, caused by the firing of the gun, which is absolutely silent, but was the impact of the projectile, a 1-lb. shell, on a wooden target, which it penetrated. The gun works magnetically. The shell is drawn out of the bore, and not, as hitherto, impelled by gunpowder. The use of magnetism as motive power, according to Professor Birkeland, will enable 1000-lb. shells to be hurled much further than by the old-fashioned methods. Although no particulars are given, the gun is doubtless of the type described in our June issue, 1900, a model of which had then been constructed.

THE *Aluminum World* says that the best lubricant to use on aluminium when turning it in a lathe is either petroleum or water, and in the press, when it is being drawn or stamped, vaseline.

The Steam Turbine.

(*Continued from page 74.*)

THE first Parsons steam turbine and generator was built in 1884. It developed 10 h.-p. at 18,000 revolutions per minute. It ran for several years in Gateshead-on-Tyne, supplying current for the manufacture of incandescent lamps. It is now in the South Kensington Museum. It consisted of two groups of fifteen turbines each, the steam entering between them and passing in opposite directions through each group.

Fig. 3 is a general longitudinal section through a Westinghouse-Parsons steam turbine. The steam enters at the governor valve and arrives at the chamber A, and passes out to the right through the turbine blades, eventually arriving at the exhaust chamber B. The blades are shown in Fig. 4, the steam passing first a set of stationary blades and impinging on the moving blades, driving them around, and so on. The areas of the passages increase progressively in volume, corresponding with the expansion of the steam. On the left of the steam inlet are shown revolving balance pistons C, C_1, C_2, one corresponding to each of the cylinders in the turbine, which, according to size, may be one, two, three, or four in number. The steam at A presses against the turbine and goes through doing work. It also presses in the reverse direction, but cannot pass the piston C; but at the same time the pressure, so far as the steam at A is concerned, is equal and opposite, so that the shaft is not subjected to any end thrust.

The pressure on D is equal to that at E by reason of the balance port F, so, similarly, so far as the steam pressure at E is concerned, there is no end thrust. This same fact also applies to G. The area of the balance pistons is so arranged that no matter what the load may be, or what the steam pressure or exhaust pressure may be, the correct balance is preserved, and the shaft has no end thrust whatsoever.

At H is shown a thrust bearing, which, however, has no thrust to take care of, but serves to maintain the correct adjustment of the balance pistons. The thrust bearing is in two halves, the lower half capable of adjustment in one direction, the upper one in the reverse. The balance pistons never come in mechanical contact with the cylinder, and consequently, there is no friction. The thrust bearing has ample surface, and is subjected to forced lubrication.

There is obviously some leakage past the pistons, but it is found to be very small. Centrifugal force seems to have something to do with keeping down this leakage. The particles endeavouring to escape have to pass radially inwards in going through the small clearance. It is supposed, then, that the rapidly revolving pistons have the effect of throwing outwards the particles with which they come in contact by reason of skin friction, so that the particles being slung outwards tend to oppose the escape of the particles inwards. This theory, however, is somewhat imaginary; but, in view of the economy obtained, the leakage cannot be very great.

At K is a pipe connecting the back of the balance pistons at L with the exhaust chamber, to ensure the pressure at this point being exactly the same as that of the exhaust. At J are shown the bearings. They are unique in construction. The bearing proper is a gun-metal sleeve, which is prevented from turning by a loose-fitting dowel. Outside of this are three concentric tubes, having a small clearance between them. This clearance fills up with oil, and permits a vibration of the inner shell, at the same time restraining same. The shaft, therefore, revolves about its axis of gravity, instead of the geometric axis, as would be the case were the bearing of ordinary construction. The journal is thus permitted to run slightly eccentric, according as the shaft may be out of balance. This form of bearing in a very remarkable manner performs the functions of de Laval's slender flexible shaft. But in this case the shaft is built as rigidly as possible. At R, Fig. 3, is shown a flexible coupling, by means of which the power of the turbine is transmitted. The governor gear and oil pumps generally receive their motion by means of a worm-wheel gearing into a worm cut on the outside of the coupling.

ways; that is to say, the mid-position of the levers is admitting a full head of steam to the turbine. A movement from this in either direction is tending to cut off the supply. This serves a useful purpose in the event of a very excessive load coming on the turbine, such as a short circuit, which has the effect of bringing down the speed more than the percentage variation permitted, by the adjustment of the spring when the steam immediately becomes shut off. Again, in such an event as some of the governor-driving mechanism becoming broken and the governor balls slowing up independently of the turbine, the steam is shut off before any damage could take place. The speed of the turbine may be varied within all the limits of the governor spring while the turbine is running. This is particularly useful in bringing alternators in synchronism and adjusting their differences of load when in multiple.

There is absolutely no variation of angular velocity (revolutions) in the turbine, which is necessarily present

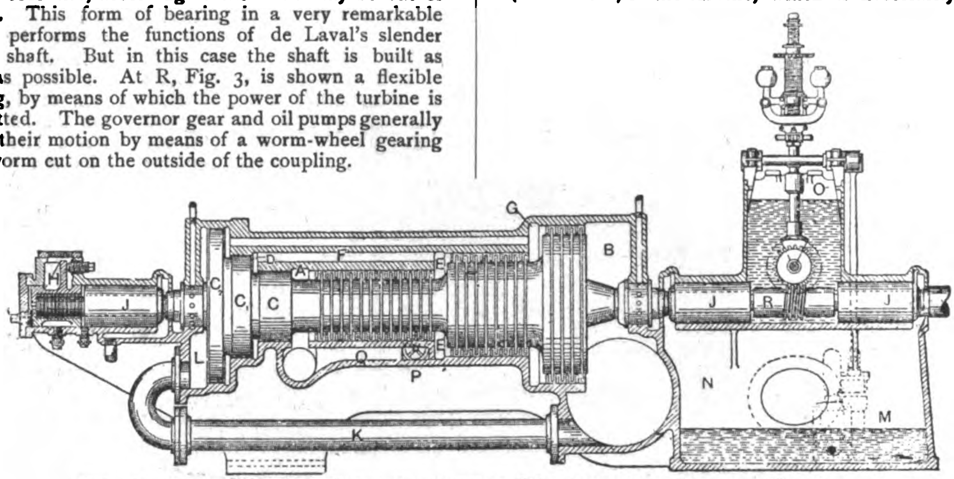


FIG. 3.—LONGITUDINAL SECTION THROUGH WESTINGHOUSE-PARSONS TURBINE.

At N is an oil reservoir, into which drains all the oil from the bearings. From there it runs into the pump M, to be pumped up to the chamber O, where it forms a static head, which gives a continuous pressure of oil to the bearings. The pump is single-acting and of simple construction. The oil runs in by gravity.

A by-pass valve is provided, shown at P, which admits high-pressure steam by means of port Q to the steam space E. By opening this valve as much as 60 per cent. overload may be obtained, and with turbines operating condensing, full load may be obtained should the condenser be inoperative, and the turbine exhaust into atmosphere.

The glands consist of packing rings set in grooves cut in the shaft. The rings press outwards, and remain stationary. Any form of frictionless packing necessarily leaks a little. In the case of the turbine exhausting into a vacuum a little live steam is admitted between the rings by means of a small reducing valve, so that the leakage consists of a negligible quantity of live steam, instead of air, which would impair the vacuum.

In the case of the turbine exhausting against anything above atmospheric pressure a small ejector is provided, which drains the leakage steam from between the packing rings, and allows it to drain through a suitable drain pipe, instead of escaping into the engine room.

The governor is of the fly ball type. The ball levers are swung on knife edges. The governor works both

in reciprocating engines, hence the value of turbines for running alternators in multiple. This can be realised when we know a 500 h.-p. turbine will run twenty minutes after the throttle has been closed. This, of course, speaks well for the low friction; but is principally due to the tremendous flywheel effect of the shaft. All the power is transmitted rotatively—there are substantially no reciprocating parts and no vibrations, hence no costly foundations and no holding-down bolts are necessary.

The essential parts of the turbine are, of course, the blades and buckets. They are made of hard drawn material. They vary in size from ½ in. to 7 ins., according to where they may be used. Every row of these blades has passages of increased area, corresponding with the volume of steam. This increase of volume is obtained by increasing the heights of the blades, and when these have reached the desired limit the diameter of the turbine is increased and the steam permitted a higher velocity that enables the blades to recommence another progression. Considering one barrel of the turbine, the fall of pressure, or to be more exact, the co-efficients of expansion, are the same for every row.

Referring to diagram, Fig. 4, the steam at pressure P in expanding through row 1 to pressure P_1 converts its energy into velocity, and impinges upon the moving blades row 2. The steam then performs a second expansion in expanding through row 2, again converting its energy into velocity; but this time the energy of the efflux is to react upon the blades from which the steam issues. The same cycle is repeated in 3 and 4, and so on until exhaust pressure is reached. The moving blades, therefore, receive motion from two causes, the one due to the impact of steam striking them, the other due to the reaction of the steam leaving them, and in this respect is this turbine a combination of Bianca's wheel and Hero's engine.

Many people suppose that these blades wear under the action of steam. Experience shows that they do not, In the case, however, of a nozzle such as has already been described, in combination with the blades, the result is very different, by reason of the tremendous velocity of the steam. The wear even then is not much when superheated steam is made use of; but with any entrained water the wear is quite rapid. In the Parsons turbine the velocities of steam never exceed 500 ft. to 600 ft. per second, and for the most part are considerably less than this. The blades are secured by caulking. Experiments show that the pull necessary to pull them out is as much as the elastic limit of the material of the blades themselves. The strain to which they are subjected in practice is about 1-40th of this amount. Danger of the blades colliding sideways is very remote. The smallest blades have ⅛ in. clearance sideways, and the largest as much as

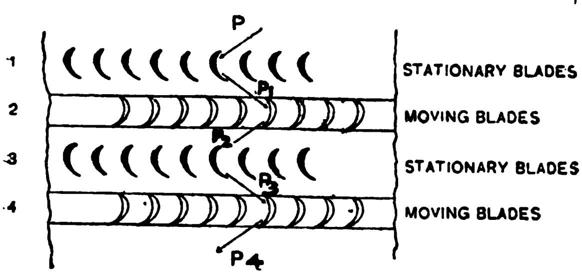


FIG. 4.—ARRANGEMENT OF BLADES IN PARSONS' STEAM TURBINE.

⅛ in. These dimensions are far beyond the limits of lateral motion permitted by the balance pistons.

It may be interesting to record the actual pressure exerted on individual blades in a turbine. Take, for example, one of 300 kw. capacity, to which special reference will be made. There are altogether 31,073 blades in the turbine, of which 16,095 are moving blades. The pressure that each of them exerts in revolving the shaft varies from ·89 oz. to 1·04 ozs. The boiler pressure is 125 lbs. per square inch, vacuum about 26 ins., and revolutions 3,600 per minute.

The steam consumption of 16·4 lbs. per electrical h.-p. at full load is in itself remarkable; but such results as at the light loads have never been approached before. It may be said that the consumption at half load is only ten to twelve per cent. greater than at full load.

It must not be lost sight of that these results are per electrical horse-power. To make a comparison with a reciprocating engine and assume the efficiency of transmission from the steam cylinders to the switchboard to be eighty-five per cent., which is about the very highest attainable, would bring the full load water rate on the turbine just described to 14 lbs. per i.h.-p. The tests were made under ordinary conditions so far as dryness of steam is concerned, the boilers being some distance away, and no allowance made for wetness of steam.

Superheating may be made use of with considerable gain in economy and without the usual difficulties. There are no internal rubbing surfaces and no packing glands to become injured by the high temperature; 60 degs. to 70 degs. of superheat improves the economy by some 20 per cent. In this connection, Professor Thurston has lately recorded some experiments with a de Laval turbine. For every 3 degs. Fah. of superheat 1 per cent. of gain in economy was attained; with 37 degs. of superheat the capacity of the turbine was doubled. This gain was entirely due to reduction of the skin friction.

The practical efficiency of the turbine-power plant may be gathered by some tests made by the Westinghouse Air Brake Company. After the plant had been installed some nine months, the whole plant was shut down, and the steam engines which had been previously doing the work, were connected up again, put in service, and were kept running a week, during which time careful measurements were taken of fuel and water. After this the turbine plant was again put in operation, and similar measurements made with the electrical transmission. The saving in coal averaged 35·7 per cent. during the day, and 36·4 per cent. during the night in favour of the turbines. The saving in feed water averaged 29·8 per cent. during the day, and 41·4 per cent. during the night. In round numbers, this meant a saving of 40,000 lbs. of coal in twenty-four hours. The gain is, in a great measure, due to the economy of the turbines, but also to some extent to the elimination of the condensation in long lengths of steam pipe, and to the advantages of electrical transmission. The whole plant of three turbines and generators, aggregating 1,500 h.-p., occupies a floor space of 24 ft. square.

The Astor turbine, designed by Col. J. J. Astor, and described by the *Scientific American*, is fitted into a steam launch for purposes of propulsion. It has no stationary parts other than the journals and foundation frames which carry it, the casing of the turbine revolving as well as the shaft, but in an opposite direction. The general construction of the motor consists of one interior shaft which extends from the forward journal through the rear propeller. Upon this shaft is formed a series of spiral blades, which have a steady increase in diameter from the forward or admission end of the turbine to the rear exhaust end. The shaft and blades rotate within a flaring, funnel-shaped casing, around the inner surface of which is formed another series of spiral blades, also increasing in diameter, whose twist is in the opposite direction to that of the blades on the shaft, the two set of blades or vanes being respectively right and left handed. The tubular casing is drawn down to the exhaust end to form a hollow shaft, which encloses the central shaft, and extends through the deadwood and the sternpost. The propellers are right and left handed, to match the direction of the blades of the respective shafts to which they are keyed, the two propellers thus rotating in opposite directions.

The casing increases in diameter at the proper rate to secure an even rate of expansion of the steam, which is conducted from the exhaust through a length of piping formed in the keel of the launch, the keel thus being made to serve the purpose of a condenser. The condensed steam collects in a well, from which it is drawn by the boiler feed pump. Steam is admitted to the forward end of the turbine, and, striking on the two sets of blades, the shaft is rotated to the right, and the outer movable casing to the left, the respective propellers being, of course, driven in corresponding directions.

Lately a 1000 kw. outfit has been built by C. A. Parsons & Co. for the Elberfeld Corporation, in Germany. At 1,200 kw., 130 lbs. boiler pressure, 18 degs. F. of superheat, the turbine driving its own air pump, etc., an electrical horse-power was produced for 14·025 lbs. This is probably the highest economy ever attained in any steam engine.

Home-Made Dry Cells: The Secrets of Success.

By F. E. P.

IN spite of the fact that instructions of a very specific character have been given in these pages from time to time on the construction of dry cells, the number of anxious enquiries which find their way to the offices of THE MODEL ENGINEER show that something still remains to be said on a subject of direct practical interest to every amateur electrician. Speaking generally, the difficulty experienced by those who have attempted to follow these instructions is that of getting a sufficient return in current for the outlay expenditure of time and materials. Queries from readers, who have "carefully followed the directions in every detail," yet fail to obtain "current enough to ring an electric bell," are amongst the more frequent troubles dealt with in a popular section of this journal. Perhaps a few practical hints from one who has experienced such difficulties, and who has since had many opportunities of studying the causes of failure, will be of use; and these remarks may well be prefaced by an enumeration of some of the pitfalls into which the amateur, often quite unconsciously, falls headlong.

One point which is difficult to make clear to many people, is that the results of an amateur's first attempt to make a dry cell cannot possibly be expected to compare favourably with those of a tried and established commercial article. It seems useless, sometimes, to point out that the latter is the outcome of a long series of severe tests and experiments, and is manufactured with every convenience in the way of appliances and machinery, by skilled hands. The successful manufacturer of a really satisfactory dry cell might feel no trepidation whatever, if its exact constitution were given to the world; without his machinery and his *methods*, the exact quantities of materials are of comparatively little moment.

Undoubtedly, the chief reason why the home-made dry cell is so often a failure is insufficient ramming—the materials are left as a loose, honeycombed mass, often with carbon grains too coarse or too irregular in size. The carbon mixture is wanting in homogeneity, and as this simply means that the points of contact, over which the current *inside* the battery has to flow, are comparatively few, the resistance is greatly heightened, and the resulting current feeble. The same cause produces also another result—rapid polarisation, as to which a few words will not be out of place.

Polarisation is the condition set up in a galvanic battery by the more or less complete covering of one of the electrodes by gas bubbles. Usually these bubbles are of hydrogen gas, and they tend to accumulate on the carbon plate immersed in the electrolyte. This accumulation of gas has the effect of reducing the effective area of the electrode it covers, and so offers extra resistance to the current. It also has a further tendency to act as a battery on its own account, the hydrogen itself constituting an electrode, and the current it tends to produce is unfortunately in the opposite direction to that of the cell proper. To prevent this tendency, various materials are used (in different batteries) to absorb the hydrogen, cause it to leave the battery, or combine with it in such a way as to render it harmless. In the dry cell, as in the Leclanché, this depolarising material is an oxide of manganese, and its function is to part with sufficient oxygen to combine readily with the hydrogen before this reaches the carbon plate. The resultant compound is water, which is, of course, innocuous as far as the action of the battery is concerned. The speed, or readiness with which the above operation can take place, depends very largely on the intimacy with which the materials are combined. In the carbon mixture, of which the manganese oxide forms a part, the carbon really acts as a conducting medium and a vehicle for the oxide, and has no chemical action in depolarisation. If, however, the spaces between the particles are large, the gas meets the oxide at fewer points, it more readily covers the few available contact points of the carbon particles, and, in short, polarisation rapidly ensues.

The first essential, then, in the construction of a good dry cell is tight filling, pre-supposing that the quantities of materials and the form of the cell are correct. Ramming is easily accomplished by the aid of a stick of wood and a mallet or light hammer. The plaster-of-Paris mixture, when that is used, does not, of course, require this treatment. The stick should be small enough to ram every part of the mixture round the carbon, but as large as possible or it will prove ineffective. The mixture should be well hammered down at stages, not more than an inch depth of material being put in at a time until the cell is full.

With regard to the plaster coating, this should be as thin as can be put on—⅛ in. thick should be the maximum for the largest cell. It is of the utmost importance that it be perfect, as the least direct contact of the zinc with the carbon plate or mixture is bound to prove fatal. This is, indeed, a fruitful source of trouble, and it occasionally happens in consequence of injudicious ramming, so that care must be taken when doing this.

Occult qualities are evidently attributed by some (usually unsuccessful) amateurs to the exact combination of a *large number* of chemicals in the paste or mixture. If such qualities exist they are doubtless objectionable ones, and in spite of the apparent necessity for hygroscopic materials such as zinc chloride, or other moisture-retaining substances, they must be regarded as evils, however unavoidable. The perfect conditions for a Leclanché cell are (1) an amalgamated zinc in a half-saturated solution of salammoniac of good quality; (2) a carbon rod tightly packed with a mixture of coarse *grains* of hard carbon and manganese dioxide (black oxide of manganese). The dry cell is a modified Leclanché merely, and the nearer its contents approximate in character to those of its congener, the better it may be expected to act.

With regard to the zinc, it is sometimes asked whether this or that thickness will make any difference to the action. Within limits, the answer is No. A very thin zinc will wear through more rapidly, it is true, but zinc about No. 24 S.W.G. will do very well in the majority of cases. It may be thicker with advantage.

The question of amalgamating is also of frequent occurrence. Zinc cannot very well be bent after amalgamation, as it is rendered exceedingly brittle. Neither is it easy to coat the inside of a zinc-containing vessel evenly with mercury. It is consequently seldom done, and a fair proportion of faulty home-made dry cells may trace their condition to the use of a thin, or even sometimes thick impure zinc plate unamalgamated, and therefore unprotected from "local action." The writer strongly recommends makers of small cells—such as those to be described—to wash out the containing zinc vessel with weak sulphuric acid and rub in a few drops of mercury. As little should be used as possible or the soldered joints will suffer.

Samples of every kind of carbon (except diamonds, it is true!) have been forwarded by readers who wished to know whether they had been supplied with the proper material. The proper material is the hard, sparkling, black carbon called "retort-scurf," which is found lining gas retorts after firing. It is much harder than coke, which is a poor substitute sometimes used, and is entirely different in character from either graphite (lead-pencil carbon) or charcoal (wood carbon), both of which have been submitted for the writer's criticism as battery materials. For ordinary dry-cell purposes the carbon should be crushed to grains much about the size of a pinhead—say, not more than 1-16th in. in diameter—but it is very important to sift out all *powder*. The reader's common-sense must be trusted to realise these distinctions: they are unfortunately difficult to make clear on paper.

The carbon rod itself should come from the same source as the particles. It is, however, allowable for this to be of the "compressed" variety—which certainly should not be the case with the particles themselves. There is only one really satisfactory way to treat the top of a carbon plate for any battery. It should be well soaked in hot paraffin wax nearly down to where it comes in contact with the electrolyte, and the extreme top should then be copper-plated. The process is fully described in "Electric Batteries," wherein also will be found constructional details of dry batteries.

The other component of the "carbon mixture"—the manganese dioxide, should also be in grains, and not in powder; though in this case the individual particles may be smaller. The carbon and manganese must be thoroughly mixed so that they are both equally distributed. If no substance is added to extract moisture from the air, the mixture must be damped with salammoniac solution, a very little glycerine being added to retain the moisture. It is advisable to have none of the manganese mixture below the end of the carbon plate, which should stand on a rubber or paraffined-card disc to prevent to some extent any action taking place on the bottom of the zinc cup.

The character of the sealing material appears to be of some importance. If pitch is used, it is liable to be burnt in the process of melting, and it appears to the writer that this may render it partially conductive. It is not at all improbable that this may account for many faulty cells in which nothing else appears to be wrong. Sulphur is recommended for the purpose, and is very good; it requires a very considerable heat to melt it properly. A small glass tube reaching down to the carbon mixture is advisable, but is not inevitably necessary. The whole of the surface of the sealing material from zinc to carbon should receive a coating of melted paraffin wax.

The wire or strip for connections should be soldered to the zinc and the copper-coated top of the carbon. It is almost impossible to prevent "creeping" when the terminal is simply screwed into the unprepared top of the carbon, and this creeping promptly stops all effective contact between the two. Finally, the various cells of a battery should be separated from one another by paraffin-waxed cards, and care should be taken that no moisture can accumulate in the bottom of any containing case into which the battery is put, or it will be short-circuited through the zinc vessels. If these precautions are taken, there is no reason why "dead failure" should follow the efforts of any reader to make a dry cell.

A new dry cell has recently been put on the market for the special purpose of lighting small lamps—not necessarily intermittently—and as this is a feature which will appeal to many amateurs, the construction is worth describing. As the batteries by themselves are sold cheaply, any reader can, of course, obtain them and examine their construction without difficulty. This has been done for the purpose of this article, and while no wonderful secret was discovered, some valuable facts were observable.

The cells in question are each about 1¼ ins. diameter by 3 ins. high, of thin zinc, which appears to be of specially pure quality. Three cells light a 3½-volt ½-ampère lamp brilliantly, the voltage of each cell being 1·46 (tested). The cells are guaranteed to light the special lamps for which they are intended, for about eight hours in all, and a test of the three cells in question shows that they were capable of running a small motor for half-an-hour without showing strong signs of polarisation.

The zinc cup, which is, of course, soldered, is lined with about, but not more than, three thicknesses of white blotting-paper, well soaked in salammoniac solution. The paper fits the zinc closely. This can be accomplished by putting the spiral of blotting paper in dry, so that it springs open as much as possible, afterwards soaking it with solution. A few thicknesses of the same paper cover the floor of the cell, and on top of these, closely fitting the paper walls, is a disc of card soaked in paraffin wax.

The carbon rod for this cell is of the compressed variety. It is about ¾ in. diameter and 3 ins. long. In the process of manufacture a copper cap is buried partly in the carbon, thus making an excellent and firm contact. The rod stands on the disc of card, and is packed tightly around with apparently carbon and manganese dioxide only. Both are crushed fine—not powdered; the sensation in one's hand is that of grains of wet silver sand as commonly used in the household. The packing of this material must be carefully done, or injury will result to the paper lining, which would be a serious matter.

A quarter of an inch clear space is left at the top of the cell for sealing. Pitch appears to be used, but its extremely brittle character suggests that shellac or some other material finds a place in its manufacture. Brass strips soldered to the top of the carbon rods make contact by being soldered to the zinc of the next cell. The three cells are contained in a cardboard box, and are separated from each other by paraffined strips of card.

The heavy and continued discharge of which these cells are capable is due to the very thin space which separates the zinc from the mass of manganese mixture, to the comparatively large surface of the latter (allowing rapid depolarisation to be effected), to the excellent contacts, and to the moisture of the whole mass. The carbon mixture, while not absolutely wet, is quite damp, and as far as a chemical analysis could ascertain, this moisture consisted wholly of salammoniac solution.

The fact that comparatively little space exists between the zinc and the carbon, together with the method of burying the copper contact piece in the head of the porous carbon rod, points to the likelihood that the cells would not last a great length of time. Indeed, it is stated by the makers that the cells are guaranteed to give good results only within a somewhat limited time—three or four months. This is exactly what might be expected, but there is no doubt that it is a point of small importance compared with other qualities the cells possess.

Having briefly touched upon the troubles which most beset the amateur in his endeavour to make a really satisfactory dry cell, we may conclude with one remark as to which many appear to be in doubt. It is useless to try "re-charging" dry cells from battery or dynamo. The zinc vessel *may* be used over again by refilling; but it is probably nearly worn out, and therefore liable to fail. Dry cells that have served a reasonably long life should be thrown away—to attempt to resuscitate them is a very real (and somewhat popular) form of wasting one's labour!

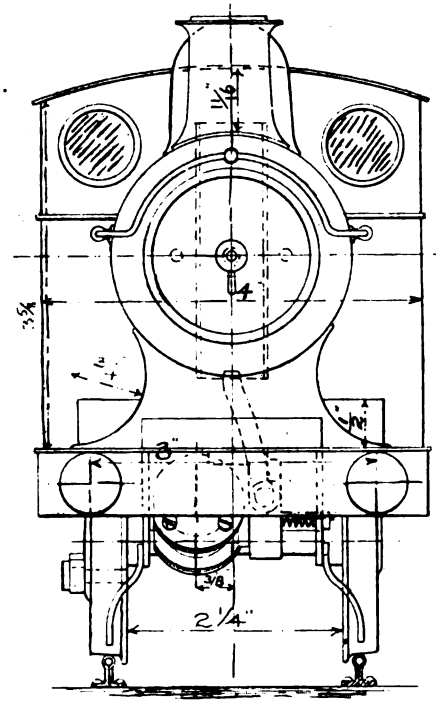
THE Commissioners of the Northern Lighthouses have decided to adopt wireless telegraphy as a means of establishing communication between the mainland and certain of their lighthouses. The first installation will be at the Flannan Islands, which are situated about sixteen miles outside the west coast of Lewis. The installation, which will be made in conjunction with Lloyd's shipping agency, will be on the Marconi system. The Flannan Islands are practically the first land sighted by vessels coming from America, and the new installation will, therefore, be exceedingly valuable in reporting the sighting of vessels, according to the *Engineer*. It will also be utilised in communicating with the lighthouse keepers.

A Simple Working Model Locomotive.

By H. Greenly.

At the time the Editor asked me to prepare a design for a model locomotive of small gauge and of simple character, I was busy with two or three other designs which were more or less complete scale models, and the change from one to the other was very irksome. It was stipulated that the model should be as simple as possible consistent with efficiency, and yet be a "cut above" the ordinary "Ajax" type of shop model.

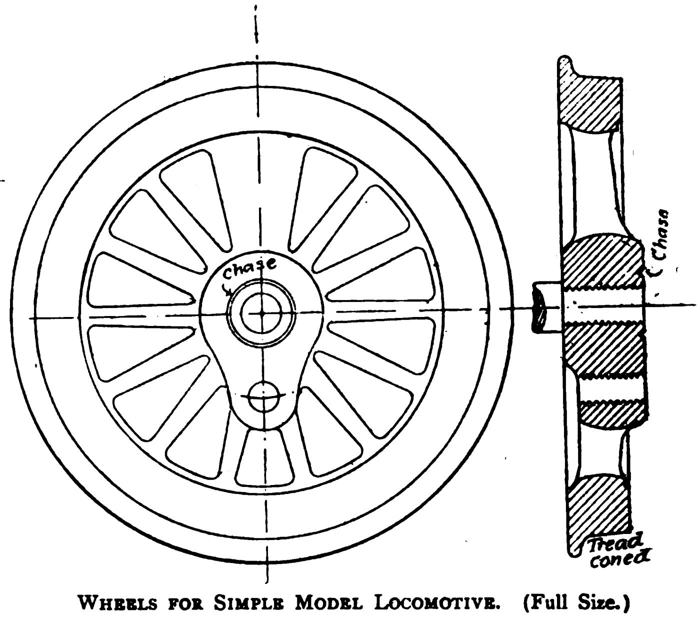
The first question to settle was the type of railway engine to copy. It was decided to have a tank engine, because there is much less work in such than in the



Front View of Simple Model Locomotive. (Half Size.)

express engine with its tender. Before, however, the exact type was definitely chosen, it was necessary to work out what one would allow the largest generator and firebox. For ½-in. scale, the latter is an important point. Locomotives with four coupled wheels—except when in front—are generally restricted in firebox length, and it is not always easy to arrange burners each side of the trailing coupled axle. Moreover, a six-wheeled tank engine, with the small carrying wheels leading, can only have a small firebox and very little bunker space. With the wheels reversed (see design in Model Engineer for July 1st, 1901), these items can be much enlarged. As all these types involved a larger number of wheels, and therefore more patterns, increased length, and extra work in springing the engine and providing for the flexibility of wheel base, a four-wheeled engine was thought preferable. The only difficulty with a four-wheeled engine is the provision of a firebox of ample dimensions. If it is placed behind the trailing wheel, it is necessarily limited. To provide for other than this, it will be noted that in this design the whole of the propelling machinery is placed in front of the leading wheel—all the space behind the crank is then available for means of firing. Such a large space for a small engine burning spirits is a decided advantage—there is no likelihood of the flame being choked.

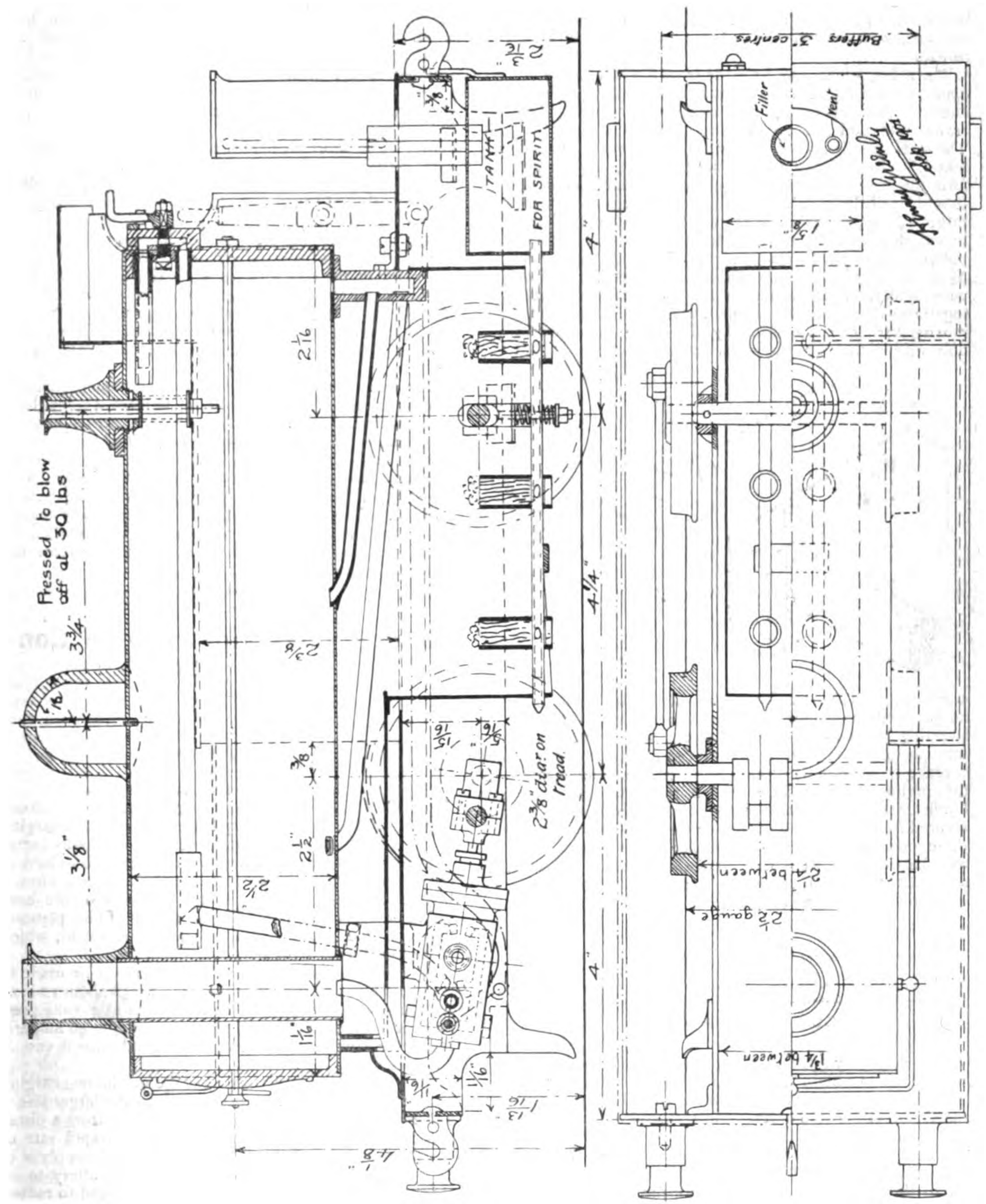
An ordinary locomotive boiler was also deemed out of the question; there is a certain amount of difficulty in the construction of these, which in itself prevents many from attempting a model locomotive, and it introduces various difficulties, such as provision of a good draught, and the small range of water possible with a reasonable amount of heating surface. The boiler adopted is similar to that used by Mr. Smithies with great success. The arrangement of the tubes is modified. The great feature of this type is that a good steaming boiler can be obtained with comparatively little "skilled labour" and with a large range of water. Saying that the engine will



Wheels for Simple Model Locomotive. (Full Size.)

consume ½ cubic in. per minute and the boiler will evaporate this, the water will last quite 40 minutes.

Coming to the construction of the model. The exact method adopted will, of course, depend upon the tools at one's disposal. A lathe of some sort seems indispensable, and a faceplate, driver, and bell chucks are almost all the fittings absolutely required. It will be necessary at an early stage to make or obtain the patterns and castings for the wheels. The accompanying drawing gives the principal details, and the number and arrangement of the spokes and balance weight. The wood should be turned up to the required profile about ⅛ in. larger in diameter than finished size, and ⅜ in. wide. The projecting pear-shaped boss on front need not be heeded at all in the turning; the boss should be left level with the spokes, so that the finished pear-shaped boss can be applied afterwards. Before this is done, however, the spokes should be marked and fretted out. The balance weight is improved in appearance if it is brought forward from the level of the spokes by the application of a piece of 1-16th in.



HOW TO BUILD A SIMPLE MODEL LOCOMOTIVE.

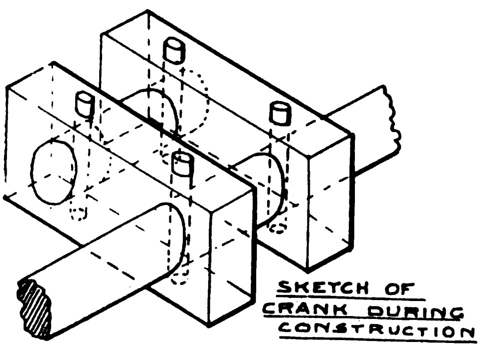
General Arrangements of Engine Showing Sectional Elevation, Half Plan, and Half-Sectional Plan.

Scale: **Half Size.**

(For description see opposite page.)

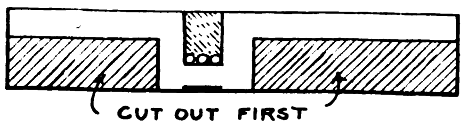
wood or metal to the pattern. To finish, they should be bolted on to the faceplate with the front of the wheels outward, and centred and bored to take a 3-16ths in. thread.

The axles, which may be made from Stubb's steel ½ in. diam., are both 3 ins. long when finished and must be reduced at the ends for ⅜ in. to receive the wheels. The crank axle will not present any difficulty if built up. The steel spindle should be centred and prepared for the wheels. Two pieces of mild steel 1⅛ × 3/16 × 7/16 in., to form the webs should be filed square, and in each two holes should be drilled, one at either end ½ in. apart, to take, rather tightly, the axle and the crank pin; the latter can be cut off a piece of the same rod as the axle. The crank pin and webs can be placed in the correct position, *i.e.*, ⅜ in. out of centre on the axle and the whole sweated with solder, cr, if the maker has conveniences, brazed together. If brazed, the crank should be secured from moving during the operation by pins being driven into a hole drilled through the webs and axle and webs and



SKETCH OF CRANK DURING CONSTRUCTION

crank pin. The real strength when this method is adopted will be supplied by the brazed joint. If only sweating the joint with ordinary soft solder, the crank must be made reliable by driving taper pins in a similar manner into carefully drilled and broached holes after the preliminary sweating. When these are fitted, the crank might be again subjected to heat and the pins secured from falling out by the solder. When either of these operations have been completed, the piece of the axle between the webs may be cut off with a hacksaw and then filed flush as neatly as possible. There are, of course, many ways of making a crank—one which



would give very good results without a great amount of trouble is to obtain a bar of iron or mild steel 15/16 by 7/16 in., from which with a hacksaw all superfluous metal on either side of the crank should be cut. The axle can then be turned to its proper diameter. The crank should then have the piece of metal between the webs removed and by means of throw plates screwed on to the ends of the axles the crank pin may be turned. The webs can then be filed clean completing the axle.

The frames should now claim attention; they are of the simplest character. From a steel plate 1-16th in. thick cut two strips, 1¼ ins. deep by 12⅜ ins. long (finished size). The wheel base of the engine is 4¼ ins. equi-distant from the ends. For the leading axle—springs not being used, because if such were used the distribution of the steam would be interfered with—a plain ½ in. hole is all that is needed for the axle. To lengthen the bearing, however, a brass axlebox should be riveted or screwed to the outside. In the drawings the trailing wheels are shewn with springs; these, although simple, add somewhat to the work, and may be left out if the builder desires. Springs are an advantage, but with an engine of so short a wheelbase are not absolutely necessary, if the flanges are at least ⅛ in. deep.

The axleboxes, if the trailing end is sprung, are plain square bushes of brass, and are not controlled sideways, the movement of the axle in this direction being retained by the slot in the frames, which is filed to fit it. Under the axlebox a hornstay is arranged, and upon its horizontal flange the spring takes a bearing. The drawing shews clearly the profile of the frames at either end, and also the guard irons, which should be riveted with brass or copper rivets on the outside of the main frames, and be set so that the lower end comes over the centre of the rail.

The buffer planks can be cut from the same sheet of steel as the frames, and should be finished 4⅜ ins. long by 11-16ths in. deep. The holes for the screws securing the buffers, and for the drawhook, should be centre popped and drilled before affixing the planks to the frames. The joint between these should be made with brass angle, riveted to the buffer planks in the proper position. The buffer planks, with the projecting angles, can be then sweated to the main frames to hold them in position while drilling for the rivets or screws, according to which is preferred.

(To be continued.)

Motor Cycles and How to Construct Them.

By T. H. Hawley.

(Continued from page 79.)

XVII.—Motor Manipulation (*continued*).

MANY will prefer employing accumulators instead of the uncertain dry batteries; and if charging facilities are at hand, they are decidedly better in every way, because the amount of energy contained in the cell may be more accurately estimated, and after a little experience, the rider is able to judge of the condition of his accumulators by the colour of the plates—that is, if the cells are of a transparent celluloid, which is the best form for the purpose.

A two-cell storage battery of this type may be made to replace a four-cell dry battery: it will weigh about 12 lbs., and have a capacity of 20 ampère-hours at 4 volts pressure; or a larger size may be employed, giving 40 ampère-hours, the latter being preferable if the additional cost is no objection.

Both batteries give 4 volts; but the maximum charging rate in the smaller is 2 ampères, and in the larger size 4 ampères. The charging must, of course, be from a direct current, and excessive overcharging or too rapid rate of charging must be avoided. If the source of supply is in excess of the requirements of the storage battery to be charged, a resistance board must be employed to reduce the charging rate, and all accumulators should be charged at a voltage but slightly in excess of the voltage of the cells: thus, with two cells coupled in series, the charging current would need to be reduced to a little over four volts; but where a number of cells of one type can be charged at one time, then the number of cells in series may be regulated to balance the charging current, as example—suppose the dynamo to give 50 volts, this pressure would be suitable for charging 24 cells in series. But in any case a variable resistance is preferable, because at the start the charging current should not exceed by much the voltage of the cells, though when the charging is advanced, the pressure may be increased without danger to the plates, and with consequent saving of time, though in the absence of regulating devices and exact knowledge, it will usually be best to keep on the safe side by coupling up the cells to a minimum supply and taking the maximum time, which will, for the class of cells described, be from seven to twelve hours. Many users even prefer to employ accumulators on the machines, by reason of the certainty of action, and use a dry battery or other form of primary battery at home for charging purposes. This, of course, is a more expensive method than charging by dynamo; but it has the advantage that the storage cells may be coupled up overnight and require no further attention, being found fully charged in the morning. For this purpose any form of constant-current battery may be employed; but most of the makers of motor accumulators are supplying special charging batteries, suitable for charging their own make of accumulators.

It will be seen that to be thoroughly master of the electrical side of the motor subject, it is necessary to be provided with an efficient voltmeter and ampère-meter, and a word of warning may be offered against purchasing some of the cheap flimsy instruments which the motor movement has called into existence.

Having briefly dealt with the subject of ignition, we may proceed to consider other causes which operate in bringing the machine to a standstill, or lessening the power of the motor, for it must be understood that it is one thing to merely coax the engine to work, but an entirely different matter to maintain that working at maximum efficiency, and this remark should be specially emphasised, for in small high-speed gas motors the piston area is so small that any loss of power through faulty valves or piston, is very pronounced, and of far greater consequence than similar defects in the steam engine. We have not space to enter into the whole of the gas engine theory; but it may be stated that in the first place it is imperative that the compression be good, otherwise the explosion cannot be effective, and the loss is a double one, by reason of the fact that the very conditions which lead to indifferent compression, operate to further reduce the engine power on the explosion stroke. "For the power of the engine is dependent on correct compression in combination with complete combustion," and, as the gas engine is a heat engine, "its power is dependent on high initial temperature in combination with a rapid drop in temperature," conditions which can exist only in combination with good compression and proper combustion.

The degree of compression may be readily tested by simply pushing the machine along with the compression release tap closed, and under these circumstances, if the piston and valves are in perfect order, it will require a distinct effort to push the tricycle over the compression stroke. At the same time, the machine should be easily moved when the compression tap is open.

The *degree* of compression in any given engine is controlled by the area of the combustion chamber or compression space in relation to the area of cylinder bore through the working stroke, and as a general guide it may be added that in small high-speed motors this degree of compression is about four to five times—*i.e.*, the total amount of gas which can be accommodated in the working portion of the cylinder and the combustion chamber is compressed into one-fourth to one-fifth of the space, and the higher the degree of compression aimed at, the greater will be the attention demanded to maintain it in working.

Maintaining the compression is entirely dependent on the attention bestowed to valves and piston, the most important factors being the exhaust valve and the piston, and of these two the exhaust valve will require by far the greatest amount of attention.

When it is found that the engine lacks power, although the firing takes place regularly, the valves should be removed for examination, this being easily done on the roadside. Occasionally it will happen that some foreign substance, such as charred lubricating oil, has formed into small caked particles, some of which have stuck to the exhaust valve lip or seating, thus preventing it closing properly; but more often the fault will be due to corrosion of the valve lip from overheating, rusting, or the pounding of particles lodging in the valve, the remedy, of course, being re-grinding. In grinding in a valve, crocus powder, or the very finest emery flour, should be used in a paste formed with oil, and, after grinding in, all traces of the powder should be washed away. The exhaust valve head has a screw-driver slot for rotating it during grinding, and each stroke should make a complete to and fro revolution of the valve, and between every three or four strokes the valve should be slightly lifted and dropped again in a fresh position, the grinding being continued until a continuous bright contact line is formed on both valve and seating. In the case of a neglected and deeply pitted valve, the grinding in, to be effective, would be extremely tedious, and the best policy is to insert a new valve (previously ground or tested), and leave the defective one for home treatment, when it will be best dealt with by taking a mere scraping cut in the lathe, the valve being chucked true by its stem, this being followed by a light grinding in the seating, because the truly-turned valve may not correspond with the seating.

The inlet valve will give far less trouble, though it is important that it be kept tight and up to its work. The entire valve, with its seating, is removable in one piece, and the grinding may be done in the fingers, the inlet valve never gets so badly fitted as the exhaust by reason of the cool entering gases, and the real trouble is more likely to be found in the valve spring, for a very slight variation in the tension of this spring will cause the valve to leak by closing too slowly on the other hand, or, if the spring be too strong, the valve will be late in opening, and so diminish the supply of explosive gas.

In fact, the action of the two valves and the piston should be studied conjointly, otherwise a false conclusion may be arrived at.

This will be better understood if we imagine two exactly similar motors, both having valves and springs in perfect order, but one in which the piston is leaky. Now the inlet or induction valve is opened against the resistance of its spring by the suction action of the piston; but if the spring be at the correct tension to suit a correctly fitting piston, then in the case of the leaky piston the valve would not open until the piston was well away on the charging stroke, the result being that the cylinder would be but half charged with the explosive, the compression would consequently be one half and the power stroke weak in proportion. The remedy here, of course, is in the piston, not in the spring; but to take a reverse condition, in which the piston is efficient but the inlet valve spring too weak, then the valve will open quickly but will close only when compelled by the pressure due to the returning piston on the compression charge, the result being that a certain amount of gas is forced back through the valve with resulting loss in compression.

There are other and more complex conditions controlling the working of valves and piston, which we cannot investigate; but one example will set the intelligent student on the right line for thinking the matter out. Rapid evaporation produces cold; hence the inlet valve is maintained comparatively cool. Heat causes gases to expand; hence when the piston is on the charging stroke the early entering gases commence to expand immediately they reach the heated combustion chamber, and this action continuing the rapid expansion tends to close the inlet valve before the piston has completed the suction stroke, so robbing the cylinder of a portion of the charge.

This illustration is further evidence of the importance of correctly fitting valves and *correct tension* of inlet valve spring, with the tendency in the direction of a weak spring preferable, and in combination with a high degree of compression.

It will be gathered from the above that the piston plays a very important part in the working, quite irrespective of its function as a power transmitter; for, unless it be tight, the suction stroke will be ineffective, and there will be a further loss by leakage past the piston during the compression stroke.

It is no exaggeration to state that in the majority of motors in use the pistons are more or less faulty and receive far too little attention, and that a more frequent renewal of the piston rings would result in vastly increased efficiency.

In fitting new piston rings allowance should always be made for some slight enlargement of the cylinder bore, and the new rings should be correspondingly larger. A good plan is to turn up an experimental ring as described in the constructional article on this subject, and to cut out an extra wide gap with the saw, the ring having been turned, say, 2 mm. larger than the original or worn rings. It will then be seen from this experimental ring what pressure is necessary to force it into the cylinder, and whether such pressure is within the elastic limits of the cast iron used for the purpose. The spring tension of this ring should not be so great as to require considerable effort to move it up or down the cylinder, but it should be sufficient to take a firm frictional hold on the cylinder wall; thus a guide will be afforded as to the finished size of the renewal ring, and each of these must be individually fitted with respect to the diagonal saw cut so that the two ends of the ring meet when in position in the cylinder.

The side fit between piston rings and the grooved seatings in the head is not less important, for, if too slack, there will be leakage past on the compression stroke; while if too tight the rings will be unable to expand to a fit to the cylinder wall, especially in the event of bad lubricating oil being used.

(*To be continued.*)

SIR ALFRED L. JONES, of Liverpool, has presented to Mr. Chamberlain a handsome model of the steamer "Port Morant," the pioneer ship of the Imperial Direct West India Mail Line, in recognition of the right hon. gentleman's efforts to improve the trade of the West Indies. The gift has been placed in Mr. Chamberlain's room at the Colonial Office.

* * *

THE Midland Railway Company have just turned out from their works, at Derby, two compound passenger engines for the Scotch express service. These have two high-pressure cylinders and one low-pressure cylinder, while there are four coupled driving wheels 7 ft. diameter. The steam pressure is 180 lbs., and, in order to enable the engine to run long distances without stopping, the tender has a capacity of 4,800 gals. of feedwater, and a correspondingly high coal capacity. The engine is 60 ft. 10 ins. long, including the tender, and is expected to excel even the high results got last season, especially between Nottingham and London.—*The Mechanical Engineer.*

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.*]

South Shields Model Yacht Club.

TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—I send you a report of our annual general meeting, which took place at the North of England Café, King Street, South Shields, the President (Alderman R. Readhead) presiding. The Hon. Secretary (Mr. R. A. Terviel) read the annual report, which stated that the season had been a most successful one. Not only were the finances of the club in a very healthy condition, but the membership had increased, and the increase promised to be further augmented next season. They had seventeen competitions last season, including two inter-club tournaments. He was sorry to say that the club was unsuccessful in both races. There was not a model yacht club in the kingdom that could boast of as many cups and trophies, nor of better facilities in lake, etc., than they possessed; but in the matter of building, rigging, and sailing their ships were far behind some of the smaller clubs, and unless the members of the club improved their ships and adopted later designs, he was afraid they would never have the honour of winning any inter-club competitions. The amalgamation of the Jarrow Club with them had added undoubted strength to the South Shields Club, and the assistance of the Jarrow men had been most loyal and helpful. The Parks Committee of the South Shields Corporation received their application for the alterations of the lockers in a favourable manner, and the improvement had added much to the comfort and utility of the boathouse.

Alderman Readhead was unanimously re-elected President of the club, and, in returning thanks, said it had been suggested that prizes should be given for steam yachts. If any encouragement was wanted in the matter, he should be glad to give what was necessary for such prizes. The following officers were also elected:—Commodores, Messrs. R. Swainston, T. Young, and Bird; sailing captain, Mr. W. Thomas; captain, Mr. H. Thomas; hon. secretary and treasurer, Mr. R. A. Terviel; racing committee, Mr. A. E. Long, Mr. D. Lamb, Mr. Hunter, Mr. John Taylor, and Mr. W. Crowell; general committee, Mr. George Scrafton, Mr. W. Crowell, Mr. W. Hoare, Mr. S. Murrell, Mr. R. Wilson, Mr. W. G. Maxwell, Mr. A. E. Long, Captain Nellest, and Captain Moffett.—Yours truly, R. H. TERVIEL, Hon. Secretary, 28, Woodhove Street, South Shields.

Symmetry in Model Yacht Design.

TO THE EDITOR OF *The Model Engineer.*

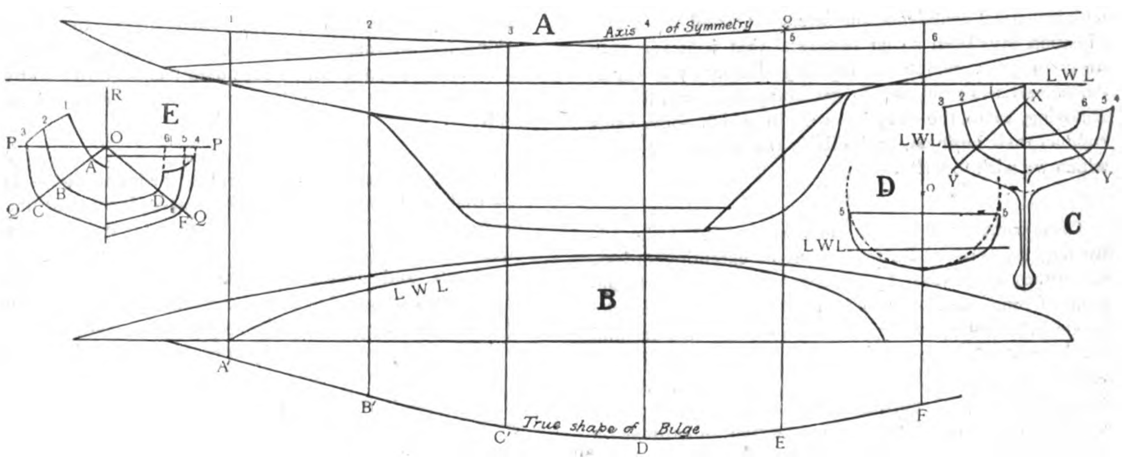
SIR,—The accompanying drawing shows an ordinary sheer plan, A, deck plan, B, and on the right hand side, a body plan, C, of a model yacht. In order to *fair* a design, it is usual to take *diagonals* such as XY and project them on the lower side of the deck plan. These diagonals, however, cannot be chosen so as to give the true curve of the bilge, and I think that this particular curve is most important. Take any section (say, No. 5), and inscribe a circle touching at four points, as at AD, and mark the position of the centre of this circle (O) in the sheer plan. Do this for all the sections, and draw a straight line as nearly as possible through them. This is our axis of symmetry. Redraw the body plan, but measure the heights and depths from a fixed point O, which represents the axis of symmetry in the new body plan (see figures on left-hand side, E) instead of from the L. W. L. Draw the horizontal line P. O. P., and it will be seen that the sections are very similar and their outlines are very equi-distant and parallel, and also that a diagonal can be drawn which shall give the true shape of the bilge (A. B. C. D. E. F.).

In designing a boat on this principle, the ordinary body plan may be omitted or put in at a later stage for the sake of the water-lines.

Consider the convexity of the sides of the boat from bow to stern, and the convexity of the floor. If O is *exactly* the centre of the circles inscribed in the sections, then these two convexities are exactly alike, and each half of the boat is symmetrical about the bilge, and the boat will not tend to steer out of its course when heeled so as to sail on the bilge. If the sides are more convex than the floors, the boat will tend to luff in the strong puffs; but if the floor is more convex than the sides, as in narrow fin-keelers with heavy overhangs, the boat will pay off as it feels the strong breezes and gathers speed, and this will cause her to feel the breeze more, and pay off more. I know two or three boats which are quite unmanageable in strong breezes for this reason.

For a boat to be perfectly symmetrical at all angles of heel, circular sections must be used; but with the above method fairly symmetrical results can be obtained for all types of midship section. In the accompanying design the floor gets flatter and flatter towards the stern, the sides get more and more vertical, and the bilge gets harder and harder. I think it a distinct advantage to have the bilge lie in one plane, as in the accompanying drawing.

The design is my own impression of the shape of the America-cup boat, *Columbia*, from photographs, descriptions, and dimensions published in the yachting press.—
Yours truly,
N. S.
Liverpool.



Symmetry in Model Yacht Design.

Our readers may be interested to learn that a new society, the object of which is the encouragement of the acetylene industry, has been formed in London. A copy of the articles of association, together with a list of the original honorary and other members, has reached us, and particulars can be obtained by those directly interested on writing to the Secretary, Mr. Lacey Downs, 11, Ironmonger Lane, Cheapside, London, E.C. The Acetylene Association, as it is called, is a "limited" firm, and numbers amongst its members some of the best known names in the trade.

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.]*

Home Bookbinding. No. 41, "Useful Arts and Handicrafts" Series. London: Dawbarn & Ward, Ltd., 6, Farringdon Avenue, E.C. Price 6d. nett. Postage 1d. extra.

Most practical people find the need of a little book of this character at one time or another. It appears well suited to the needs of the amateur, as it is clear and terse and goes just far enough into the subject.

Finishing the Negative. London: Dawbarn and Ward, Ltd., 6, Farringdon Avenue, E.C. Price 2s. 6d. nett. Postage 3d. extra.

It is claimed for this volume that it is an encyclopædia of that section of photographic technique with which it professes to deal. We are not disposed to quarrel with that claim, but we can hardly congratulate the Editor on his choice of illustrations. Half-tone blocks are doubtless very "trying" in their ways, but the set showing under and over-development, &c., should never have been passed, since no one could tell, apart from the printed title, which picture represented the one or the other.

Wireless Telegraphy and Hertzian Waves. By S. R. Bottone. Second Edition. London: Whittaker & Co., 2, White Hart Street, Paternoster Square. Price 3s. Postage 3d. extra.

This is a really practical little work on the subject of wireless telegraphy, and it is one we may recommend to numerous readers who desire to experiment in the more recent fields of electrical discovery. The first edition has been improved upon by the addition, in the present volume, of particulars of Popoff's experiments in wireless telephony. Very nearly half the book is devoted to "constructional details," which will be welcomed by all practical people, no less than the carefully explained principles underlying the secrets of "etherography."

It is reported that the London and North-Western Railway Company is applying electric energy to almost all the machinery in the Crewe railway workshops, and it is working a revolution. The latest application of electric energy is to the heavy cranes which lift the boilers and heavy weights through the shops.

The Editor's Page.

IN view of the periodical troubles which seem to arise between readers and advertisers, we think it necessary to say a few words on the mutual obligations of these two sections of our supporters. In these comments we propose to mention no names, nor to refer to any firms or individuals in particular; but we hope our remarks will be carefully digested by those to whom they may apply. In the first place we would point out that while it is impossible for us to guarantee the *bona fides* of every advertiser whose announcement appears in our pages, we never accept any advertisement which appears to be at all misleading, or which appears likely to promote unfair or dishonest dealing. Moreover, we have in several instances debarred advertisers from further use of our pages, when we have found that they have been defrauding or otherwise ill-using our readers. It is as much to our own advantage as to that of our readers, that all the advertisements in our pages should be from firms who can be dealt with in perfect confidence and safety. Our efforts in this direction have been so far successful that it is very rare for us to get a complaint imputing dishonesty to any of our advertisers; but we do get complaints, hardly less annoying, as to the very lax way in which some firms conduct their business, and this is the main point about which we wish to write.

* * *

These complaints usually come within one of the following classes:—(1) Extreme delay in executing orders, sometimes aggravated by absence of any acknowledgement of remittance or replies to letters asking when the goods will be dispatched; (2) the repeated making and breaking of promises as to dispatch of goods; (3) the dispatch of goods, such as sets of castings, incomplete, or the dispatch of sets of castings in driblets, extending over several weeks; (4) disputes as to payment of carriage on goods; (5) goods not being in accordance with catalogue description, or with terms of the order. The fault is not always on the part of the advertiser, as some customers neglect to state *exactly* what they want, some neglect to enclose the right amount of money, and some are so forgetful as to omit their name or their address, or both, from their letter. Some firms, however, are much to blame for their faults in the first three above-named classes, and we feel that they can hardly realise the immense amount of harm they do themselves by unbusiness-like methods of this kind. We have over and over again known of good orders being placed elsewhere because some one or other of our advertisers had spoiled a customer by a negligent execution of his first order. There are many firms who have been advertising in our pages for months, or even years past, about whom we have never received a single complaint, and it is interesting to note that these are the firms who get the most business from our readers. Why? Simply because they give good value for money, and they keep faith with their customers, who accordingly not only come again, but recommend them to their friends.

The following hints to our readers may, perhaps, be of service:—(1) When sending an order, state your requirements clearly and fully, and, if ordering from a catalogue, quote the page and catalogue number of the article you are ordering. (2) Be sure that your name and address are perfectly legible, and, if necessary, state how the goods are to be sent. (3) Enclose the correct amount of money, including the cost of extras and packing if required. (4) If you have any doubts about the firm you are dealing with, or if you wish to inspect the goods before purchasing, deposit the money with us under the terms of our Deposit System, and ask for the goods to be sent on approval. Where goods are sent on approval and are not accepted, they should be returned to the sender within three days of receipt, and each party should pay carriage one way. (5) Where an order cannot be executed by return, ask for a definite date for complete delivery, and deposit the money with us on the understanding that the money is to be returned to you and the order cancelled, if the firm's promise is not kept. (6) Have all promises and conditions clearly understood and expressed in writing on both sides. (7) When writing to a firm asking for information not immediately connected with the transaction in hand, be considerate enough to enclose a stamped addressed envelope and not to expect a long reply.

* * *

To the advertiser we would suggest the following:—(1) See that your goods are strictly in accordance with the description and illustrations in your catalogue or your advertisement. (2) State clearly your terms as to carriage on goods and charges for packing and extras. (3) Invariably acknowledge orders and remittances by return of post. (4) Keep strictly to every promise you make as to delivery of goods. (5) If you cannot execute an order within a reasonable time, return the money. (6) Send exactly what is asked for, and not something which you think is "near enough." (7) Let everything you send out be a credit to you. (8) If you get a complaint from a customer give it prompt and careful attention, and if it is well founded rectify it without delay. Remember, a dissatisfied customer may lose you a lot of business. If both readers and advertisers will act upon the suggestions we give above, we shall receive considerably less complaints in the future than we have done in the past.

* * *

A correspondent writes us with reference to Competition No. 20, announced in our last issue. He says: "Seeing that this will be, or should be, a competition for amateurs in the strictest sense of the word, I think the neatness of the drawings ought to be a secondary consideration." We do not quite see on what grounds our correspondent would differentiate this competition from others announced in THE MODEL ENGINEER, but we are willing to regard the matter with a certain degree of indulgence in this instance. As a matter of fact, it is very rarely the case (as we pointed out only a fortnight ago) that the drawings we receive come up to our standard at all, even in the competitions. Our judges have to exercise their discretion in a number of important points, of which neatness of drawing is but one. Others are the originality or special adaptability of the mechanism described, the accuracy and completeness of the description, and so on. Of course, where two competing articles are practically equal in other respects, that with the best drawings will naturally win. In any case, if the competitor feels himself unable to reach the standard, and contents himself with sketching the design, it is absolutely essential that these sketches be *fully, clearly, and accurately dimensioned.* This is the more important, since in a scale drawing an error in either dimensions or drawing on one view is often unimportant. It can easily be rectified by reference to another view. With rough sketches that course is not possible, and a single mistake, or the omission of one or two dimensions, may quite spoil the competitor's work.

Prize Competitions.

Competition No. 18.—Two prizes, value respectively, £5 5s. and £3 3s., are offered for the best and second best original designs for a small modern type direct-coupled steam engine and continuous-current dynamo. The donors of these prizes make the following stipulations:—The output of the dynamo to be not less than 500 watts, and the voltage to be not less than 50. The competitor may make it more if he likes, but due regard must be paid to the tools at the disposal of amateurs who are not beginners. The engine may be of any type preferred by the competitor, either single or double cylinder, single or double acting, simple or compound, enclosed or open. The boiler pressure is to be taken as 60 lbs. on the sq. inch. A design is required that will represent something more than a toy, and yet within the power of a good amateur mechanic to build, and capable of giving satisfaction when made. Complete scale working drawings, with dimensions of both engine and dynamo, must be given, as well as all necessary mechanical and electrical calculations. There should, in addition, be a full written description of the set, explaining the methods to be adopted in its construction. The usual general rules will also apply to this Competition. The closing date for receiving entries is March 31st, 1902.

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. 20.—Prizes, consisting of an "Anglo" Lathe (list price, £3 10s.) and another Lathe (list price, 17s. 6d.), both presented by Messrs. S. Holmes & Co., of Bradford, are offered for the best and second best articles describing a model made by the competitor without using a lathe. The model described may be anything of a mechanical or electrical nature, and should preferably, but not necessarily, be a working model. More credit will be given to a model in which the parts which are usually produced in a lathe have been worked up in some other way than to a model so designed as to avoid the necessity for any cylindrical parts. The description should be sufficiently full to enable any other reader to make a similar model, and working drawings showing clearly the details of construction should be given. All entries should be received by us not later than March 15th. The general competition rules should be observed.

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.

Answers to Correspondents.

"R. A. P." (Dublin).—We have no further information; but if you comply with all our rules in this department, we can put you in touch with the contributor.

"C. P. D."—Address not given.

"F. L." (Sunderland).—Kindly comply with the rules. Unless we have your address in full, we cannot communicate with you.

"H. F."—Note our rules and enclose address.

5046 (Nelson).—Name not given.

"T. W." (Wolsingham).—Query much too extensive, and not within the scope of The Model Engineer. Rules not adhered to.

In an article in an American journal on railway train brakes and their power to stop trains at high speed, Mr. George Westinghouse, junr., says that with a perfect brake, acting upon all of the wheels of an express train running at 90 miles an hour, at the end of ten seconds the train would still be moving at a little over 60 miles an hour, and would have travelled about 1,130 ft. With the application of the brake, under the best actual conditions, the train would be running 16 miles an hour at the end of sixteen seconds, and would have travelled in that time 1,796 ft. As a matter of fact, with the brake force now fitted to trains, the reduction of the speed of trains running above 60 miles an hour would, under favourable conditions, not exceed two miles for each second.

Practical Letters from Our Readers.

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

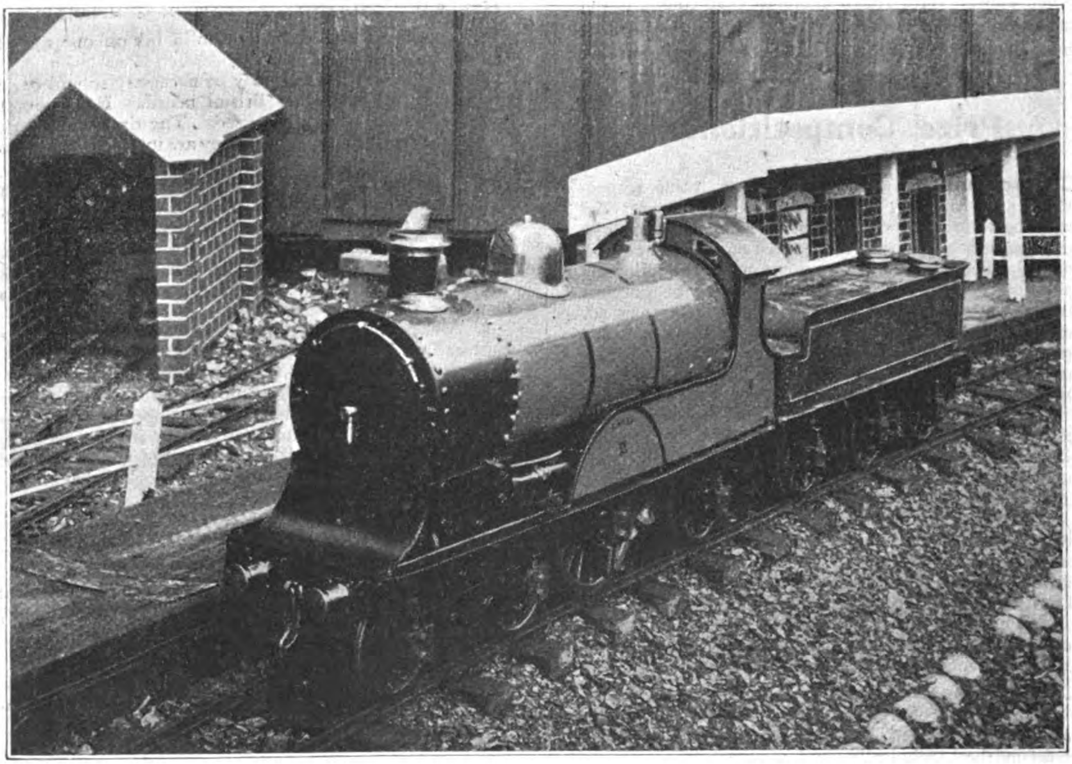
A Model Locomotive.

To the Editor of *The Model Engineer*.

Dear Sir,—I have much pleasure in sending you a photograph of my latest single engine, "Snark," which is designed to run on my railway, having a gauge of 3 ins. The trial trip was run with charcoal fuel in the presence of Mr. J. C. Crebbin; but, unfortunately, the engine did not show then the excellent form which it has since done. I now use a methylated lamp with twelve burners, and this makes all the steam I require. I shall eventually fit a "Primus" oil burner on, which should give still better results. The chief dimensions of the engine are:—Cylinders, 1½-in. bore by 1¾-in. stroke; driving wheels, 4 ins. diameter; bogie wheels, 2½ ins. diameter; trailing wheels, 2¾ ins. diameter; boiler, 4½ ins. diameter by 12½ ins. long from back plate to tube plate; wheel base, 15 ins.; working pressure, 40 lbs. per sq. in.

I also send a photograph of the engine pulling the standard train of three Pullmans, brake-van, and composite carriage. It does this easily. The train is seen standing on one of the bridges, and goods shed and sidings can be seen in the background.—Yours truly,

Hove. Harold Soper.



Mr. Harold Soper's Model Locomotive "Snark."

An Easy Method of Fitting Brass Nuts to Steel Screws.

To the Editor of *The Model Engineer*.

Dear Sir,—It may interest some of your readers to know how to fit a tight screw to a brass nut. It is done by simply oiling the screw well and sprinkling some powdered glass on it. On screwing it into the nut, it will be found to go on quite easily; moreover, the glass has the property of grinding the thread of the nut to fit the screw very neatly. Care must be taken afterwards to wipe all the glass off the screw and nut. This method is particularly handy in fitting square-thread screws to brass nuts for use in slide-rests for lathes.—Yours truly,

Glasgow. Andrew Black.

We learn that the longest power transmission service in the world has been inaugurated in California by the completion of a transmission line bringing electrical power from waterfalls in the eastern portion of the State into Oakland and San Francisco. The distance is 222 miles, and forcibly illustrates one of the most characteristic services the electric current can be made to discharge.

* * *

It is stated that a number of Nernst lamps have been installed in Farmington, Conn., U.S.A., for street lighting service, and that the new lamp will also be used for this purpose in Unionville, Conn. Nernst lamps are now to be seen in one London shop window at all events, for sale, the efficiency being such that the guaranteed consumption of current in an 80-c.-p. lamp is not more than that of the usual 16-c.-p. incandescent lamp.

Queries and Replies.

(See last issue for Conditions under which Queries are replied to by post or in these columns).

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

[5500] **Motor Tricycle: Connections to Coil.** A. H. (Penrith) writes: I have a motor tricycle, the motor being a De Dion, as described lately in your Journal. I have connected same up in precisely the manner as described in Fig. 77, November 15th issue, only the coil M has only two terminals, not four, in the primary, as shown on your plan, so I have connected same as follows :—Positive of accumulator, through switch in handlebar, and then to plug switch on frame and on to terminal P of primary, through coil to terminal M, and thence to contact-breaker stud D and trembler and back to negative of accumulator. I can get the machine to run now and again. but when I get any high speed the spark in sparking plug fails to act. Am I rightly connected as regards electric circuit? Would you also give me your idea as to where you think the fault is in the sparking plug not firing every time?

Your connections to coil and accumulator are quite right, as evidenced by the motor firing sometimes. It is almost certain that the fault is in the adjustment of the trembler on contact-breaker, unless you have a partly broken cable giving intermittent contacts. Sometimes the wires break away, but the loop is held up by insulation especially where connected to contact-breaker, and this would answer to your symptoms, because in one position of the contact breaker (late firing) you might have contact, but in the advance spark at high speed the movement of wire destroys contact. First, test for the above and also all other contacts throughout circuit, and if no fault is detected, try tightening up the contact screw by half a turn; don't bother too much with the fine adjustm-nt for vibratory spark, but make sure you have contact when trembler shoe falls into notch in cam, and try this over the full range of the advance movement as it has occurred that in one position the current has been short-circuited through some faulty fitting of some of the contact-breaker parts.

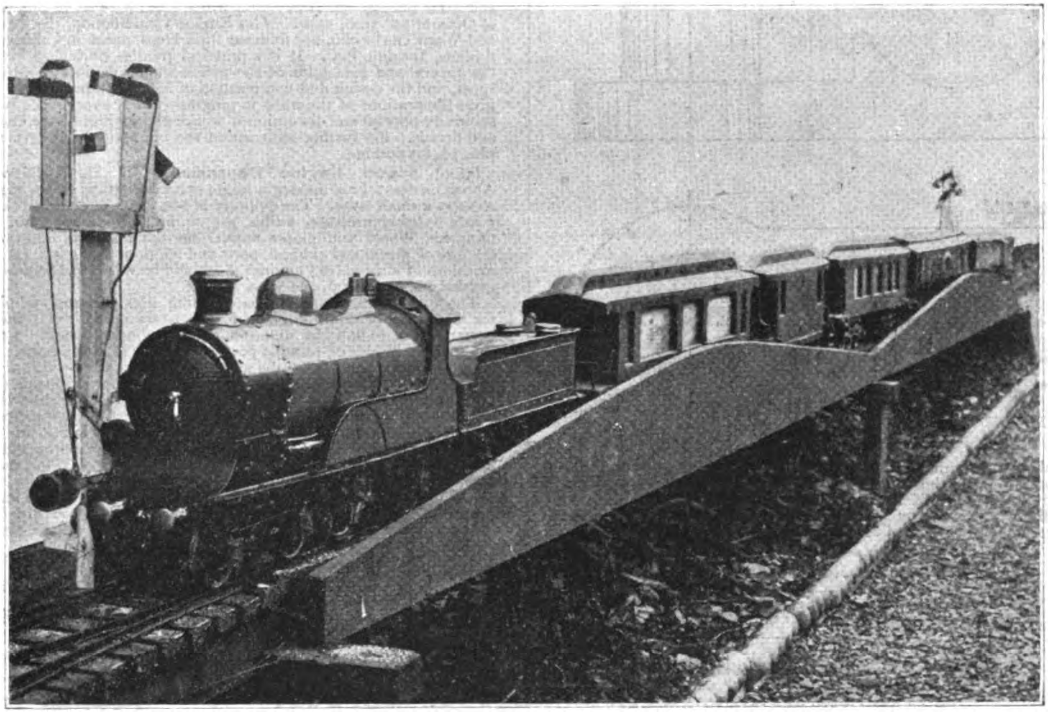
[5530] **Tank Capacities.** A. T. (Hawick) writes: Please tell me the capacity in pints of a tank the dimensions of which are—length 13 ins., height 6½ ins., breadth 2 ins.

Kindly comply with our rules in asking queries. The capacity is 169 cub. ins., and as a cubic inch = ·003606 galls., therefore the tank will hold (169 × ·003606 ÷ 8) pints = about 4⅞ pints.

[5545] **Induction Coil.** J. M. M. (Wandsworth) writes: I recently made an induction coil to the following dimensions: core, 24 ins. long; 2½ ins. diam.; No. 24 B.W.G. iron wire, varnished; primary, 20 lbs. No. 12 cotton-covered B.W.G.; wound in four layers, about 500 turns. I then rolled micanite sheet round to a thickness of ¼ in., and run the lot in with best wax. The secondary was wound in two sections of 7 lb. each of No. 36 B.W.G. single silk, each section about 42 layers. With an alternating current of 100 volts, 100 periods, 8 amps., I get a thick spark 2 ins. long, which will lengthen to 5 ins. before it breaks. I have also tried continuous current 100 volts, 8 ampères, Wehnelt break, and only get 1¼ in. spark. Can you please tell me the reason I get such poor results? I have not got a condenser. I unwound all the No. 36 wire, thinking the secondary had broken down, but only found two places black—discoloured—but the paper was not the least burnt. Is it possible to have too much iron in the core? Any suggestion you can give me before I again start winding will be acceptable.

Nothing can very well be worse than the construction you have adopted for the coil. So large an apparatus should be constructed with the utmost care, and in the most improved method, or time and material is simply wasted. The results you obtained were sufficient proof of the badness of this construction, since a 10-in. spark should have been easily obtainable from the materials. Although you found no very obvious damage, in all probability the coil has sparked from turn to turn, or from layer to layer, almost through the whole coil, and this might go on a long time before an actual breakdown occurred. An alternating current is not suitable for coil work, although it is difficult to understand why the continuous current gave less good results, unless the fact is that a really higher voltage was obtained in the secondary, enabling it to spark even more readily from layer to layer, and so manifesting itself less in the spark length. The absence of a condenser is a serious factor, and one should certainly be fitted. Of course, we cannot deal thoroughly with the question in this reply, and our best course is to recommend you to read Mr. Hare's "Construction of Large Induction Coils," price 6s. 3d., post free, from our Book Department.

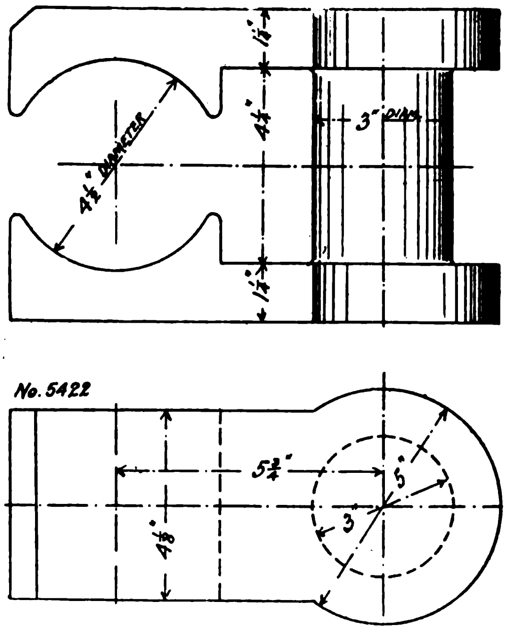
[5422] **Simple Dynamo (400 watt),** H. O. (Armley) writes: I have dynamo castings as per sketch, and wish to make them up. Will you kindly say what would be the best size and quantity of wire



THE "SNARK" WITH PULLMAN TRAIN STANDING ON ONE OF THE BRIDGES.

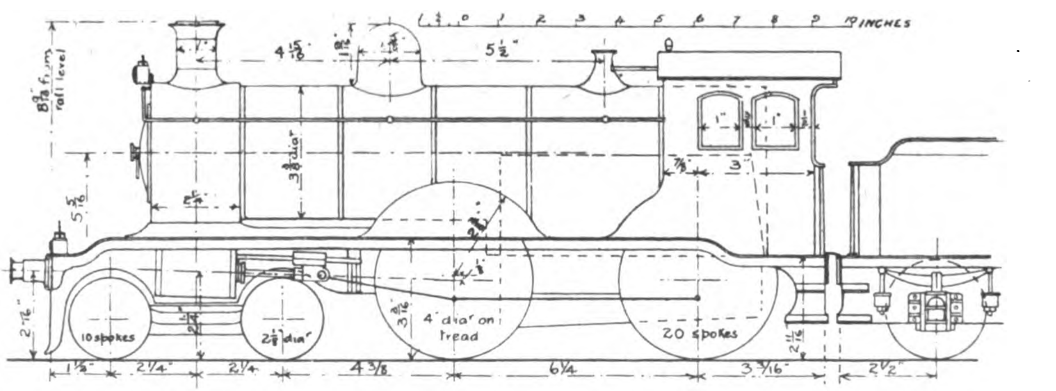
to use? I require it to be 50 volts, and should like it compound, if possible, as it will not always have full load on. Do you recommend a ring or drum armature?

The proportions of your machine fit it for a ring armature. This should be not less in diameter than ⅛ in. less than the field-magnet tunnel. A slotted ring should be employed, with slots ⅜ in. × ¼ in., 24 in number, and about 2½ lbs. of your No. 19 wire. Each of



No. 5422

should take 22 turns of wire. The field-magnet may be wound with 10 lbs. No. 21 for the shunt winding, and on top of this you might wind three layers of No. 19 for the series wire. This cannot be stated definitely as the correct amount—experiment alone will decide the exact amount of series wire.



[5473] **Model Loco. Design.** S. C. (Edinburgh) writes: You will be doing me a great favour by answering the following questions:—(1) I have a pair of D.A.S.V. cylinders, 13-16ths in. diam. by ⅞ in. stroke. Would you please state what scale locomotive should be built for them? (2) Dimensions of boiler and thickness of shell, heating surface required for same, with spirit lamp as fire. (3) Do you think a double or single driving wheel model best, and what size should driving wheel be?

(1) The cylinders are not quite in proportion for a model loco; you do not state exactly, but we presume they are only suitable for an outside cylinder loco. The cylinders, to make them appear in proportion, should be cased all over, caps being fitted at the ends. This will also protect them from effects of cold air. We should advise a scale of 11-16ths in., with a rail gauge of 3¾ ins. The cylinders should be longer in stroke if used for an engine with a single driving wheel, which would, for appearance sake, have to be of larger dimensions, and for this reason we have adopted, in the annexed design, comparatively small drivers. Width over footplate, 5⅛ ins. (2) Diameter of boiler barrel, 3⅜ ins.; thickness of shell, 1-16th in. Heating surface should be about 130 sq. ins. You can easily arrange seven ⅛-in. flue tubes, and some six to eight water tubes, ⅜ in. diam., in the firebox. (3) For reasons given in first part of answer, the engine had better have coupled wheels. The smaller the wheels are, the better the model will work.

[5607] **Book on Gas Engines.** A. B. (Glasgow) writes: Can you tell me if there is such a book as "How to make a Gas Engine," somewhere about ½ or ¾ h.-p.? If so, kindly let me know where I could get it, and also the price.

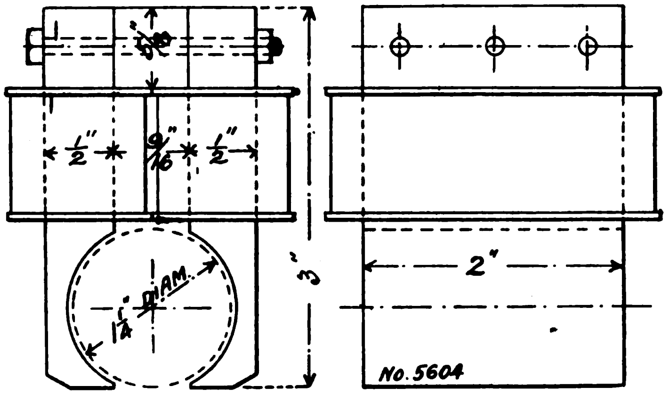
In our 1st and 2nd volumes we gave a design with details of construction of a small 1-6th b.h.-p. gas engine. The information contained therein would be useful to you in the construction of a larger engine. These are now out of print, but may very likely be obtained through our advertisement pages. A book which would suit your purpose admirably, and which was reviewed in our issue of October 1st, 1900, called "Gas Engine Construction," by Parsell and Weed, can be obtained from our Book Department, 6, Farringdon Avenue, London, E.C. It is a practical treatise describing briefly the theory and principles of the action of gas engines of various types, and the design and construction of a ½ h.-p. gas engine. It gives illustrations of the work in progress (nearly every piece being shown by photos) and dimensioned working drawings of the engine and details. For further information see our review. Price is 14s. plus 5d. for postage.

[5609] **Steam Engine Dimensions.** S. H. P. (Newton Abbott) writes: I am making a single cylinder vertical steam engine to drive a small lathe. The cylinder is 3-in. bore, and the stroke is 5-in.; wokring pressure, 80 lbs. per sq. in.; speed, 200 revs. per minute. Would you please answer me the following questions? (1) Size of steam and exhaust ports and width of bridges. (2) Dimensions of slide-valve; amount of lap and travel. (3) Diameter of crankshaft, piston-rod, and valve spindle.

The following are rules for determining sizes of ports and pipes for cylinders of small engines for moderate speeds:—(1) Steam ports: length = half the diameter of the cylinder; width, 1-16th the stroke. Width of exhaust ports twice that of steam ports; the length should, of course, be the same. Port bars same width as the steam ports. Exhaust pipe area = area of steam ports. Steam pipe area should be two-thirds of steam port area. (2) The slide-valve should have about 3-16ths in. lap. The advance of the eccentric should be 3-16ths, so that the lead is *nil*. The travel is 2 × lap + 2 × port opening. We should arrange, as the steam ports will be 5-16ths in. wide by above rule, with a port opening of ¼ in., therefore, the travel will amount to (2 × ¼) + (2 × 3-16ths) = ⅞ in. (3) Diameter of shaft, 1 in.; diameter of piston-rod, ⅜ in. or 5-16ths; diameter of valve spindle, 3-16ths in. If you are only going to drive a lathe, the steam pressure of 80 lbs. will be greater than required. Either use a smaller cylinder or a reduced steam pressure—or both. ½ h.-p. is required. See *M.E.* for October 1st, 1900, for the calculations necessary to find the h.-p. of any engine.

[5604] **L.T. & S.R. Model Locomotive Electrically Driven.** J. M. writes: I am making a ½-in. scale model L.T. & S.R. locomotive from the plates in your January 1st number. My power will be electricity; the motor similar to Dr. Hovenden's only larger. As I have never seen inside of the cab of a locomotive for any great length of time, my ideas are a little confused, and as this is my first attempt at locomotive building, you would greatly oblige by answering the following:—(1) Could you give me a rough front sketch of the cab, showing levers, etc.? (2) I am making the motor out of two pieces of wrought iron of the following sizes—2 ins. × 2 ins. × ½ in. Will you kindly state what size of core will suit, what size of armature, and size and amount of wire to wind the machine?

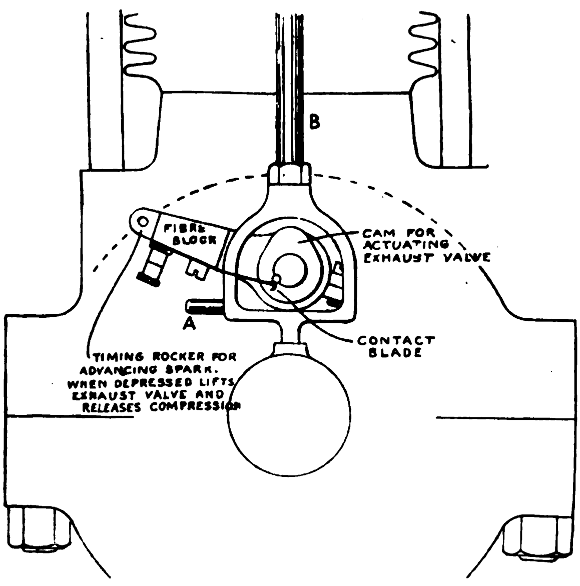
(1) Full particulars of the cab for the L.T. & S.R. locomotive model have now appeared (see February 1st issue of THE MODEL ENGINEER), and doubtless this will clear up your difficulties. (2) Make the motor up as in sketch below, using a 6 or 8-part armature, 1¼ ins. diam., 2 ins. long. The wire for armature will be 2½ ozs. (12 yards), No. 20, and that for field-magnets, 6 ozs., No. 18, very carefully wound to get it in the limited space allowed. The motor



will be a powerful one, and well suited to the work if supplied with sufficient current—4 amps. at 6 volts.

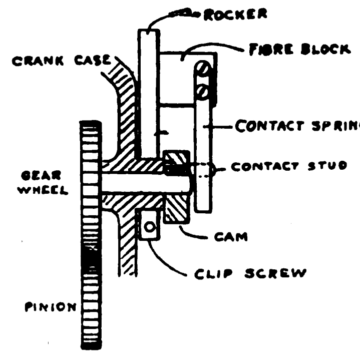
[5726] **Primus Burners.** E. L. (London) writes: I should be very much obliged if you could furnish me with the name of anyone supplying "Primus" silent burners for models, which I have frequently seen mentioned in THE MODEL ENGINEER.

Messrs. Melhuish, Sons & Co., 84, 85, Fetter Lane, Holborn, E.C., will supply you with all types of "Primus" burners and fittings. You must state whether you want them bent, as shown in our August 1st issue, or not. This matter will depend upon the depth at your disposal.



[5640] **"Hercules" Cycle Motor.** J. T. (Erdington) writes: I am making "Hercules" motor by Messrs. Butler Bros., and want to know if you can give me the following information: (1) Can you tell me the use of peg A? (2) Can you give me a rough sketch showing timing rocker and contact block arrangement more fully than this one does? Is the spring and contact block to be tipped with platinum?

(1) The drawing (see above) is very clear, but the following will no doubt assist you. The vertical rod B, going up side of cylinder from the stirrup piece, is the exhaust lifter, and as the cam is turned round by the 2 to 1 gear inside the crank case the stirrup is depressed, forcing the exhaust valve open. The rocker at the back of the exhaust stirrup works on a shoulder, and when depressed to the left catches the stud marked A, and moves the exhaust valve rod downwards, thus releasing compression for starting. The contact blade simply touches the stud at a predetermined point and fires the compressed charge in the cylinder. (2) The side view of the arrangement, which we show immediately below, will help to make the drawing still more distinct. We understand from the makers that this



Query No. 5640.

pattern is their old one, and is materially different from their 1902 design, which has all exhaust gear and also cam enclosed in the crank case.

[5474] **Overtype Dynamo (60-watt).** A. C. (Edinburgh) writes: (1) How much and what thickness of wire will be required for winding a drum armature 2 ins. diameter, 8 cogs, to obtain best current for lighting and charging? (2) The tunnel in which the armature runs is 2⅝ ins. in length; should the armature without wire be the whole length of the tunnel? (3) How much current should I get out of it, having 1¼ lbs. of No. 22 wire on each magnet (overtype dynamo)? (4) What size of a gas engine will be required to drive it to get the full current? I hope you will answer these questions as soon as possible.

(1) The size of the slots is not stated in your query. For an armature 2 ins. diameter, with 8 slots, they should be about 5-16ths × 5-16ths. Wind with about 6 ozs. No. 22 in 8 sections. (2) Yes. (3) If the field-magnets are well-proportioned, the available output should be about 60 watts = 20 to 30 volts, 2 to 3 ampères. The field-magnet wire is, of course, to be connected in shunt. (4) The gas engine should be capable of developing 1-6th b.h.-p. You require an answer "as soon as possible," but you do not take the trouble to comply with the simple rules we lay down. Will you and other querists please endeavour to realise that our conditions are not permissive, but *must be adhered to strictly*. You must not write on both sides of the paper.

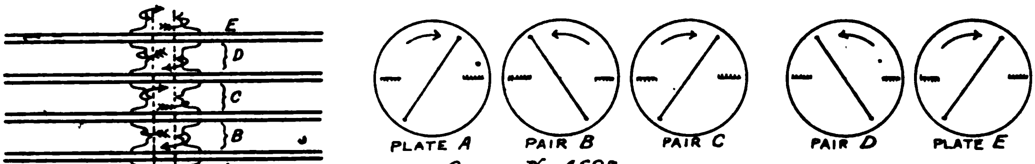
[5615] **Induction Coil, Faulty.** H. W. M. (Wolverhampton) writes: I have made a small induction coil, bobbin 3 ins. between flanges; primary, 20 yards 20 S.W.G. copper wire; secondary, 475 yards (¼ lb.) 32 S.W.G. copper wire; core, bundle of soft iron wire, 16 S.W.G.; contact-breaker has not platinum contacts; condenser, 40 sheets tinfoil. I have tested both primary and secondary with galvanometer, but can find no defect. I should be glad if you would say how I could remedy it, and what size spark it should give. At present the shock is only just perceptible.

There are two important faults in your construction. In the first place the iron wire core is composed of wires too thick for the purpose, and in the second place, the secondary wire is too large a gauge. If you alter the core to wire of No. 20 or 22 gauge at the largest, and the secondary wire to No. 36 or 38, you should easily get a ⅜ in. or ½ in. spark. With regard to your tests with a galvanometer, these are of little use for discovering defects of a certain class, since they are only observable when the high tension current of the coil is passing through the wires.

[5619] **Heating Water by Electricity.** W. B. (Chorley) writes: I wish to know if there is a practical way of heating water by electrical energy, *i.e.*, produced by a dynamo. It is intended to heat to nearly boiling point, say 500 gallons of water in a wood vat; a 6 n.h.-p. gas engine is available for power. Please state size of dynamo required and style of apparatus to be used in the vat and would it be a costly way of heating water? A moderate size dynamo preferred, as it is not intended to heat the water in a specified time.

We do not know of any instance in which such a method of heating a large quantity of water has been carried out and certainly cannot recommend it where any other system is available. We should doubt whether any more costly method could be found, as you will readily gather from the fact that even the smallest electrically-heated kettles consume an enormous amount of current for boiling water. This is quite apart from the fact that the expense of fitting a high resistance wire of suitable length properly bedded in suitable material would be almost prohibitive.

[4698] **Wimshurst Machine.** C. E. W. (Guernsey) writes: Having made a Wimshurst on very similar lines to the one described in THE MODEL ENGINEER about a year or so ago, I should like a little advice on it. It has a pair of ebonite plates, 22 ins. diam., and they touch in one or two places. Sectors number 32, one on each plate. My length of spark is now about 5 ins. (1) Should it not be 7 ins. or 8 ins.? (2) What is the best glass for condensers, green or white? I mean Leyden jar condensers. (3) Since ebonite turns colour with age, will it be as well if I give my plates a complete covering of shellac varnish all over both sides, but not in track of the brushes? If I do, will this in any way deteriorate the plates or decrease the spark length? I am making a machine with mica plates—eight plates or four pairs. Will you please give a sketch of neutralising rods and brushes? Plates will be small, 6 ins. to 8 ins. diam. only, but will run at a high speed. Please state your opinion on same, and, when mine is completed, I will give you particulars of its working (also of the ebonite one which I have now nearly finished).



Query No. 4698

(1) You cannot expect much more than a 5-in. spark with a machine of this size under ordinary circumstances. (2) Generally speaking, the green is better than white glass for Leyden jars or other electrical purposes. (3) Do not varnish the ebonite plates. We are more convinced than ever that it is a mistake to use ebonite for Wimshurst machines, since not only do these plates warp, but as you say, the surface deteriorates, as shown by its discolouration. Shellacing the surface will not aid it, but it is just possible that a thin film of paraffin wax on outside edges and for a depth of an inch or so on the rim of the plates would be of use. This could be put on by dissolving the wax in turpentine and painting it on with a brush. We are very glad to have your kind offer of particulars of the working of your new machine, especially as we are not aware of any case where mica has been used for Wimshurst plates. A sketch showing the position of neutralising rods, etc., is given above, but is really hardly needed. Of course, the plates are paired to run together, the outside plates and middle pair of plates running in the same direction, the others in the opposite direction. The plates in so small a machine should run close together, and you cannot expect a very long spark. The discharge will probably be a short thick spark—possibly 1½ ins. to 2 ins. long—useful for many experiments for which an induction coil is more generally employed.

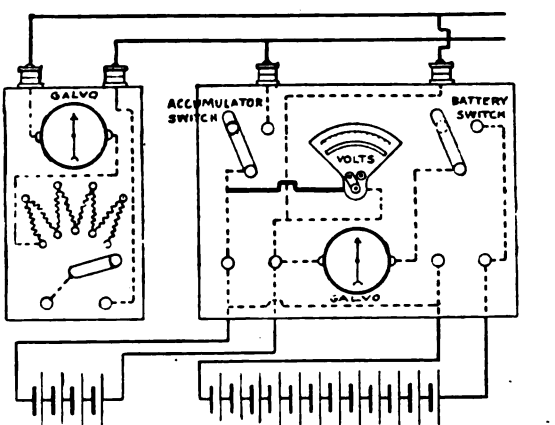
[5620] **Wimshurst Machine.** W. E. P. (Wycombe) writes: (1) What is the best cement for securing the glass discs of a Wimshurst to the wooden spools? (2) If a single Wimshurst plate is rotated with a neutralising rod, as is usual, and a charged conductor is brought near the disc, will the single plate machine build up and produce electrification? (3) What results ought I to obtain from a Wimshurst machine with 16-in. plates; 26 sectors, sectors 3 ins. by ⅝ in. to ¼ in.; plates revolving at ¼ in. apart? (4) Is the discharge in a vacuum tube continuous, or no? (5) If wood plate were used in a Wimshurst instead of glass, and were well varnished and waxed, would the machine act?

(1) Fish glue is about as good as any material for this purpose. (2) No. (3) The plates are too far apart. If not more than ⅛ in. apart, which would be the maximum for size of machine, you might expect a spark from 3 to 4 ins. long, but under the circumstances we should doubt whether a spark would be obtained at all. (4) No. (5) It is almost impossible to get a wooden plate thin enough and flat enough for the purpose. No doubt, if it could be done, the results would be at any rate nearly as good as with glass plates, but we are confident the method is quite impracticable.

[5647] **Induction Coil for Electric Bath.** H. E. W. (Moseley) writes: I wish to fit up an arrangement for having electric baths. I thought that an accumulator and induction coil with two plates dipping into the water would be necessary. Could you tell me (1) About what voltage and what size the accumulator would have to be for an ordinary bath? (2) What size coil? (3) Would both plates have to dip into the water—one at each end—or would they act as well if they were near together? Would it be better to have one dipping in and the other attached to the bath itself? Would this last method make it more powerful or otherwise? (4) Could you advise me as to a good make of accumulator to use and about the price; also make and price of coil? I suppose the new Edison accumulator cannot yet be obtained. If it can, I should think it would be a good thing to use it. Would it be more expensive?

(1) With the coil made as follows, a single cell either bichromate battery or accumulator will usually be found sufficient. If the bichromate battery is used, it should be at least quart size, or if an accumulator, must be large enough to stand a fairly heavy discharge. (2) The coil should have a soft iron wire bundle for core, not larger than 22 gauge, and this may be ½ in. diameter, 5 ins. long. The primary may consist of 4 layers of No. 22 copper wire, and the secondary ½ lb. of No. 34. The winding should be done as carefully as possible. (3) Either a metal or wooden bath may be used. In the former case it must not be varnished or painted, but must be connected directly to one wire from the coil, the other wire being taken to a metal handle, to be held in the patient's hand or stroked over the affected part. A wooden trellis should be placed on the bottom of the bath to prevent the patient's body coming into actual contact with the metal. If a wooden bath be used, a large curved sheet of copper, about 18 ins. × 12 ins., should be placed standing upright at the feet end, the patient, as before, grasping a metal handle while the copper sheet is in connection with the other coil wire. (4) You will find plenty of advertisers of suitable accumulators in our pages, and can ascertain the prices for yourself by perusing their catalogues. The accumulator should be capable of safely discharging 5 or 6 ampères. The Edison accumulator is not at the present moment on the English market, we believe, although it is stated that it soon will be.

[5601] **Gravity Batteries.** S. S. (Bristol) writes: I have thought of making up six gravity-cells (as per illustrations, page 226 in May 15th issue of MODEL ENGINEER, Vol. IV); but being quite a beginner I shall be glad if you will kindly tell me (1) if enclosed wire would do to hold the elements, and, if so, must I leave the insulator on? (2) Kindly advise what thickness of wire, if this is not strong enough; (3) if the copper strip should lay on the bottom of the jar; (4) what kind of syphon I should require; (5) should I replenish cells with sulphate of zinc or water? and (6) could I work cells direct to a lamp without an accumulator? The diagram on page 225, (Vol. IV), is a complete puzzle to me, as it seems to me there ought to be two more switches under battery and accumulator switches, to make it effective. If you would kindly indicate the way current travels by arrows I should be much obliged.



Query No. 5601.

(1 and 2) The wire is suitable (about No. 22 S.W.G.), and it is essential to have it thoroughly insulated all the way through the liquid. (3) Yes, or it may be placed as indicated in the illustration on page 226 (Vol. IV). (4) Either a glass or indiarubber tube will be suitable. (5) A weak solution of sulphate of zinc is more active, and offers less resistance than plain water. (6) No, the current from gravity cells of the ordinary size is very weak, owing to the considerable internal resistance of the battery. (7) We note there is a mistake in this diagram; the correct arrangement is here shown.

[5658] **L. & N.W.R. Tank Locomotive.** E. P. (Lynn) writes: Will you kindly give me a drawing of the L. & N.W. Railway's four-coupled, inside cylinders tank loco, "2219" class? I wish to work the engine with 1 slide-valve cylinder. Would you kindly state —(1) size of cylinder necessary for ½-in. scale model? (2) diameter of driving wheels? (3) diameter of boiler and thickness of copper for same?

We regret that we cannot give you a proper drawing of the type (we presume you mean the "double end" eight-wheeled tank engines) you require. Size of single D.A. cylinder: ⅝ in. × 1 in., or ¾ in. × 1¼ ins. Driving wheels: as to these you do not state whether the engine to which you refer is one of the eight-wheeled tank engines with 5 ft. 6 in. or one with 4 ft. 6 in. wheels. The 5 ft. 6 in. engines are easily distinguishable by their larger general proportions. Diameter of boiler, 2⅜ ins. outside, that is if the lagging is dispensed with, as is usual with ½-in scale models. Copper or brass tube 1-16th in. in thickness.

[5679] **Vertical Boiler.** J. J. F. (St. Denys) writes: I am making a small vertical boiler, and should be glad of your kind assistance in the following particulars. Shell 4 ins. diam., 10 ins. long, copper plate, No. 20 B.W.G., double riveted lap-joint with ⅛ in. copper rivets. ¾ in. centre to centre, and well soldered. I have one of Thomassin's flanged crown plates for top of boiler and top of firebox, flue tube being ⅞ in. Will you please tell me the following? Height of firebox; sizes of gauge cocks and safety valve; will ordinary brazed brass tube do for flue tube and for a water tube? pressure (maximum) for working.

Boilers with a single flue are generally very inefficient for their size. You should arrange several rows of water tubes about ¼ inside diam. in the firebox, as shown in our issue of February 1st, page 69. Give the tubes a good rise, and, so as to get as many rows (three in a row), make the firebox at least 4½ ins. high. Use solid-drawn tube for the water tubes; brazed tube will do very well for the flue. Working pressure about 35 lbs. You may fire the boiler with charcoal, but a No. 4 (2½ ins.) Primus burner would give just as good, if not better, results with much less trouble. Safety-valve, 7-32nds diameter. The water gauge should have no passages less than ⅛ in. in diameter.

[5707] **Electric Locomotive.** J. G. D. (Bridlington) writes: I am thinking of fitting out a model railway on a ¼ in. = 1 foot scale, and as this is too small for the locomotives to work satisfactorily by steam, I should be glad if you could advise me as to whether electricity could be adopted with any prospect of success under the following conditions:—(1) The locomotives to be correct scale models of existing express passenger engines (2) The motors to be entirely concealed in the boiler-barrel and firebox of engine, and (if necessary) an additional motor in the tender, to be worked on the central rail system (3) No motors in coaches, if possible.

We think that ¼ in. is rather a small scale. Why not make the engines to ⅜ in. scale and use a type of engine which has a short flexible wheel base. You might arrange to have a tank engine to the scale required in order to gain the necessary width; but before you settle anything, the best course to adopt will be to find out what motors you can obtain. We believe that Messrs. Whitney, 117, City Road, London, E.C., have made very small motors for model express locomotives of somewhere about the scale you wish to use. You might apply to that firm.

Amateurs' 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.*]

*Flanged Boiler Castings.

Those who have tried flanging the tube-plates for a model locomotive in the orthodox way, and have found it a nearly insuperable undertaking, will hail with delight the castings now being supplied by the Model Manufacturing Company, 3, Harley Road, Willesden Junction, N.W. These castings are primarily intended for use on boilers for "Dunalastair No. 3," but are obviously suitable for any locomotive of equal size. They comprise front and back tube-plates, back outside casing plate (with firehole and ring cast in), back firebox plate and front saddle plate—all in gunmetal. The quality of the castings is all that can be desired. Of course, the employment of such castings implies a slight increase of weight, unless a good deal of metal is removed by lathe or file, but this is a point to be weighed against the very difficult matter of flanging thick copper plates. The present set is reasonably thin in all parts not requiring to be filed, and we can strongly recommend them to our readers. Three stamps are asked for this firm's engine and castings list

Surgical Electrical Apparatus.

Electrical apparatus for the special uses of surgery and medicine are manufactured by Messrs. Marshall & Woods, 2, Gray's Inn Road, Holborn, London. Induction coils for *x*-ray work are amongst the more important of these specialities, coils from 4-in. to 18-in. spark being manufactured on the premises and fully guaranteed. Other items are alternating current rectifiers (for charging accumulators, etc.), special lamps for laryngological purposes and for the treatment of lupus and other skin diseases, dynamos for electric bath treatment, transformers—both alternating and continuous—and accumulators. The improved electrical apparatus made by Messrs. Marshall & Woods are used in leading hospitals, surgeries, and scientific laboratories, and are the outcome of very considerable experience of the practical requirements of the special work indicated.

Storage Batteries.

Storage batteries or accumulators for motor-car or cycle ignition, carriage and hand lamps, phonographs, electro-medical appliances, and electro-plating, are supplied by Messrs. Burnham & Terrey, 79, Pemberton Road, Harringay, London, N., who also undertake repairs to accumulators at the lowest prices. The batteries listed range from 8 to 75 ampère-hours' capacity, and are supplied in teak boxes with leather straps, and sealed to prevent spilling of solution. Particulars will be gladly supplied by the firm on application, The Model Engineer being mentioned.

A Portable Drilling Machine.

Messrs. Wallach Bros., 57, Gracechurch Street, London, E.C., send us particulars of a somewhat novel portable drilling machine they supply. Three sizes are made, the smallest, weighing 6½ lbs., being suitable for holes up to ⅜ in. diameter. The drill is adjustable in every possible way, and is specially adapted for use in confined or awkward positions. The price of the smallest set is 37s. 6d. A descriptive list sent by the firm shows how the drill may be used in various difficult situations, where the ordinary drill, either hand or machine, would be more or less useless. Particulars will be sent post free to any reader mentioning this journal.

*The "Columbus" Sliding Gauge.

Readers who turn to the advertisement of Messrs. Cotton and Johnson, 14, Gerrard Street, Soho, London, W., will see an illustration of the "Columbus" sliding gauge supplied by this firm, who have sent us a sample gauge to inspect. We are very pleased with the good workmanship displayed in its manufacture, the fitting being excellent, and the scales accurately marked. English and metric divisions are given and the instrument combines inside and outside calliper gauge, with depth gauge, and has vernier readings to both scales. It is warranted accurate and the finish we have already commented upon. The price is 7s. 6d. including a neat leather pocket case. Readers who take an interest in doing their model work accurately and carefully will find this a useful tool, well worth their attention. To others who require something of the kind in their everyday employment, we can also strongly recommend it.

Catalogues Received.

Lever Bros., 101, Dawes Road, Fulham, London, S.W.—A new enlarged price list of electrical goods and scientific and mechanical novelties is to hand from this firm. It is fully illustrated, and comprises particulars of small electric lamps, accumulaters, scarf pin lamps, holders, model engine details, and finished engines. Dynamos and motors, together with parts and accessories for same are all included in this comprehensive list, which will be posted to any reader sending a penny stamp and mentioning The Model Engineer.

J. F. Larner, Darenth, Dartford.—Readers who require particulars of the powerful wickless paraffin burners now coming into favour for use in boilers should send a penny stamp for Mr. Larner's price list. Four sizes are quoted, particulars being given of the burners complete and for various details and accessories. The Model Engineer should be mentioned in the above connection.

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, 12, Cortlandt Street, New York, U.S.A., to whom all subscriptions from these countries should be addressed.

Sale and Exchange,

(Continued from page vi.)

Steel Tool Company can now supply in two days, having finished bulk of orders; lists 1½d. Cheapest house for Amateur's Engineering Materials.—94, Mile End Road, London.

Private.

Kindly see under Sale and Exchange heading for rates for these advertisements.

Also note the details of our Deposit System in the same place, which gives protection to both purchaser and seller.

Gun.—Double 12-bore Breechloader, top lever, rebounding locks, proof tested barrels, left choke, walnut stock; well finished, good killer, new, 40s., approval.—E. BATES, 22, Rathcoole Gardens, Hornsey, London.

Horizontal Engine, 1½ ins. × 3 ins., with pump, governors, throttle-valve, etc.; in good working order, 50s.—R. JACKSON, 23, St. Nicholas Street, Ipswich.

Several Accumulator Plates for Sale, 4 ins. by 4 ins., 1s. each or 11s. 6d. the dozen. Also a number, 4 ins. by 2½ ins., 9d. each, 8s. dozen; positive or negatives same price.—C. GREENWOOD, Oldland, near Bristol.

For Sale.—10-ton Model Sailing Yacht, 2 ft. 6 ins. long, 8 ins. broad; take £1.—JOHN BALLANTYNE, 164, Stobcross Street, Glasgow.

Quantity of Formed Accumulator Plates (Positives and Negatives same price).—3 in. × 1½ in., 4d. each, 3s. 6d. doz.; 4 in. × 1½ in., 5d. each, 4s. 6d. doz.—J. SENIOR, Oldlands, Gloucestershire.

Wanted.—A good Oil Engine, ¼ or ⅓ b.h.-p.—State price and full particulars to T. R. CLUTTERBUCK, Elmfield, Harrow.

Exchange.—2 amp. 13 volt Dynamo, for complete set of finished parts of 40 c.p. Dynamo.—WOODING, Market Street, Wellingborough.

For Sale.—Lathe; back geared, 6 in. centres, 5 ft. bed, slide-rest, Cushman chuck, faceplate, catch plate; £6 5s.—Write T. BARNES, 47, Trafalgar Street, Carlisle.

Bargain.—Gas Engine, 1¾ × 2¾; water jacket, 6½-in. flywheels, plated fittings, gas bag; perfect order; £2, or best offer.—T. WHITE, Junr., Queen's Road, Barnsley, Yorks.

Sale.—"Gem" Air Gun; cost 35s., take 21s.; good condition.—GEORGE FIRTH, Pale Side, Ossett, Yorkshire.

Vertical ½-h.-p. Engine and Boiler, with large pump, complete; £10, or exchange ½ b.h.-p. Oil Engine. Also exchange 8 volt shunt Dynamo for 25 Voltmeter.—Full particulars from DAY, Langley, Chippenham.

Wanted.—MODEL ENGINEER, Vols. I and II, unbound preferred; must be clean.—H. K., 8, Richmond Terrace, Liverpool.

High-class Lathe, by Milnes, 4-in., 4 ft. gap-bed, chucks, tools, etc.; £10, or exchange (see below).

Wanted.—Hand Planer, Geared Drilling Spindle, Cushman's four-jaw Chuck, Fluted Drills, Wire sizes.—LINCOLN THOMPSON, Bishop Auckland.

Exchange Compound Marine Engine, cylinders, 3 ins., 5 ins., by 4½-in stroke, not quite finished, for small Locotype Boiler or Lathe.—64, Chief Street, Oldham.

Loco.—4-coupled Bogie Tank Engine, one inside cylinder, reversing tube in firebox and flue; 40s.—BLACKMORE, 92, Drummond Street, Euston Station, N.W.

Horizontal Steam Engine, 1¾ bore, 1¾ stroke, and copper boiler, 13 × 7, 9 tubes; 37s. 6d., everything complete (boiler alone worth double); or exchange, with little cash, for Gas Engine.—4, Baytree Cottages, South Streatham.

Lathe Wanted.—Treadle, about 4-in., back-gear, screw-cutting, gap-bed, swivel compound slide-rest; good condition; with or without tools, chucks, etc.—Particulars to J. A. READ, 19, Park Avenue, Spring Bank, Hull.

Wanted.—A small Bench Drilling Machine; also independent Lathe Chuck for small work; near London.—B. PALMER, 48, Avondale Square, Old Kent Road.

Model Yacht, 4 ft. long, splendid condition, excellent sailer; £2 10s., or nearest offer; photo, one penny.—NICOLL, 29, Duckett Road, Harringay, London.

Two Slide-valve Cylinders, ½ × 1 in., lagged with asbestos and covered with tin, never used, suit loco, 8s. Four Loco Driving Wheels, 3¼ ins. diameter, 2s. 6d.—Below.

For Sale.—Model Railway, 1¾ in. gauge, 2 locos, goods waggons, signals, rails, points, etc.—Particulars, CASSELLS, 207, Kenmure Street, Pollokshields, Glasgow.

For Sale.—3-in. gap-bed Lathe; 14s., or exchange for anything useful.—A. WILES, Nene Parade, Wisbech.

Gas Engine, 1 h.-p., by A. and S. Barker, with tank and fittings complete, two heavy flywheels, governor; new last year; price £17.—W. S. S., 20, Loats Road, Clapham Park, S.W.

What Offers?—Ten *Railway Magazines*, 8 *Locomotive Magazines*, 62 *Hobbies*, 62 *Designs*, 18 *Amateur Photographer*, 38 *Photographic News*, 20 *Photography*; or exchange for Dynamo or cash.—ARTHUR KEARSLEY, 5, The Retreat, Worcester Park.

For Sale or Exchange.—One Liquid Fuel Burner, 6-in, with arm made by Sinclair and Co., suitable for 4 h.-p. boiler; also one Petrol Tank and connections, 18 ins. long, 13 ins. diam., with air pressure gauge, air pump; also one starting lamp. The above cost £12; only been used twice; exchange for good Screw-cutting Foot Lathe, or offers.—RHODES, Wesley Road, Stanningley, Leeds.

Electric Night or Hand Lamp, with accumulators 6s. 6d.; unfinished Phonograph, 15s.; three double dark Slides, 10s.; 2 or 4-volt Motor, 4-in. ring, 10s.; or exchange Tools.—OAKLANDS, St. James's Road, Bexhill-on-Sea.

Autoharp (Meinbold's improved), 13 chord-bars, full chromatic scale; will sell for £1.—WHITTLE, 61, Walton Road, Liverpool.

Wanted.—1-6th b.h.-p. Oil Engine, "Otto" cycle preferred; must be cheap for cash, and in good running order, and all complete.—JOHN LEE, 1, Old Lane, Knowlwood, Todmorden.

Horizontal Steam Engine.—Cylinder, 4 ins. diam., 7-in. stroke; flywheel, 33 ins. diam.; crank-shaft, 1¼ ins. diam.; gunmetal bearings; bed-plate, 44 ins. × 9 ins.; price £12; further particulars stamp. Deposit system.—WILCOX, 121, Rushey Green, Catford, S.E.

3-in. Lathe Headstock (Britannia Co.), two chucks, six wood-turning tools. Also Castings for loose Headstock, Handrest, Faceplate; cheap.—COULSON, 126, Clarendon Road, Middlesbrough.

4-in. Astronomical Telescope.—Exchange for small Dynamo or Electrical Goods. What offers?—155, Hemsley Road, Newcastle-on-Tyne.

Bargain.—Horizontal Engine, 1½ × 3½ ins.; 25s., or exchange good Launch Engine.—LOCKWOOD, 7, Vernon Street, Woodhouse Lane, Leeds.

First-class Single-geared Lathe, 5 in. centre, 5 ft. bed, on heavy iron standards. Five speeds for gut, with overhead countershaft; self-centring chuck, 5 in. diam., with two sets jaws, and a full set of chucks. A perfect tool for accurate work. Photo, 6d. Approval for cash, £6 10s.—MECHANIC, 75, Lister Lane, Halifax, Yorks.

Two 3 h.-p. Air-cooled Motors, almost as new, £12; double cylinder Steam Engine, about 6 h.-p., suitable for launch, £20 or near offer.—OSBORNE, Distillery, Cow Cross Street, London.

Wanted.—Second-hand Ruhmkorff Coils, for cash; 2, 3 or 4 in. spark.—RAWLINGS, York Road, Edgbaston, Birmingham.

Spring Motor Gramophone; as new; takes ordinary or "Monarch" records, 28s.—J. COLLING, "Westholme," Priory Road, Hastings.

Wanted.—Thorough good Lathe; exchange 18-ct. gold Repeater, value £10. For sale, Gent.'s 24 in. new "Rapid" 16 in. chain wheel. 8 in. cranks, 100 gear; cost £19; cash, £6 15s.—FITTER, Lenwade, Hythe Road, Preston Park, Brighton.

Columbia Graphophone, with 24 records, aluminium trumpet, recorder, reproducer and case.—For particulars, HAWKINS, 79, Landsdowne Gardens, Croydon.

30-in. Model Sailing Yacht for sale, £1.—FLETCHER, Pyt House, Tisbury, Wilts.

Engineer's Parallel Vice, 3 in. steel jaws, opens 3¼ ins.; almost new; what offers? Letters only.—H. RICHARDS, 37, Uplands Road, Harringay

Automatic Acetylene Gas Generator.—Burns 30 hours, with two burners; holds 5 lbs. of carbide; 1 ft. 7 ins. high by 9 ins. diam.; suitable for a workshop; 21s., bargain.—C. J. BROWN, 11, Fore Street, Wellington, Somerset.

Gas Engine, 2-in bore, water-jacketed; cost £5. Another, 1¼-in. bore; cost £3 10s. Two Dynamos for engines, cost £3 10s. The lot, £6. Full particulars on application.—FRASER, 132, Stirling Street, Alva, Scotland.

On Sale.—Stockport Gas Engine, 2½ h.-p.; in good working order; gas-bag and all complete; can be seen running; price £14.—W. BOOTH, Baker, Ripley, Derby.

Vertical Engine and Boiler, all complete, one nominal h.-p.; cost £40, take £12; a bargain.—W. BRADLEY, Holmfirth.

Books.—Rankine's "Civil Engineering, 1874," 2s.; Parkinson's "Elementary Mechanics, 1896," 2s.; Twisden's "Practical Mechanics, 1868," 1s.; Rankine's "Applied Mechanics, 1864," 2s.; Goodeve's "Elements Mechanism, 1865," 2s.; Todhunter's "Conic Sections, 1867," 2s.; Goodwin's "Elementary Dynamics, 1867," 2s.; Besant's "Elementary Hydrostatics, 1867," 1s.; many other works, engineering, etc.; good condition, lowest prices.—Write YOUNG, Monica, Exmouth.

Sale.—Lathe, 2½ in. centres; tools, treadle, etc.; 25s.—BILHAM, 9, Wood Street, Heworth, York.

Slide-rest.—Suit 8 or 9 in. lathe. What offers?—PRINGLE, 108, Canada Street, Newcastle.

Model Torpedo Boat.—5 ft. long; metal hull; whaleback and conning tower; rails and stanchions fixed. Marine Engine, 1¾ in. bore, for same. What offers?—J. W., 54, Rigly Street, St. Helens, Lancs.

Bargain.—Slide-Valve Loco, with tender, truck, rails, etc., 1¾ in. gauge, by Bassett-Lowke; £1, or near offer.—H. DUDLEY, 15, Salvin Road, Putney.

Ritter Road Skates, men's size, quite new; also large Tool Chest, with quantity of tools. Will exchange for second-hand Zonophone, in good condition, without records.—For particulars to C. KEEGAN, Stonyhurst College, Blackburn, Lancs.

Medical Battery of 30 Sach Leclanchés, in ebonite cells and walnut case; two electrodes; for sale; only requires re-charging with salammoniac; would exchange for good Autoharp.—WHEELER, Hotel Alexander, Vauxhall Bridge Road, London, S.W.

For Sale or Exchange.—Steam Gauge, 2½ in. diam. to 300 lbs; safety valve all brass; 7-16ths in. bore; crankshaft (double), 1¾ throw. Wanted, Anvil, independent Chuck.—S., 116, Marion Street, South Splott, Cardiff.

Six Accumulators for sale, singly or the lot; practically new; 1s. 6d. each.—STOKES, 70, Prestage Street, Manchester.

Horizontal Engine, 3 i.h.-p., girder type, bed-plate, heavy flywheel, wall box and outer bearing cylinder lagged with polished mahogany, lubricators throughout; also complete set of boiler mountings, including pressure gauge, water gauge, steam valve, safety valve, back pressure valve, 2 test cocks and blow-off cock; also Gresham and Craven's No. 2 injector. All the above in excellent condition. Price £15 the lot, or would sell separately. Photos and particulars, a stamp. Approval on deposit.—"LANGROVD," West Didsbury, Manchester.

Lathe Wanted.—2¼-in. to 3-in. Lathe and Outfit wanted; moderate in price.—Write L., 36, Bury Road, Gosport.

Model Loco, "Emperor," 17 ins. long, very fast; also 50 ft. brass rails, excellent condition; £4.—READ, 75, Maury Road, Stoke Newington.

For Sale.—Manchester Dynamo (maker Bottone), new, has only been run twice, 25 volts 4 amps. at 2,750 revs.; a first-class machine; 50s.—87, Lower Seedley Road, Pendleton, Manchester.

For Sale.—15 c.-p. Dynamo, 12s. 6d.; worth 30s., a bargain; a first-class machine and in good working order; photo sent.—CHAPMAN, Austin Street, Stamford.

Splendid Scale Model 3-masted full-rigged Ship, *Condor*; copper built hull; about 4 ft. long; all sails complete and good sailer; automatic rudder, painted ports, boats on davits, &c.; £5, worth double.—CLIFFORD, 17, Yew Tree Avenue, Levenshulme, Manchester.

For Sale.—New Roger Fretwork Machine, in good condition, 10s.—Address G. DASSETT, 73, Ripley Terrace, Bradford.

The Aëronautical Institute and Club (P. L. Seneal, Founder).—For information apply to O. FIELD, 20, Adelaide Road, Brockley, Kent.

For Sale.—40 MODEL ENGINEERS, and 90 *Yachtsman*; would exchange for "Memo Frena" or similar hand camera.—C.S.E., 30, Trent Road, Brixton Hill, London.

(Continued on page xiv.)

THE

Model Engineer

AND

Amateur Electrician.

A JOURNAL OF MECHANICS AND ELECTRICITY FOR AMATEURS AND STUDENTS.

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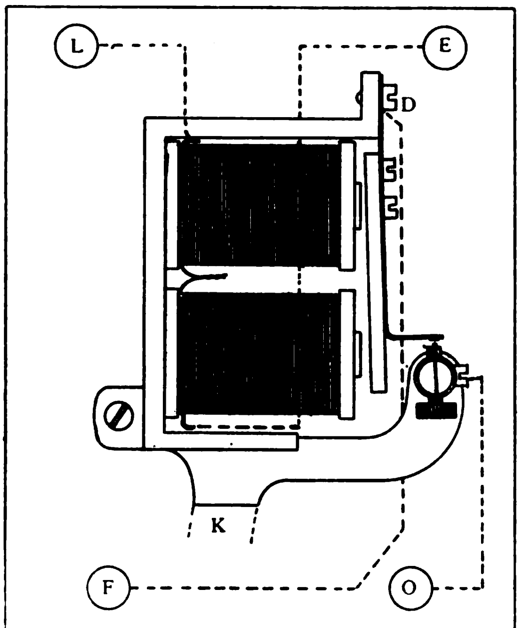
VOL. VI. No. 69. MARCH 15, 1902. PUBLISHED TWICE MONTHLY.

How to Make a Simple Relay.

By W. L.

READERS are sometimes puzzled by the difficulty of constructing some comparatively expensive piece of apparatus in a cheaper and equally efficient manner. For the benefit of such amateurs, the illustration below shows a simple yet useful relay, which can be constructed by any amateur at a trifling cost out of an ordinary trembling bell—the only extra materials being two terminals, unless it is desirable to have another baseboard, in which case a two-way block answers. This can be obtained from any electrical dealer's. It will be seen by sketch that one wire from the magnets goes to terminal marked L (line), and the other to terminal E. The bell pillar is cut off at K as is also the bell hammer, or the latter may be unscrewed from the armature. The contact-spring is turned out at right angles to armature, and armature screw turned around to act as contact. A piece of wire must now be taken from end of armature D to terminal F and another piece from contact screw to terminal O, when the relay is ready for use. Connect terminal L to line and terminal E to earth; also connect terminal F to one terminal of bell, and terminal O to carbon of battery; then another piece of wire should be run between the other terminal of bell and negative of battery, and the relay is connected ready for use. The current coming from line on its way to earth magnetises the core, attracts armature, thus making contact with screw, completes local circuit, and rings the bell. This relay can also be used in telegraphy, and would also be suitable for use in "wireless telegraphy" experiments, if modified to some extent. The bobbins would need re-winding with a much finer wire (from No. 36 to 40), and care should be taken that the cores are thoroughly soft and well-annealed. The usual bell magnet spring will probably be too stiff, and should be replaced by a lighter one, which must at the same time be carefully set, so that a very trifling space occurs between the faces of the magnet cores and the armature. The contact spring will also require special adjustment, so that a minute current through the coils of the electro-magnet will suffice to bring the local battery into action.



A SIMPLE RELAY.

A really sensitive relay is a rather delicate piece of apparatus, and care is therefore necessary in adjusting both the distance of the armature from the magnet poles and the space between the platinum contact on spring and that on the contact screw. These surfaces should be kept clean, and it should be observed that the platinum point does not catch the contact piece, or the relay spring may be held. A good, well-fitting cover must be placed over the apparatus, or dust will probably spoil the contact.

The cores of ordinary bell magnets are sometimes fitted with small brass plugs, which project about 1-64th in., in order to prevent the armature from sticking to the poles when the iron is of a sufficiently hard character to retain a considerable degree of magnetism. If this is the case, the brass pins should be filed down to the level of the iron, and particular attention paid to both the magnet and armature that they are soft enough for the purpose. The relay may be hung in the same manner as the bell is usually fitted, but it is better to let it rest horizontally, when the action of gravity will not have so much effect on the armature.

The Society of Model Engineers.

London.

THE following dates have been fixed upon for ordinary meetings of the Society:—Wednesday, March 12th, a series of short papers on various model engineering subjects—electrical and mechanical—by Messrs. Boorman, Crebbin, Bowling, Riddle, Hildersley, Greenly, and other members; April 10th, Rev. W. J. Scott, B.A., on "Modern N.E.R. Locomotives." The meetings commence at 7 p.m. in the Board Room, Memorial Hall, Farringdon Street, E.C.

MODEL MAKING COMPETITION, 1902.

As announced at the January meeting of the Society, a model making competition, open to all members of the Society, will be held in May next. The date of the exhibition has been fixed for May 22nd, instead of the 5th. The entries for the competition, accompanied by one shilling entrance-fee, must be sent to the Hon Secretary, Mr. HENRY GREENLY, on or before May 5th, upon forms which will be posted to all members. Full instructions will be given to each competitor as to the dispatch of his model for exhibition.

The prizes will consist of silver and bronze medals, and will be awarded in the following classes at the discretion of the judges: 1, Locomotives; 2, Marine, Stationary, and other Engines; 3, Electrical Apparatus; 4, Ships and Boats; 5, Best Model made by a member under 21 years of age; 6, Best Model exhibited by a Provincial member; 7, Best home-made Tool; 8, Miscellaneous models.

The prizes will be awarded according to the number and quality of the exhibits in each class; and the judges, in allotting marks, will pay especial attention to originality in design and construction—*i.e.*, methods of constructing. Members who are users of metal-working tools in ordinary business, or who have had professional instruction in mechanical work, will be handicapped according to the nature and extent of their experience. Members who are professional model makers, cannot be entered for Classes 1, 2, 4, 5, 6, 7, and 8, and those who are engaged in electrical apparatus making as a livelihood will not be allowed to enter for Class 3. Only *bona fide* members of the Society are eligible.

Models which have gained a medal in the previous competition (1900) cannot be allowed to compete in the present one, and no model shall take more than one prize.

The competition entry form will contain all further particulars as to prizes, rules, and form of declarations as to the extent of the work done by the competitor, and his occupation and training.—HENRY GREENLY, Hon. Sec., 4, Bond Street, Holford Square, W.C.

Provincial Branches.

Edinburgh.—On Saturday, February 1st, fifteen members of this Branch travelled to Cowlairs, on a visit to the North British Railway Locomotive Works. Leaving the Waverley Station at 1.5 p.m., we reached Cowlairs at two o'clock, and were joined there by a number of the members of the Glasgow Branch, who had been invited to accompany us. The party, numbering thirty, was then split into three smaller parties, each being conducted round the works by an engineer. Owing to the visit taking place on a Saturday, the works were shut down; but, in spite of this, the visit was an exceedingly interesting one. All the shops were visited in turn, and especial attention was paid to some specimens of East Coast Joint Stock, which were receiving their final coating of paint in the Paint Shop. These vehicles, which form part of the North British Railway's contribution to the Joint Stock of the East Coast Railways, are magnificent specimens of the railway carriage builders' art; they are all fitted with the automatic coupling, the working of which was explained to the members. After inspecting the works the members visited the engine-house, which operates the cable on the Queen Street incline. The winding engine, constructed about sixty years ago, with a view apparently to elegance as well as efficiency, was examined with interest by the party, and many amusing criticisms were passed on its design. This engine, which is a worthy crown to an antiquated system, has done its work nobly for more than half a century, and, judging from its appearance, is still a long way from the scrap heap. A very hearty vote of thanks was given to the gentlemen who had so kindly acted as our guides. In connection with this visit an arrangement has been made with Mr. Rodger, the Hon. Secretary of the Glasgow Branch, whereby the members of our Branch are to join the Glasgow members on any visit of interest in the Glasgow district.

FUTURE ARRANGEMENTS.

March 13th.—General Meeting. Lecture by Mr. Dodds on "Steam and the Steam Engine"; Mr. Miller's carburettor, etc.

March 22nd.—Visit to the Newbattle Collieries of the Lothian Coal Company, Ltd.

—W. B. KIRKWOOD, Hon. Secretary, 5, North Charlotte Street, Edinburgh.

Leeds.—The Leeds Branch of the Society of Model Engineers held a meeting in St. Andrew's Church Schools, on Tuesday evening, February 18th, when Mr. F. C. Speke exhibited a model of an old type of compound condensing side lever engine, being a correct model of an engine at a mill near Leeds. It had geared rotary valves, and was rather a novelty to the members present. Afterwards the question of holding the meetings monthly instead of fortnightly was discussed, the meeting terminating at 9.45 p.m. — W. H. BROUGHTON, Hon. Sec., 262, York Road, Leeds.

Oldham.—The ordinary meeting of this branch was held on Tuesday, February 18th, in the Oriental Restaurant, Church Terrace. Mr. Bodden occupied the chair. Mr. Buckley introduced a set of patterns for a compound marine engine, and Mr. Pitman also sent for inspection a set of 1/4 h.-p. water motor castings. Mr. Pollitt had on view a starting valve and throttle valve combined, which was highly finished, and also a slide valve cylinder, 3/8 in. bore 5/8 in. stroke. After an inspection of the above, some discussion followed, and, with a vote of thanks to the chair, the meeting closed at 10.30. — R. L. COLLINGE, 15, Widdop Street, Oldham.

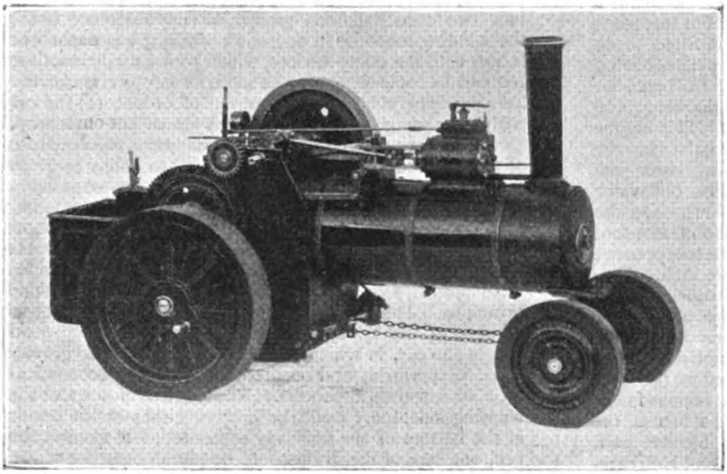
Sheffield.—The ordinary meeting of the Sheffield Branch took place on Monday, February 10th, at the Y.M.C.A., when a fair number of members were present. After the usual business had been disposed of, there followed a general discussion on the petrol motor in course of construction by members of the Society, and a number of patterns and castings were exhibited by Mr. Shaw. Mr. Milner brought an excellent pattern of the 500 watt 4-pole dynamo, field-magnets for which were designed by Mr. Burrows, and this was very much admired. A very interesting and enjoyable meeting was brought to a close at ten o'clock.—Geo. B. BURROWS, Hon. Sec., 37, Edge Hill Road, Netheredge.

Stroud.—A meeting of the Stroud Branch of the Society of Model Engineers was held at the Stroud School of Science and Art, on Friday, February 7th, thirteen members being present. Mr. Crowe read a very interesting lecture on the construction of the Forth Bridge, and was assisted by Mr. Newsome with a limelight lantern, by means of which some interesting pictures of the bridge at different stages of its construction were thrown upon the screen. The lecture was listened to with great interest, and a hearty vote of thanks was given to Mr. Crowe and to Mr. Newsome. The meeting terminated at 9.30 p.m. The following meeting took place at the School of Science and Art, on Friday, March 7th, at 7.30 p.m. Arrangements are in progress for an interesting and instructive course of lectures.

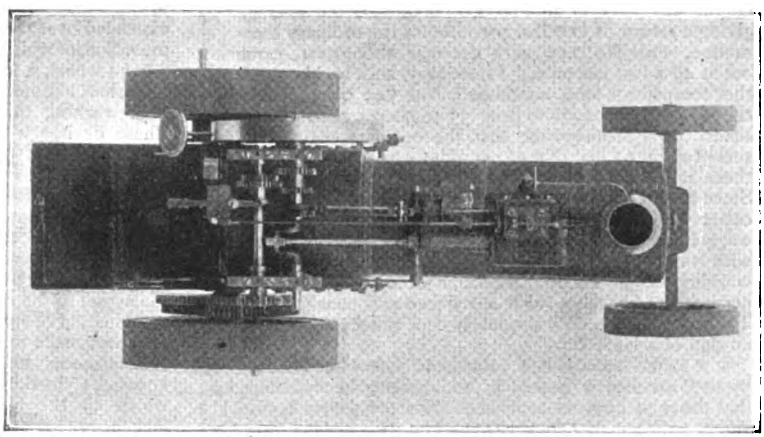
Full particulars of membership can be had from the Secretary, who will also be glad if firms supplying tools, castings, fittings, &c., will send their catalogues for the use of members.—T. Newsome, A.R.C.Sc., Hon. Secretary, School of Art, Stroud.

A Model Traction Engine.

A considerable amount of interest exists in favour of models of traction engines, although we may express surprise that it is not greater. Such a model possesses several excellent qualities. It needs no expensive track to display its powers, and a very moderate space will accommodate it. The model has considerable power—which is, of course, developed instead of speed—and it can, if so desired, be regarded as a portable engine, the driving gear being temporarily disengaged. It will be remembered that we published a design, together with some notes on the construction of a 1½-in. scale model traction engine in our December 1st issue, Vol. V, which was intended to be fired with charcoal or similar fuel. In accordance with what may now be termed the latest model practice, our contributor, Mr. Tyrrell Cooke, has arranged for firing this type of model with a No. 5 Primus burner. The oil-tank, together with air pump, he stows in the tender or bunker space, and this arrangement, he informs us, is highly satisfactory. At the time the above article was published only photographs of the engine in its unfinished state were available, and they do not, consequently, show the model to best advantage. Mr. Cooke has now very kindly supplied us with the accompanying prints, one of which shows a plan view of the engine, and makes it easy to follow the gearing on the various shafts. This may be of use to some of our readers who do not happen to be well acquainted with this class of engine.



Model Traction Engine, Designed by Tyrrell Cooke.



Top View of Model Traction Engine.

To Readers in Bolton.

An effort is being made to form a new branch of the Society of Model Engineers in the above district. Mr. S. L. Thompstone informs us that he, in company with Mr. C. A. Hays, of 36, Gilnow Road, Bolton, will be pleased if readers in that district will send in their names as soon as possible.

The directors of Messrs. John Oakey & Sons, Limited, state that the net profits for the year, including £442 9s. 2d. brought forward, amount to £22,226 3s. 4d. Out of this sum a dividend of 6 per cent. per annum has been paid to the preference shareholders, and the interim dividend of 5 per cent. to the ordinary shareholders, absorbing the sum of £12,250, leaving a balance of £9,976 3s. 4d. From this balance the board recommend the payment of a final dividend of 5 per cent. to the ordinary shareholders, making a total of 10 per cent. for the year; and in addition, a bonus of 2½ per cent., free of income-tax, leaving a balance of £601 3s. 4d. to be carried forward to next year.

The well-known firm—Anti-Friction Alloys, Ltd., 52, Queen Victoria Street, London, E.C., who manufacture the "Atlas" metal, inform us that their title has been altered to that of the Atlas Metal and Alloys Company, Ltd. This change has been found necessary owing to the fact that some firms have not associated "Atlas" metal with the old title.

A New Locomotive Valve Gear.

MOST of our readers will have read with interest the information in the daily Press with regard to a new valve gear, which is said to have worked wonders in the reduction of coal consumption and increase of power of a locomotive on the Great Northern Railway. The following details form the gist of what has appeared in the Press on the subject of this new valve gear, which is the invention of Mr. J. T. Marshall, a Leeds engineer :—In order to put the invention to a practical test the Great Northern Railway had it fitted to an old mineral locomotive, with a very small boiler, having under 1000 sq. ft. of heating surface, 17½-in. by 26-in. cylinders, six driving wheels of 5 ft. in diameter, and weighing (with the tender) about 70 tons. This engine —No. 743—was pitted in a series of trials, in the same work, day after day, against a sister engine of the same pattern, but having the old valve gear. The results exceeded all expectations. On the first trip, on May 2nd, No. 743 took a load of 279 tons 15 cwt. up an incline of 1 in 71½, the steam pressure never being higher than 140 lbs. per square inch. This load is nearly 50 per cent. greater than that booked to be taken by this class of locomotive at this point. On May 6th, on the same bank, the load was made up to no fewer than 307 tons, with which the locomotive successfully coped. On the next day she was tested on the well-known Wrenthorpe to Burkinshaw section, famous for its very bad banks, which vary from 1 in 40 to 1 in 100, the load being increased above the standard by one half, again with excellent results. On May 9th and 10th careful trials were made between the two sister engines on the section between Lofthouse and City Road, Bradford, in order to get statistics of the comparative coal consumption. The non-converted engine used about 20 cwt. of coal, or 72 lbs. per mile ; while No. 743 used only 11 cwt., or about 39 lbs. per mile, in spite of the fact that on the return journey she was saddled with a heavier load than her sister. From May 13th to 18th, each engine did work of an identical character, the average giving a return of 57·7 lbs. per mile for the ordinary locomotive, while No. 743, with the new valve gear, came out at 46·2 lbs. per mile. From May 20th to May 25th the competition was continued, No. 743 being handicapped by being made to drag 33 to 50 per cent. greater loads, the figures showing that the ordinary engine consumed about 67 lbs. of coal per mile, while No. 743, with these much greater loads, used only 63 lbs. per mile. Since May 28th, No. 743 has been running from Doncaster to Peterborough, taking from thirty to forty-five waggons of coals, returning on the "Express Goods" with thirty-two waggons and upwards, the averages working out at about ninety-nine extra waggons taken per week of five days, with a reduced coal consumption. The valve gear keeps absolutely cool and shows little or no sign of wear so far.

It is stated that the new valve gear causes the steam to be so "excellently passed in and out of the cylinders, that thirty to fifty per cent. more haulage power is provided, with less fuel consumption, and with a steam pressure some 30 lbs. lower than modern practice. Back pressure is markedly reduced."

It is difficult to see how an improvement in valve gear will work a revolution in coal consumption to the extent indicated, especially if the very excellent working of the best class of mill-engine, fitted with Corliss gear, be considered. It is, at anyrate, significant that the chairman of the Great Northern Railway announced that the figures were published without the authority of the company.

Electric Passenger Lifts.

AT a meeting of the Institution of Junior Engineers, held at the Westminster Palace Hotel, on February 7th, the chairman, Mr. Percival Marshall, presiding, a paper—"The Electric Passenger Elevator"—was read by Mr. William J. Cooper.

The principal requirements of an effective electric elevator were stated to be safety, reliability, effective control, economy, and compactness, and were divided into two clearly defined groups, having reference to (1) the winding machine in operation while the elevator was in use with the safety devices, which were usually inactive, but had to come into play as soon as any portion of the hoisting apparatus failed or got out of order ; (2) the car with its safety gear moving up and down the hoistway. The chief features of an ordinary gear were the armature of a motor coupled to a worm with ball or collar bearings to take the end thrust of the worm ; a worm wheel submerged in an oil bath, and fixed in a suitable bracket, entirely protected from the action of dust or grit ; a grooved winding drum or veed wheel fixed to the worm wheel or mounted on the same shaft. Such machines were almost exclusively operated on the over-balance principle. This had the advantage of economy of power by making the system balanced when the average load was in the car, in which case the elevator had no gravity work to perform, and resulted in the most economical type of hoisting apparatus. The electric motor and the winding machinery could be erected either at the top or at the bottom of the hoistway as desired. If fixed at the top, one face of the drum could be plumb over the centre of the car, and the other face plumb over the counter-balance weight.

The author dwelt on the importance of an efficient form of brake. It might be mechanically operated from the switch gear shaft by the controlling rope, or be an automatic magnetic solenoid brake, the type now generally adopted. A solenoid and magnet of small dimensions could be made to give a pull of 500 lbs. or 600 lbs. through one half-inch. Considerable ingenuity has been expended over the starting and controlling switches, the operation, of which might be effected either by a hand rope, a hand wheel, a lever, or by a push-button device.

Various automatic safety devices are used in connection with working the controller or push button switches. These devices were operated by both car and hoisting machine, to cut off the power and supply the brakes at the limits of the car's travel. To guard against the car falling unretarded to the bottom of the hoistway, in the event of the ropes breaking or becoming unshipped, there were several types of safety gears employed, attached to the bottom or platform of the car, and arranged to operate by gripping the fixed guide posts or backings, either by the action of the compressed springs or levers, or by the combination of springs and centrifugal governor. Reference was made to accidents arising from the insecurity of the entrances to the hoistway. An electrical locking apparatus should be fitted to all electric elevators, by which all the hoistway doors or gates would remain locked, except when the car itself was at the landing in position, and stationary. The opening of any door was arranged to break the main circuit of the motor, and it was impossible for the motor to be started again until the gate was shut and locked, and the circuit re-made.

A discussion followed the reading of the paper, and a vote of thanks having been passed to the author, the proceedings closed with the announcement of the next meeting on March 14th, when a paper on "The Use of Engineering Models" would be read by Mr. Percival Marshall.

The Hyde Park Model Steamer Explosion.

IN our issue of February 1st appeared a brief note on the exploding of a large model steamboat on the Serpentine in Hyde Park. Since going to press with that number, we have been able to see the remains of the boat and to make further enquiries, with a view to writing a correct account of the accident.

The model was 8 ft. long, and, it is stated, weighed nearly 2 cwt. It was a fine specimen of the boat-builder's skill, and represented very closely a large merchant vessel. We have been able to obtain the accompanying photograph, which, although not the best possible, shows its fine proportions. The deck fittings were very complete—such details as anchors, davits, boats, hatchways, binnacles, ship telegraphs, all being perfect models in themselves.

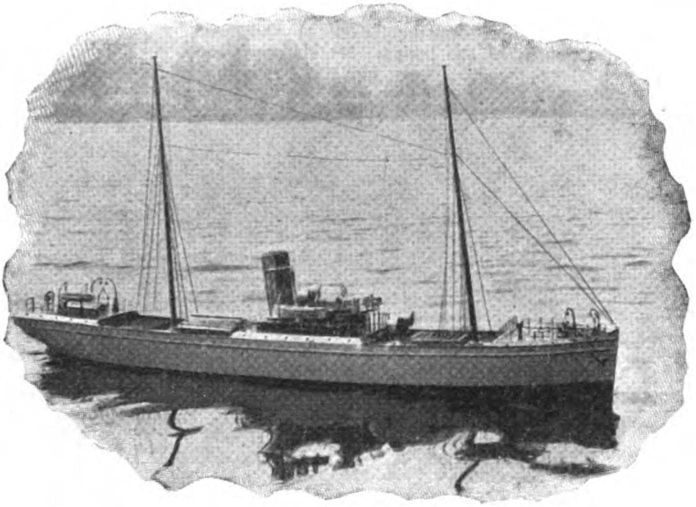


FIG. 1.—THE MODEL STEAMER, "AMY HOWARD."

The owner, Mr. George Howard, made the engines, boilers, and all metal work in the boat; and Mr. Edwin Brooks, at whose house the model was "docked," was responsible for the hull, the general work of the erection, and painting.

Sunday morning was the usual time of sailing, and the Serpentine in Hyde Park, some twenty minutes' walk, the place. The boat had, prior to the explosion on January 5th, crossed this water over a hundred times, and no mishap of this sort was at all anticipated by her captain and crew.

The engines were high-pressure marine engines, beautifully made, having two cylinders 1⅛ ins. by 2 ins., and link motion with screw-reversing gear. The engines, excepting that the steam piping was torn asunder, were not damaged at all by the accident.

Coming to the cause of the explosion, it will perhaps be better, before describing the construction of the boiler, to relate the circumstances which led up to the accident.

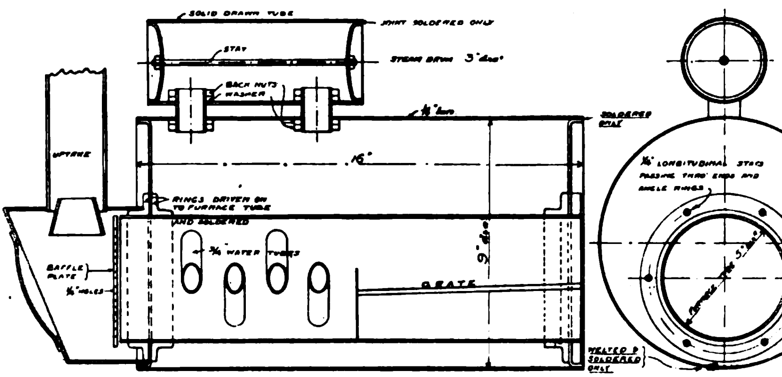


FIG. 2.—BOILER OF THE MODEL STEAMER, "AMY HOWARD."

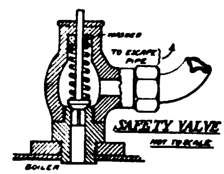


FIG. 3.

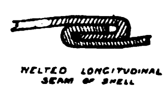


FIG. 4.

The usual course of procedure was on this morning adopted. The boiler—which, by the way, used charcoal as fuel—was filled at home, and the fire lighted, steam raised, and the boat removed from the room in which it was stored on to a special wheeled truck and taken to the lake. Contrary to the general custom, the boiler was not filled up with water with the pump—a rather large affair—which was entirely separate from the boat, the delivery pipe being a flexible tube with a screwed coupling, attached when required to the check valve on the boiler, at the end. One of the party—Mr. Brooks—mentioned during the journey to the lake that the water was getting rather low in the boiler, but, seemingly, no notice was taken of it.

On arriving at the Serpentine, the remark as to the shortness of water was repeated, but it was decided to give her one run across before pumping up. The model worked splendidly—better than ever it had done, it is said. On arriving at the other side, Mr. Brooks stooped down and shut off the steam, bringing the boat broadside to the shore. He stood up from attending the boat, and a moment after the explosion occurred. The decks and the side of the boat nearest the shore burst open with a loud roaring noise, and all the bystanders were smothered in water, charcoal ashes, and splinters. Mr. Brooks was hit by the flying shell of the boiler, which hurt his arm and lacerated his ear so badly that they had to be treated at the depôt of the Royal Humane Society close at hand.

The ends of the boiler and furnace were torn out of the boat and laid in the water beside her. The keel was in two pieces, and practically all of the middle of the boat was demolished. The funnel, which weighs quite 3 lbs., was hurled a considerable distance. The bystanders who had not hurriedly left the scene helped to collect the more valuable fragments, most of which are shown in the accompanying photograph (Fig. 5). The remains of the boat were hooked out of the water and taken home. The shell of the boiler was laid absolutely flat, the ends and furnace being intact.

As we have before mentioned, we have had an opportunity of seeing the wreckage, and although some of it has been cleaned up and taken apart in the meantime, sufficient remained for the purpose of showing the cause of the failure. The drawing (Fig. 2) shows the general arrangement of the boiler. Mr. Howard must forgive us if we are hard upon him; but a boiler is like a chain—only as strong as its weakest link. All portions should be of the correct dimensions, and these sizes should be fixed by the nature and extent of the work each part has to do, so that they resist failure up to a certain point, which should, as nearly as possible, be for each a similar figure. It is not the least use to put very strong material in all parts but one, or use heavy metal throughout with the weakest of connecting joints.

Rule-of-thumb should never be adopted for boiler work, at least, for boilers which are capable of doing such damage as the one now before us. We may with advantage at this moment, cull from our handbook, "Model Boiler-Making," a paragraph which refers more especially to the rules for proportioning boilers:

"The strength of a boiler is the most important consideration. For a given thickness and diameter a piece of solid drawn tube will make the strongest boiler. When the boiler is made from a sheet of metal rolled or bent to a cylindrical form with the joint lapped and riveted, the strength depends upon the kind of joint made. For double riveting it is seventy per cent. of the solid plate, and for single riveting fifty-five per cent.

"The rule for calculating the bursting pressure of a boiler is as follows:—The tensile strength of the metal in pounds per square inch is multiplied by thickness of metal and by two, because two sides are always opposed to the tendency to burst at any point—and this result divided by the diameter in inches gives the bursting pressure for solid plates. This should be multiplied by ·70 for double riveting, and by ·55 for single riveting, and divided by 6, 8, or 10, whichever may be the desired factor of safety. An example or two will make things clear. Let us take a piece of 4-in. drawn copper tube for the barrel of a boiler 3-64ths in. thick. The tensile strength of sheet copper is 13 tons = 29,120 lbs. per sq. in., but as copper loses a little in strength when subject to high temperatures—at about 350 degs., which is the temperature of steam at 100 lbs. per sq in.—the tensile strength may be taken as 25,000 lbs. per sq. in Putting the above rule into the shape of a formula, it will work out as under:

$$\frac{25,000 \times \frac{3}{64} \times 2}{4} = \frac{2,343}{4} = 585 \text{ lbs.}$$

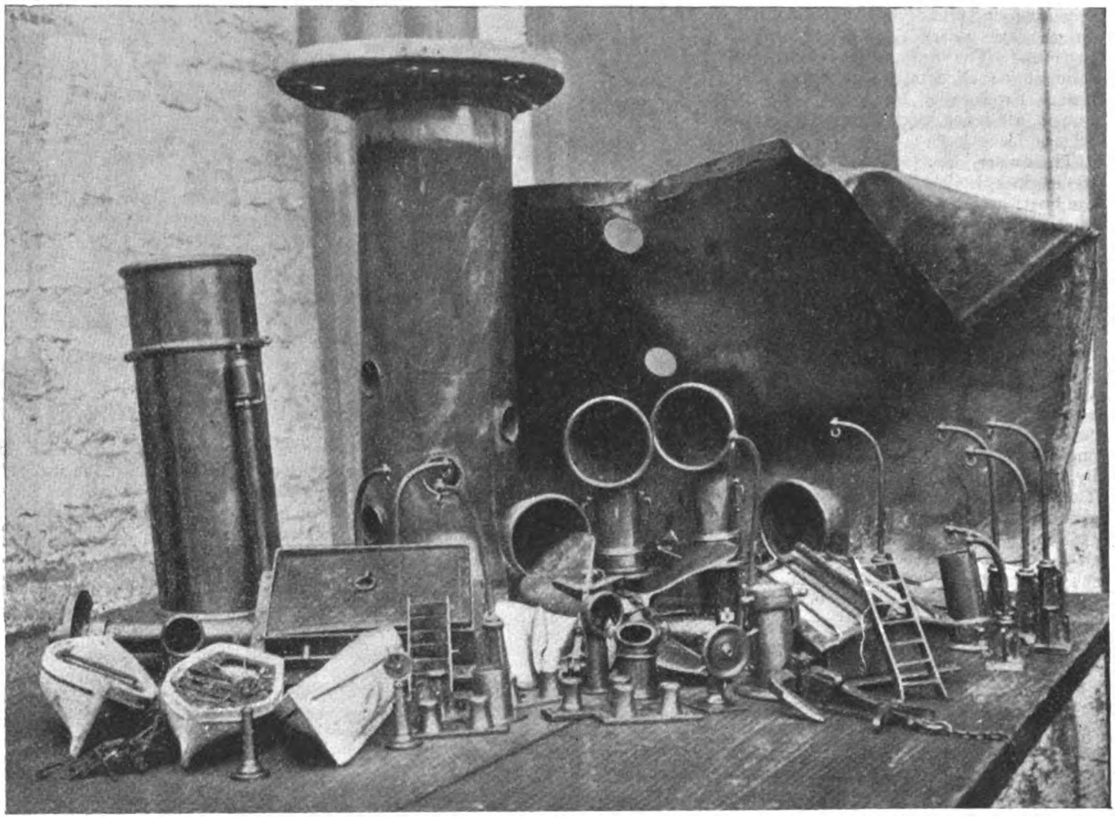


Fig. 5.—Boiler and Fittings of the Wrecked Model Steamer.

bursting pressure. Taking 8 as the factor of safety, we get $\frac{585}{8} = 73$ lbs. safe working pressure. If instead of using a tube, the boiler is made from a sheet of copper with a double-riveted lap joint, the figures become $585 \times \cdot 70 = 409$. This divided by 8 as the factor of safety will give a working pressure of about 50 lbs. If a single-riveted joint be employed we shall have $(585 \times \cdot 55) \div 8 = 40$ lbs. as the safe working pressure."

The boiler in question was a Cornish type boiler, the shell being 16 ins. long by 9 ins. diameter, with four ⅜-in. water tubes crossing the furnace tube at the rearmost end. The furnace consisted of a 5-in. solid drawn brass tube, connected to the ends in a very efficient manner with angle rings inside and outside, with stays passing right through them and the ends of the shell. These ends were of 5-64ths-in. copper plate flanged over, the shell being laid over and soldered. This joint *was not riveted*, and except for the little resistance to breaking offered by the soft solder with which it was sweated, was not secured in any way.

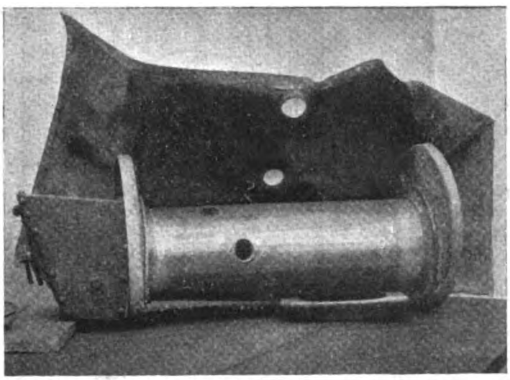


Fig. 6.—The Boiler after the Explosion.

This oversight or neglect further aggravated the weakness of the shell, the longitudinal seam of which was only secured by welting, as shown in the sketch (Fig. 4). It is certain that these joints were the cause of the failure, the pressure having risen beyond the safe limit, owing to the rapid accumulation of steam after the engines had been shut down. No doubt the blast during the last run had produced a fierce fire, which, together with the shortness of water, accounted for the high pressure. This has been estimated at about 70 or 80 lbs. per square inch, at which pressure the water and steam would be at about 300 degs. F., and at this temperature soft solder of the ordinary quality would be getting near its melting point. This circumstance would practically nullify the strength given to the joints by the solder. The welted seam simply opened out, and then the shell and the ends parted.

"Where was the safety valve, and why did it not act?" the reader will ask. A safety valve was provided, but it was such only in title. The illustration (Fig. 3) shows the general construction of this. Without the washer shown we tried the strength of the spring, and, considering the smallness of the outlet, we should judge that it would blow under a pressure of 90 or 100 lbs. per square inch, and even then would not lift sufficiently to relieve the boiler altogether. If the boiler had had riveted joints this valve would not have been correct, as the working pressure with the best of joints should have been 35 to 25 lbs., according to the factor of safety adopted.

This accident, therefore, only shows the amateur that —especially if a large model boiler is to be attempted —he should not forget to provide a good reliable safety valve, or even two; and also that the theoretical part of the design of a boiler, or, indeed, any working model, should not be neglected. If he is not well acquainted with the boiler-making arithmetic he should avail himself of some text-book or our own Query Department.

The last of the *Amy Howard* now hangs on the wall of Mr. Brooks' workshop, with the inscription written underneath, "Lost, January 5th, 1902."

The Construction of a Small Storage Cell.

By H. F. Shepherd.

The accompanying sketches and description apply to a small storage cell which has been found to give excellent results in practice. One of these cells, built by the writer, has been used for igniting the charge of a gas engine, and had a capacity of a trifle over 2 volts and about 12 ampères. For the construction of the cell there are required about 1½ sq. ft. of sheet lead 1-16th in. thick; 1 lb. of red lead; 1 lb. of yellow lead or litharge; 1 lb. of sulphuric acid; 6 ins. of lead wire, ¼ in. in diameter; two brass nuts, and a binding post.

The outside shell of the cell is of sheet lead, and forms part of the negative electrode. This is made by cutting out of the lead sheet a piece 9⅝ ins. wide in one direction, and 6 ins. wide in the other, with a lug or ear at one corner 2 ins. long and 1 in. wide, as shown by Fig. 1. This is rolled into the form of a cylinder 3 ins. in external diameter, which will give a lap of about 3-16ths in. The edge that is 6 ins. wide should lap on the outside of the edge 8 ins. wide, and the joint should be soldered, taking care not to fuse the lead any more than is absolutely necessary.

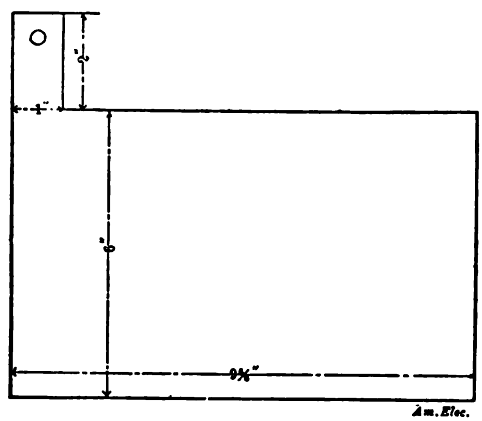


Fig. 1.—Lead Sheet for Outer Cell.

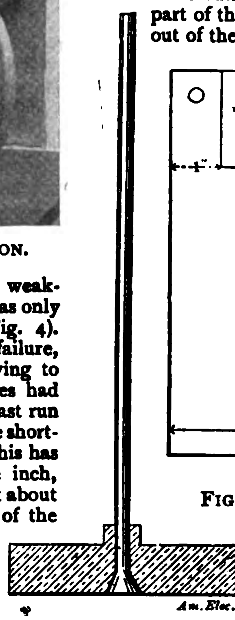


Fig. 2.—Wooden Disc.

The bottom of the cell consists of a disc 3 ins. in diameter, to which the edges of one end of the cylinder should be fitted rather carefully and soldered. Next cut out a sheet of lead 5⅝ ins. by 8 ins., and punch this full of holes not larger than ¼ in. in diameter, and as close together as possible without making the lead so weak that it cannot be safely handled. The holes can be cut with an ordinary belt punch. This perforated sheet should be rolled into a cylinder 2½ ins. in outside diameter and 5 ins. long, the lap being soldered in three or four places, but not necessarily throughout its length. This cylinder should be set inside the first cylinder so as to leave an annular space of 3-16ths in. uniform width between it and the interior wall of the main cup. This annular space should be filled with a paste made of litharge or yellow lead and dilute sulphuric acid, the acid being diluted by mixing it with ten times its weight of water. After packing the paste into position, let it dry thoroughly. The structure thus far obtained constitutes the negative plate of the cell.

or thoroughly dry wood across the top of the first dish for the second dish to rest on until its paste has hardened. The holes in the centre of the dishes should be a tight fit on the lead wire, so that the friction there will tend to prevent the dishes from slipping down. The succeeding dishes are slipped on the wire and filled with paste one by one, until the whole ten are in position, and the cell may then be assembled, as shown by the cross sectional view (Fig. 4), the electrolyte being put in before the cover is put on, of course. The electrolyte consists of dilute sulphuric acid, exactly like that used in mixing the paste, and the level should be well above the topmost dish.

The cover of the cell may be made of hard wood or of rubber, preferably the latter, and should be of the shape shown by Figs. 4 and 5, the lower part of the cover fitting

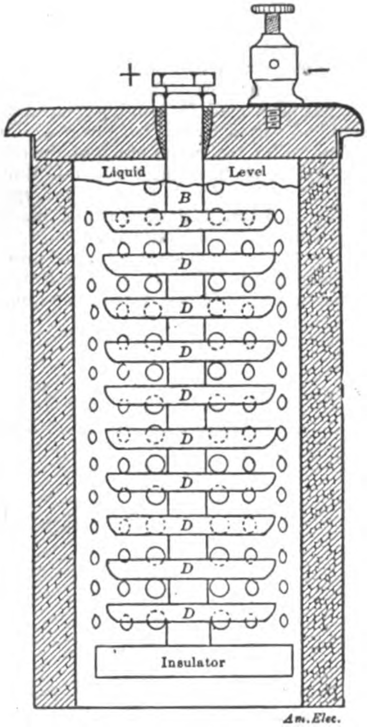


FIG. 4.—CROSS SECTIONAL VIEW OF STORAGE CELL.

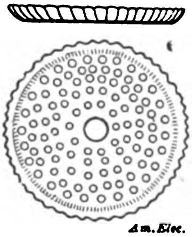


FIG. 3.—LEAD DISHES PUNCHED WITH 3-16THS IN. HOLES.

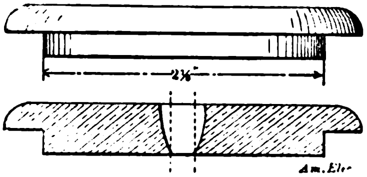


FIG. 5.—COVER.

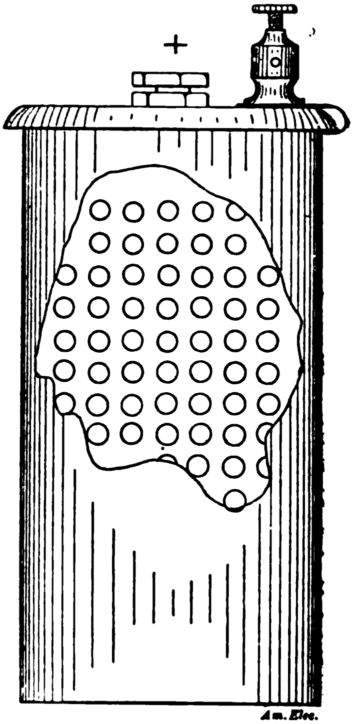


FIG. 6.—STORAGE CELL COMPLETE.

Next take the piece of ¼-in. lead wire, thread it through a countersunk hole in the centre of a wooden disc, 2 5-16ths ins. in diameter and ½ in. thick, beating a burr on the end of the lead wire which will fill the countersink in the wooden disc, as indicated in Fig. 2. This disc must be thoroughly boiled in paraffin. Then cut out ten lead discs, 2¼ ins. in diameter, and drill a hole ¼ in. in diameter in the centre of each disc. Flute the edges of each disc with a pair of pincers, so as to convert each one into a very shallow dish, as indicated by Fig. 3, and punch the bottoms of these dishes full of holes not over 3-16ths in. in diameter. Thread the first dish on the wire, letting it rest on the shoulder of the wooden disc, and fill it with a paste made of red lead and dilute sulphuric acid. Next thread another dish on the lead wire, taking care not to push it entirely down on top of the first dish, and fill it also with red lead paste.

It will be found a good plan to set two strips of rubber

snugly the interior diameter of the outer lead shell. If the cover is made of hard wood it must be boiled in paraffin. The hole in the centre of the cover, through which the lead wire passes, should be tapered, as indicated in Fig. 5, and filled with coal tar or pitch, so as to prevent the acid fumes from passing up through the hole and attacking the brass nuts on the outside.

The binding post should be of the wood-screw variety, and its screw should not be long enough to go entirely through the cover. The ear, 1 in. by 2 ins., shown in Fig. 1, is bent over on top of the cover, and the binding-post passed through the hole in the ear, the post being screwed down hard on the ear to form connection with the outer shell. The cover must have a vent hole about 1-16th in. in diameter, in order to allow the escape of liberated gases. Fig. 6 shows the cell with the outer shell and the litharge paste cut away to reveal the perforated inner shell.—*American Electrician.*

A Simple Working Model Locomotive.

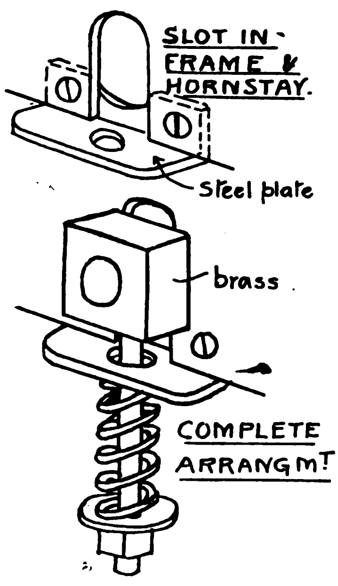
By H. Greenly.

(*Continued from page 108.*)

THE footplating, out of 1-16th in. brass plate, hammered out flat, should be cut out by drilling all round and cutting with a chisel, or by a fine jeweller's fret-saw, enough to allow the tops of the wheels to pass through, the steam and blast pipe, and the front end of oscillating cylinder to clear, and the open space for firebox.

On both sides, before fixing down, a clear centre line should be accurately scribed. This will considerably help in the fixing of the motion and other parts.

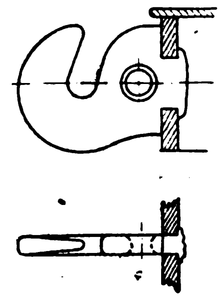
The buffers are shown to be in brass, without any spring arrangements; this, of course, may be altered by those who wish to improve their engine. Sufficient metal, if castings are used, should be left for holding it, although by far the best method would be to turn them out of 11-16ths in. brass rod. A length, enough for all the buffers, might be purchased, and the first two turned



up, while the other end is fast in a bell chuck; the remaining two might be centred and turned in the ordinary way. Of course, these remarks will not apply to the builder, who possesses a self-centreing chuck. The drawhooks should be correctly shaped—nothing looks worse than a model locomotive with badly shaped drawhooks—out of some iron or brass sheet, 3-32nds in. thick, with a shank about ¼ in. by 3 32nds in., so that it may enter the hole in the buffer plank, and be riveted without fear of its turning round at any time afterwards.

The chief difficulty in the construction of the locomotive has now to be described. The cylinders—or rather cylinder, as to save a large amount of close and accurate work only one is adopted—may be either slide-valve or oscillating. The latter presents much less trouble, and for so small an engine the steam distribution peculiar to the oscillating engine would make no difference. It is impossible to obtain lead and an early cut-off with an oscillating cylinder.

The arrangement shown on the general view and in detail on page 130 is capable of being reversed from the cab. This property, while making it possible to dispense with a regulator, as in the mid position of the lever steam is shut off from the steam distributing block, is considered by some as very desirable. It is, however, not really essential, as with a single-cylindered engine it is very often necessary to help the engine over the dead point with the hand, and while doing this a slip eccentric of a slide-valve cylinder may also be reversed.



Drawhook (Full Size).

For those who require a cylinder even simpler than the one shown, a steam block without a reversing cock may be used. Later in this article an alternative arrangement of cylinder will be described.

Returning to the construction of the model. It is very likely that many will be unable to bore and face the cylinder with sufficient accuracy, if at all, and therefore it will be necessary to get this done by a professional. The drawings of the cylinder, &c., are, for the benefit of the engineer, reproduced full size. The patterns should be made and the castings obtained. When the cylinder is bored and the cover-faces prepared, the cylinders can be placed upon an angle plate and packed up where required, so that the front of the sliding-face is accurately square with the centre line of the cylinder, and is laid in a way that when faced it shall be in a plane at right angles with transverse centre line.

A cut, as accurately as it can be accomplished with a hand tool, where a slide-rest is not forthcoming, should be taken across it, and in the centre a hole for the centre pin should be drilled. Also a recess should be sunk concentric with the pin, so that when grinding together only the part near the ports is in contact.

To face the covers and make the stuffing-box without a self-centring chuck and a slide-rest, a method lately adopted by the writer may be employed. The cover is bored with a hole the same size (or a trifle smaller is better, as in event of damage it can be broached out afterwards) than the piston-rod. A little piece of Stubb's steel, about ¼ in. diameter, is held in a bell or other improvised chuck, and turned down to a shoulder, and with a very slight taper, so that the cover will just drive up to the shoulder. Upon this the cover may be faced and afterwards turned round the other way to turn the front and bore the stuffing-box. The ordinary type of model-maker's screwed gland will not be easy for the builder with few tools to make, and the proper type, with screws or studs at the side to compress the packing, will not only be less difficult to make, but better. There are many objections to the screwed gland. The wing of the gland should be oval in shape. Four screws should be used to secure each of the covers, and the front cover, if the method of finishing here described used, may have he small hole in the centre stopped by a pin sweated in or by a screw.

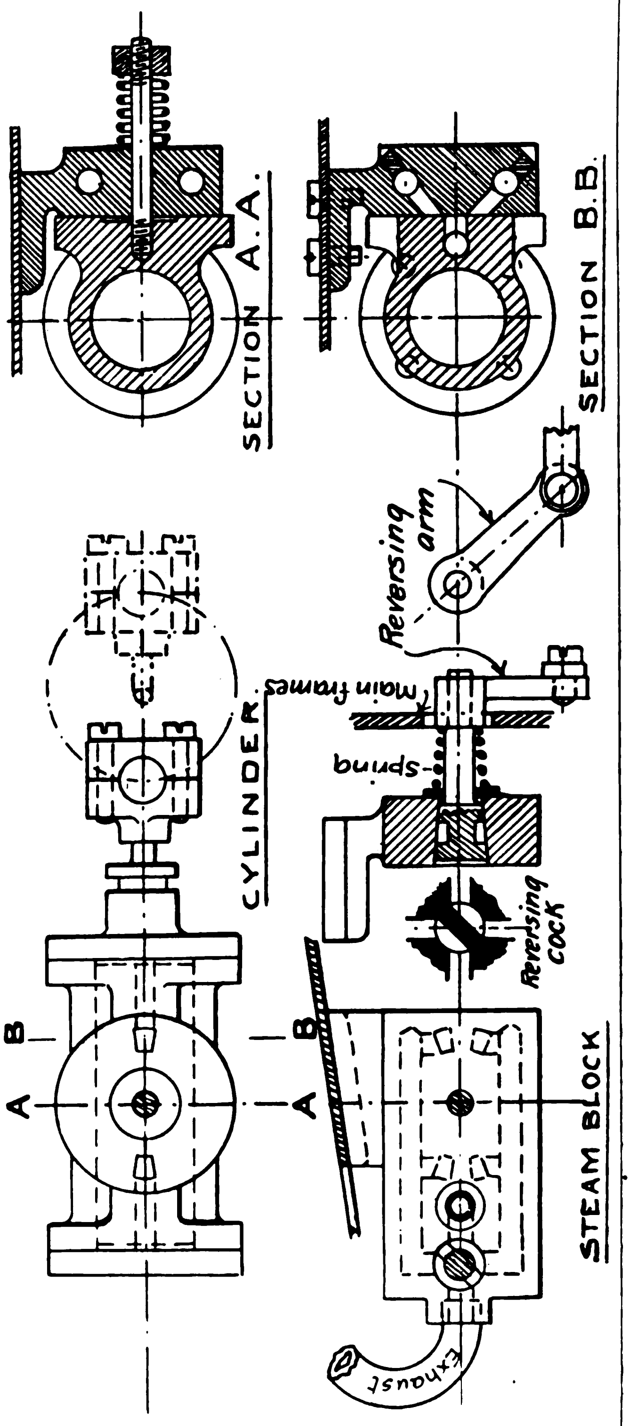
The piston should have a deep groove and be screwed to the piston-rod. The big end should be similarly screwed to the rod. The construction of this detail is evident to most model engineers, and does not need especial description.

A pattern should now be made for the steam block. It will be noticed that the block is fixed to the footplating, and that the face of the flange is in a different plane to the centre of the cylinder. This flange, ear, or lug should be attached to the footplate by four set screws. Care must be taken in filing up to make the block accurately to the drawings; if the fixing flange does not rake at the right angle, is too high or too low, the steam distribution in the cylinder will be affected. A centre line, coinciding with that of the cylinder, should be scribed along both sides of the block, and the centres of the various parts "centre popped." On the pattern a small boss should be provided for the steam pipe, which enters on the outside of the block just behind the reversing cock. The exhaust pipe is fixed to a boss in the front end of the block. To drill all the various passages, first take the 3-32nds-in. hole from the exhaust boss longitudinally in the centre line of the block, and let it extend only as far as the steam-pipe entry, which may be sunk from the back face of the block. In a parallel line to this passage above and below in the centre of the block, two more 3-32nds-in. holes should be drilled until they nearly come out at the back end. The first part of these holes will have to be plugged with a short pin of brass wire sweated in with soft solder.

On section A.A. is shown the arrangement of the pivoting of the cylinder. The spring and nut are to keep the cylinder face sufficiently tight up against the steam block to prevent escape of steam and yet not to arrest the swinging motion to any appreciable extent. The amateur should beware of using the type of oscillating cylinder which is held up by means of a screw pivot without an intervening spring. These generally result in either the cylinder and block being held together so that they only slide when considerable force is applied; or, on the other hand, if they run freely a considerable leakage of steam occurs.

Great attention must be paid to the steam ports of the cylinder and the block. The cylinder ports should be on the same radius as those of the block, and they should be slightly less in width—very slightly—than the distance between the upper and lower ports of the block. They should be two in number, as shown, and directly upon the longitudinal centre line of the cylinder.

The ports on the block should have a small hole drilled not more than 1-16th in. deep—in fact, only a mere sinking—and then be chipped to the shape indicated with a fine chisel. To connect the ports with the passages already drilled, holes should be drilled down to meet them diagonally from the back. To start the drill fairly, the corner of the block at the point where the drill enters should be filed off at right-angles to the holes, as shown in section B.B. The holes will have to be stopped with a small plug at the entering point. Of course, the holes could be drilled from the port face, but this method might result in damage to the shape of the ports.



Cylinders for Simple Model Locomotive (Full Size).

Crossing that drilled from the exhaust pipe boss a hole 3-32nds in. diameter should be drilled vertically from either the top or the bottom connecting the two long passages to the ports. Having arranged all the passages and rimered out the holes for the steam and exhaust pipes, the reversing cock should be made. This is the most difficult detail in the construction of the block. Special tools should be made which will practically rimer out the hole for the plug to the correct coning. When this is accomplished—if attempted by the beginner at all—the plug of the cock should be made to fit and ground in whilst solid. When a sufficiently good fit has been obtained, two slots should be cut in it, parallel to each other, and the same width as the passages, cutting away the plug until only a parallel strip of its section, 3-32nds in. in thickness, remains. The larger end of the plug should be filed so that it is below the port face of the block, and the other end reduced, as shown; a washer and a spring should be used between the block and the reversing arm —which is placed outside the frames—so that the plug is always kept pressing itself into the conical seating.

(To be continued.)

INTEREST has again been stimulated, says the *Electrical World*, by the exhibit of a complete cell of the Edison nickle-steel storage battery. The cell was 12 ins. high, 2 ins. thick, 5 ins. wide, and weighed 7½ lbs., giving 120 watt-hours, or 46 lbs. per horse-power-hour. The cell was also shown in its detail parts, and the steel plates excited much comment and surprise, being in sharp contrast to the familiar ones of lead. It is stated that the manufacture of batteries were to begin with the new year. When interviewed on the subject, Mr. Edison expressed himself with the firmest conviction as to the real success he has attained in the new battery. As to the cost of the cell, Mr. Edison proposes to market it somewhere around the present cost of lead batteries. So far as can be ascertained, the type of cell noted above is the standard. It would appear that for stationary work far larger grids can be used; indeed, there is said to be no valid reason why they should not be 10 ft. high, or even as big as the side of a house.

Motor Cycles and How to Construct Them.

By T. H. HAWLEY.

(Continued from page 110.)

XVIII.—THE QUADRICYCLE.

THE quadricycle, as its name implies, is a four-wheeled vehicle and for two riders, the occupant of the front seat being a mere passenger, and having no part in the management of the machine, the driving, steering, and all other manipulations being performed by the occupier of the cycle saddle form of rear seat.

In many ways the quadricycle is a delightful little machine, and it is to be regretted that at the present time it should have lost some measure of popularity, though why this is so is easily explainable and capable of being remedied. It has many advantages over the tricycle, and may be constructed so as to be convertible into that machine in a very little time. In the first place, the tricycle has three tracks and three separate road resistances to overcome, whilst the quadricycle has two only; then there is greater space for the addition of such items as a reserve petrol tank, a larger sized carburettor, and increased luggage carrying capacity, added to which is the pleasure of society; indeed, except that the occupants do not sit side by side, the quadricycle offers all the advantages of the small voiturette and costs less, with the further gain that wind resistance is lessened.

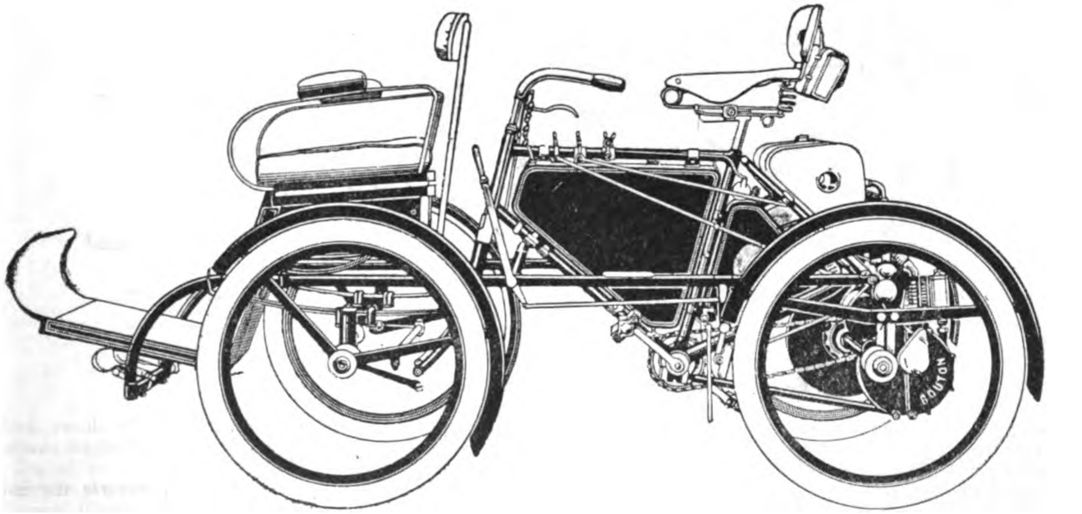


FIG. 82.—EADIE MANUFACTURING COMPANY'S CONVERTIBLE MACHINE.

Now for the disadvantages of the quadricycle. Where the machine is not fitted with a free engine clutch, the additional weight of a second person tells heavily on the driver in starting the machine by the pedals, especially on rising ground or when the engine does not "catch on" quickly; then the earlier machines were under-engined and lacked power in hill-climbing, so that frequent dismounts became necessary and much pushing power had to be exercised over even average country; in fact, the quadricycle started life under a very great disadvantage, for the double machine was equipped with the same motor as the tricycle, which was at the time fitted with 1½ to 1¾ h.-p., and it is chiefly this lack of power in the earlier models which is the cause of unpopularity to-day.

With a motor of 2 to 2¾ h. p., however, very good trips at high speeds may be made, and if the average country on which it is to be used is of a particularly hilly character, it is simply necessary to fit a smaller pinion on the engine shaft, thus gearing it down.

The greatest advance in the present day type of quadricycle is the fitting of a water-cooled combustion chamber and a free engine clutch (two speed gears have also been fitted, but are not commonly voted a success, on account of the overheating when the engine is making an extra number of revolutions in combination with extra effort when on the low gear), so that the machine may be started anywhere, even up a steep hill. Still, these two items mean a considerable increase in cost, and some complication in the fittings by reason of the space occupied by the necessary water-cooling tank.

In the design to be described, I do not intend incorporating either of the refinements named, but will briefly describe them separately, as either one or both may be added to existing machines without structural alteration of the machine proper. As to the convertible form of quadricycle, I am not greatly impressed with its utility, not that it is impracticable; but that experience teaches that few owners care to go to the trouble of making the change, unless for an extended period, and as convertibility can be arranged only by some sacrifice of rigidity and increase of weight, I consider the non-convertible form preferable.

The design of the quadricycle differs but little from that of the tricycle, except in the fore carriage, being arranged with two wheels carrying the extra seat, and some modification in the framing; but the whole of the component parts described for the tricycle will remain exactly the same as regards the rear portion of the carriage, thus the same balance-geared axle, wheels, motor, coil, silencer, battery, and carburettor are employed, and as the variation or added mechanism is of a simple and easily understood nature, I shall not enter into minute details of every small part, feeling sure that any maker who could succeed in the building of the complete tricycle, would readily adapt the design to the quadricycle with the assistance of general outline drawings.

Turning back to the construction of the bridged axle, as described in Chapter iii, and referring to Fig. 11, which is a dimensioned plan view of the bridge, with lugs for balance axle in position, two outer lugs or sockets are shown, which have no part in the construction of the tricycle, and these large lugs carry the two extra outer horizontal tubes, which are the chief addition to the tricycle frame, in order to turn it into a quadricycle, but with the exception of those two additional sockets, the whole of the bridged axle and balance gear will remain as described.

As already suggested, I do not propose to describe the construction of a convertible machine, but, in order to illustrate that type, I present what is probably the best form of convertible in Fig. 82, which represents the Eadie Manufacturing Company's model, as fitted with genuine De Dion engine, the whole of the rear portion and the centre frame being practically as described in these articles, the front forks alone differing, the long horizontal side tubes mentioned being clearly shown, and in this case (the convertible) being attached to the axle bridge tube by clips.

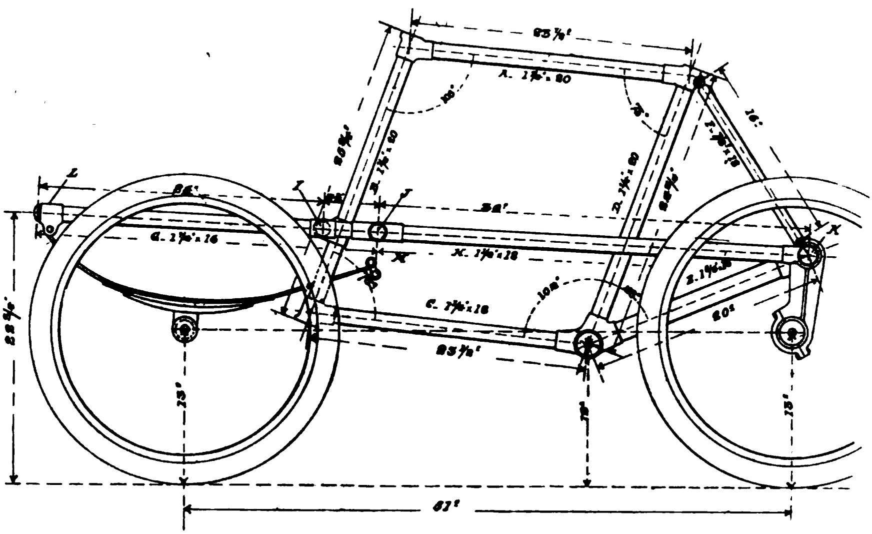


FIG. 83.—SIDE VIEW OF MOTOR QUADRICYCLE FRAMING.

These tubes, it will be observed, traverse the entire length of the frame from the back axle to well forward of the front wheels, curving downward at the forward end to form a support to the footboard of the front seat, the seat being attached to these tubes by four clips, and immediately over the front axles.

The front portion of the tricycle frame is supported on these outer tubes by two struts clipped just below the head of the tricycle frame on the bottom tube or diagonal, the tricycle front wheel being simply removed, and the front fork ends coupled to the connecting-rod of the steering gear. The lever seen at the side of the machine is for operating the brakes, but in a recent pattern this lever is replaced by a foot pedal or platform mounted on a rocking shaft operating the brake connecting-rods.

In the non convertible form of quadricycle the general arrangement is much the same as the above, except that the tricycle front forks are dispensed with, and in their place the steering head or frame socket is extended in length sufficiently to bring the lower ball race down to the level of the connection to steering gear, the bottom member or down tube of the centre frame being about parallel with the top tube, thus necessitating the employment of a special bottom bracket outer shell, with the bottom forward lug at a different angle to that given for the tricycle, and the forward end of the centre frame being supported on the horizontal side tubes by a transverse tube brazed up by sockets to each side tube and to the head tube.

The method of procedure in building the frame of this machine will be much the same as in the tricycle; the bridge work and balance-gear axle being completed for a starting point, then the main framing which will finally be joined to the bridge piece, and the two side tubes, though as the work proceeds it will be necessary to look well in advance, lest some portion be brazed up prematurely, and a lug or socket be omitted or a difficult job involved.

Fig. 83 shows the general arrangement of the quadricycle frame, side view, and Fig. 84 is a plan or top view of same; dimensions are marked in English inches, as designs for both seat and spring work in the next chapter, together with the arrangement of the steering gear.

It will be a great advantage in the workshop if full-sized working drawings of Figs. 83 and 84 can be made, and I have figured the same fully so that there will be no difficulty in enlarging from them. The whole of the angles given for the frame sockets correspond to the excellent fittings manufactured by the Eadie Manufacturing Company, of Redditch, though several of the tube lengths and other dimensions are varied; but anyone undertaking the construction of this machine would be well advised to procure the full set of frame lugs and all the hardened bearing parts, together with the bracket clutch and the balance-gear axle, from one of Messrs. Eadie's numerous agents.

The constructional detail of the balance-axle and bridge was fully dealt with in the tricycle articles, and remains exactly the same with the exception of the addition of the two sockets O, P, connecting tubes H, H, with the bridge tube K (Fig. 83), so that it may be passed without further comment.

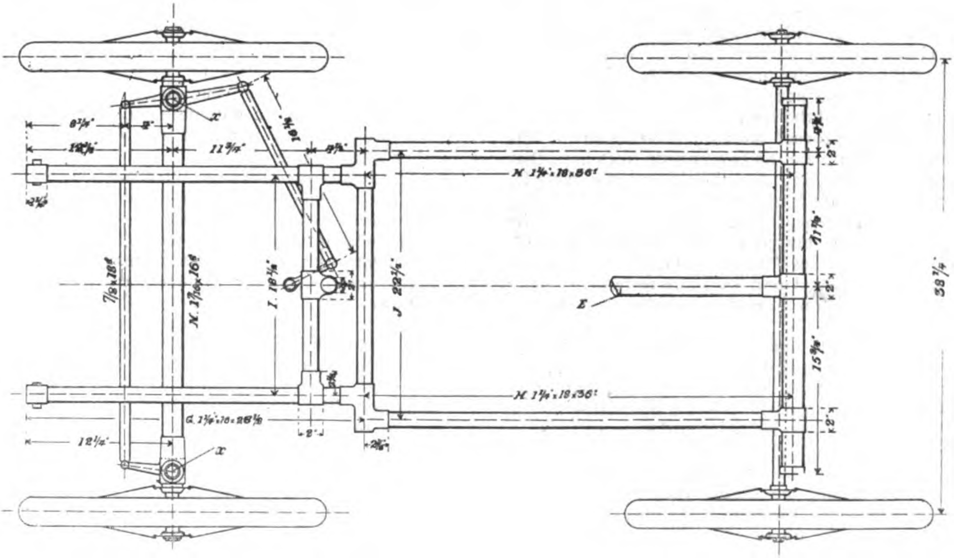


FIG. 84.—PLAN OF MOTOR QUADRICYLF FRAMING.

the fittings which will correspond to this design are English make, and following the plan adopted for the tricycle, I have carefully avoided incorporating anything in the design which would set up difficulties in procuring parts which it would be impossible or impracticable for the amateur to make, although I have not adhered slavishly to any design in certain respects, and consider such variations as have been made in the design presented to be distinct improvements, and the result of actual driving experience.

The wheel base is somewhat longer than usual, gained by lengthening the portion of the frame forward of the steering socket, thus permitting of the fitting of a deeper and more comfortable front seat, and adding to the elasticity of the springs. Some of the frame tubes are also marked of stouter gauge than usual, as instances are known of the frame twisting under the exceptional stress to which it is subject at high speeds over rough roads, as it is impossible to so spring a frame of this class so that the springs shall absorb all the lift due to the movement of any one wheel or pair of wheels. I have not shown the seat in the present drawing, but shall offer alternative

The next job will be to build up the centre portion of the frame, consisting of the tubes A, B, C, D, not forgetting to slip the lug Q (which connects the cross member I to the steering post B) loosely over the centre of tube B before brazing up the top socket. The tube E may then be brazed up to the axle bridge, and every care must be taken to prove it truly at a right-angle to the driving axle, preferably by a straight-edge from the large gunmetal gear wheel bolted to the differential gear.

This accomplished, the whole of the front frame, if tested and proved true, may be brazed up to tube E, first double pinning it in position, so that the frame maintains the straight line of tube E, and also stands perfectly true in the vertical direction in relation to the driving axle. From this point the frame becomes somewhat unwieldy in the brazing operation, and great care will have to be exercised in placing it on the brazing hearth to guard against warping the tube where it is hot, the safest plan being to support the frame at four corners or extremity points quite clear of the brazing hearth and at such height as will bring the joint to the most convenient point for arranging the coke or asbestos fuel in such a manner that a good backing is formed for the flame of the blowpipe. Another factor of importance is that the joint must be brazed without turning over the frame, and these large diameter, heavy gauge tubes require considerable heating to raise the under portion to brazing-point without burning the top; thus, there is scope for skilled judgment in arranging the fuel, and for this particular class of joint coke which has once been heated to redness to drive off the sulphur is perhaps preferable to asbestos, as it is hotter. One or two slabs of firebrick should form a background, and the coke at first so arranged around the joint that the blowpipe flame may be deflected to the underneath side of the joint, this action being continued until the socket shows dull red, by which time there will be a hot coke fire which may be re-arranged so as to expose the upper face of the joint to the blowpipe, whilst the coke keeps the underpart hot. By this method the spelter may be seen to flow directly into two-thirds of the circumference of the joint, when a little more bottom heat will complete the job.

The brazing up of the outer frame tubes G, H, I, J, must be approached with care as to the order in which the joints are brazed. It will be seen that the forward end side tube G is two sizes stouter than the rear side tube H; this to stiffen the front unsupported portion with no cross-stay and no side support except what is derived from the attachment of the seat.

The best way to proceed with the brazing up of this outer frame is to complete the two outside lines first, that is, brazing the tubes G, H, up to the three-way sockets R, first passing the sockets S over the end of G, but leaving them loose for the present; the lugs L, which connect to the springs, may next be brazed to the forward end of G, when the two side pieces formed by G, R, and H, must be filed up and finished and carefully tested for being in a straight line and true to each other when laid side by side.

The cross tube I will now be passed into the socket Q, which is loose on the steering post of the machine, and now bringing the whole structure together, the other cross tube J may be placed into position by closing up the two sides, the sockets S, S, being slipped forward to allow clearance for the rear end of the tubes H; all being tapped up into position with the hide hammer, and the measurements checked, we should then have to merely push the outer frame backward into the lugs O, P, on the axle bridge to bring the frame together, the lugs O, P, Q, S, still being loose and unbrazed.

The next thing to be done is to pack up the forward end of the frame tubes G, G, to 32¼ ins. from the ground level, the rear portion, of course, being packed up to the equivalent of a 26-in. wheel, so that the position of the lug Q, on B and I may be determined, and when this is found, a scribing mark should be made on B; then the lug Q is similarly set exactly in the centre of I and also scribed; or when found, it is even better to drill and pin those positions, but leaving the pins so that they may be withdrawn. With reference to the position of the lug Q, on B, it will be seen that varying the position will merely have the effect of altering the pitch of the entire frame in relation to the ground line, so that by raising the lug the frame would come out more approaching the horizontal top tube, bringing the bracket nearer the ground, and decreasing the rake of the steering and seat post. But although I have shown the front end of the frame higher than it is usually built, I had reasons for doing so—first, it raises the front end of the top bar, and so brings the manipulation levers somewhat nearer to the rider's hand; secondly, the extra rake of the steering column affords more room for the back of the front seat, and adds to the comfort by the increased rake of the seat back, which for appearance sake should be in line with the steering post.

At this juncture of the proceedings a complete testing of the true alignment of the whole structure should be made, and when passed as satisfactory, pins should be passed through the sockets O, P, into the bridge tube, and also into H, H, and the remaining sockets S, S may be pinned to I, sockets R, R being immaterial, as the frame is now held up to position in all directions, though it will be well to put a temporary stay between the forward ends of the tubes G, G, when the whole of the loose joints are ready for brazing. The complete frame will now be packed up to the brazing hearth, as previously described, and should be again tested when in this position for twisting, which is easily done by laying straight edges across the frame near the ends of G and H, and sighting them, this sighting taking place each time the frame is moved, and between the brazing of each joint, the joints being brazed in the following order:—R, R, O, P, then Q to B and I, and finally S, S, to G, G, the object in leaving these to the last being that end movement of the tube I, and the sockets S, S, along G, G, will allow for the expansive effect when brazing Q to B, and for which operation the pins should be drawn from S, S, otherwise the steering-post B, being of lighter tube, would surely be deflected from the straight line. For a similar reason the tube I should not bear hard up against the tubes G, G, inside the sockets S, S, but should be dressed up some ⅛ in. shorter, to accommodate end movement of expansion, the pin being removed from one socket whilst the other is being brazed.

The small space between the sockets S, R, on the tube G, must not be decreased, or it will be impossible to get the ends of H into the sockets O, P, under the method of assembling we have adopted. There are other ways and means of assembling which may suit particular circumstances better, but I think the one suggested is, at any rate, best for the amateur worker.

If any setting should be necessary, it must be taken in hand immediately the fault is discovered, and before brazing another joint, as each joint brazed greatly interferes with any after correction of the frame, and the completed structure will be practically immovable, with the exception of the free ends of G, G.

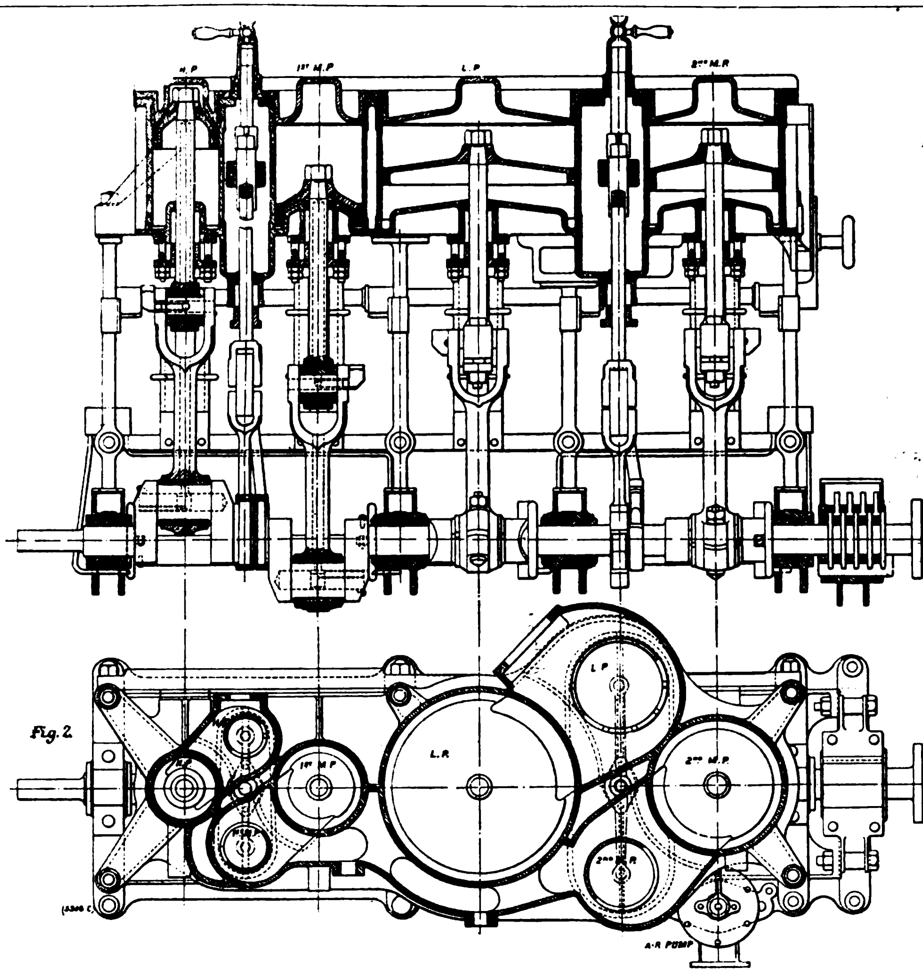
(To be continued.)

USE turpentine instead of oil when drilling hard steel. It will then drill readily, when oil would be of no effect —*Shop Talk.*

* * *

THE Second General Meeting of the Aeronautical Institute and Club was held on Saturday, February 8th, at the Society of Arts, Adelphi, W.C., the Chair being taken at 8 p.m., by Mr. C. H. M. A. Alderson. The provisional rules were read and adopted with certain amendments. The election of Officers and Committee for 1902 was then proceeded with, the following gentlemen accepting office:—Vice Presidents: P. L. Senecal (Founder) Chelsea; H. Middleton, Brighton. Committee: C. H. M. A. Alderson, Farnborough, Kent; Lewis Wells Broadwell, London; E. C. Dwyer, London; Aug. Le Gaudron, London; R. Mo. Nair, London; and Ed. Mote, London. Hon. Secretaries: H. E. Holtorp (Editorial); and O. C. Field (General). At the conclusion of the meeting the Chairman made a few remarks dealing with the scope of the Society and the frequent meetings which were called for by the rules. The Institute had been formed with the intention of initiating an exhaustive research into all matters in any way connected with Aeronautics, and with a view of giving publicity and financial aid to inventors who should be Members or Associates, and whose designs might warrant such encouragement. A hearty vote of thanks was passed to Mr. Alderson for presiding, and the meeting dispersed.

Engine and Boiler for a Fast Steam Launch.



FIGS. 1 AND 2.—QUADRUPLE-EXPANSION ENGINE FOR FAST STEAM LAUNCH.

VERY few people outside the technical circle have the least idea of the enormous amount of work which has to be done to drive even a moderate-sized launch at a high speed through the water. Those unacquainted with the complex machinery are surprised that so few vessels of the same type are afloat. We are glad, therefore, to be able to reproduce some particulars of a successful set of engine and boiler, together with photographs of the 30 ft. launch in which they are fitted, as designed and built by Messrs. Simpson, Strickland & Co., whose reputation for that class of work is of the highest. Most of the particulars are reproduced from our esteemed contemporary *Engineering*, the photographs having been kindly supplied by Messrs. Simpson, Strickland & Co. We have little doubt that these details will prove at least interesting to our readers, while some will doubtless find them very useful.

The engine set, which is shown in the accompanying illustrations, is a Cross patent four-crank quadruple expansion engine and water-tube boiler of the Thornycroft-Cross type. The engine has cylinders 3¼ ins., 5 ins., 7½ ins., and 11 ins. in diameter, by 4½ ins. stroke. With a working pressure of 375 lbs., and running at 1,200 revolutions, it gives 140 indicated horse-power.

One interesting feature is that the engine is fitted with Cross's patent valve gear, shown clearly in the sections of the engine (Figs. 1 and 3). It consists of two eccentrics and a link of the usual type; but the valve spindle has a yoke, from which two piston valves are carried. These work in liners and have a common steam chest, one taking steam on the outside and the other on the inside of the valve. The valve spindle is guided by a dummy-gland, and the valves can find their own centres. Thus, two sets of valve gear only are needed for the four cylinders, and as the valves are at the side of the cylinders, much less fore and-aft space is taken up. The crankshaft has balance weights, but the valves are all exactly balanced, and the pistons are of equal weight. Centrifugal oiling gear is fitted throughout the crankshaft, as shown in detail by Fig. 4.

The piston-rods and connecting rods are of nickel-steel; the second intermediate crosshead has a forged arm projecting in front and working the air pump. The engine is built entirely on the columns. Combined drain and relief cocks are fitted to the top and bottom of the

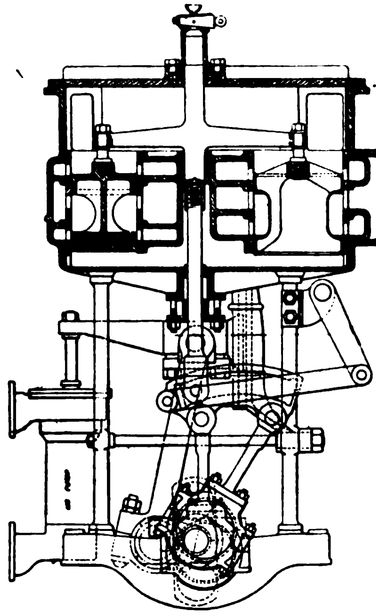


FIG. 3.

cylinders. The engine has ample bearing surfaces, the main bearings being white metal. The engine occupies a space of 4 ft. by 2 ft. 2 ins., and is 27 ins. high from the bearers. Its weight is 7 cwt.

The casting of the cylinders for this engine is of a very intricate nature, having receiver belts throughout. Forty-six core boxes are required for its construction, and it is ¼ in. thick; its weight is 2 cwt. 1 qr. The boiler, lagged like the engine in polished aluminium, of the Thornycroft small-tube type, as modified by Messrs. Simpson, Strickland & Co., is shown by Figs. 5 and 6. It is fitted with solid-drawn steel tubes. The circulation is from a small lower drum, through the tubes, into a big top drum, and down the down-takes. It has water-walls on each side. The boiler has been tested to a pressure

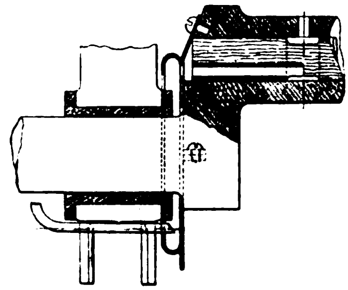
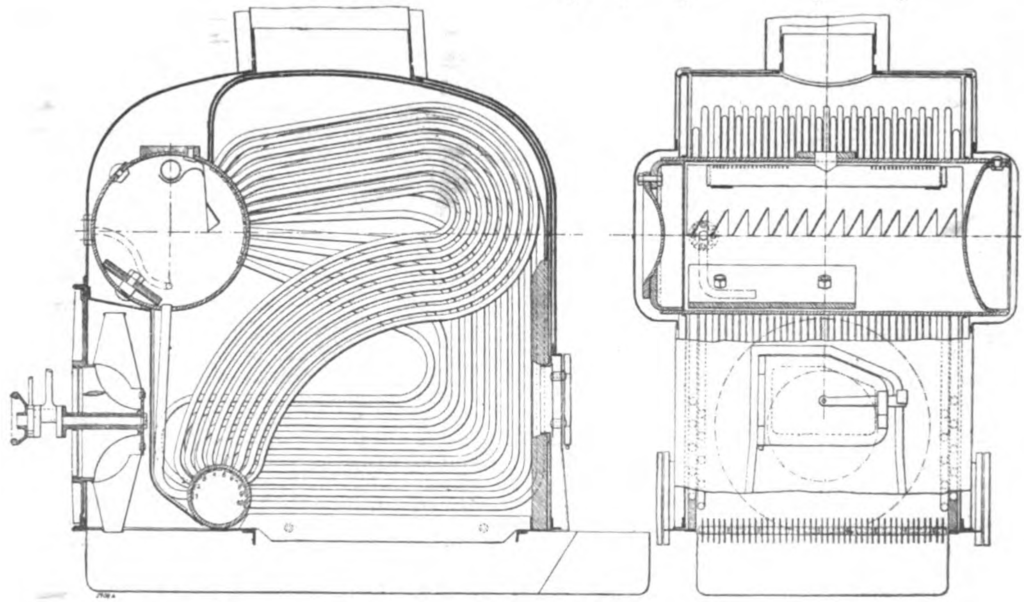
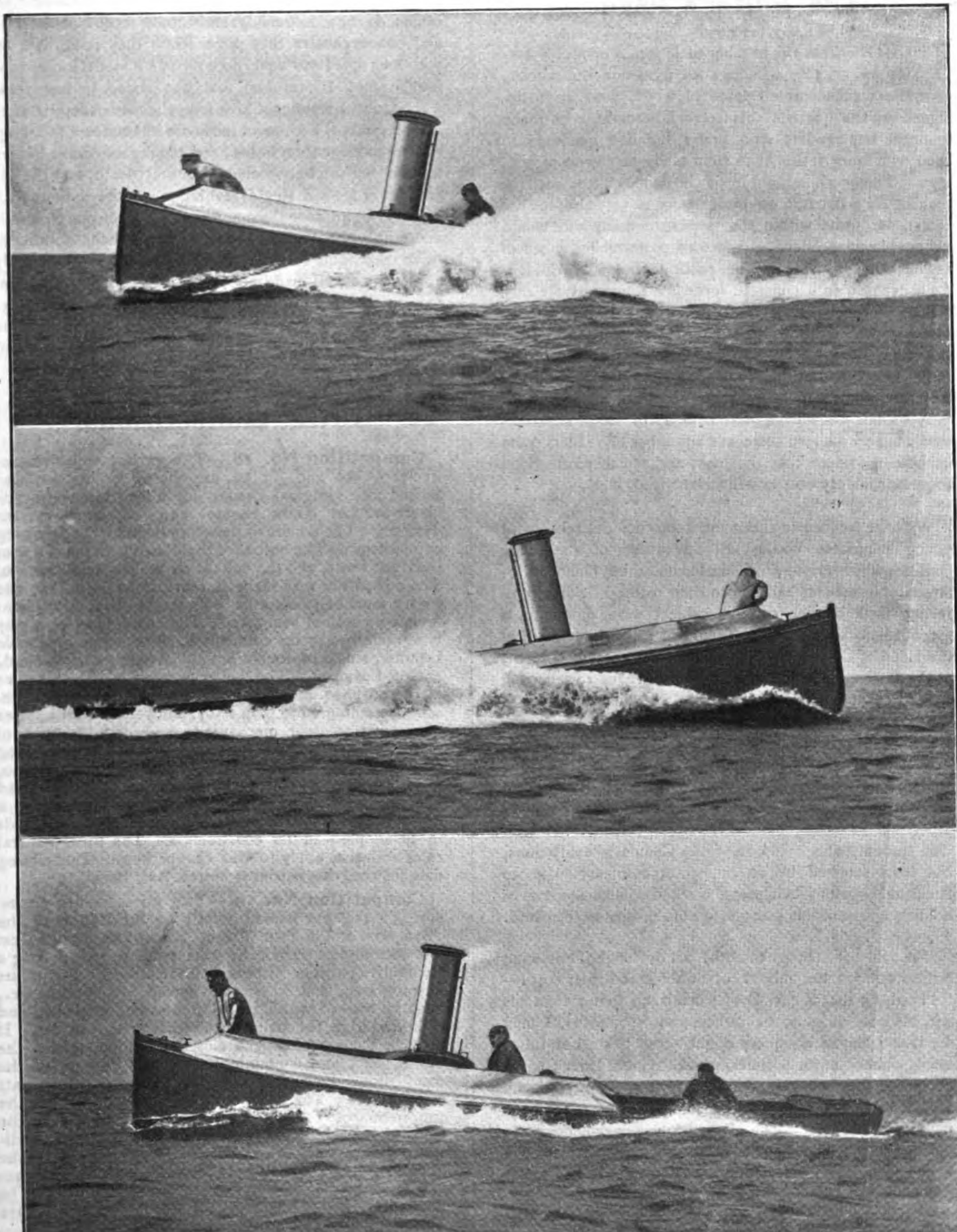


FIG. 4.—CENTRIFUGAL OILING GEAR FOR CRANKSHAFT.

of 750 lbs. The working pressure is 375 lbs., and the forced draught is maintained by a fan, 14 ins. in diameter, inside the casing. The ash-pan is closed in, and the draught reaches the fire from under the fire-bars. A lever opening and shutting the fan shutters is so arranged as to prevent the forced draught being on when the fire door is opened. A separate engine with a 1¼-in. diameter cylinder, and a piston valve with a spring valve spindle, works the fan at 3000 revolutions, and, if required, will give 2 ins. to 3 ins. of pressure. Two of Klinger's water gauges are carried off distance pieces from the big drum, and a double Schaffer and Budenburg pressure gauge is fitted. A branch fitting carries the main stop valve and all the auxiliary steam valves. The total dry weight of the boiler and fan gear is 13 cwt.



FIGS. 5 AND 6.—BOILER FOR 30 FT. FAST STEAM LAUNCH.



A FAST STEAM LAUNCH BUILT BY MESSRS. SIMPSON, STRICKLAND & CO.

The photographs show the launch running at the following speeds :—(1) 18½ knots ; (2) 15 knots ; (3) 12 knots.

(For description see page 135.)

The Editor's Page.

JUDGING from the number of letters we receive asking for suitable windings for dynamos and motors, the mechanical elements of which have been designed by the querists themselves, there must be many amongst our readers who prefer building machines to their own fancy rather than from ready-made sets of castings. This is probably due to the fact that the pattern-making for a dynamo or motor is of a very simple character, and quite within the powers of many who would be unable to produce satisfactory patterns for a set of engine castings. Hence the putting of one's own ideas for a dynamo into concrete form is a comparatively easy task. We feel disposed to encourage this tendency towards originality amongst our electrical readers, by offering a prize for the best design for a small electric motor (see Competition No. 21) to fill certain conditions. The preparation of a satisfactory design, of course, involves a fair knowledge of the theory of motor construction; but we believe there are a number of readers quite capable of undertaking the task, and we therefore hope some satisfactory entries will be received.

* * *

We have frequently commented on the desirability of young engineers taking full advantage of the many facilities which are now offered for obtaining technical instruction in matters relating to their calling. Some interesting facts bearing on this subject were quoted in a recent report issued by the Technical Education Board of the London County Council. One engineering student, at the Borough Polytechnic, had his wages raised from 25s. to 45s. per week, as the result of his attendance at the Polytechnic classes, while twelve students of the Regent Street Polytechnic have obtained appointments as managers or as assistant managers in various firms; one student has obtained a situation as chief electrician in an electrical construction company, and another has obtained a position as head engineer at a large firm of printers. One student, who held one of the Council's exhibitions, has been selected by an important company to go to America to study American methods, with a view to holding a responsible position on his return to England.

* * *

"A. S. L." (Bournemouth) sends us the following further note on the subject of hobbies and their cost:— "Premising that if 'A. D.s' work is no better than his wit, his models must be rather poor specimens, I may say that I hoped my query might serve to start an interesting discussion on hobbies, generally, and their cost as compared one with another. Speaking for myself, my first model was a horizontal engine with an eccentric working a four-way cock. It had a proper crosshead and guides, and not merely a piston-rod poked through a stuffing-box, as in many present-day models. The boiler (horizontal) had an internal flue and firegrate, with charcoal as fuel. That was well over fifty years ago, and between that time and this I have had a great many hobbies—mechanical, electrical, optical, and miscellaneous, so I am not quite a novice at riding them. Now, what I found in my own case, and have observed in others, is how extremely short-lived most hobbies are, and how expensive they prove while they last. Not so very long ago I saw advertised for sale a model locomotive (large scale, I presume) that was stated to have cost £1000, and I wondered how long the owner kept it after he had got it. I know of instances of amateurs fitting up engines to drive their lathes, and buying expensive boilers to suit; but the hobby died a natural death, and the engine never gave a single revolution to the mandrel. I could also instance locomotives that never ran on a rail, and rails without a locomotive; dynamos with nothing to drive them, and so on, and so forth. I can thoroughly appreciate a well-made model, but I feel sorry to see them so soon consigned to the second-hand dealer after a brief period of glory in a glass case. Who shall reckon the time, trouble, skill, and expense, that have been lavished on the poor derelicts?"

Prize Competitions.

Competition No. 18.—Two prizes, value respectively, £5 5s. and £3 3s., are offered for the best and second best original designs for a small modern type direct-coupled steam engine and continuous-current dynamo. The donors of these prizes make the following stipulations:—The output of the dynamo to be not less than 500 watts, and the voltage to be not less than 50. The competitor may make it more if he likes, but due regard must be paid to the tools at the disposal of amateurs who are not beginners. The engine may be of any type preferred by the competitor, either single or double cylinder, single or double acting, simple or compound, enclosed or open. The boiler pressure is to be taken as 60 lbs. on the sq. inch. A design is required that will represent something more than a toy, and yet within the power of a good amateur mechanic to build, and capable of giving satisfaction when made. Complete scale working drawings, with dimensions of both engine and dynamo, must be given, as well as all necessary mechanical and electrical calculations. There should, in addition, be a full written description of the set, explaining the methods to be adopted in its construction. The usual general rules will also apply to this Competition. The closing date for receiving entries is March 31st, 1902.

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. 20.—Closing date for this competition, March 15th. For full particulars see the last issue of THE MODEL ENGINEER.

Competition No. 21.—A prize of the value of £2 2s is offered for the best description and drawings of a small electro-motor, to work from continuous current supply mains at 60, 100, 110, 200, or 220 volts. The output of the machine should be about 1-10th h.-p. actual, suitable for working light machinery, a fan, or sewing machine, without heating. The particulars should include a description of the method of making patterns for all parts required to be cast, the best way to machine the parts, the construction and winding of the armature, and suitable windings for each of the voltages mentioned above. The article should also include details of the starting and controlling mechanism. The type of machine is left to the competitor's discretion, but due regard should be paid to simplicity, economy and safety in running. The drawings should show all details separately and clearly, as well as general arrangements where necessary. To ensure accuracy and clearness, it is desirable that all details, at all events, be drawn full size. The usual general conditions (see below) apply to this Competition. The closing date for receiving entries is June 15th.

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.

Answers to Correspondents.

"W. H. G."—It is not easy to gather from your letter how much information you require. If you want to understand the subject from the beginning, you must study a text-book. You do not send us your address, so we are unable to write you direct, and the question you put is not of sufficient general interest to justify our finding space for it in The Model Engineer.

"T. W." (Barnsley).—Thanks for your note. We are glad to hear of your success, which tallies with dozens of other readers' attempts.

"E. L." (Ohio, U.S.A.).—We do not quite understand what you want. If you consult our advertisement pages, you will find addresses of numerous firms who make model steam engines. We do not know of anyone who sells a model sight-feed lubricator.

"W. G. B." (Waltham Abbey).—Thanks for your letter. The subject has received our consideration, and an article may be published in the course of time. The engines are not so easy to construct as you may imagine.

"M. G." (Swalwell).—Your question is not quite clear. For prices and particulars of such appliances apply to any large tool dealer.

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.*]

Keels of Model Yachts.

To the Editor of *The Model Engineer.*

Dear Sir,—As "Silver Star" has attacked the double fin (see January 1st issue, 1902), may I say something in its defence? It is said that there is a continual wash through the gap, which stops the boat. When this wash occurs—and I have often noticed it—the reason is that the boat is making considerable leeway. The leeway is due, not to the fact that there are two fins, but to an insufficient area of fin to give proper lateral resistance, or more commonly is the result of too great an angle of heel, so that the fins are not vertical enough to give good lateral grip. There is just as much wash round the edges of a single fin when the boat is hard pressed and being forced sideways. A double fin boat is no more liable to leeway than any other, if the fins are large enough to hold the water properly. So far as I can see from the picture to which he refers, which in my copy is indistinct, I should think that the fins might be wider with advantage. The narrow, dagger-shaped plate works very well in a boat like the old 1-rater *Sorceress*, because the live ballast can keep it perfectly upright; but in a model, which must be designed to sail at a considerable angle of heel, the lateral area must be greater.

Another charge laid against the double fin is that it decreases stability. How this can be, I am at a loss to understand. Stability depends on the depth of the centre of gravity and the form of the mid-ship section, and has nothing to do with the outline shape of the keel or fin. A boat would be just as stiff if the bulb were supended on two or three rigid wires. Such a boat would be more apt to roll in choppy water when the wind was too light to keep the sails full, because there would be no lateral plane to check such movement by doing the work of bilge keel on a steamer; but to stop jerky motion of this kind, two fins are just as good as one, if of the same area. Stiffness under sail, however, in a fresh breeze is a different thing altogether. If the pressure of the water on the fin were to make the boat stiffer, as is suggested, the pressure would have to be on the weather or upper surface when the boat is heeled; whereas the pressure is, of course, on the lee or under side, being the lateral resistance of the water, and its tendency is to heel the boat still more and not to bring her upright.

A racing yacht must be designed so that she will turn very easily, and a deep short fin or centre-plate amidships, as in the 24-footer *Speedwell* or *Sorceress*, renders the boat very quick on her helm. Precisely the opposite is required of a model, which must sail in a straight line; every obstacle must be placed in the way of a turning movement. Plenty of lateral resistanee should therefore be put near the ends of the water-line; the further from the centre the flat surfaces, the steadier the boat will sail. Now a single fin, reaching nearly to the ends of the water-line and deep enough to provide a good leverage to the bulb, will have a very large wetted surface, a good deal of which is doing no useful work, but is causing unnecessary surface friction and diminishing the speed very much. If, therefore, a large piece be removed from the centre of the fin, and its weight added to the bulk, the boat gains both in speed and power. The double fin enables the model to carry her lead low without detracting from her speed by a large increase of that great factor of resistance, surface friction; and it is just for this reason that the cutaway ends and deep fin-keel of the *Shamrock* type is such an advance on the old straight-stemmed straight-keeled craft like the *Arrow*. The increased resistance of two cutting-edges instead of one is inconsiderable if the edges are made sharp—an easy matter with thin metal fins. So far as experience goes, I have made several boats of both types, and have found those with double fins faster, steadier, and more powerful. Of course, I do not attribute this entirely to the double fin, but I believe it is one cause of their superiority.

In so complex a matter as yacht designing there always has been wide divergence of opinion; so I wish to assure "Silver Star" that I write simply in a spirit of friendly discussion.—Yours truly, A. V. Prior.

Harrow.

Travellers for Model Yachts.

To the Editor of *The Model Engineer*.

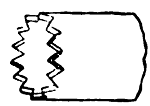
Dear Sir,—I see that Mr. Wilson Theobald, in his article on "Spars," brings into use a traveller—why? It is a useless piece of goods—why not pass the halyard through the mast and tie it to the yard? By this means the sail not only sets better, but you can alter the peak. This is a great convenience in rough weather, as the tendency to drag the boom in models is great, which incurs loss of speed, and broaching most probably, or, in other words, gybing, and coming back to the starting-point.

Even in open racing boats up to 20 ft., when using lugs and racing canvas the traveller is discarded, so why should the model have such a useless piece of gear?—Yours truly, "Silver Star."

Blackburn.

A Brick Boring Tool.

A very good and inexpensive tool for boring in brick, lime or sandstone can be made in a few minutes' time by taking a piece of wrought-iron gas pipe about 10 ins. long and ½ in. or ¾ in. in diameter. With a three-cornered file, cut a number of teeth on one end, as shown in the illustration. This tool is driven into the



wall with moderate blows of a hammer, and should be gradually turned or twisted while being driven in. The rapidity with which it cuts is most astonishing, and it has the advantage of cutting a hole which requires no cleaning out, as the dust passes out through the hollow of the pipe while being driven in. Make the holes about 2 ins. or 3 ins. deep. Cut or turn plugs of wood to fit the holes tightly and drive them in. Hooks may then be driven in these plugs. The tool can be quickly sharpened when dull, with a few strokes of the file.

At a recent meeting of the American Society of Mechanical Engineers, Prof. C. H. Benjamin read a paper on the bursting of flywheels. Tests were made on sixteen wheels, each 24 ins. in diameter, the weights varying from 60 lbs. to 123 lbs. The author's conclusions are that for wheels of moderate size, correctly proportioned, a solid rim is by far the safest form, and will require a speed of 350 ft. to 400 ft. per second to produce rupture. It has been found that jointing the arms at the rims and bracing the rim by internal webs, have no important effect on strength. Joints in the rim are the principal source of weakness, especially if situated between the arms. Hollow rims will permit of a much more efficient joint.

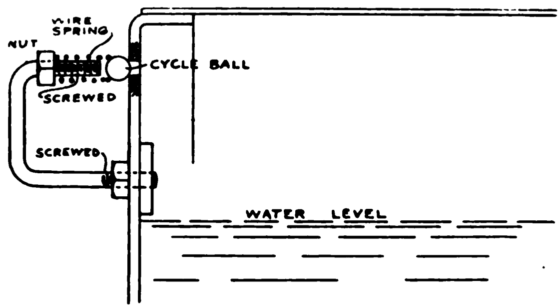
Practical Letters from Our Readers.

[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 Safety-Valve for Model Boilers.

To the Editor of *The Model Engineer*.

Dear Sir,—Below is sketched a small safety-valve, which may be of interest to my fellow model-makers. The valve is an ordinary ¼-in. cycle ball, and fits into a



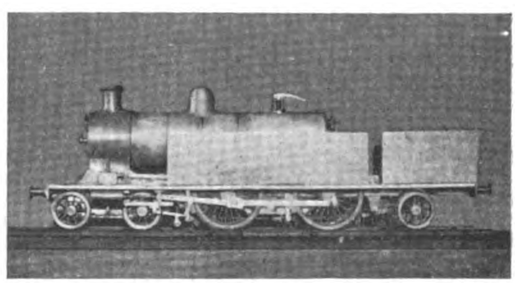
hole in end of boiler. This valve is very easy to make, and works well, but the surface the hole is drilled in *must* be flat. I have been a regular subscriber to your journal from the first number, and find each number of more interest than the last.—Yours truly,

Birkenhead. T.

Model Locomotive Construction.

To the Editor of *The Model Engineer*.

Dear Sir,—Since writing my last letter on the above subject, which you very kindly published in The Model Engineer of December 1st, 1901, I have had my model locomotive running, and now that the cylinders are connected to boiler it makes all the difference in the world. I am delighted to say I now find my 2½ in. silent Primus gives by far the best results; but I sincerely hope



Mr. Wm. Duthie's Model Locomotive.

I have not misled any of your many readers, and caused them to follow my footsteps, and go in for a "Hekla" paraffin burner (non-silent Primus), which I found to work so satisfactorily *before* cylinders were connected to boiler.

I have had my engine running, as mentioned above, on a 30 ft. track, which is 3½ ins. gauge, reversing automatically at each end splendidly.

I send you a photograph of the locomotive in its present (unfinished) state, which will serve to give some idea of its proportions.

I send herewith a drawing of the automatic reversing gear exactly as fitted to my model, which, by the way, has outside cylinders operated by Joy's radial valve motion; but I see no reason why it should not be fitted to any other valve gear, and I can testify it as being thoroughly reliable.

The whole arrangement derives its motion from an incline between the rails, placed about 6 or 8 ft. from end of track (depending on the speed the locomotive gets up before reversing). In my case I use two pieces of beech, 2 ft. long, ⅝ in. wide, and a maximum difference of ⅜ in. between the two ends, but this latter should be capable of adjustment by a screw at the higher ends, while the other is hinged. However, I find ¼ in. vertical movement about right for my engine. These inclines are not shown in drawing.

Now, referring to the drawing, both figures are lettered similarly, for the sake of clearness. The centre line being adjusted, and do not require to be movable like those which Mr. Henry Lea uses to shut off steam and apply the brakes of his excellent model.

I notice with my locomotive when running, when it reaches the inclines, the coupled wheels begin to slide on rails and continues doing so until it comes to rest, which is a few feet past incline; of course, this is caused by the steam, and the momentum of the engine trying to drive the wheels in opposite directions.

If you think this drawing and rather long letter worth publishing in the columns of your excellent paper, I shall be very pleased, as I should like to hear the criticisms and opinion of any authority on model locomotives, as very probably there may be similar arrangements fitted to models; but, in any case, I am quite prepared to accept friendly criticism from any of your readers.—Yours truly, WM. DUTHIE.

Aberdeen.

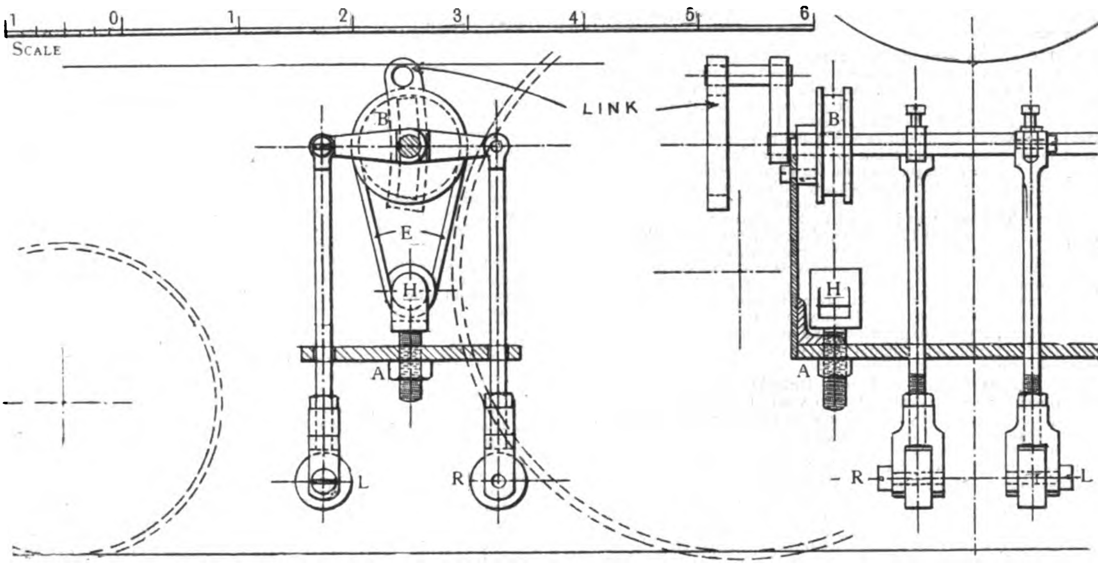


FIG. 1. AUTOMATIC REVERSING GEAR FOR MODEL LOCOMOTIVE. FIG. 2.

of the small roller R is ½ in. to right side of centre line of engine, while roller L is similarly placed to left side of centre line (see Fig. 2), so consequently these rollers are 1 in. apart relative to centre line, but L at the same time is 1½ ins. in front of R (see Fig. 1). Now, with the inclines mentioned above, placed to engage with these rollers, it is easily seen that only one roller will come in contact with incline at once, and will consequently alter the position of link, according to the height of incline, and also to the direction the engine is running. In the drawings the link is shown in "mid gear," and, of course, this makes both rollers the same height as shown. Fig. 2 also shows very clearly the method I have adopted of building up the link.

Now, we have shown how to move the link, the next thing is how to lock same from moving when running, and yet allow of it being moved by inclines. This is accomplished by a band-brake in the form of a leather bootlace E (Fig. 1), passed twice round brake-drum B and buckle H, with an extra turn round the buckle and tied on top of same. The said buckle H is provided with a screw and nut, as shown at A, for adjustment of brake E. The brake is omitted in Fig. 2, to show more clearly the construction of brake-drum and buckle.

The inclines at each end of track are stationary after

Cleaning Files.

A FILE, to do its work fast and well, should be kept free from its cuttings, says *American Manufacturer.* Cuttings "pin" when they lodge so finely that they can not be removed with a brush. Pinning may be obviated by chalking the surface of the file, but this has the effect of reducing its bite. A little oil on the file will frequently reduce the tendency to pin. It should be used, however, only on the fibrous metals, as it glazes the surface of the non fibrous metals, making them harder to cut. Chalk is usually applied to a file when a smooth, fine work surface is desired. The effect of the chalk is to prevent the teeth from cutting as freely as when it is not used, and thereby produces about the same result as would occur if a finer cut file had been used. When oil has been used on a file, it can be readily removed by thoroughly chalking.

PROPOSED MODEL YACHT CLUB FOR BLACKBURN.—It is proposed to form a Model Yacht Club for Blackburn and district. Those interested are requested to give in their names to Messrs. Sandham & Co., North Gate, Blackburn.

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.

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:—

[5512] **Traction Engine Queries.** C. H. (Tunbridge Wells) writes: Would you kindly answer the following questions with regard to model traction engine, described in December 1st issue of *M.E.*? (1) Would the work of making it be of too heavy a character for a 3½-in. centre lathe, with slide-rest? I also have a 20-in. stroke planer. (2) Would engine drive one of Avery's 30-watt dynamos if run at 50 lbs. pressure, as I think 100 is rather high?

(1) The work to an amateur with a fair amount of skill and experience would not be very great, especially with machine tools such as you have at your disposal. There is much less labour necessary in a traction engine than that involved in the construction of a model railway locomotive. (2) The engine, if fired by one 3 in. "Primus" (No. 5) oil burner, and provided that the firebox contained some cross water tubes, and the total heating surface amounts to 200 or 220 sq. ins., would, with a cylinder 1¼ in. × 1½ in. stroke, just drive the dynamo referred to. We should prefer to use a slightly larger engine, or a smaller dynamo. If you increase the cylinder above 1¼ ins. diam., the heating surface and grate area must also be augmented. The firebox might, in that case, be arranged to allow of two smaller burners (2½ ins.) being used.

[5611] **Steam Engine Cylinder Details.** J. G. S. (Boat of Garten) writes: I am making a ½ h.-p. vertical engine and I should feel very much obliged if you could answer the following questions. (1) Do cylinder covers require anything between them and the cylinder to keep steam from escaping? (2) What ought to be placed around the circumference of a steam piston to prevent steam passing? (3) What should stuffing-boxes be packed with?

(1) In large work there are several methods commonly adopted, such as jointing with red lead and hemp, copper wire (which becomes compressed upon tightening up the cover), and asbestos rings. In small and model work, red lead and brown paper, lead foil, and also asbestos millboard is used. (2) For a ½ h.-p. engine you should use piston rings. In place of these, you may arrange a deep groove in piston for hempen or asbestos yarn as packing. (3) Stuffing-boxes may be packed with hemp, or with asbestos yarn.

[5636] **Boiler and Engine Queries.** A. S. C. (St. Margarets) writes: Will you kindly tell me what size engine a vertical boiler, 9 ins. × 18 ins., made of 10 B.W.G. Weardale steel, with a firebox 7½ ins. diam., 8 ins. high, with ten 1 in. vertical brass tubes for 50 lbs. working pressure? Will the boiler drive a double cylinder engine, with reversing gear, ¾ in. × 1 in., or would it drive a single cylinder engine, 1¼ ins. × 2 ins., or a 1½ in. × 2½ in., with reversing gear better? Please inform me the size of pump required for the engine. Would a "Vic" injector be suitable? Will you give me the size required? I want the engine to drive a dynamo for charging accumulator, and what voltage?

The boiler would drive four cylinders, ¾ in. by 1 in., and one 1¼ ins. by 2 ins., subject to proper firing arrangements. If oil be used as fuel, place burners as shown in February 1st issue, page 68. Speed of engines, about 400 revs. Pump must be able to force into the boiler from 5 to 6 cubic ins. of water per minute continuously. Arrange the pump with some means of reducing speed to 150 or 200 revs. per minute, and of turning excess of water back into the tank. A ram, ⅜ in. diam., with not more than ¾ in. stroke, would be about the best size to use. The b.h.-p. would be about ⅛, and it would drive a dynamo giving 50 watts. A "Vic" injector can be used, leave this matter until the engine and boiler have been tried together; and then let the maker know exactly the range of pressure of your boiler, its power, and other particulars.

[5684] **Paint for Model Locomotives.** T. T. (Manchester) writes: I have just finished a small scale (½-in.) model of a loco, and should be glad if you will tell me the best material to use for painting it dark green or black. Needless to say, it gets very hot after working a little while.

Maurice's "Porceleine," or Aspinall's Enamel will suit your purpose admirably. The only difficulty is the colours. You cannot alter them as you would ordinary paint, and, therefore, unless you can afford to purchase a large quantity, costing 15s. or £1, you will not be able always to obtain just what shade you require. This paint will resist the heat, and will look fresh for a considerable time.

[5717] **Hot Air Engine.** J. E. E. writes: I want to make a hot air engine, but I do not quite understand the principle of them. The power I want is about ⅛ h.-p. Should be very pleased if you would give me a rough sketch of an engine about that power, and also valves and air pump and sizes of same. Would gas do to heat the cylinder?

Kindly refer to our issues of July 1st and August 15th last for an explanation of the principle and working of a hot air engine. The type shown may be improved upon by arranging the pipe to power cylinder to exit from the middle of the displacer cylinder. The length of the connecting pipe may also be made much shorter by the use of two cranks at 90° apart, and the cylinders being placed side by side. The required engine will have to be of considerable size compared with a gas engine of the same power, and the consumption of gas (which may be used to heat the displacer cylinder) will show it to be much less efficient. The power cylinder should be at least 2½ ins. diam. × 5 ins. stroke. We cannot undertake to design the engine required. Kindly adhere strictly to our rules when asking questions in future.

[5723] **Lathe Queries.** F. W. F. (Frome) writes: I shall be much obliged if you will enlighten me on the following: (1) The rule to calculate out the wheels for cutting threads on self-centering chucks. (2) What other makers of lathes, besides J. Whitworth and Co., supply machines to cut above threads? (3) Might one have to cut threads like these in a Whitworth Scholarship examination?

(1) The methods of calculating are similar to those adopted in ordinary screw-cutting. The matter is, of course, complicated by the extra gearing required. (2) Most of the larger firms will supply lathes for the purpose. (3) You are unlikely to have such a task set you in the examination for a Whitworth Scholarship. Usually the student is asked to make an inch bolt and nut. If you are in difficulty with any such calculation, we shall be pleased to work it out for you. Of course, you will have to give us full particulars of the lathe, viz.—pitch of the screws, leading and slide, and details of the driving gear between the leading screw and that of the slide.

[5732] **Accumulator Charging.** J. S. (West Ham) writes: If a dynamo gives 25 volts 6 ampères and is directly connected with ten cells in series what current will pass through the cells? Kindly show how calculation is made.

Unfortunately your query is not one to be answered properly in a few words. The exact current passing at any given moment depends on the "running resistance" of the dynamo, the resistance of the mains conveying the current, and that of the accumulators. The first two items are practically fixed, the third varies. It depends on the size of the accumulator, its internal construction, and its degree of charge. When fully charged the battery will have an electromotive force of nearly $10 \times 2{\cdot}5 = 25$ volts (nearly) and as this is opposing the dynamo current it will act, in effect, like resistance, and will therefore have a result in keeping down the charging current. When the cells have been discharged to the normal amount, there is still an E.M.F. of 1·85 volts (about) per cell, so that when charging commences the opposing E.M.F. $= 10 \times 1{\cdot}85 = 18{\cdot}5$ volts. Since the other factors which combine to make the total resistance remain but little altered throughout the charging, it is obvious that a greater current would pass in the early stages of the operation. This is obviated in practice either by regulating the E.M.F. of the dynamo or by interposing variable resistances which can be gradually cut out as the "back E.M.F." rises. You will see that a definite reply to your question, giving a certain number of ampères, is impossible. If you can state the values of the different resistances in circuit, an answer can be worked from Ohm's law. This is, indeed, the fundamental principle of any such calculation. Of course, in practice, the resistances are not taken into theoretical account, and the accumulators are charged by attention to the volt and ampère meter and by regulation of the current as above indicated.

[5735] **Non-Polarising Bichromate Battery.** J. McK. (Edinburgh) writes: Referring to description of non-polarising bichromate battery on pages 45 and 46 of your "Electric Batteries," I shall be glad if you will send me replies to the following queries: (1) Whether ordinary clean gas coke will suit for packing? (2) What current may be expected from 4 cells, say 6 ins. high and 4 ins. diam.? (3) Is this a suitable battery for charging motor car accumulators? (4) Which terminal of battery should be connected to + of accumulator in charging? (5) Should zinc be withdrawn when battery is not in use?

(1) Yes; but it must be *hard*. The harder the better. (2) A current of 1 ampère at 2 volts. The cells should not be drawn upon at a much higher rate. (3) Yes; but it will be found a rather expensive and inconvenient method if much riding is done. (4) The carbon plate is the right one to connect to the positive pole of the accumulator. (5) Yes, and the cells should not be left unused for many days without removing the solutions and filling all up with clean water.

[5746] **Induction Coil for Motor Ignition.** J. H. (Islington) writes: Will you kindly give me dimensions for a spark coil and condenser for a 1¾ h.-p. motor bicycle. What I want to know is—(1) Size and quantity of wire for primary and secondary coils; (2) size of core; (3) whether shellac varnish or paraffin wax is the better for insulating wires; (4) length and diameter of reel; (5)

size of condenser; (6) method of placing condenser round coil. (7) Can you recommend a book dealing with coils for this particular purpose?

Unless you have some experience and skill in making sparking coils, we cannot recommend you to enter upon the construction of one suitable for motor ignition purposes. There are so many chances of failure of some part of the motor mechanism, that we should be chary of adding to them in this way. However, the particulars asked for are as follows:—(1) Wire for primary, ¾ lb. No. 16 D.C.C., two layers. Wire for secondary, 10 ozs. No. 36 S.W.G. 2-core, soft iron wire bundle (not larger than 22 S.W.G.), ⅝ in. diam., 6 ins. long. (3) Do not use shellac. Paraffin wax is incomparably better. (4) Length over ends, 5½ ins Ends ½ in. thick and 3½ ins. diameter (or square). (5) Fifty sheets of tinfoil, 4 ins. × 7 ins. (6) Simply wrap the condenser around the coil, separating them by at least half-an-inch of insulating material. (7) The principle of making coils for this purpose is not different from that for ordinary purposes, and we can recommend H. S. Norrie's "Ruhmkorff Induction Coils," price 2s. 2d. post free from our Book Department.

[5736] **Chemical Apparatus.** A. D. D. (Leeds) writes: Could you supply me with the addresses of any London firms who could supply simple chemical apparatus for carrying out experiments in elementary inorganic chemistry?

In reply to your query, we can recommend you to Messrs. Brewster, Smith & Co., 6, Cross Street, Finsbury, London, E.C.

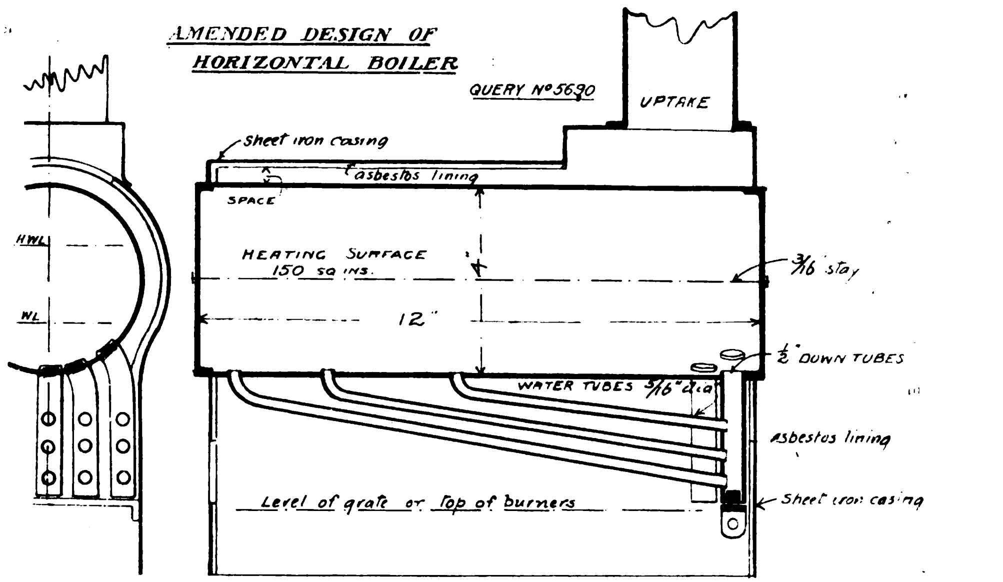
they can only supply combustion heads to their own standard sizes. These are, of course, unsuitable for the cylinder described. May I ask where the *M.E.* heads may be procured finished, as I have the majority of the other castings now.

We believe the genuine De Dion combustion head of their 2¾ motor will work in with the castings to the drawings given, but are not certain on that point. In any case, you will be able to get the complete head or any other part exact to The Model Engineer drawings from the London Autocar Company, Limited, 182, Gray's Inn Road, W.C.

[5730] **Engine for Steam Launch.** J. L. G. (Limerick) writes: I am building a single cylinder launch engine, 4 ins. by 4 ins., which I intend to work at 150 revs. per minute, with 80 lbs. pressure per square inch. Will this be strong enough to work 14 ft. boat—3 ft. 6 ins. beam—at eight or ten miles per hour? What diameter and what pitch propeller should I use? Will steam ports ¼ in. by 1 in. be large enough?

Provided that the engine is supplied with sufficient steam you will have no difficulty, we think, in obtaining the required speed. For ordinary purposes we are of opinion that the engine will be found to be too large. Propeller about 14 ins. by 16 ins. pitch. Steam ports should be 1¼ ins. or 1½ ins. long by ¼ in. wide.

[5738] **Steam Cars.** J. M. (Govan) writes: I am building a tricycle, which I intend to propel by steam at a speed of about twelve



[5690] **Boiler and Engine Queries.** G. U. (Bulawayo, S.A.) writes: I am contemplating purchasing a horizontal engine, 1¾ ins. × 2¾ ins. (bore and stroke), with 7 ins. flywheel. The boiler is 4 ins. diam. × 12 ins. long, just a plain brass cylinder without any tubes, and firing is accomplished by means of spirit lamps running the whole length (or nearly so) of the boiler. I require the engine to run a dynamo giving an output of 5 amps. 30 volts, by means of a belt from the rim of the flywheel. Will such a boiler as mentioned above be able to make steam fast enough, and keep up pressure for such a purpose? It seems to me that there would not be sufficient heating surface to allow of much of a pressure being kept up, and therefore the speed of the engine would be rather erratic.

To work the engine referred to in your query a boiler with 250 sq. ins. of effective heating surface is necessary, and in face of this it is needless to say that a boiler such as the one you have, which has perhaps 50 sq. ins., will fail to run the engine continuously. You can, however, alter it, and make it do a reasonable amount of work without much trouble; but we do not think that even if the boiler in altered form were worked exceedingly hard it would keep up a pressure, at a speed of 200 revs. per minute, of above 15 or 20 lbs. per sq. inch. With reference to the dynamo-driving capabilities of the engine, if worked at 50 lbs. pressure and 500 revs. per minute, it would develop only about ¼ h.-p. The dynamo mentioned would require an engine giving at least ⅓ h.-p.

[5600] **Castings for Tricycle Motor.** J. F. (Glasgow) writes: In his articles on the construction of motor cycles, Mr. Hawley advises that the motor cylinder should have a bore of 72 mm. This is a size between the De Dion standards of 2¼ and 2¾ h.-p. He also advises the purchase in a finished state of the combustion-head with valves, &c. From inquiry of the De Dion agents, I find that

to fourteen miles per hour. The driving wheels are 30 ins. diam. each. I intend using a single cylinder engine, 1½ ins. bore with a stroke of 2 ins., and a boiler pressure of 80 lbs. to 100 lbs., using a boiler similar to that on page 46 of "Model Boiler-making," only, of course, much larger. Would the above engine, in your opinion, be sufficient to propel the tricycle at the above speed, carrying a man twelve stone in weight? If not, what size of engine would it require, speed of above engine not to exceed 1000 revs. per minute when travelling at fourteen miles per hour? My reasons for using a single cylinder engine is that I want to reduce the working parts to the fewest possible number.

The engine would, at the speed named, if properly designed, develop nearly 1 h.-p. It is usual to fit tricycles with petrol motors of 2¼ to 2¾ h.-p., and we think that a larger engine would be necessary. The engine, however, will not present any appreciable difficulty. The generator will have to be carefully designed, and it seems to us that this part will, unless you have had some considerable experience, give you trouble. To develop 1 h.-p. a boiler capable of evaporating over 20 cubic ins. of water per minute and having from 1,800 to 2000 sq. ins. of heating surface must be arranged. You will see that to make a journey of any distance, a large amount of water must be stored. If the saving by condensing be neglected, some five gallons per horse-power will be required every twelve or fourteen miles. To save water in motor cars the steam is generally condensed and returned to the boiler; care, however, must be exercised in doing this, the oil carried from the cylinder must be separated from the feed-water as completely as possible. You will understand from these few remarks the difficulties of the task you are setting yourself, and you had better, before commencing, obtain some expert advice upon the especial subject.

[5749] **Boiler Queries.** G. G. (Gainsboro') writes: I have an engine ¾ in. × 1⅛ ins. What size boiler should I make to drive it at 300 revs. a minute? I should like to make a Cornish type, the same as the one in "Model Boiler-Making." Could I make it smaller if I put a number of ¼-in cross-tubes in the flue?

A boiler to drive the engine referred to at 300 revs. per minute with any considerable pressure (say 30 lbs.) would have to have at least 70 or 80 sq. ins. of effective heating surface, and to provide this with a boiler of reasonable size, some ten or twelve cross-water tubes should be used. Make the shell 10 ins. long and 6 ins. diam. The furnace tube may be 3 ins. diam., and should be kept as low as possible. The water tubes should be about ¼ in. outside diam. If liquid fuel is used the firing should be arranged so that the flame is blown into the furnace tube in the form of a jet; this can be accomplished with methylated spirit by the use of a vapouriser, such as shown on page 235 of our issue of November 15th last, or that given in the February 15th number. For oil fuel a "Vesuvius" Swedish burner should be fitted. These can be obtained from Messrs. Melhuish, Sons & Co., 85 Fetter Lane, E.C.

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 Gas Lighting. By H. S. Norrie. London: E. and F. N. Spon, Limited, 125, Strand. Price 2s. nett. Postage 2d. extra.

This little book, bound in an attractive cover, purports to describe methods of electrically lighting gas jets by means of the spark from an induction coil. The systems enumerated are all based more or less on one principle. We should have expected to find every practical method of electrically lighting gas described in a book with so comprehensive a title, but no mention can even be found of the common "Clarke" gas-lighter.

Amateurs' 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 Good Soldering Paste.

We have made a few tests with a sample of "Rozinal" soldering paste, submitted to us with that object, and are able to give a good report of its value. It is a sticky paste, somewhat like vaseline in appearance, and it is stated by the makers that it is not in any way injurious to the material operated upon, in which it is undoubtedly superior to the ordinary soldering fluid. At the same time, it is much easier to make a satisfactory joint with this paste than with resin, and a further very considerable advantage is the "stickiness" whereby it is prevented from leaving the joint just at the most critical moment. Messrs. Beanland, Perkin & Co., Leeds, are the sole agents, and will send a small sample tin on receipt of one penny stamp, or a large box for a shilling (post free), The Model Engineer being quoted.

Gas and Oil Engine Castings.

Gas and oil engines are the staple productions of the Madison Works Castings Co., Madison Works, Woolrych Street, Derby, as a new list to hand indicates. Engines from ½ to 5 h.-p. are supplied either finished or in parts, rough or machined. These should prove acceptable to those anxious to build engines of this type. Dynamos and electromotors up to 150 c.p. are in stock, and the firm also supplies a bicycle petrol motor in three sizes. An illustrated descriptive price list will be sent to any reader mentioning this journal and enclosing three stamps.

Model Horizontal Engine Castings.

Readers of The Model Engineer will hardly need an introduction to the work of Mr. S. L. Thompstone, some of it having already been published in these pages. A neat list, which he is issuing post free on application, illustrates a model horizontal engine which is made in two sizes. Those who require castings of this type of engine should make application to Mr. Thompstone, Nelson Street, Broughton, Manchester.

Change of Address.

Will readers please note the address of the Model Manufacturing Company has been altered to 52, Addison Road North, Notting Hill, London. In their new address the firm intend to stock everything the amateur model maker may require, so that the goods can be seen before being purchased.

Catalogues Received.

Elbridge Electrical Manufacturing Co., Elbridge, New York, U.S.A.—Model and small-power dynamos are the chief productions of this firm. Small machines with hand-wheels are intended for schools and students, whilst others are arranged for driving by means of steam, gas, or water power. Sparking dynamos in two sizes for gas engine ignition purposes, and larger machines for electric lighting up to 8 kilowatts, are supplied. Other items specified in the neat illustrated descriptive list issued by the firm are a model transformer, a model arc lamp, and a polarity indicator. Readers requiring this list should mention The Model Engineer and should not forget that postage to the United States is 2½d.

G. Calvert, 12, Woodville Road, Mildmay Road, N.—The 1902 list of bicycle motors and parts is to hand from this firm. A good deal of information is given with respect to bicycle motors, coils, carburettors, &c., all of which is worth studying, and an intending purchaser should certainly obtain this list. Important changes have been made by the firm in the construction of their motor, with the result, we are informed, that a great increase in power and speed has been obtained. The Model Engineer should be quoted when writing for the above list.

J. G. Looker, 91, Stockport Road, Levenshulme, near Manchester.—A list is issued by this firm giving prices of small screws, nuts, bolts, &c., up to ⅜ in. diameter in bright steel or brass. Prices of round "German-silver" steel rod for tool and machine work are also quoted. Readers should send a stamp and mention this journal to obtain a copy.

Seneca Falls Mfg. Co., Seneca Falls, N.Y., U.S.A.—The "Star" lathes are known well enough to require no introduction to the public. They are not the only productions of the Seneca Falls Mfg. Co., as a well-filled and carefully-illustrated price list to hand reminds us. A number of chucks, clamps, and other lathe accessories—many of them of a specially interesting character—are described therein, and we can strongly recommend readers who are thinking of purchasing a lathe to post a letter (not forgetting to put a 2½d. stamp on it) to the above firm, mentioning The Model Engineer, and asking for "Catalogue 18B" to be forwarded.

Ludw. Loewe & Co., Ltd., 30 & 32, Farringdon Road, London, E.C.—Messrs. Loewe & Co. are sole agents for the goods manufactured by the Bullard Machine Tool Company, whose productions are illustrated and described in a well-bound volume, a copy of which has been sent to us for notice. The machines comprise boring and turning mills of various sizes, combination turret lathes, and screw-cutting engine lathes. A separate booklet, a "Treatise on Boring and Turning Mills," is also published by the firm, and gives particulars of various classes of work which may be advantageously carried out by means of such machines. Messrs. Loewe & Co. invite an inspection of the tools at the address already given, or will be glad to forward their catalogue to purchasers, The Model Engineer being quoted.

Robert Stock & Co., 69-71, Knightrider Street, London, E.C. —A well-printed list from this firm gives particulars of fluted and twist drills, reamers, and drill sockets. All are illustrated and fully priced, and the list includes a few important hints on the grinding and use of twist drills. Readers should quote The Model Engineer when writing for further particulars.

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

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AND

Amateur Electrician.

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

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Some Hints on Building a Model Torpedo Boat Destroyer.

By WILLIAM A. SHARMAN.

THE model steamer here described and illustrated has been designed with a view to simplicity and efficiency. The hull is 3 ft. long 7 ins. beam and 5 ins. deep, and is made of tin with a ¼ in. square wrought-iron keel which also forms the stem and stern post. The photograph, Fig. 2, gives an idea of her general appearance.

The engine is of the oscillating type, having one cylinder ⅝ in. bore, 1 in. stroke, and driving direct on propeller shaft. The photograph, Fig. 3, shows how the engine is hung, thus saving both time and labour in fitting up and material for bed, supports, crankshaft, bearings and coupling. The stern tube is made of a piece of brass tube, an ⅛ inch larger internal diameter than the shaft, and having a short piece of tube nicely fitting the shaft driven in the end, which arrangement, if kept well oiled, lets in a very small amount of water, and has less friction than a stuffing-box.

The propeller, which is 2¼ ins. diameter, is made with sheet copper blades soldered on to a brass boss, and the latter is fastened to the shaft by a set-screw. I have tried four propellers on the boat and find that one with blades, narrow and of oval shape, gives better results than either a large broad blade, clover shape or broad ended blade.

The drawing, Fig. 3, will explain the type of boiler adopted in the model. It is of copper, and is 7 ins. long, 3 ins. diameter, with six ⅝ in. brass flue tubes discharging into a smokebox on top. This type of boiler was devised by a friend of mine and has several advantages, including large water capacity (this boiler will steam for over an hour), fairly large heating surface, all joints and tubes easily got at for repairs, good draught (which is essential in small boats) and ease of construction, being only soldered with a small soldering iron and soft solder. I have tested it to 70 lbs. hydraulic pressure (which made the ends

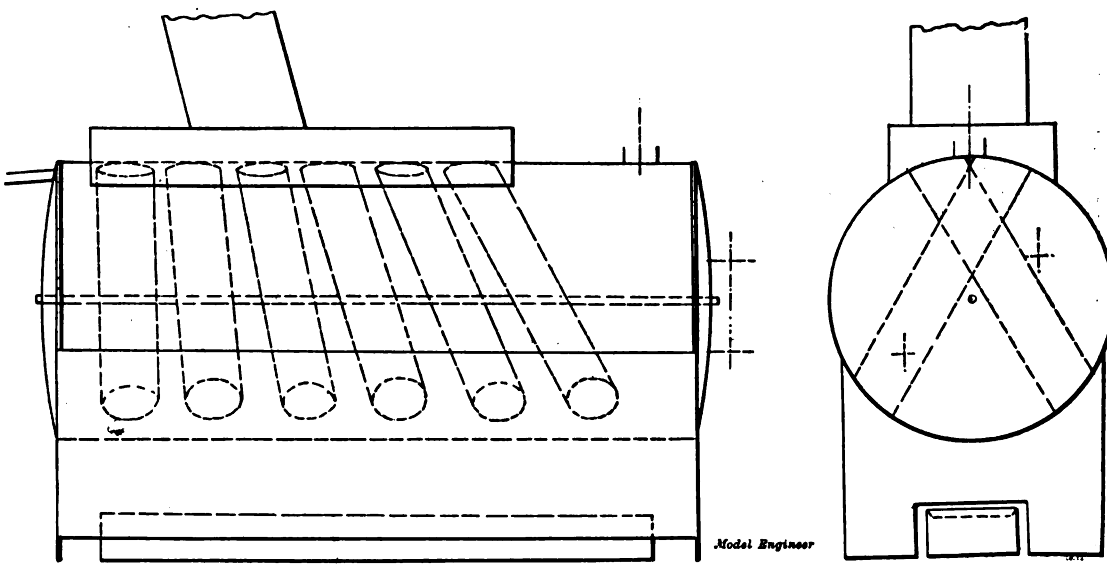


FIG. 1.—SIMPLE BOILER FOR MODEL STEAMER.

bulge out about ⅛ in. and caused me to put a ⅛ in. longitudinal brass stay through the ends). It raises steam from cold water in just over six minutes and a pressure of 20 lbs. in about 5 minutes more and keeps up 10 lbs of steam with the engine running full speed. The lamp is 6 ins. long and 1 in. wide by ½ in. deep stuffed with cotton wool; copper gauze is soldered over the top and then pressed down below the edge of the tray as seen in Fig. 3 This prevents the spirit over-flowing and burning on the bottom of the boat when expanded by the heat. I also find that about ¼ in. of cold water in the bottom of the boat keeps the lamp cool and prevents the spirit going off in gas.

I have discarded a tank in the bows of the boat to feed the lamp as it is difficult to regulate the flow, the lamp in question burning for quarter of an hour when soaked with spirit by pouring over the top.

Plenty of smoke can be made, if desirable, by soaking brown paper in a weak solution of saltpetre, which when dried and lighted and dropped down the funnel gives off volumes of smoke.

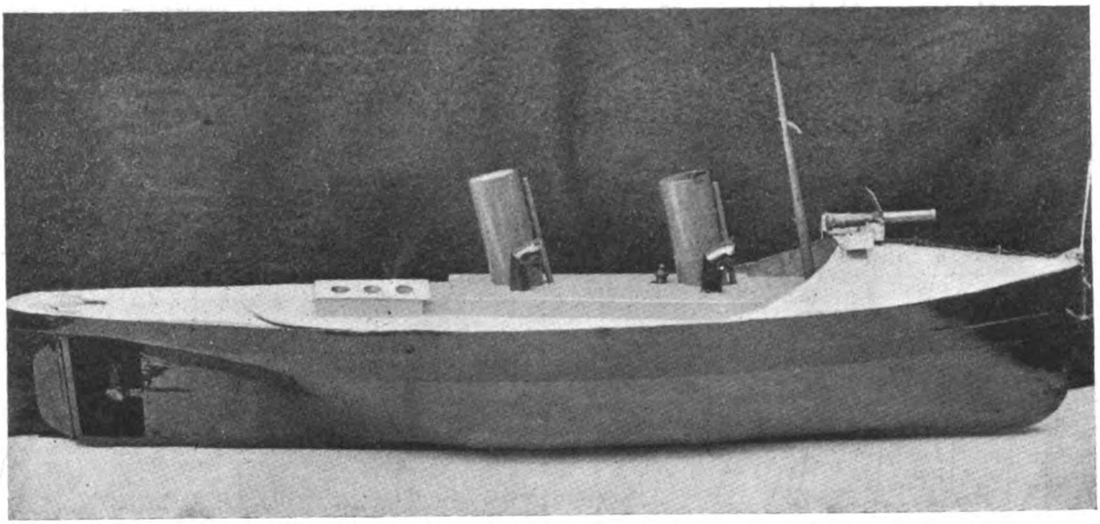


FIG. 2.—MR. W. A. SHARMAN'S MODEL STEAMER.

The Principles of Illumination.

A PAPER bearing the above title, read by Mr. D. Burnett before the Brooklyn Institute of Arts and Sciences last December, and reproduced by the *Engineer* is worth studying in abstract as indicating the directions in which further improvements in the generation of artificial light may take place. There are three ways in which substances can emit light—by fluorescence, by phosphorescence, and by incandescence. Fluorescence is a property possessed by certain liquids, such as oils, and a few solids like fluorspar and quinine sulphate, of yielding light of a characteristic colour when exposed to white light. Phosphorescence is a property exhibited by some solids of yielding a feeble light after exposure to light for a sufficient time. Incandescence is a chemical and physical phenomenon involving the production of heat as well as of light, and is the light emitted by a body when raised to a temperature exceeding 525 deg. Cent. The spectrum of an incandescent body is continuous, like that of sunlight; and the relative brightness of the various colours increases from the red end to the violet end as the temperature rises. In general, therefore, the whiter the light the higher the temperature. The spectrum of luminescent bodies is usually split up into lines or bands.

One method of comparing the efficiencies of different sources of light is to measure the illumination emitted per unit of surface. Thus, in candle-power per square centimetre, the Argand gas burner at 1,800 deg. Cent. gives 0·3; Siemens' regenerative burner 0·38 to 0·6; electric incandescent lamp, 40; Nernst electric lamp, 100; crater of an open arc at 3,500 deg. Cent., 6,400. In ordinary cases, one square inch of gas flame gives 4 c.-p., and one square inch of arc crater 42,600 c.p. As the temperature of a given source of light is increased, the light becomes brighter, a larger proportion of the total light plus heat energy being manifested as light. This ratio is called the "optical efficiency," and is as follows:—Argand oil lamp, 2½ per cent.; gas flame, 5 per cent.; electric incandescent lamp at three watts per candle, 6⅓ per cent.; Nernst electric lamp at one watt per candle, 13 per cent.; burning magnesium, 15 per cent.; 5000 c.-p. arc lamp, 25 per cent.; sunlight, 25 per cent.; Geissler tubes, 33 per cent. The higher efficiency of the incandescent lamp in comparison with gas flames is partly due to absence of heat lost by convection—the filament being in a vacuum—and to the small heat lost by radiation and conduction through the connecting wires. Another reason depends on the fact that the electric energy adjusts itself automatically to the size of the filament, whereas in a gas flame the quantity of free carbon cannot be adjusted so as to absorb all the heat energy. The intense brightness of the magnesium flame is due to the whiteness of the oxide produced, and to the large amount of oxide liberated in a flame of a given size, as compared with the incandescent carbon of a gas flame. The flame temperature of magnesium is 1,400 deg. Cent., or about 400 deg. Cent. less than that of an ordinary gas flame. Expressed in terms of candle-power per one cubic foot, the duty of various illuminants is:—Naked gas flame, 3; London Argand, 3·2; Welsbach burners, 5·5 to 33; Sugg's incandescent pressure burner, 22 to 32; "claimed for the Kern burner," 25; pure acetylene, 84. This presumably means incandescent acetylene.

It was observed many years ago that an intensely bright light was obtained when the hot non-luminous flame of hydrogen burning in oxygen was allowed to impinge on a piece of lime. Only recently the efficiency has been improved by reducing the mass of the solid substance from a weight of several ounces to a few grains, distributing that mass in the form of a mantle or hood over the flame at the exact point of combustion or maximum temperature. The efficiency of the oxy hydrogen flame was formerly ascribed to its temperature, which was the highest known; but some additional explanation is required of the great luminosity of the Welsbach mantle, for if a mantle be composed of either thoria or ceria alone, the light emitted is faint in comparison with that of the 99:1 Welsbach formula. Similarly, if the mixed oxides are raised to the same temperature in a vacuum, *e.g.*, by the heat of cathode rays, the quantity of light is small; so that the oxygen of the air plays some part in causing the luminosity of the incandescent mantle. The author ascribes this luminosity to an alternate oxidation and reduction of one of the two oxides, with the corresponding formation and decomposition of the alloy of both oxides—the heat of combination

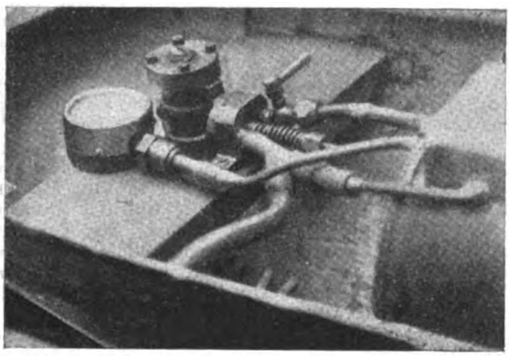


FIG. 3.—A SIMPLE METHOD OF FITTING AN OSCILLATING CYLINDER TO DRIVE A MODEL SCREW STEAMER.

(*See page 145.*)

of the unstable oxide adding itself to the temperature of the flame, and producing a higher temperature, and consequent greater illuminating power. The temperature of a Welsbach mantle is estimated at from 1,800 deg. to 1,915 deg. Cent., or rather more than that of a gas flame. Another reason for the high luminosity of the mantle depends upon the much larger quantity of incandescing matter present; in an ordinary gas flame there is 0·1 milligramme of carbon at a white heat; in a Welsbach burner, about 4 milligrammes of ceria are present.

The Nernst electric lamp is a more recent development along similar lines, although its phenomena are complicated by some electrolytic action. The lamp consists of a rod made of some of the rare Welsbach earths, which has the colour, hardness, and mechanical properties of porcelain. At ordinary temperatures the rod is a non-conductor of electricity, but on being heated to just above the point of visibility, it begins to conduct and to emit light. In practice the Nernst lamp is provided with an auxiliary heating device, consisting of platinum wires embedded in cement. This heats the rod to the necessary temperature, and is then disconnected by an automatic cut out. Regulation is effected by an iron rod in an exhausted globe, which prevents any increase in its own resistance. The efficiency of the best electric glow lamps is about 3·1 watts per candle, that of the arc about 1 watt per candle—referred to mean spherical intensity—that of the Nernst lamp about 1½ watts per candle.

The Geissler tube is the most efficient of all sources of artificial light, and a practical application thereof is to be found in the Cooper-Hewitt vapour lamp. In this device an electric current of the usual lighting voltage is passed through the vapour of mercury, the pressure and properties of which are such as to bring the conducting power up to a high point. Although the efficiency of the lamp is high, and it is quite applicable to existing circuits, the light is so rich in the rays of the mercury spectrum, and so little capable of modification by introducing substances such as nitrogen—with the object of adding other components of white light—that its effects are startling, if not ghastly, and may render its use impracticable. Except in so far as the employment of metallic osmium may further increase the efficiency of incandescent lamps, future developments are likely to be in the direction of the Nernst lamp, which unites the efficiency of the arc with the convenience and pleasant colour of incandescent electric lights.

The present tendency of gas engineers is to improve the calorific value of coal gas, which now stands at about 600 B.T.U. per one cubic foot, even at the expense of its illuminating power; for in theory, now that the Welsbach system of lighting is available, and gas is more generally used for warming, cooking, and power, there is no longer any need for the supply of a gas having an illuminating quality. From the above-mentioned theoretical data it is clear that future endeavours to improve artificial lighting must be (1) to increase the temperature of the light source, in order to increase the whiteness of the light; (2) to decrease the heat losses; to adjust the quantity of the luminous substance till it absorbs the maximum heat at the maximum temperature; (4) to select an incandescing material of high emissivity; and (5) to increase the area of the luminous material so as to gain maximum diffusion.

The Society of Model Engineers.

London.

THE next meeting of the Society will be held at the Memorial Hall, Farringdon Street, E.C., on Thursday, April 10th, at 7 p.m. The Rev. W. J. Scott, B.A., will give a paper upon "Modern North-Eastern Railway Locomotives."

MODEL MAKING COMPETITION, 1902.

As announced at the January meeting of the Society, a model making competition, open to all members of the Society, will be held on the 22nd of May next, at the Holborn Town Hall, Gray's Inn Road, W.C.

Full particulars of the competition have already been published, and will be found on page 122 of the last issue of THE MODEL ENGINEER.

The usual monthly meeting of the Society was held at the Memorial Hall, on Wednesday, March 12th, Mr. Percival Marshall taking the chair at 7.30 p.m. After the formal business of the evening was concluded, some six members read short papers upon the various subjects enumerated below:

- Mr. H. S. Boorman—"How I Made the Back Gear of my 4-in. Lathe."
- Mr. J. C. Crebbin—"The Construction of the Bogie of my New Model Compound Locomotive."
- Mr. H. Hildersley—"On the Making of a 4-in. Spark Coil," concluded by experiments.
- Mr. A. Bowling—"How not to do it."
- Mr. H. Riddle—"The Building of a Model Over-type Dynamo."
- Mr. H. Greenly—"Model Making Arithmetic."

The lecturers illustrated their remarks by sketches upon the blackboard and by reference to examples of their handiwork, which lay upon the table before them. At the conclusion of each paper, questions were asked and answered. The Chairman proposed a hearty vote of thanks, which was carried with acclamation, to Messrs. Boorman, Crebbin, Bowling, Hildersley, Riddle, and Greenly, for the admirable way they had contributed to the success of the evening.—HENRY GREENLY, 4, Bond Street, Holford Square, W.C.

Provincial Branches.

Cardiff.—The annual meeting of this branch was held at 7 and 8, Working Street, on March 4th, with Mr. Eastabrook in the chair. The attendance was not large, but included a good sprinkling of visitors. Mr. Ferrier's launch engine, now finished, was shown, and considerable discussion ensued as to the best means of securing concerted action between the two propellers. The question of automatic steering gear for model steamers arose out of this, and the discussion spread thence over motor-cars, turbine engines, and electric trams. The next meeting will take place on April 1st.—R. T. HANCOCK, Hon. Sec., 168, Newport Road, Cardiff.

Dublin.—The first open meeting of the Dublin Branch for the present year was held at the Society's Rooms, 3, Burgh Quay, on Tuesday, February 18th, 1902, the President (Mr. J. Graham Purser) taking the chair. After the usual routine business, in the course of which letters were read from Mr. J. H. Ryan, M.A., T.C.D., President of Institute of Civil Engineers, Ireland, accepting the post of patron, and from Mr. Marmaduke Backhouse, B.A., M.I.C.E., accepting the post of vice-patron to the Dublin Branch, a most interesting lecture was delivered by Mr. A. W. Whieldon, Chief Electrical Engineer to the Hill of Howth Tramway (G.N.R.I.), on "Some Continental Applications of Electricity." He prefaced his remarks by some observations of an introductory nature, and then gave particulars of many interesting Continental installations—chiefly those in which water-power was employed as the prime mover, illustrating them by some very effective lantern views, prepared by Mr. T. Mason, Dame Street, from photographs in the possession of the lecturer. The lecture was highly appreciated by a large audience of members and friends, who heartily supported the vote of thanks conveyed to Mr. Whieldon before the proceedings terminated.

The next meeting of the Society will be held at 3, Burgh Quay, on Tuesday, March 18th, when a paper will be read by Mr. Blissett on "The Construction and Working of Motor Carriages."

Intending members are requested to correspond with the Hon. Secretary, who will be pleased to send them full particulars.—TREVOR E. WINCKWORTH, Hon. Secretary, 149, South Circular Road, Dolphin Barn, Dublin.

Edinburgh.—The usual fortnightly meeting of the Edinburgh Branch was held at No. 13, South Charlotte Street, on February 26th, Mr. F. R. N. Curle in the chair. There was a large attendance of members. After two new members had been elected, Mr. Curle read a letter from a member, who does not wish his name made public, offering a sum not to exceed £20 for the purchase of a lathe for the use of the Branch. This generous offer was enthusiastically received by the meeting, and a motion that the Hon. Secretary be instructed to convey the thanks of the Branch for this handsome gift was carried with acclamation. Mr. J. Gillon Fergusson had brought up for our inspection a model marine engine and water-tube boiler, constructed by himself, and this he now showed working. The engine (a two-cylindered launch engine, ¾ in. bore, 1⅛ in. stroke) had originally been of the oscillating type, and had been converted, by the addition of circular valve boxes to the circular valve faces. The boiler is a water-tube one of the Yarrow type, having sixty-four ¼ in. brass tubes 5 ins. long. The steam drum is 10 ins. long, 2⅛ ins. diameter outside measurement, and is made of ordinary brazed brass tubing. The boiler is fed by a feed pump driven off the engine shaft. The steam-raising powers of this boiler surpassed anything that most of us had ever seen. From cold water steam at 40 lbs. pressure was raised in a fraction over three minutes, the supply of steam being greatly in excess of the requirements of the engine. The boiler is fired by methylated spirit in two lamps, each with about ten burners. Quite sufficient steam was obtained with the use of one lamp. Some amusement was obtained by connecting a Whitney donkey-pump with the exhaust. The pump ran at a great speed, probably not far off 3000 revolutions per minute. The meeting closed with a vote of thanks to Mr. Fergusson.—W. B. KIRKWOOD, Hon. Secretary, 5, North Charlotte Street, Edinburgh.

Glasgow.—The monthly meeting of this branch was held in the Society's new rooms, 309, Shields Road, S.S., on Wednesday, March 5th, at 7.30 p.m., Mr. Beith in the chair, the minutes of the previous meeting being read and adopted, and two new members elected. Mr. Beith gave a very interesting opening address, explaining very forcibly the many advantages members would have in the Society's workshop. The Chairman received a very hearty vote of thanks for his address; also for supplying the benches and the necessary woodwork for Society's workshop. A Capital Fund has also been started in connection with this branch. Mr. McMillan exhibited the novel electric night light, illustrated in THE MODEL ENGINEER of October 15th, 1901, which is a finely finished model of a railway waggon. Mr. Falconer exhibited a beautifully finished model paddle wheel for a scale model of the G. & S.W. Railway steamer, *Glen Sannox*, which he has nearly completed. Mr. Cassells exhibited several castings of a ⅛-in. scale locomotive.

The next meeting will be held on April 2nd, at the Society's rooms. All communications should be addressed to JOHN ROGERS, Hon. Secretary, 79, Dundas Street, S.S., Glasgow.

Leeds.—A meeting of the Leeds Branch of the Society of Model Engineers was held on Tuesday evening, March 4th, there being nine members present. Dr. Wear brought a set of model locomotive castings, partly machined, with cylinders 1 in. diameter. Mr. F. C. Speke brought the pattern of cylinder head for a 1½ h.-p. bicycle motor which he is making, and has already got his casting from it. It was afterwards suggested by Mr. Tawns that we should make arrangements for visiting several large works in and around Leeds, the meeting terminating at 9.45 p.m.—W. H. BROUGHTON, Hon. Secretary, 262, Carlton Terrace, York Road, Leeds.

Nottingham.—A branch of the Society of Model Engineers has been started in this town, and the first general meeting will shortly take place. Will Nottingham readers who wish to join kindly communicate with the Secretary, Mr. R. P. READER, 4, Wellington Square, Parkside? The subscription is 5s. 6d. per annum.

TO READERS IN NEWCASTLE AND GATESHEAD.—The formation of a branch of the Society of Model Engineers in Newcastle-on-Tyne is proposed, and readers in this district are invited to correspond with Mr. R. W. Bamford, 7, Noble Terrace, Gateshead, with a view to holding a preliminary meeting. There is plenty of scope for a strong society in the great engineering centre on the Tyne.

How to Make a Simple Voltmeter or Ammeter.

By W. J. Nicholas.

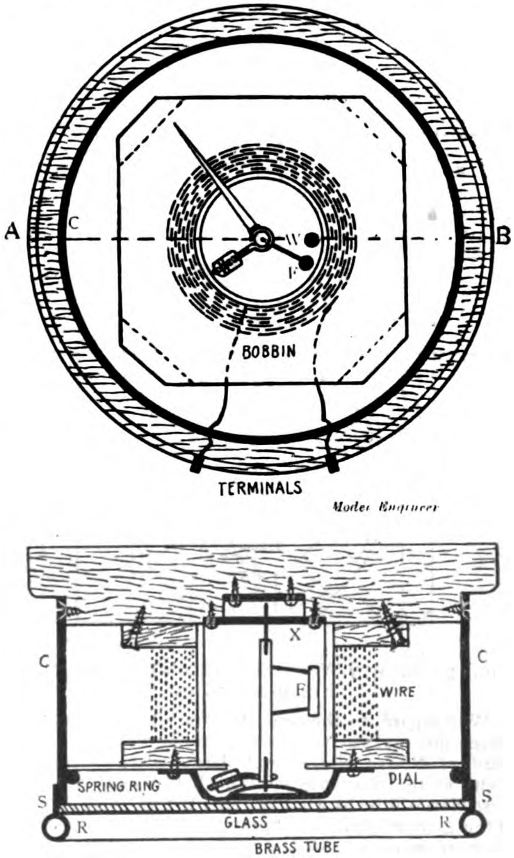
A NUMBER of readers of The Model Engineer, who have been interested in my article, "A Model Electric Light and Power Plant," published in the January 15th issue, have made enquiries with regard to the construction of the voltmeter mentioned therein. With a view to assisting those who desire to make a similar instrument, I have prepared the following description and illustrations. To this I have added the dimensions and a few particulars of my dynamo, queries having been received in respect to that, and I trust these will be of use.

Dealing first with the voltmeter, the first part to be made was the base, which in my case was cut from a piece of mahogany board, 1 in. thick, and turned in the lathe to the shape shown in the drawings. This could, however, be very easily made by using two thin pieces of wood, and cutting out one of them with a fretsaw, then screwing it to the other, and finishing off nicely with a file and glass paper. This method will appeal to the amateur who does not possess a lathe.

The containing case C, C (shown in Figs. 1 and 2) is a piece of large brass tube, 4 ins. in diameter and 2 ins. long. Holes were drilled around the circumference of this for the purpose of ventilation, and small countersunk holes for wood screws at one end to fasten the tube to the turned part of baseboard. The cover or outside rim R, R (Fig. 2), which keeps the glass in position, was made from a length of ¼ in. brass tube, bent in a circle by hand, the two ends being soldered together. A strip of sheet brass was next procured 5-16ths in. wide, and soldered around the edge of this tube, so as to be a snug fit on the outside of containing case (see S, S, Fig. 2). The glass front was, as explained in the previous article, taken from an old alarum clock.

The bobbin was constructed in the following manner: Two pieces of fretwood being obtained 2¾ ins. square, with corners cut off as shown in Fig. 1, for the ends, a hole was next cut out of the middle of each, and a paper tube 1-16th in. thick, 1 5-16ths ins. diameter, 1⅜ ins. long, made and glued in these holes so as to form a bobbin; and when dry this was wound with No. 36 cotton-covered copper wire till about three parts full, after which the two ends of the coil were connected to my dynamo, which gives a current at 20 volts. The dynamo was then run for about half-an-hour or more, and by this experiment I found that the coil got warm, proving that there was insufficient wire on the bobbin. I added more wire, till this defect was cured. Pieces of wood were then cut to fit, and glued in each corner of the bobbin as supports (see dotted lines in Fig. 1), the bobbin was screwed on the base, and an ordinary wire nail (minus the head) driven into the base at right hand side of paper tube (inside), as shown at W, Fig. 1.

The action was made from a piece of brass wire about ⅛ in. thick and 1⅜ ins. long, in each end of which was drilled a small hole with a needle drill about 3-16ths in. deep. An ordinary fine pin (without the head) was soldered in each end to act as straight pivots, as will be seen by reference to Fig. 2. A glance at this illustration will show readers how the bearings were constructed, and I may point out that it is very necessary to have a good working fit here and yet no binding, as, should the holes in bearings be a shade too large or too small, the instrument would be useless. It will be easily understood that if the holes are too large there is a rolling action, and the spindle would not revolve on its own axis; and, on the other hand, should it be too tight a fit, it would not move at all, or very little. Fixed to this spindle by fine wires is a small piece of iron wire F, which, as soon as a current of electricity circulates in the coil, becomes magnetised in the same manner as the fixed rod W in Fig. 1. Now, since "like poles repel," F moves further away in accordance with the strength of the current; in other words, the higher the voltage the greater the flow of electricity in coil, and, consequently, more movement of F. I did not find it necessary to have a compensating coil in this instrument, as I found I could do all that was required by varying the size of F and the distance it was placed towards or from the centre, the final adjustment being made by means of the little weight shown in both figures. The pointer was cut out of very thin sheet brass and soldered on the extreme end of the spindle.



Figs. 1 and 2.—A Simply made Voltmeter.

The dial is of white cardboard, held in place by the outer bearing, and also by a thick brass wire spring ring at outer edge, which is also a finish to the dial. I first marked the position of scale in black lead and put the dial back in instrument, and then fixed another voltmeter in parallel with it. The dynamo was then started slowly and gradually run faster, until the maximum voltage of both instrument and machine was reached, which is 20 volts, having meanwhile marked the dial at 0, 4, 8, 12, 16, and 20. These points were afterwards marked over with ink.

It will be noticed that the iron wire nail W (Fig. 1) is omitted in Fig. 2, as it would have to be drawn exactly on top of the piece F, which would, perhaps, be con-fusing. It should also be understood that the piece of brass X (Fig. 2), which forms part of the inner bearing, is dipped at this side to allow W to be driven into base of instrument. Both F and W were well annealed.

I feel constrained to remark that this instrument would be more satisfactory if pointed pivots with jewelled seatings were used in place of the straight pivots shown, as one cannot always rely on the pointer coming back exactly to zero, if the current dies out slowly, and also that the voltmeter must always be kept in one position, owing to the fact that it is of "gravity" type. If readers will kindly refer to the article, "A Model Electric Light and Power Plant," they will see that the instruments are fastened to a switchboard, which, of course, has to be levelled each time it is refixed, and this puts matters right.

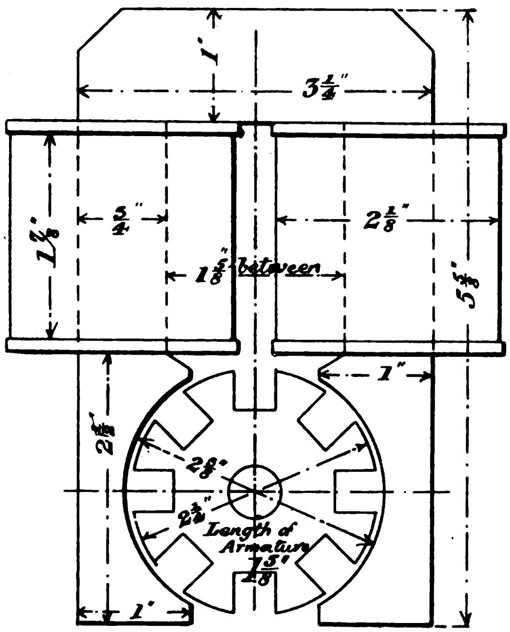


FIG. 3.—EIGHTY-WATT DYNAMO WITH LAMINATED FIELD-MAGNETS.

With regard to the ammeter, the only difference between this and the voltmeter is in the winding. A few yards of No. 14 wire, or even larger wire, will be sufficient, as the resistance must be kept very low, and the best plan will be to wind on, say, twelve turns, and see if this gives enough deflection of the pointer before putting on more wire.

The dynamo, it will be remembered, is an undertype drum machine, giving 4 ampères at 20 volts. The field-magnets are of sheet iron, cut out with the shears, and are illustrated in the drawing Fig. 3. Following are the principal dimensions of the dynamo:—The field-magnets are 5⅝ ins. high and 1½ ins. long. The armature is 1⅝ ins. long and 2¼ ins. diameter, slotted drum type, with eight slots, ⅜ in. by ⅜ in. by 1⅝ ins., wound with about 8 ozs. No. 22 wire. The field-magnet bobbins are 1⅞ ins. high, 2¼ ins. long, and 2⅛ ins. wide, entirely filled with wire, which would amount to about 1¾ lbs. No. 24.

The bearings are 1½ ins. high from base to centre of shaft, and 1⅜ ins. long; their construction is described in the article previously referred to. The shaft is 9½ ins. long and ⅜ in. diameter.

Motor Cycles and How to Construct Them.

By T. H. HAWLEY.

(*Continued from page 134.*)

XIX.—ALTERNATIVE DESIGNS FOR QUADRICYCLE FRONT SEAT, SPRINGS, ETC.

THE only work remaining to be done to complete the quadricycle is the construction of the front axle and steering mechanism, the springs, and the seat for passenger. The general arrangement of the front carriage is made clear in Fig. 84 in last article, in which the wheel hubs are pivoted at X, X, the front axle N being connected to the frame tubes by the springs, and the steering effected by the ordinary cycle handlebar operating the levers and connecting-rods as shown.

I am not giving drawings of the individual small parts of this portion of the work, for the connection-rods, etc., require no further explanation, and I am sure that it will be advisable to purchase the hubs and steering sockets connected to them complete, as it would be a difficult and tedious job to make these, and would not at all repay in actual results, for both hubs and steering sockets are on ball bearings, and this involves a lot of careful hardening and tempering. The hubs cost about £1 10s. per pair, and both hubs and sockets may be purchased complete from the "United Motor Industries," of 42, Great Castle Street, Oxford Street, W., or of the Eadie Manufacturing Company, Redditch.

Fig. 85 shows the arrangement complete, the axle tube A may be either 1 7-16ths in., or 1 9-16ths-in. diameter, according to the make of fittings; but the drawing, which is a French pattern, is really bored for 40-mm. tube.

The hub has an extended spindle B, which passes through the body of the pivot C, the hub spindle extension being tapered and of great diameter and strength at the shoulder.

The pivot block C is bored as shown, in a reverse direction, to take the connecting rod arms of the steering gear, and extends in one piece to the point D, being a strong tapering pillar, forming the seating for the ball-bearing socket, which is brazed up to the axle tube. This socket may, of course, be simplified by making the bearing an ordinary parallel or taper pin; but it is decidedly worth while fitting balls, as the dead weight is considerable, and it is imperative that there should be little or no backlash or lost motion in the steering gear, and to this end great care should be taken at each connecting-rod joint to have reamed holes, and preferably case-hardened pins or bolts. The pivot C to D, and also the hub spindle B must be in best forged mild steel, as there is a very considerable shearing strain on each.

We now come to the question of fitting up the vehicle with a front seat, and this portion of the work, according to the manner in which it is carried out, will either make or mar the whole machine, and my experience is that directly the average amateur metal worker touches woodwork and upholstery, he as a rule leaves a great deal to be desired in the matter of beauty of outline, and smart finish; so that in a job like this quadricycle front seat, we have to guard against the soap-box-on-wheels effect, which it is so easy for the amateur designer to produce; nor can many of the regular makers of this type of vehicle be complimented on their ideas of what constitutes a luxurious front seat.

About two years ago I had a quad specially built to my order by one of our largest and best firms, and I was particularly careful to impress the importance of elegance in appearance, correct proportion, and first-class upholstery; but, although the mechanical work was A1, the front seat was far from being comfortable, and the positions and dimensions badly worked out, the chief faults being—want of slope on the seat proper, so that the rider had the feeling of slipping out forward unless holding himself up by the footboard; the back rest placed so that it came right in the small of the average back, with unpleasant results when passing over bumpy road; arm rests placed at wrong angle and out of reach when reclining against seat back; insufficient depth from front edge to back of seat cushion, and too great a distance from front edge of seat cushion to footboard; whilst the general appearance was spoilt through the outlines not conforming to the angles of the frame tubes.

in last article, and consisting simply of two side springs bolted to front axle and to forward end of frame side tubes, the rear ends terminating in a shackle, and connecting them to a similar cross spring bolted to the centre of the cross frame tube J.

The body part of this seat looks very well in polished American walnut, and the rest of the woodwork comprised in the well under the seat and the footboard extension may be stained black and varnished, with just a polished walnut splashboard in front, or, if a little extra time and cost is not objected to, the whole of the outsides may be in polished or varnished walnut.

The back rest and the arm rests are of stout cycle tube or solid steel rod in nickel-plated finish, and furnished with padded rests for back and arms as shown; the deep

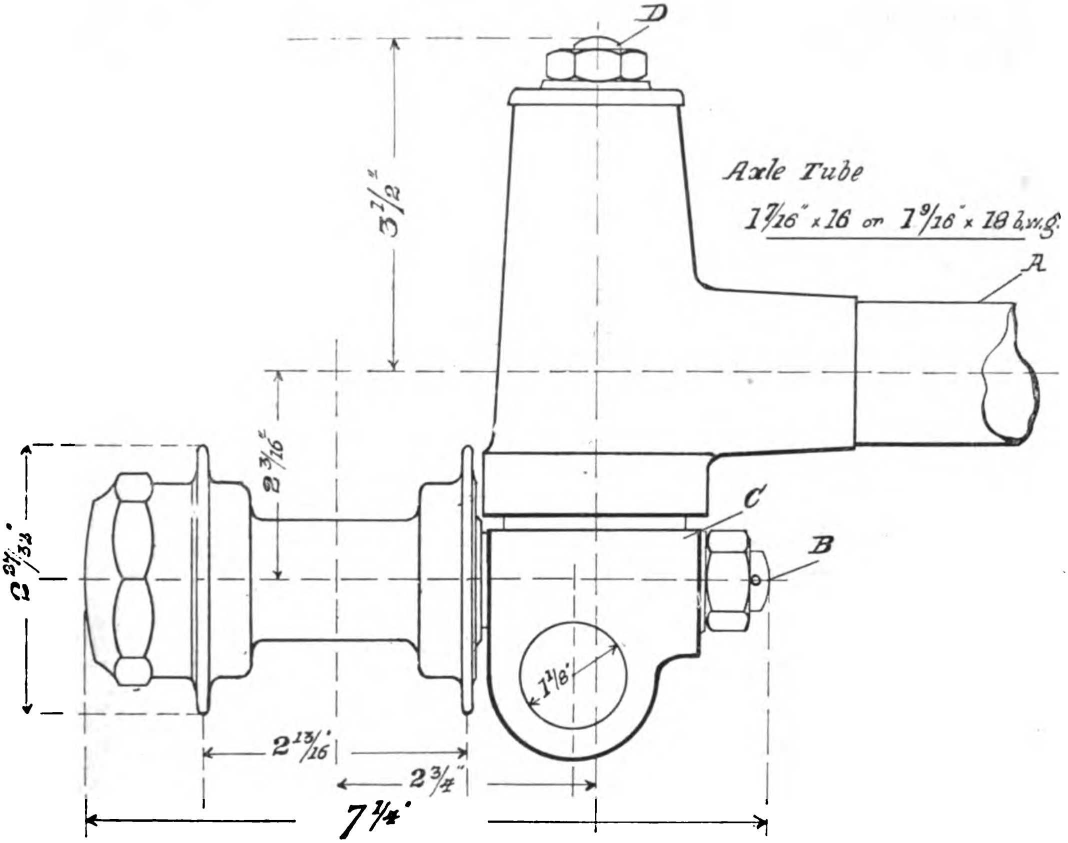


FIG. 85.—HUB AND STEERING SOCKET FOR FRONT AXLE OF QUADRICYCLE (Half Size).

I mention all this because in the designs I am now presenting I have embodied all my experiences through a series of alterations and observations in connection with the above faulty seat, and I submit Fig. 86 as being about the correct thing in its various dimensions to suit a person of average size, whilst in appearance it is light and graceful enough if the work be well carried out.

It will be seen that the complete seat and footboard is simply clipped directly to the two side tubes of the main frame, these clips simply encircling one half of the tube and permitting of the removal of the seat by slacking off the clip nuts, which screw on to bolts passed through from the inside of the seat body framework. The springs are not shown in this drawing, but were given in Fig. 83

well or boot below the seat forms a roomy cupboard for tools and other small luggage, and will be found most convenient. The seat proper is a wedge shaped removable cushion, shown by the dotted lines, and under this is a false bottom on the dotted line *a, a*, which when lifted gives access to another space between it and *b, b*, which is the fixed bottom and the main support between the two side frames; this latter space *a, b*, was devised for stowing away a waterproof sheet or any spare article of clothing requiring to be kept dry, and to this end the false bottom should be in one piece, well-varnished, and preferably resting on a rubber strip fixed on the edge of the seat framing at *a, a*, and small drain tubes fitted to each corner at the rear end, carry water clear away of seating and both under compartments.

I have not thought it necessary to give a lot of detail drawings of this seat, as the essential features are made clear in the one drawing, and a few words of description should enable any amateur to produce a satisfactory result.

The simplest way to build this seat will be to make a light skeleton framing in ash or other similar well-seasoned wood, the joints preferably mitred, but may be simply halved together. A suitable size of "stuff" for the main portion of the body frame is 1¼ ins. by ¾ in., with the exception of the two main side pieces, which are ¾ in. stuff tapering from 2½ ins. to 1½ ins., as shown at *a*, *b*, *a*, *b*, and from this the underpart of the frame is continued, as shown by the dotted lines *c*, *d*, *e*, a piece of wider stuff, extending from the forward end of *a*, *b*, as far as *f*, to form the support for the footboard, the sides of which should be in one piece to the full outline of the drawing from *f* to *g*, this portion of the framing being attaching the panels after polishing being by round-headed bolts of small size with plated polished heads, and spaced about 4 ins. apart for the main panel A, with one at each corner of B and C, the remainder of the outline of B and C being fixed with invisible screws.

The cushion for the seat, and the arm and back rests should—for preference—be stuffed in curled horsehair, though picked wool or fibre makes a good stuffing at a fraction of the price; and the outer covering would, of course, be best in morocco leather of a brown or dark red shade; but an almost equally good appearance and great durability is obtained by using Crockett's best grained imitation leather cloth; woollen or fabric coverings are unsuitable, because of absorbing wet in bad weather.

Fig. 87 is an alternative design of even more graceful appearance, and extremely luxurious by reason of the hammock seat and special method of spring.

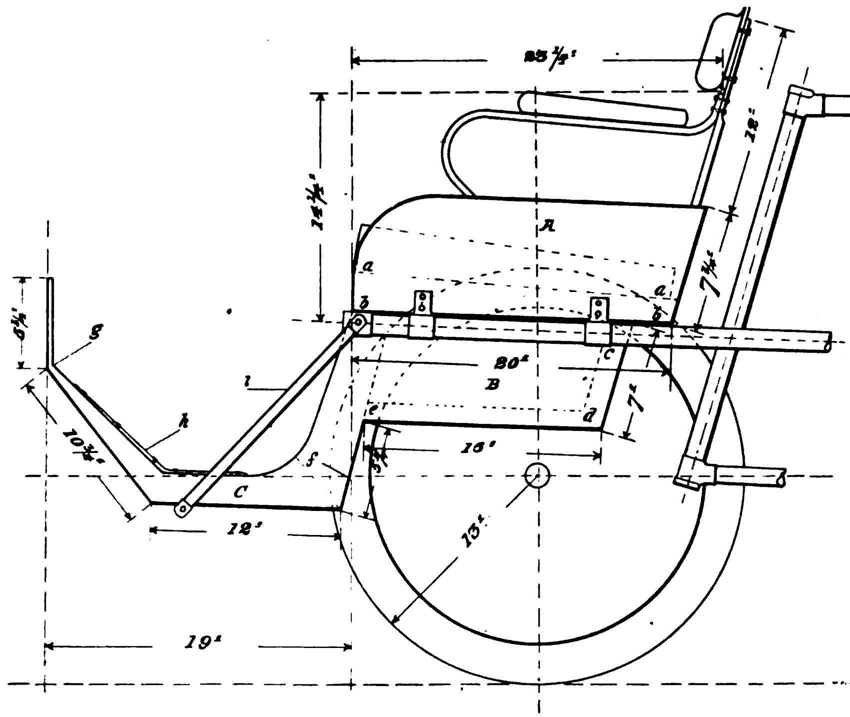


FIG. 86.—FRONT SEAT OF QUADRICYCLE. *Scale:* 1 in. = 1 foot.

strengthened by some half-round strip iron at *h*, and the steel tube suspension rod *i*, which is bolted to the tube at the upper end, and to a flattened steel rod screwed to the underneath side of the footboard, in addition to which a sheet iron plate should be screwed to the inner faces of the woodwork at the joint *f*.

The top body part is built at a width which will just bring the two tapering side pieces *a*, *b*, to rest on the centre of the two side tubes of the frame, and as the box body has to pass between these tubes, the difference in width may be taken advantage of if desired to fix the two vertical supporting pieces from *c* to *d*, and *b* to *f*, by screwing to the inner face of *a*, *b*. The method of attaching the back rest and arm rods will naturally suggest itself when the woodwork framing is completed, and the panelling of the sides will consist of three pieces, A, B, and C, of ¼ in. or 5 16ths American walnut, finished according to taste and inclination, the easiest and neatest method of

Although the outline of this seat bears no resemblance to the other, it will be found, on comparing the chief measurements that the actual position of the passenger will be much the same, and to those who prefer tubular work to woodwork, this seat will probably be the selected one; and with all the side tubes nickel-plated, it certainly makes a handsome finish to the whole machine. But there are other advantages in the arrangement, for the two D-shaped supports for the hammock or suspension seat cushion are hollow drums *E* and *F*, forming tanks for reserve petrol and lubricating oil, or the larger one for a water tank if it is decided to fit a water-cooled engine, and it would be impossible to arrange the same tank capacity elsewhere on the machine with so little interference of other fittings.

The side tubes of the vehicle frame are attached to the spring work at the block *j*, and the fore-carriage by the front axle, the big C spring being bolted to one of the frame sockets at K, and resting on the block *l*, which is free to rotate on the pin on which it rests; the upper end of the C spring terminates in a rubber buffer and shackle attached to the side framing, whilst the forward end of the axle spring is bolted to a wooden footboard at *m*, which is attached by bolts and clips, or otherwise, to the main side tubes of the seat frame. The lateral rigidity of the seat is provided by the connection of the two complete side pieces to the aforementioned footboard, and the two tanks E and F, though if the tank F is to be brought out the full width, so as to bolt directly to the side tube, it will be necessary to cut away the portion of the vehicle frame tube which is forward of the spring block *j*.

With the two tanks and footboard bolted in position the structure is very firm and also lighter than the wooden seat, the suspension cushion being slung by means of leather straps held in eyes brazed to the flat bottoms of seat cushion; but the seat will lose something of its luxury by reason of unequal motion, though not to any great extent. I calculate that if the tanks are made the full sizes drawn, E will contain lubricating oil for 700 miles, and F, together with the ordinary carburettor tank, will carry petrol sufficient for 350 miles; or, again, if F be used as a water tank, it should be sufficient to work a water cooled combustion head by any ordinary method of securing a circulation without any additional condensing or radiating apparatus; but I shall have something more to say about water cooling and water circulation in the next chapter.

The drawings will, I think, make the rest of the construction fairly clear, but care should be exercised with the spring work.

The large C spring should be ¼ in. thick by 1⅛ ins. wide at its lower end, and preferably tapering to 3-16ths in.

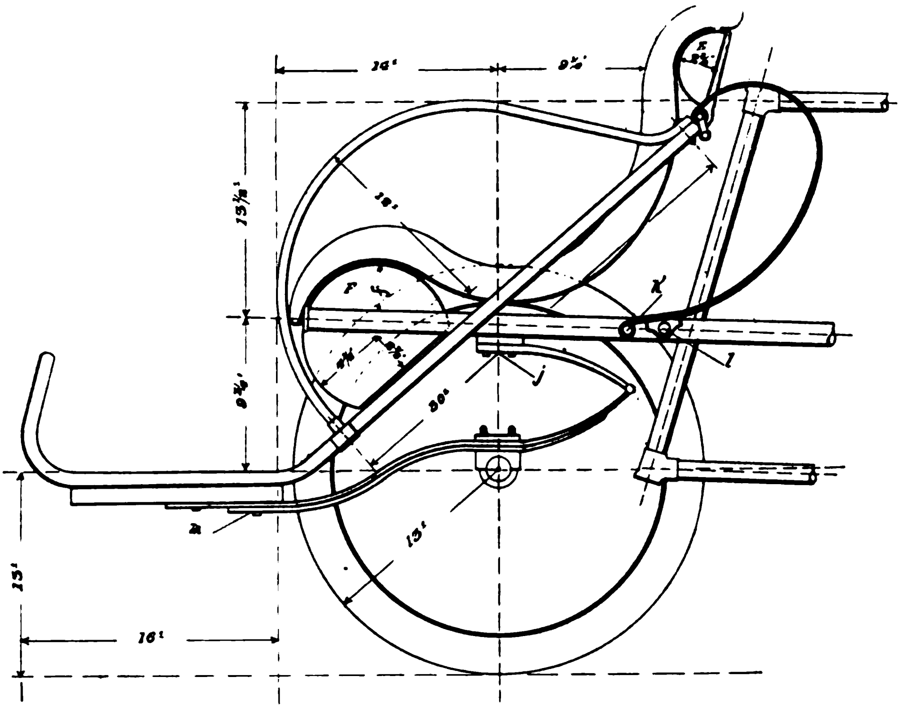


Fig. 87.—Alternative Design for Front Seat of Quadricycle.
Scale: 1 in. = 1 foot.

the two tanks, thus permitting of easy adjustment or complete removal of the cushion. The supporting material, or foundation of the cushion itself, is extra strong and wide chair web, a strip down each side and one in centre, to each of which the leather straps are sewn, the covering and upholstery as desired.

The tanks may be made of 20-gauge tinned iron, galvanised iron, or copper; but should be strengthened by 16-gauge end plates, which may be flush jointed and brazed or soldered up.

If so great tank capacity as would be afforded by tank F being carried through the full width of the seat and to the full D section is not required, then the better plan is to make the tank to the smaller cross section something less than the half circle, as shown, at *f*, and bolt it directly to the main tubes of the vehicle frame, where it will still answer the same purpose as a support for the thick at its upper end; the other springs are 3-16ths in. by 1⅛ ins., all of best spring steel, which after being heated and bent to shape, should be allowed to cool slowly; then each spring is tempered by smearing it thickly (all over) with ordinary thick machine oil, and then heating it by passing it to and fro over a fire or through a blowpipe flame until the oil blazes off, when the spring should be quenched by immersing it sideway and edgewise first in the water trough, taking care that the whole length of the spring makes contact with the water at the same time. But before this tempering is done, the springs should be fitted in place on the machine to see that they fall well into place, and in the first shaping and the after tempering it is important that corresponding springs on each side of the machine be alike in shape, strength, and temper, more particularly the two C springs, or the rider's weight will quickly cause a sagging over to one side when bumpy road is encountered.

This really completes the construction of the ordinary air-cooled quadricycle, and on a machine practically as described I have done some long and fast rides; but there was still something left to be desired, especially on long trips.

In the first place, with a fairly heavy passenger in front the machine was sometimes *difficult to start*, even when all was in good order; but if the ignition or the mixture was at fault, or the road slightly up hill, it was pretty well horse work to get the engine to "catch on," as it is necessary to do a short, sharp "sprint" at each attempt, consequently I usually contrived to start on a downhill slope, even if in the reverse direction to the one to be travelled, because once the engine commences to work and you can close the compression tap, regulate the air mixture to a nicety, you can take the first opportunity of turning round when the machine will be going strong and well.

On one occasion I got three parts of the way up a steep hill nearly a mile long, and when going well, was stopped by a nervous horse; but I found it impossible by any dodge to start the engine up hill, or to push the machine, hence I had to run down to the commencement and start again, when we came up in good style.

The only mechanical remedy for this is a clutch gear to enable you to start the engine alone and gradually take up the load.

The next trouble is *overheating* of engine through hard pressure at full power up long hills, or high-speed long runs on the level, and this can be obviated only by fitting a water-cooled cylinder or water-cooled combustion chamber or cylinder head.

Inability to climb steep hills is due to the piston gradually slowing down just at the time when it should be travelling fastest, as the power of these small motors is entirely dependent on piston speed. Once this is allowed to drop below a certain point on going up hill, it is impossible to start the machine again.

The remedy here is a two-speed gear, or else the original gearing of the motor must be low enough to overcome all likely hills. The ideal combination, then, would be a combined free engine clutch and two-speed gear, with a completely water-jacketed motor; but the first combination is an expensive item, and the second is difficult to arrange in the matter of water cooling on such a small machine as the quad; but very good results may be got from a water-cooled head and a simple free engine friction clutch, which I will deal with in my next.

(To be continued.)

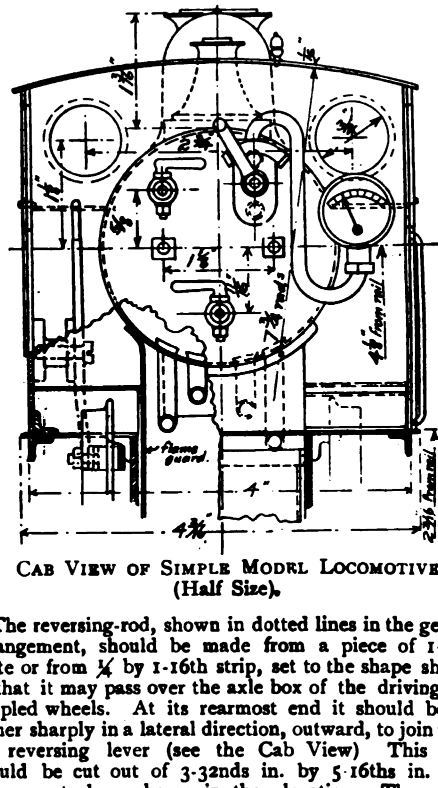
THERE is a distinct advantage, says the London *Electrical Times*, for industrial purposes in using alloys which are definite compounds on account of their being homogeneous, and therefore not liable to unequal corrosion. Considerable attention has been giving to the combining of alumina with magnesium, either by fusing the metals together or by reducing mixtures of alumina and magnesia in the electric furnace. From the specific gravities, Mg 1·74, Al 2·67, it will be seen that one of the valuable properties of aluminium, its lightness, will be enhanced, while the durability is stated to be little affected. M. Boudouard has just announced his discovery of three definite conpounds of these metals, obtained from alloys containing 30 to 70 per cent. of Al by partially dissolving them with ammonium chloride or hydrochloric acid. They form well defined crystals of the formulæ $AlMg_2$, AlMg and Al_4Mg, and the densities 2·03, 2·15 and 2·58, respectively. As shown by their preparation, their resistance to destructive agencies is very decided. But the process is an expensive one, as much of the metal is wasted.

A Simple Working Model Locomotive.

By H. GREENLY.

(Continued from page 131.)

IN the last issue, on page 130, a full-size drawing of the reversing arm was given, but the method of its connection to the spindle of the plug cock was not indicated. The best method of accomplishing this is to turn the spindle down to a shoulder, from 5-32nds in. diameter to an eighth, and fit the arm to it tightly, securing it from revolving by means of a 1-16th in. steel pin passing through the boss of the arm in such a position that half of its diameter engages the spindle in a similar manner to the cotter pin of a bicycle crank. The pin may be made sufficiently long for enabling its removal at any time the engine has to undergo repairs, and it should be a driving fit into its hole.



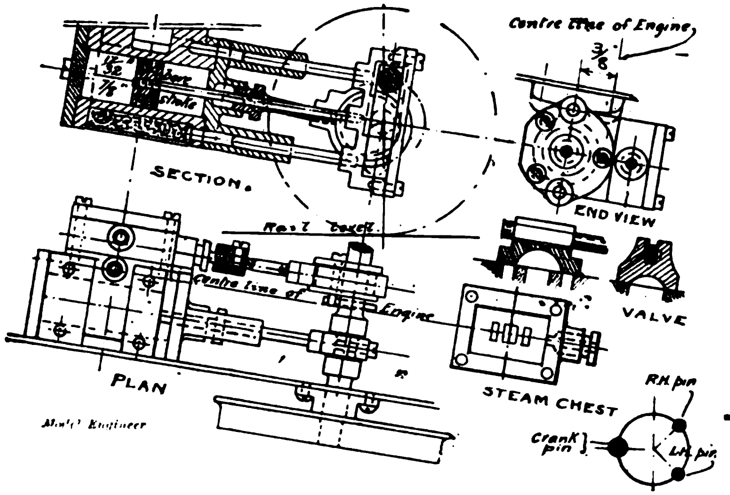
CAB VIEW OF SIMPLE MODEL LOCOMOTIVE (Half Size).

The reversing-rod, shown in dotted lines in the general arrangement, should be made from a piece of 1-16th plate or from ¼ by 1-16th strip, set to the shape shown, so that it may pass over the axle box of the driving and coupled wheels. At its rearmost end it should be set rather sharply in a lateral direction, outward, to join up to the reversing lever (see the Cab View) This lever should be cut out of 3-32nds in. by 5-16ths in. strip brass or steel, as shown in the elevation. The centre hole should be made deeper by the addition of a short piece of the same material, soldered and riveted on. A cast socket should be made, and into this the screw upon which the lever pivots should be fitted. When assembling this part, care should be taken that the screw just drives home at the moment when there is no looseness of the lever; this precaution will prevent the screw slacking back upon the movement of the lever, and also prevent it rocking in an undesirable manner.

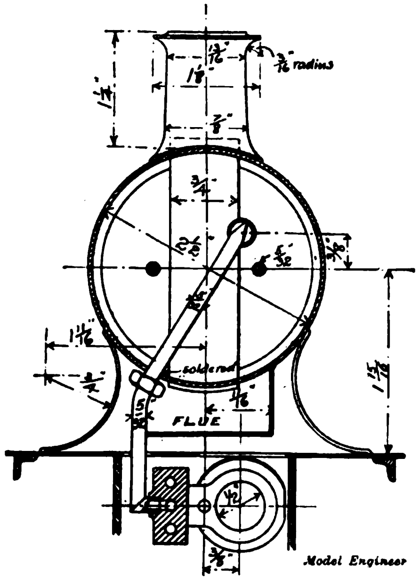
As previously mentioned, it is intended to provide an alternative arrangement of cylinder for this design. The accompanying illustration gives to half full size a slide-valve cylinder in place of the oscillating cylinder already described. The drawings are self-explanatory, and it is not here intended to go into a detailed description of them; but some of the respective advantages and dis-advantages may be commented upon. In steam distribution the slide-valve cylinder is much superior to the oscillating; but in an engine such as this it is not so apparent in practice, and also, because of the very light weight of the reciprocating parts and the comparatively low piston speeds, not so necessary, to provide "lead," which cannot be accomplished with the oscillating cylinder without lateness of cut-off. However, it is said by users of single cylinder model locomotives that a trifling advance in the admission of the steam is an advantage. The oscillating cylinder, however, can be reversed from the cab without complicating the engine to such an extent as is rendered necessary with a slide-valve engine, and is much simpler in construction. The use of the slide instead of connecting-rod is not altogether an advantage; but if carefully fitted in the first place, wear will not become evident for some time.

place, however, a circular plate with the ¼ in. hole for the crankshaft placed eccentric to the same amount as the sheave should be affixed on the outer side by the screw which projects from the other side of the sheave and engages the stop pin in the axle.

At the right-hand corner of this cylinder drawing is shewn a diagram of the arrangement of the crank in relation to the "side" rods. The crank pins for the coupling or "side" rods *must be at* 90 degs. apart; therefore, to preserve the best balance it seems preferable to place the crank at 135 degs. from each. To perfectly balance the engine would necessitate some considerable trouble, and the balance weights in each pair of wheels would have to be in different positions and of different magnitude; but to simplify matters the counter balances for the crank and reciprocating parts are dispensed with, and only the outside crank pins, bosses, and coupling rods are balanced, and even then only in an approximate manner. It will be noticed on the wheel bosses a chase is marked. This



SLIDE VALVE CYLINDER FOR SIMPLE MODEL LOCOMOTIVE—ALTERNATIVE ARRANGEMENT (Half Size).



SECTION THROUGH SMOKEBOX (Half Size).

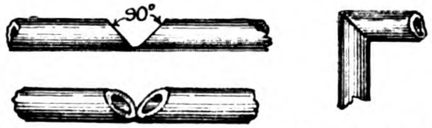
To provide the same power, as it is desirable that the length of the slide in which the crank-pin works shall not be too long, the bore is made 1-32nd in. larger than the oscillating one. The guides are designed in a manner which allows the engine to be very compact. In constructing these, special care must be taken to make the centres of the guide rods equi-distant, and also perfectly parallel to the piston-rod, and to ensure this, the following method—out of the many possible—of casting and machining, which has occurred to the writer, may be adopted:—The front of the slide, and the projections on the cylinder cover, might be cast in one piece, and after the filing up of the slide and facing of the cover, three holes should be drilled right through the whole, the two outer ones for the guide-rods, and the centre one for the piston-rod, with the drill stationary, whilst the work lies cover face outwards on an angle from the faceplate. The front of the slide could then be sawn off, and the piston rod and guide rods sweated into the front slide, when it has been finished, and afterwards secured by small 1-16th in. pins. The eccentric and strap are not of the usual construction. The strap is in one piece, and the sheave has only one flange. To keep the strap in

chase is meant to indicate the end of the axle, which, if to scale, would be of about that diameter. If the real axle is cut off flush, when the engine is painted no one will know that the circular line does not represent the joint between the axle and the boss. This expedient has been used by the writer with good effect.

The section at the cylinders looking toward the chimney shows the arrangement of the steam pipe clearly (see above). The union may be dispensed with if necessary; if this is done to fix or remove the boiler, the joint of the steam pipe and steam block will have to be sweated or unsweated, as the case may be. To make the elbow, the best method—one always used by the writer—is as follows: Mark off the position of the elbow correctly, and, holding the pipe between lead clams, in the vice, in horizontal position, make a triangular notch in the pipe. The adjacent sides of the notch should be at 90° for a right-angled elbow, and only cut half through the metal of the tube at the apex of the notch, leaving sufficient for bending without severance. If the tube is not soft enough to do this without fear of breaking, it should be softened by making red-hot and plunging in water. When the burrs have been cleaned from the inside of the tube, the faces should be given a stroke or two of the file, especially if it has been "thro' the fire" to soften it, to make it perfectly bright. The outside of the tube, near the joint, should also be cleaned. The tube may now be bent to form the elbow, as shown in the drawing below. It should be coated, by means of a camel-hair brush, with some borax, which should be ground up by rubbing a small lump upon a slate with a little water; then lay on the joint to be soldered several small pieces of silver solder, about 1-32nd in. square. The solder, which costs about 2s. per oz., is sold in sheet, 1-64th in. thick. This can be cut into minute pieces with a pair of scissors.

To heat, an ordinary gas bracket, the burner of which has been removed, and the vertical elbow given a ¼ turn into a horizontal position, and a mouth blow-pipe—such as jewellers use, costing about 5d.—is required. Lay the tube on a piece of asbestos millboard or charcoal, and blow upon it, at first gently. If the heat be applied fiercely at the commencement, the ebullition of the borax will most likely push the solder off the joint. When the borax has ceased to move, the flame may be concentrated upon the joint, and, at cherry-red heat, the solder will run into the joint; do not carry the heating any further, or the tube may become "burnt."

Such a joint as above will make the elbow almost as strong as if it were in one piece of metal without a joint,



METHOD OF MAKING A RIGHT-ANGLE BEND IN SMALL STEAM PIPE.

and when it is necessary to sweat the steam pipe into the block there is no fear of the joint unsoldering, as it would do if made with ordinary soft solder. The pipe may then be sweated into the enlarged end of the horizontal part of the pipe, with a blowpipe, before the front end of the boiler is affixed. It will be necessary to tin the joints previously. The shape of the end of the vertical pipe, shewn in the general arrangement in the issue of March 1st and in the section herewith, should be noted. It prevents the pipe being pushed in too far into the horizontal member, and stopping a clear way through them.

The construction of the boiler itself is clear from the drawings. A piece of brass tube, 9¾ ins. long by 2½ ins. diameter and 1-16th in in thickness is required. Two cast ends must be provided the flanges of which should be turned to fit the tube fairly well; an allowance should be made for tinning the tube and the ends before fitting together. To secure the ends, six screwed pins, made from 3-32nds (No. 12 I.W.G.) brass wire should be driven through the tube and the flanges. A handy length of brass wire, say three or four inches, should be cut off. and when the ends are finally to be fitted the six holes at each should be drilled and tapped. The wire should be screwed at one end for about ¼ in., and before driving it may be dipped in the tinning acid or other soldering flux, and forced into the hole as far as it will go. With the nippers, the superfluous wire may be cut off and the pin filed flush. The operation should be repeated in each case, and when completed the boiler ends may be made warm, and the whole securely prevented from leakage by the soft solder, which will run into all the joints with a little persuasion.

(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 AUTOMOTOR POCKET BOOK FOR 1902. London: F. King & Co., Ltd., 62, St. Martin's Lane, W.C. Price, boards, 1s.; leather bound, 2s. Postage 3d. extra.

We owe a debt of gratitude to the publishers of this excellent pocket book, the successive issues of which have occupied an important position on our reference shelves. Those of our readers who are interested in any of the branches of motoring should likewise be grateful for the enterprise displayed by the compilers, who deserve every support. The volume is very well printed and produced, and is crammed with subject matter of great importance, as well as of great interest, pertaining to automobilism. Apart from tables of measures, squares and roots, &c., common to most engineering pocket books, special information on the following subjects is included. The law as regards "light locomotives," units of power, roads, gearing, and cycle mechanism, springs, flywheels for motors, fuels, petrol, liquid fuel burners, types of steam generators, and engines for motor purposes, the action of a petrol engine, carburettors, and electrical matters; drawings of various types of petrol and light oil engines are given, and also a French-German-English glossary of technical terms. Altogether, THE MODEL ENGINEER reader who would not find something in the book to interest him, would be hard to find, and we may incidentally warn quite a number of our querists that their replies will take the form of a reference to the pages of the "Auto-motor Pocket Book."

THE SELECTION OF SUBJECT IN PICTORIAL PHOTOGRAPHY. By W. P. Tindall, R.B.A. London: Iliffe and Sons, Limited, 3, St. Bride Street, E.C. Price 3s. 6d. nett. Postage 3d. extra.

The best that can be said of this volume is that its printing and (generally) its illustrations are excellent. We do not always agree with its author's views, and where we do, it is usually in regard to some self evident fact which hardly needed the space and the picture devoted to its exposition. Nearly all the illustrations are reproductions from studies in oil-colour by the author himself.

PUMPS: THEIR CONSTRUCTION AND MANAGEMENT. By Philip R. Björling. London: P. S. King and Son, 2 and 4, Great Smith Street, Westminster. Price 3s. 6d. nett. Postage 3d. extra.

As might be expected from Mr. Björling's reputation in matters pertaining to pumping machinery, this volume is an eminently practical treatise. It contains constructive details and excellent drawings of pumps of various types and for dealing with different liquids, and includes also some hints on their fixing and management. The extent of the ground covered may be gathered from the fact that pumps of the plunger or ram, bucket, piston, rotary, centrifugal, diaphragm, and pulsating types are all fully described, each with the modifications and variations found in practice.

MACHINE SHOP COMPANION. By Wallace Bentley, M.I.Mech.E. Halifax: Bentley Publishing Co, Crossley Street. Price 1s. nett. Postage 1d. extra.

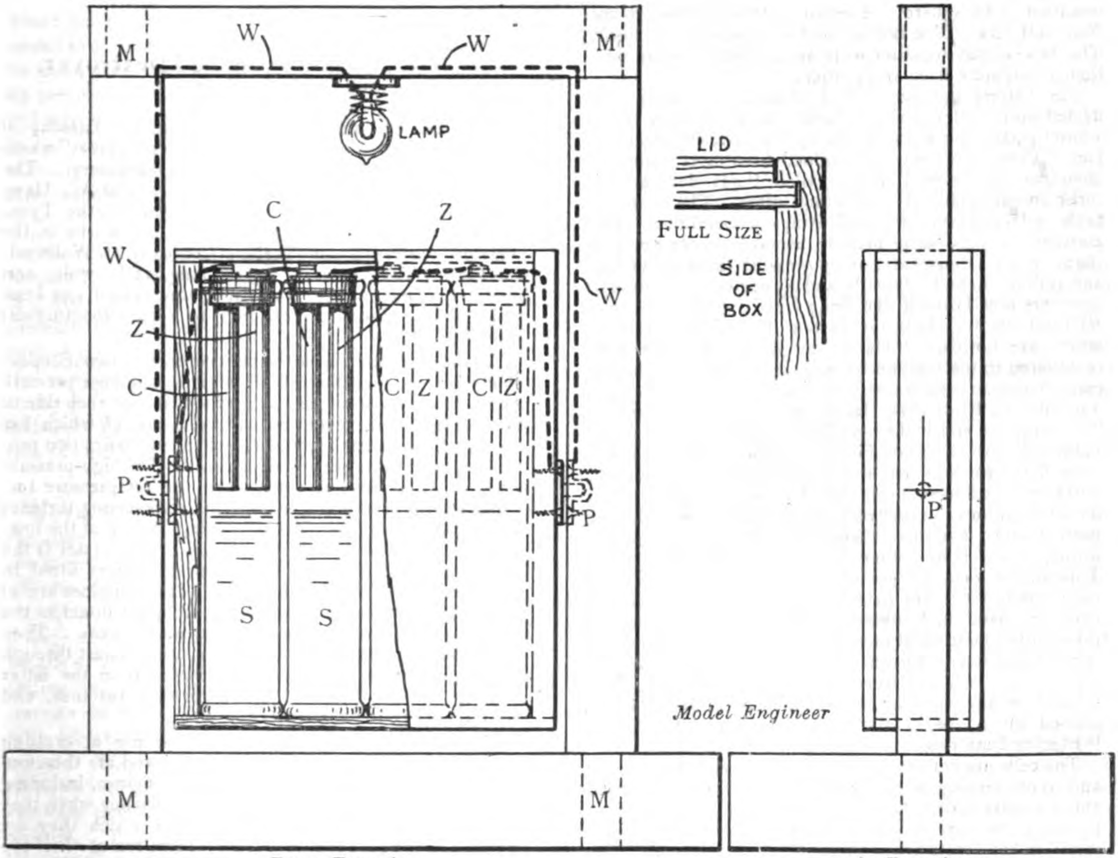
This little handbook is one of those which every model engineer who is engaged in mechanical work should have by him. It contains a well-assorted display of notes, rules, and tables, all of which will be found useful for solving quickly and accurately the little calculations daily met with in the shop.

An Invertible Electric Night-Light Set.*

By J. Strachan.

THE night light about to be described was constructed with the following two objects in view, namely, compactness and portability. There is no clumsy Leclanché battery, and consequently it can be removed from one room to another easily. As to its economy, there is no consumption of zinc when the battery is not in use, and lastly there is no such trouble as feeling for the switch in the dark.

The construction of the arrangement is plainly shown in the sketch, which is drawn to a scale of 3 ins. to a foot; but the detailed dimensions, as given hereafter, need not be rigorously adhered to, so long as the battery is of the requisite size, as described. The battery is contained in a flat box swung by means of pivots, in the fashion of a mirror, between two side-pieces mortised (see M, M.) into a baseboard at their lower ends and into a cross-piece at their upper extremities. On the underside of this cross-piece in the centre, the electric lamp is suspended. The battery consists of four long glass cells having the carbons and zincs suspended in the upper half, while the battery solution rests in the under portion S, in the Fig. On inverting the box containing the battery the latter comes into action because the solution then covers the elements. The current is conveyed, as shown, by wires inside the box from the battery terminals to the pivots, thence into other wires W leading to the lamp. These latter wires are imbedded in a small groove or saw cut, which runs up the inner faces of the side-pieces and along the underside of the top cross-piece of the frame. This groove is afterwards filled in with putty. This arrangement of swinging the battery on pivots attains the double object of a handy switch and of preventing the elements from wasting away when not in use. We shall now describe the constructive details of each part separately, but before doing so it may be mentioned that yellow pine wood was used throughout the construction.



Front Elevation. Side Elevation.

An Invertible Electric Night-Light Battery.

The baseboard is 15 ins. long by 8 ins. wide by 2 ins. thick. At a distance of 2⅞ ins. from both ends of the board and equi-distant from both front and back edges of the same, a couple of mortises are made ¾ in. square to receive the side-pieces. The latter are 17½ ins. long by 1¼ ins. broad by 1 in. thick. For a distance of 2 ins. their lower ends are tenoned to ¾ in. square to fit the baseboard mortises. The upper ends are tenoned in a similar fashion for a distance of 1¼ ins. to fit into

* This article was awarded an "extra" prize in our Competition No. 16, "How to Make an Electric Night Light."

mortises cut in the top cross-piece which is 11¼ ins. long by 1½ ins. deep by 1 in. thick. The mortises are glued.

The external dimensions of the battery box are 10 ins. by 8 ins. by 2½ ins. The front and back are ¼ in. thick by 10 ins. long by 8 ins. wide. The sides, into the centre of which the pivot screws are fastened, are ½ in. thick by 10 ins. by 2 ins. The top end of one of these sides is cut short by ¼ in. to permit of the lid, which is ¼ in. thick, sliding on and off. A groove or "corner" ⅛ in. square is cut all round the inside of the very top edge of the box. The distance of the top edge of this groove from the top edge of the box is ⅛ in. This groove is for a bead on the lower edge of the lid to run in, so that the lid (being ¼ in. thick) is flush with the top edge of the box. This bead is, of course, a little less than ⅛ in. square. A detail of this is shown in the Fig., full size. The bottom of box is also ¼ in. thick. The box is put together with ½-in. brass screws with their heads sunk flush and puttied.

The battery consists of four chromic acid cells connected up in series as shown in the sketch. Each cell is a stout glass tube about 9 ins. by 1¼ ins., closed at one end. These tubes may be obtained from most dealers in chemical apparatus and are called "gas detonation" tubes and are made of combustion glass. The mouth of each cell is closed by a cork bung—a sound one. The elasticity of these bungs may be increased by compressing them in a cork squeezer, or by pressing them under foot and rolling them backwards and forwards. A couple of holes are now bored in the bung with a cork borer or a rat's-tail file to admit the carbon C and zinc rod Z, which are both about 4½ ins. by ¼ in. A copper wire is soldered to the top end of each zinc rod. The upper ends of the carbons are coppered as described on p. 44 of THE MODEL ENGINEER Handbook, "Electric Batteries." The coppered end is then drilled to admit a ⅛ in. sharp pointed "Daniell" type binding screw. The coppered ends of the carbons are also painted with paraffin wax. After the holes have been cut in it each bung is soaked for a few minutes in melted paraffin. After the cells have been charged and firmly corked, a single hole is made through each bung by means of a stout darning needle. This allows gases to escape, but the solution does not pass through it to any extent. [An improvement could here be made by providing short glass tubes passing through the bungs and fitted at their outer ends with the tiny india-rubber balloons used for a similar purpose on small sealed accumulators.—ED. *M.E.&A.E.*] The solution is the ordinary bichromate one prepared as described on p. 46 of the before mentioned handbook, "Electric Batteries."

The cells are connected in series, *i.e.*, zinc to carbon, and so on, leaving an unconnected zinc as one terminal, and a similar carbon for the other. The cells are now placed in the box, and the two wires inside the box leading from the pivots are connected to these terminals. The spaces between the cells are packed tightly with sawdust till the box is quite full, and the lid is then put on. The pinching-screws of the pivots are tightened up till the box swings easily, but not freely. These pivots P, P, are ordinary mirror pivots "medium" size. The "ball" half of the pivot is screwed into the centre of the side of the battery box, a small hole beside the screw going right through the side of the box. Through this hole the connecting wire from the battery terminal comes to the pivot. The "socket" half of the pivot is sunk flush with the face of the side-piece and the connecting wire which runs in the groove mentioned before is screwed down under this half of the pivot. The connections to the other pivot are duplicate of this, so that we now have a complete electric circuit from the battery to the pivots and thence to the lamp. The latter is a 6-volt high efficiency carbon lamp, which, with the above battery, gives between 2 and 3 c.p., depending on the freshness of the solution. With fair usage the battery charge will last for about a month, or even longer, but of course that is using it occasionally for momentary lighting, to see the time, etc.

The night light is now finished except for ornamental details. In the original, the woodwork was stained mahogany and polished. A frame-work of fret of simple design was fastened along the side pieces and top cross-piece on the opposite side from that on which the pivots are sunk. A similar design was fixed on the front of the battery box, having a thin oval mirror about 6 ins. long in the centre, but of course the ornamental part of the construction depends upon the taste of the maker.

A New Turbine-Propelled Destroyer.

THERE was launched on the Tyne on Tuesday of last week the torpedo-boat destroyer "Velox," which is designed especially for steam turbine machinery. The hull has been constructed by Messrs. R. and W. Hawthorn, Leslie & Co. at their Hebburn yard on the Tyne, whilst the machinery has been made at the works of the Parsons Marine Steam Turbine Company at Wallsend-on-Tyne. The vessel is 210 ft. long, 21 ft. wide, and 12ft. 6 ins. moulded depth. Special attention has been paid to the condition necessary to secure longitudinal strength.

The main propelling machinery consists of two independent sets of Parsons turbine engines, one high-pressure engine and one low-pressure engine being on each side of the vessel. This gives four turbines, each of which has its own line of shafting, and as each shaft carries two propellers, there are eight propellers in all. The high-pressure turbines drive the outer shafts and the low pressure turbines the inner ones. For going astern reversing turbines are incorporated in the exhaust casing of each of the low-pressure cylinders. A novel feature in this vessel is the introduction of ordinary reciprocating engines fitted in conjunction with steam turbines. These engines are of the triple-compound type, and are coupled direct to the main turbines, and work in conjunction with them. They take steam directly from the boilers, and exhaust through the high-pressure turbines, the exhaust from the latter passing in turn through the low-pressure turbines, and from thence to the condensers.

These reciprocating engines are for use at cruising speeds, when low power is only needed, and are therefore of comparatively small size. All steam engines, including the steam turbine, do not show high efficiency when they are working much below the power for which they are designed, and as destroyers very seldom run at their top speed they are apt to be wasteful of fuel during the greater part of the steaming. The new arrangement which Mr. Parsons has introduced should therefore be a distinct advantage. When higher powers than those needed for absolute cruising speeds under ordinary conditions, are needed, steam will be admitted to the turbines direct from the boilers; and when the highest speed is needed, which would bring the rate of revolution beyond that permissible with reciprocating engines, steam will be entirely cut off from the latter, they being at the same time thrown out of gear, and the steam turbines alone would be used.

With this arrangement the "Velox" will doubtless prove an exceptionally economical destroyer at cruising speeds. The boilers are of the Yarrow type, and have been made by Messrs. Hawthorn.—*Mechanical Engineer.*

The Editor's Page.

OUR recent remarks on the mutual obligations of readers and advertisers have brought us a number of letters from both sections of our supporters, in all cases approving the comments we ventured to make. Some of the letters have given vent to grievances which readers have experienced in their dealings with certain firms, while others have shown conclusively that readers themselves are sometimes in the wrong. For instance, one firm writes us to say that they now have two orders on hand which they are unable to execute, because the customers have given no address in their letters showing where the goods are to be sent; and another well-known model firm tell us that they have over twenty applications for catalogues now on their desk, which are unanswered for precisely the same reason. We would urge all readers and advertisers to digest carefully the remarks we made in our issue for March 1st, and if our suggestions are carefully followed out by both sides, we think that very little trouble will occur.

* * *

Our new sixpenny handbook, being No. 9 of the MODEL ENGINEER Series, is now on sale under the title of "SIMPLE MECHANICAL WORKING MODELS." This contains a collection of drawings and descriptions of various simple working models, such as are suitable for the early attempts of the young mechanic, and will, we think, prove a popular addition to the series. It may be had from all agents for THE MODEL ENGINEER, or post free 7d. from our publishers.

* * *

We are pleased to say that we have another book in the same series nearly ready for publication, dealing with the subject of small dynamos and electric motors. This will be an essentially practical handbook dealing with the actual work of dynamo and motor making. It gives a large amount of useful information on the mechanical details of the dynamo, the various methods of winding, testing and repairing, and in addition contains a number of scale drawings of small machines, together with tables of suitable windings for giving almost any output. The proofs of the book have been submitted to an expert in dynamo matters, who pronounces it to be the most practical book for amateur dynamo builders yet written. The author is Mr. F. E. Powell, of THE MODEL ENGINEER staff, whose excellent little book on "Electric Bells and Alarms" has had such a good sale. It will be published in a few days.

* * *

"O. L." (Bridport) writes: "Allow me to congratulate you on the article just concluded on 'The Steam Turbine.' For this relief from the eternal toy boat and train I beg to tender my gratitude. Such an article appeals to me personally much more than one in the following style:—'First take a piece of brass of certain dimensions; put it in the vice, file it square, and then paint it pea-green—be sure it is perfectly square before you paint it. Next put it aside to dry, and whilst it is drying proceed &c., &c., *ad infinitum.*' My idea of model-making—and I suppose I am not alone in this respect—is that I see somewhere some mechanical contrivance, and it takes my fancy. I think over it, perhaps for months, and some day the spirit moves me, and I set to work, and make some portion of it, and from this as a starting-point I construct my model. I make no regular drawings beyond what I may term skeleton ones, intended merely to show the action of the thing; because, as I go on, I see improvements and what Nasmyth in his 'Autobiography' calls 'short cuts.' (By the way, what a book that is; it ought, I think, to be in the possession of every model maker.) The result of my labours is, generally, a fearful and wonderful engine; sometimes entirely different from what it was first intended for, but which has given me the greatest pleasure in constructing and contriving, and which would be the laughing-stock of all and every of your 'First take a piece of brass' people."

* * *

"Earlite" (Lancs.) writes: "There must be a number of model-makers in this and other districts who would send up for insertion in your valuable little journal interesting descriptions and photos of their work, only they have no facilities for having them photographed. I would propose that you open a list, and invite photographic readers and admirers of the *M.E.* to send up their names as being willing to take photos of any models likely to be interesting to readers of your valuable paper; those desirous of having their models taken, to send in applications to you, and you to appoint the nearest name on your list to do the work. I offer my services and name to be entered on such list, to take photos of any models within a radius of ten or twelve miles from here, upon receipt of note from you, any Saturday afternoon, and during the summer months, any evening. I use a half-plate stand camera, rectilinear lens. The only restriction I lay down, is that model-makers must not ask to have photos taken out of mere curiosity." Are any other photographic readers willing to help their fellow model-makers in a similar way?

* * *

"H. D. C. D." (Shepton Mallet), writes:—"I quite agree with 'R. W. B.'s' letter in your issue of February 15th, 1902, in saying how pleased he is at hearing of one firm, at least, who offer their models on easy terms. I have no doubt, whatever, that most readers of 'Ours' will echo his sentiments fully. I for one would be only too pleased to avail myself of such means of securing some models, far too high in price to buy straight off. I hope some of the firms, at any rate, mentioned in the above gentleman's letter, will take note of this, and that you will kindly find room on this page for this letter, and put in a word on this matter for the benefit of your readers." Perhaps our trade friends will kindly note the existence of a demand for easy payment facilities. We may say that we know of several firms who supply sets of castings in instalments, so that the total cost is spread over the whole period of the making of the model, instead of coming wholly at the start.

"A. N." (Bury) writes:—"I am inclined to enter for Competition No. 20, but want to know how many parts of a model engine a man has to make before he has made the engine? Some time ago I visited a friend, who, in conversation, said, 'Look what a nice engine our Robert has made.' I looked, and saw a boiler, made out of a cocoa tin, with taps, whistle, safety-valve he had purchased, also the oscillating cylinder, flywheel, and bearings he had bought. I said, 'Yes, it is a very nice engine.' I have often wondered if some limit could be placed on the things to be purchased, to allow one to say—*I* have made this engine. Ought not a limit to be fixed for this competition? For if I buy fittings and am allowed to say, *I* made this engine, I can certainly say I made it without a lathe. I have read carefully over the competition and know it refers to *models*; also, that 'more credit will,' &c.; but still am of opinion something should be done not only for this competition, but as regards model engine-making generally. I have often read in your (our) paper about 'so-and-so's' model, and how he made it; but on examination it appears to me that several things have been purchased. Then how can he say he made it, if he purchased a single article ready made? What difference is there between 'built,' and 'made'?"

* * *

The pressure upon our Query Department has been much greater during the past few weeks, arising, not only from an increasing number of correspondents, but due, in some measure, to the nature of the questions asked. Many of these require a very considerable amount of research, and when this is accompanied by the necessity of preparing careful working drawings, it is obvious that a large amount of time is consumed. Naturally, the simplest matters are dealt with first of all, and this will account for the delay—in some cases as much as two or three weeks—which some of our readers have experienced. We are pleased that more and more use is being made of the Query Department, and can assure readers that every legitimate enquiry receives the best attention we are able to devote to it.

* * *

A correspondent, who has made a large number of experiments on the construction of a model steam turbine, is anxious to know whether any such model has actually been built by a reader of this journal. If this is the case, we shall be very glad to have particulars of the machine and the results obtained therefrom.

Prize Competitions.

Competition No. 18.—Two prizes, value respectively, £5 5s. and £3 3s., are offered for the best and second best original designs for a small modern type direct-coupled steam engine and continuous-current dynamo. For full particulars of the conditions of this Competition see the last issue of THE MODEL ENGINEER. The closing date for receiving entries is March 31st, 1902.

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. 21.—A prize of the value of £2 2s. is offered for the best description and drawings of a small electro-motor, to work from continuous current supply mains at 60, 100, 110, 200, or 220 volts. The output of the machine should be about 1-10th h.-p. actual, suitable for working light machinery, a fan, or sewing machine, without heating. The particulars should include a description of the method of making patterns for all parts required to be cast, the best way to machine the parts, the construction and winding of the armature, and suitable windings for each of the voltages mentioned above. The article should also include details of the starting and controlling mechanism. The type of machine is left to the competitor's discretion, but due regard should be paid to simplicity, economy and safety in running. The drawings should show all details separately and clearly, as well as general arrangements where necessary. To ensure accuracy and clearness, it is desirable that all details, at all events, be drawn full size. The usual general conditions apply to this Competition. The closing date for receiving entries is June 15th.

The general conditions for these Competitions will be found on page 139 of the last issue of THE MODEL ENGINEER.

Answers to Correspondents.

"A NOVICE" (Nottingham).—Too big a matter for a reply in the Query Department. We will try and arrange for an article on the subject.

"J. F. M." (Manchester).—Thanks for your letter. We think Mr. Greenly's article on "Making a Simple Model Locomotive," in our March 1st and March 15th issues, will meet your requirements. If not, please write us again more fully.

"W. W." (Bellshill).—There is a certain amount of loss (by reason of heat, friction, &c.) in each machine, and consequently the full current generated by the dynamo never reaches the motor. In the same way, the full power developed by the motor never gets transmitted to the dynamo.

"A. P." (Harrow).—We are not sure which is the nearest model yacht club to Harrow. If the secretaries of local clubs who see this note will send us their addresses, we will forward them to you.

"H. S. P." (Gorton).—The query is not very clear and is not of sufficient general interest to be published. It is quite impossible for us to give a diagram of the internal connections of a telephone when you give us no information as to the arrangement of parts, nor even the name of the maker of the instrument to go upon.

"D. McM." (Glasgow).—Thanks for your letter, which we shall use at the first opportunity.

Practical Letters from Our Readers.

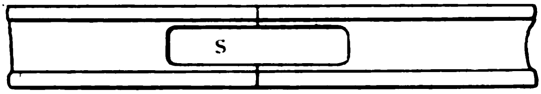
[*The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a* nom-de-plume *if desired, but the full name and address of the sender* MUST *invariably be attached, though not necessarily intended for publication.*]

Model Permanent Way.

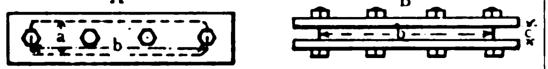
TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—I was very pleased to see your notice of the model permanent way in the February 1st issue, and am sure it will be appreciated by many of your readers.

I think, however, the fishplate both cumbersome and ugly, and suggest this sketch as a neat alternative. A socket is left in each end of rail, as shown at S, and the fishplate is made as shown by the elevation and plan views A and B. It is really solid, that is, in one piece,



A B



the hexagon heads and nuts being cast on as in the other design. The width *a* of the web between the fishplates is such as to enable it to enter the socket S, and its length *b* a little less than that of the two sockets in a pair of rails. The width *c* is such that the fishplates proper clasp the web of the rail firmly. The method of clasping the rail is thus not dissimilar to the other design.—Yours truly,

Tynemouth. MAC.

[The device described and illustrated by our correspondent shows a considerable amount of ingenuity, and ought to prove very effective. We must point out, however, that the fishplate in the original design—by Messrs. George & Co.—is probably still more effective, as it is certainly more up-to-date, imitating, as it does, the modern fishplate as fitted to the heavy rails which are now being laid by the big railway companies on main line routes. In these plates the bottom edge is prolonged to clasp the rail underneath, being "set" to the curve of the bottom flange of rail, and the two fishplates very nearly meet under this flange. The object of this arrangement is the provision of additional support under the joint.—ED. *M.E. & A.E.*]

How to Construct an Automatic Acetylene Generator.

TO THE EDITOR OF *The Model Engineer.*

SIR,—During the past year I have been a subscriber for THE MODEL ENGINEER, and, although my model making days are past, still I find much to interest me in the columns of your paper.

In the issue of January 15th I find described a small apparatus for making acetylene gas, and, having had considerable experience with such small generators in my efforts to find a light for photographic printing, &c., I think my criticism of the machine described, as given below, is to the point.

First, the apparatus is too complicated; second, the principle on which it works is wrong, in that water is fed to the carbide instead of carbide to the water. When the water is dropped upon the carbide there is a great waste of material, as it does not penetrate the lumps of carbide; but, instead, forms a coating on the outside, which prevents the entire dissolution or slacking of the lime—for carbide is but one form of lime—and the gas is given off in the process of slacking. Further, this method of feeding water generates a hot gas which clogs the minute tubes of the burners.

The accompanying drawing shows a small machine which I have built after some experimenting. It is simple, easily made, and, as the carbide is dropped into the water, the gas is cool, and as the pressure is regulated by the weight of the gas-holder, it is absolutely constant, and can be regulated by simply weighting the holder. The machine is absolutely automatic in its action, generating gas only as it is used, and stopping at once when the burners are turned off. The magazine holds 2 lbs. of carbide of the standard ¼-in. size, which we buy in cans, broken and screened to size. It will run one 24-c.-p. burner twenty hours or more, or larger burners in proportion.

My machine has a safety device as shown; but in practice I have not found this to be necessary, as the working is so perfect that it does not over-generate, and if the machine is used in the house, as it can be with full confidence, this safety escape would be plugged.

Referring to the drawing, which is made to scale of 2 ins. = 1 ft., or one-sixth:—A is the outer tank; B, the gas-holder, which carries attached to its cover by the tube D, the carbide holder C; F is the filling plug; G the valve; H, valve rod; I, valve rod guide; J, the gas tube or outlet; K, casing for gas tube; L, safety vent; M, casing for safety vent; N, a tee with plug for cleaning. O is the gas purifier; P, gas cock; Q, gas outlet; R, opening to safety vent; S, chocks for suspending the gas-holder.

My machine is made of galvanised iron, and put together—as is plainly shown in the drawing—by turning over the metal, after which all the joints are thoroughly soldered to ensure their being gas-tight. To operate, proceed as follows:—Fill the outer receptacle A with water to within 4 ins. of the top; then put the holder B in place, being sure to get the pipes J and L into the casings K and M, thus forming a guide for the holder to play upon. Put two pins into the chocks S, so that the holder will be suspended from the edge of receptacle A. Unscrew the plug F, and fill with carbide broken to a size ¼ in. or smaller. Remove the plugs from chocks S, and open the gas cock P. This will allow the air to escape until the gas-holder sinks far enough into the water to raise the valve G through rod H, striking the bottom of the outer receptacle. As soon as the carbide strikes the water gas will form, which will expel the air from the holder through pipe J, and as soon as gas forms close P. Now attach the rubber tube to the outlet on O, and the machine is ready for operation.

As the gas is consumed, the holder B sinks in the water until the rod strikes the bottom of the tank, opening valve G and admitting carbide. Each time the carbide strikes the water gas is instantly formed, which raises the holder B, thus closing the valve and stopping further admission of carbide until the gas is sufficiently used up to allow the holder to sink and open the valve.

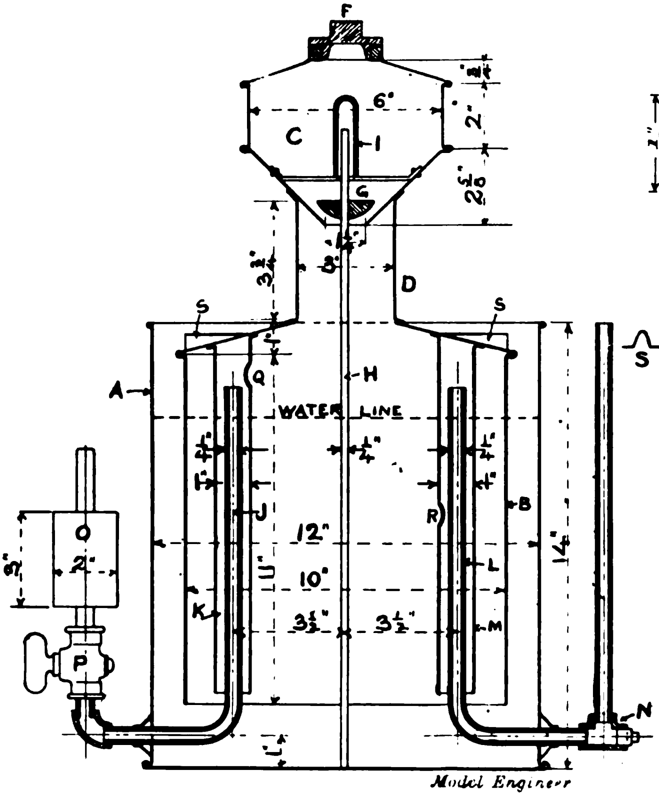
The purifier O is a piece of brass or tin tubing, very thin, filled with cotton. The safety device consists of the pipe L and the casing M. Should gas be generated faster than it can be used through the burner, the holder B will be raised until the opening R is above the water-line. Gas will then escape through R and L into the atmosphere. Of course, if the machine is used indoors, the pipe L should be plugged.

N is a tee with a plug in it for the purpose of cleaning out water, should any get into the pipe L through carelessness in handling the machine. The guide I is a small piece of pipe, closed at the end, and fastened to a narrow bridge which spans the carbide holder C, as shown. The valve G is a piece of cast iron, and need not be finished or turned.

For regulating the pressure, I have some pieces of bar iron, rolled up into hoops 7 ins. inside diameter, which I drop over the carbide holder C, and allow them to rest on the top of the gasholder, thus quickly and simply arranging the pressure to meet any conditions I may require.

The entire machine can be made by an ordinary tinman at a very low cost, and it will be found a most efficient and simple apparatus.

The inside of the machine is to be painted three or four coats with any good waterproof varnish, such as asphaltum.



An Automatic Acetylene Generator.

To clean the machine before recharging, it is only necessary to lift off the holder and dump the contents of the receptacle A, and recharge with water and carbide.—Yours truly, P. D. J.

Cold Spring, Putnam Co., N.Y.

Current Collector for Model Electric Car.

To the Editor of *The Model Engineer*.

Dear Sir,—I notice that in his article—"Design for a Model Electric Locomotive," in the December 15th issue, 1901, Mr. Sherwin has adopted my design of collector. I am very glad to see that it is coming into use. I have, however, thought of a much better form of collector, which is simpler in construction, doing away with castings altogether. It is shown in the drawing herewith. It will be seen that the collector is simply a piece of ¼-in. sheet brass, 1½ ins. by ¾ in., having three ⅛-in. tapped holes in it.

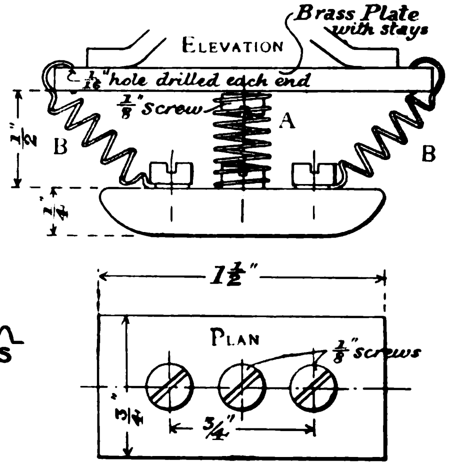
I have given the measurements, so that if wanted it can be used instead of the other one.

The two springs B, B are weak ones, while the spring A is fairly strong. The springs B, B are fastened on to the collector by an ⅛-in. screw, the other end being hooked iuto a 1-16th-in. hole at the end of the top plate. The two ⅛-in. screws, which are in the centre of the collector and on the top plate, are simply guides for the spring A.

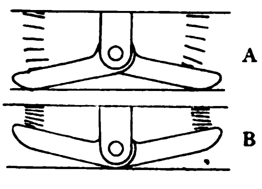
The advantage this form of collector has over the other is that it always makes a flat contact with the rail, however uneven this may be. It also allows for any difference in height of the centre rail above or below the outer rail.

I should like to hear how other model makers collect their current on their model electric cars, locomotives, etc.—Yours truly, "Collector."

Manchester.



An Improved Current Collector for a Model Electric Car.



Faults of the Old Form of Collector (A, with the Rail too low ; B, with the Rail too high).

A New Type of Small Storage Battery.

To the Editor of *The Model Engineer*.

Dear Sir,—I should like to thank Mr. Martinetti for his description of a storage cell, which, however, is not new to my knowledge in this country. I find that the following plan gives moie satisfactory results than the method described by him. Firstly, to greatly facilitate the formation of active material, I use small broken pieces of old + and − accumulator plates, mixed with red lead and sulphuric acid, which will form a firm mass, with 30 per cent. or 40 per cent. less forming charge. Secondly, Mr. Martinetti suggests formation by dynamo instead of gravity cells. Having had experience in this direction with 15 ampère-hour cells, I found by charging with 3 ampères or above the following serious drawbacks—namely, the current rapidly decomposed the small quantity of electrolyte which could percolate through the porous cell, causing much heating of the cells, eventually nearly drying them; this, in turn, caused non-conducting sulphate of lead to form on the + lug, also so much expansion through the peroxide of lead becoming hard and dry, thereby not allowing a free escape of gas, that many of the porous cells burst. To get over this difficulty bore several small holes in the bottom of porous cell on one side, then inside over these holes place a sheet of finely-perforated celluloid or other acid-proof material, then, again, a piece of old + plate above this, and have a good wide lug on plate, after which the porous cell may be filled up. By this the following improvements will be the result:

Firstly, free escape of gas; secondly, free admission of acid—therefore, no sulphating of lug or bursting of cell; thirdly, decrease of internal resistance; fourthly, larger ampère discharge. I would mention that it is preferable to place porous cell on one side of glass outer cell, instead of in the centre, forming the element only on three sides of the cell, thereby lessening the risk of short-circuiting. I trust this information will be found of practical value.—Yours truly, W. FRY.

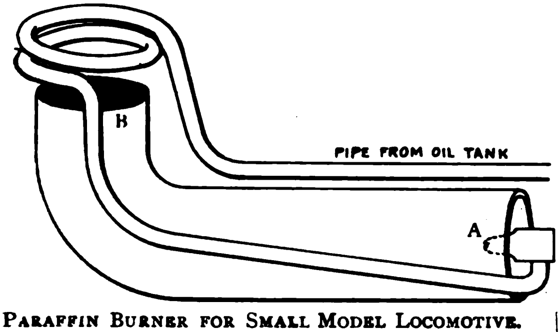
Harlesden, N.W.

On Firing Small Model Locomotives.

TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—The great difficulty in successfully working small scale model locomotives, is that of providing a suitable burner. There has lately been a great deal of correspondence on the subject in THE MODEL ENGINEER, so I send a sketch of yet another burner, hoping it may prove useful to some of your readers. For models about ¾-in. scale, nothing can of course be better than the "Primus" burner, but these require a certain amount of height above the nozzle before the vapour will ignite, and small models will not admit this height. The burner I have tried is an oil Bunsen burner, and I think the sketch explains itself. Ordinary petroleum under pressure is vapourised in the coil of pipe above the burner, and the gas then rushes out of the nozzle A, and mixing with air, which is sucked along with it, burns at B, where there is a covering of wire gauze. This produces a very hot blue flame, and I find with it I can get up 20 lbs. of steam in five minutes, in a model locomotive boiler, ⅝-in. scale. As will be seen, the height of this burner is much less than that of a "Primus," and can be easily made, as no exact measurements are necessary, the only important dimensions being that of the opening in the nozzle A, which should be $\frac{1}{16}$-in. diameter.—Yours truly,

Blandford. C. P. FYNES-CLINTON.

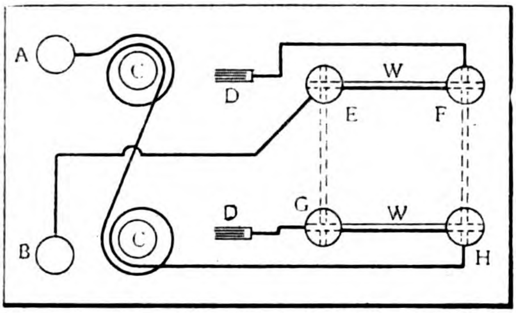


PARAFFIN BURNER FOR SMALL MODEL LOCOMOTIVE.

A Simple Reverser for an Electro-Motor.

TO THE EDITOR OF *The Model Engineer.*

DEAR SIR,—I beg to forward you drawing of an idea which I have put to practical use for the reversing of model electro-motors, and I find that it works very satisfactorily. The idea is shown in the accompanying illustration, and is suitable for reversing the ordinary series-wound motor only. In the diagram, A and B are the battery terminals and C,C, the two field-magnet cores of the motor. D and D are the brushes, and E, F, G, H are four terminals, spaced equally at the four corners of a square as shown. These four terminals have each a hole drilled at right angles to the usual hole for the connecting wire, as indicated: the wiring is clearly shown in the diagram. Two stiff wires, W, W, are used to connect the special terminals. When these are joining E and G, F and H, respectively, the current will flow in one direction. When E and F, G and H, are the terminals joined up, the current will be reversed in the armature, which will then revolve in the opposite direction. The first arrangement is indicated by dotted lines for the wires W, W.



Model Engineer

A SIMPLE REVERSER FOR A SMALL ELECTRO-MOTOR.

I hope this may be of use for readers who want the simplest possible method of effecting the desired object.—Yours truly, R. G. PARR.

Peckham.

The Institution of Junior Engineers.

THE members of this Institution recently paid a visit to the new Baths and Washhouses of the Metropolitan Borough of Fulham, shortly to be opened, and situated in Melmoth Place, Fulham Road. The architect, Mr. H. Dighton Pearson, A.R.I.B.A., showed them over, and fully explained the numerous features of interest. At the conclusion of the inspection, the party were hospitably entertained by Mr. Pearson, and the thanks of the members for the courtesy he had extended to them was expressed by the Chairman of the Institution, Mr. Percival Marshall.

SERIES-WOUND motors up to 2 h.-p. may, says Mr. A E. Gott, be safely started without the use of starting resistances, if the full load is not thrown on until they are well under way, but with all but the very smallest sizes of shunt motors such resistances are necessary. The proper method of designing such devices should be such that the resistances cut out at each successive movement vary in geometric ratio, the largest resistance being that cut out in the first motion of the switch arm, and the smallest that cut out last.

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.

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.]*

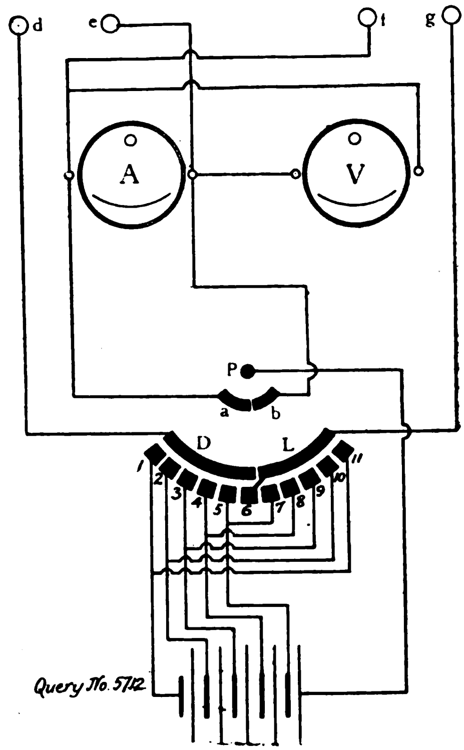
The following are selected from the Queries which have been replied to recently:—

[5748] **Accumulator Charging.** W. H. M. (Stoke-on-Trent) writes: I should be much obliged if you would kindly give me the following information: I have a small dynamo with armature, 1¼ by 2¼ ins., wrapped with 12 yards No. 20 wire, connected in shunt and field-magnets wrapped with 1½ lbs. No. 19 wire. (1) Is it possible with accumulators to have two lights in a bedroom to serve ordinary purposes for about a week after being charged by this dynamo? (2) If practicable, what kind of accumulators would be the best; what size, and how many? (3) What voltage should the lamps be? (4) How could I tell where the accumulators were charged, and what would happen if I did not stop when charged? (5) What would be the cost of all (except dynamo), if all was home-made except lamps?

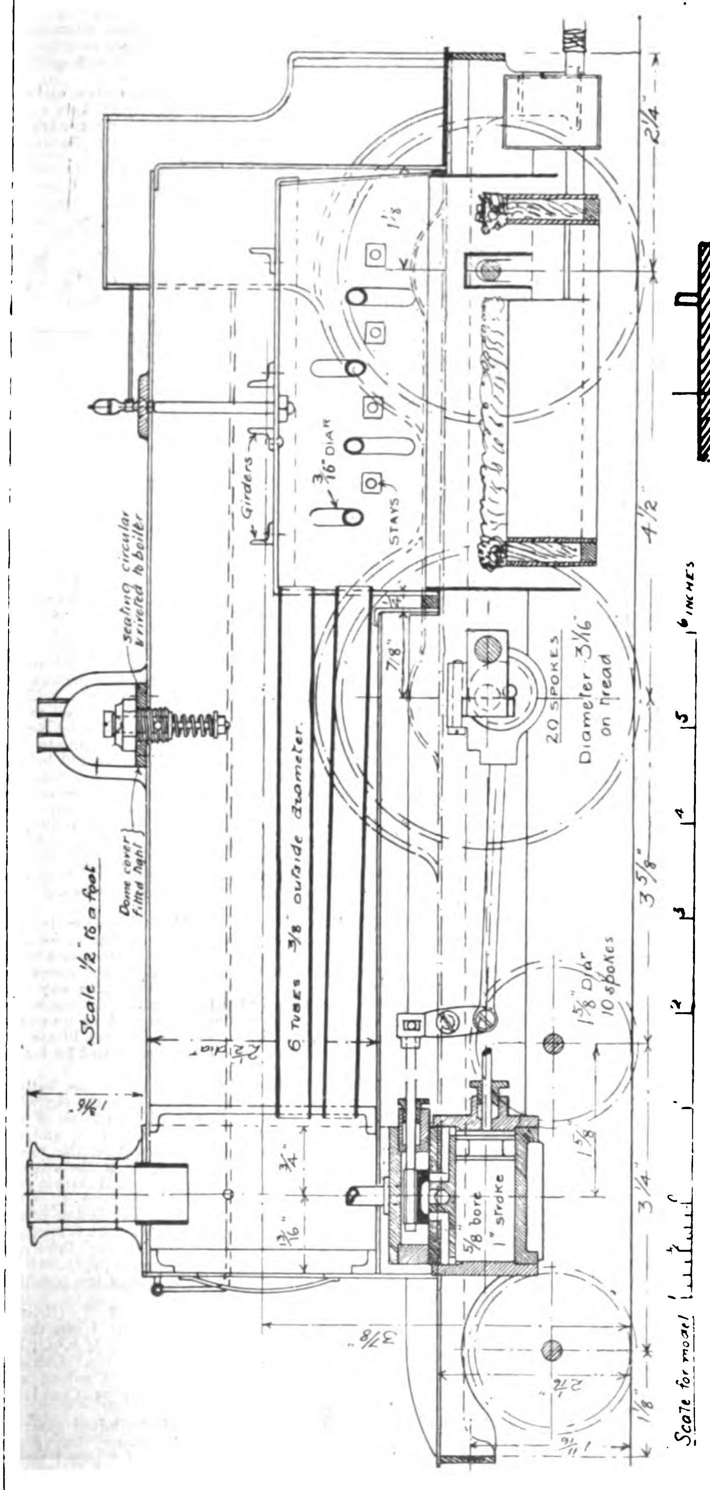
(1) Your meaning is not clear. The cells, if of good construction, will hold a charge for a week without much deterioration. Possibly you mean, however, that you wish to be able to light a lamp every night for a week. (2) This query is a little beyond our powers of divination. You do not say clearly what period the lighting is to cover with one charge, and you now omit to state what lamp or lamps you will use. What are "ordinary purposes" in your case? "Two lights" may mean, say, two 16-c.p. lamps lit for an hour or two each evening, or they may be mere "glimmers" for the purpose of lighting a dressing table or seeing the time by! Under the circumstances, we really do not see our way clear to stating what accumulators will be best. (3) Here again it all depends on matters which you alone know. If lamps of any considerable power are required, the voltage of the dynamo would be insufficient, and cells would have to be charged in parallel and connected up in series to suit the lamps. Thus, if you had lamps requiring 15 volts, 8 accumulators in series would be necessary. It is doubtful whether your dynamo could charge more than two cells in series, so that the eight cells would need to be arranged in four groups of two cells in series in each group, the four groups being charged in parallel. (4) When the cells are fully charged they bubble up ("boil" or "gas" are the technical terms). No harm will result from overcharging unless it is excessive. (5) We cannot undertake to estimate costs like this. Get prices for yourself of the various details and work out the results from them.

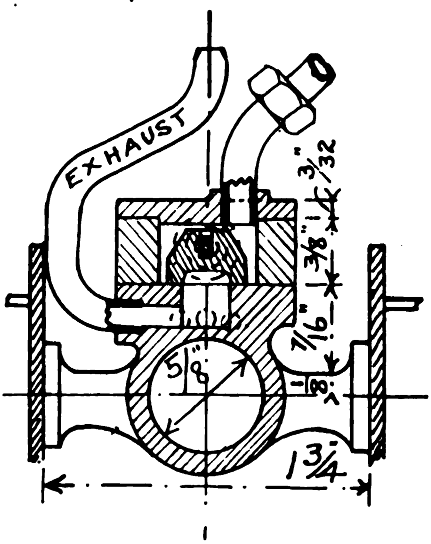
[5712] **Electric Light Installation.** C. T. (Burgess Hill) writes: Would you kindly correct sketch (not reproduced) of small electric light installation? I want the switchboard to be able to register ampères and voltage both when discharging from cells or from dynamo to lamps, and also when charging from dynamo to cells. I have put in the design a switch for the voltmeter, as I understand that the voltmeter has a great resistance. If this is so, how could I manage when the accumulators are being charged and I want to see how the voltage is going on? Will it not hurt the cells to have the current suddenly lessened? The switch with five contacts, as you will see, is either to regulate (1) the cell, F, at the mains by cutting out some of the cells, (2) or not to charge so many; if used for the latter, I suppose I should want a resistance? Where would the connections be made for same, and what sort of wire should I want, what B.W.G., and how much? I should want the resistance to cut 12 volts. I think when I want to charge the accumulators, I should switch on both cell switches and voltmeter switch, and then run dynamo up to right voltage, and then switch on dynamo switch. Or should I put down dynamo switch and voltmeter switch, and then, when run up to proper voltage, put down accumulator switch? The two-way switch is so that you can have the ammeter going both discharging and charging.

There is bound to be a certain amount of complication in your switchboard, and we should prefer to put all this complication into one switch. A suitable arrangement is shown in the annex diagram, which clearly indicates the dynamo and lamp circuit terminals, the meters, and the connections. The switch is below the meters, and the accumulator at the bottom. The construction of the switch and its working are briefly as follows: The pivot is at P. There are two curved contact pieces *a* and *b*, with a separating piece of insulation; *a* is connected to the terminal of the ammeter shown, *b* to the other terminal; D is a larger curved contact strip joined to one of the dynamo terminals; L a similar but shorter strip joined to the lamp circuit terminal, as indicated. 1, 2, 3, . . 11, are contacts, all of which, as well as *a*, *b*, D, and L, should be of brass, gunmetal, or copper. The strip D extends as far as the outer limits of both 1 and 6; L extends similarly from 7 to 11. The connections from all these contacts to the various terminals, cells of accumulator, etc., are shown clearly. The switch arm itself is built with a contact piece extending from P to *a* or *b*, and another (fully insulated from the first one), able to make contact between D and any contact from 1 to 6, or between L and 7 to 11. The contact No. 6 is electrically connected to L. All the others are carefully insulated from one another, and from the strips. The action is as follows: Suppose switch arm is in such a position that it joins D up to contact I. (Incidentally it will be observed that P and *a* are also joined in any position of the arm as long as it rests on D.) In this position the dynamo is ready to charge the accumulator, the current entering,

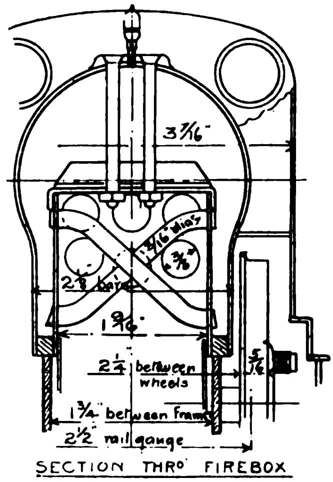


say, at *d*, traversing D, thence *via* contact 1 to the cells. Passing through these the current arrives at P, passes to *a*, then through the ammeter, and out at *e*. The voltmeter is on a shunt from the ammeter terminals, and here it may be said there is little need to cut out either meter, as they are designed to be always in circuit, the ammeter directly in the path of the current, and the voltmeter shunted across. The high resistance of the voltmeter prevents any excessive current passing through it; the low resistance of the ammeter allows the full current to flow without loss. Suppose the switch to be moved to, say, contact No. 3. The current from dynamo will now pass through only the three cells to the right, missing the others altogether. When the arm is on contact No. 6, no current will flow through the accumulator, but will pass to L, thence to terminal *g*, through the lamps (which are then lit by the dynamo direct), back to *f*, through the meters and out at *e*. The contacts P, *a* and *b*, do not here come into play. Pass the switch on to contact No. 11. The full charge from all the cells will now pass *via* 11, L, terminal *g*, the lamps, terminal *f*, through the meters, contact *b* to P, and thus back to the cells. At an intermediate position, say 9, the charge from three cells only will pass the lamp circuit. Of course, the same plan might be adopted, supposing there were 50 cells, the last three or four only being regulating ones. Also, if preferred, an "off" position might be fitted at each end of the row of contacts. We cannot say what wire will be suitable, as you do not state what current it has to carry. See page 7 of the January 1st issue, 1901, MODEL ENGINEER.





Cross Section through Cylinder (Full Size).



Cross Section through Firebox (to same scale as Longitudinal Section).

DESIGN FOR SLIDE VALVE MODEL LOCOMOTIVE

FOR 2½ IN. GAUGE.

(See Reply to Query No. 5731, Page 166).

[5731] **Model Locomotive.** J. B. R. (Edinburgh) writes: I received your kind answer to my enquiries about a 1¾-in. gauge loco, and, owing to being a novice at the work, I have decided to leave 1¾-in. alone, and build a 2 or 2½-in. gauge locomotive. The one I have bit on is No. 731 N.B.R., which was built two or three years ago at Cowlairs. I have been unable to procure drawings of it to show you its appearance, but send one of a Highland railway loco, which is very similar. (1) Could you kindly make me a drawing to ½-in. scale of the N.B.? I send a plan as to how I propose to make boiler, firebox, and tubes. (2) What stroke and bore should the single cylinder be? (3) What kind of reversing gear? (4) Could you show me the simplest way of putting in the throttle and pipe to cylinder? (5) As the N.B. locos all have dome and safety-valve in one, will the design I show do, simply taking steam from top of boiler? (6) How will copper tube, as supplied by Messrs. Bassett-Lowke, do for boiler and tubes?

In reply to your query, we cannot undertake to supply you with working drawings, but we give a design fully worked out in the essential details, which may be useful to others making 4-coupled inside cylinder locomotives to ½-in. scale (see page 165). It will be noticed that the firebox is increased in length, and as only one cylinder is intended to be used, the driving wheels are reduced in diameter. Two cylinders with such large wheels are preferable, and with a little scheming can be arranged to this scale and gauge. The valve is shown on top of the cylinder, and is worked by means of a slip eccentric and a rocking shaft. Note the position of the eccentric, which is shown correctly for going ahead. The eccentric is provided with a pin, which engages a strip of metal fastened to the web of the crankshaft. The drawn tube forming the barrel should be split at one end and bent to make the firebox. The other end should extend to the front plate of the smokebox and have a ring fitted, on to which the front plate is attached. The smokebox wrapper-plate should be placed over the barrel, and as the inner part need only be airtight, the back of the smokebox under the wrapper may not be filled in. The front tube plate is a circular casting, soldered, and secured by flush-screwed pins. The arrangement of safety-valve you suggest may be used (we amend it in detail), and you may make a regulator and steam pipe such as shown in the simple model locomotive article, the first part of which appears in issue of March 1st. The steam pipe should come out of the front tubeplate in the smokebox, and be coiled to form a superheater. As the diameter of the driving wheels are reduced, the spokes must be reduced in number slightly; these are marked as 20 instead of 22. The water tubes in the firebox may be silver-soldered in. The flue tubes should be ⅜ outside diameter solid drawn brass tubes of very thin metal, if possible. We indicate a box-like spirit lamp, with a wick all round. The air is admitted into the firebox through a ring of flame. The firm you mention will no doubt supply you with copper or brass tube of the diameter you require. The boiler you have designed is impracticable.

[5778] **Model Boiler.** C. L. H. (West Dulwich) writes: I see in THE MODEL ENGINEER for March, 1901, the description of a high pressure boiler (page 114, Fig. 2). Could you tell me what power this boiler would develope, where would be the best place to get materials, and what would be the approximate cost?

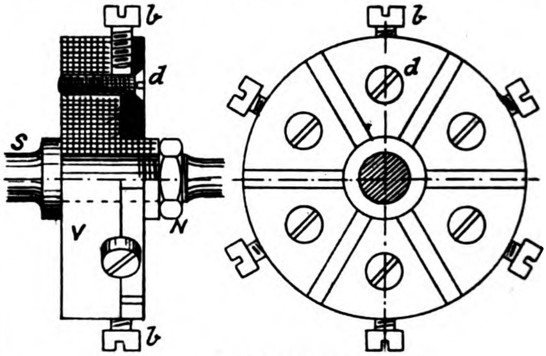
We should prefer ⅜ in. water tube, and also to leave out the first three shown on the drawings. Use a Vesuvius or Hekla oil burner, or a benzoline burner such as illustrated in the issue of November 1st, 1900. The boiler ought to evaporate if a suitable fire is arranged about 1¼ cub. ins. per minute. It will be able to work one cylinder, ⅝ in. diam., and 1 in. or 1¼ in. stroke at 50 lbs. per square inch, and 300 revs. per minute. The exhaust should be led to a jet in the centre of the chimney in the combustion chamber. The diameter of the exhaust nozzle should be 5-32nds in. The power of the boiler may be expressed as about 1-30th h.-p. You may reckon that the boiler will cost 1s. 6d. or 1s. 9d. per pound for materials, and to estimate weight you may take it that one cubic inch of copper weighs about 5-17ths of a pound. Materials can be obtained from Messrs. Cotton & Johnson, Gerrard Street, Soho, W.

[5750] **Gas Engine.** W. P. (Sheffield) writes: I have a gas engine, 2 ins. bore, 4 ins. stroke, which runs about 300 or 400 revs. per minute. Would you kindly tell me what h.-p. it is? There is only one flywheel, and I want to have two. The weight of it is 10½ lbs., and it is 10 ins. diam. Would it be too heavy to have another the same size? What size water tank shall I have to use, and what size gas bag? Will three ¼ in. bolts be strong enough to bolt it down? Could you tell me of a good gas engine book that you know of?

About 1-6th h.-p. Of course this may vary much on either side according to the richness of the charge. One engine may not develop nearly so much power as another which is accurately designed and carefully constructed. With care, however, such an engine should develop the h.-p. above named in regular working. You might test it for b.h.-p. by the method described on page 222 of our issue October 1st, 1900. The addition of another flywheel is advisable, especially if electric lighting is intended. We should think that three ¼-in. bolts will be found sufficient to hold the engine steadily. "Gas Engine Construction," by Parsell and Weed, is a good book for those wishing to make a small engine. It describes the making of a ½ h.-p. engine very thoroughly. See the review of this book in our issue of October 1st, 1900. Tank should be about 6 ins. diam. and 12 ins. high; capacity about 1¼ gallons. The gas bag may be an ordinary football bladder.

[5753] **Disc Commutator.** "OMANYD" (Brixton) writes: I wish to build a small motor, as compact as possible, for use in a model electrically-driven locomotive. The ordinary commutator takes up so much room that it seems to me this might be improved upon. If so, will you show me the best way to arrange matters? The motor will have a 6-part drum armature.

A form of commutator very useful in certain cases when space is limited is the disc or sector type. It is hardly suitable for a 2-part armature, but for any greater number of divisions up to eight, is quite serviceable. A simple form is here shown. In this illustration



Query No 5753.

the left hand figure shows the bottom half of commutator in side elevation, and the top half in section; the other view shows the six brass sectors. V is a disc of vulcanised fibre. It is bored and mounted tightly on the shaft S, being pressed against a shoulder by the nut N screwed on the spindle. When so fixed the surface of the disc is turned down, a boss being left, and a flat brass disc—previously bored to fit over the boss—placed on the fibre mounting. The brass is then correctly divided out into the required number of parts, and in each space is marked the position for the holding screw (as at *d*). Holes are drilled for any convenient small metal screws, countersunk, and the disc fixed firmly to the fibre by means of the screws. The face and edge are then skimmed lightly to true them, and holes drilled at each sector, half in the brass and half in the fibre, as at *b*, and tapped for small brass screws. The brass disc may next be removed and sawn into the right number of pieces, and it is best to number them and see that they return to their respective places on the fibre disc. This may then be done, the spaces filled in with shellac, plaster of Paris, etc., screws fitted in the holes at *b*, and the commutator is complete. It is needless to add that a special form of brush is necessary for this type of commutator. It should be a tightly rolled cylinder of copper gauze, pressed forward by a spring.

[5795] **Wireless Telegraphy.** C. B. (Manitoba) writes: (1) In an instrument for receiving messages by the system of wireless telegraphy, why is it that the current from the battery (the wires from which are connected with the coherer) does not affect the metal dust so as to complete the circuit in the same way that the current from the skyline does? Is there any difference between the battery electricity and the current which flows down the skyline and converts the filings into a conductor? (2) Please explain the principle of the transformer. Is it always used for lowering the voltage?

(1) There is a difference in the effects produced by the battery current and that which impinges on the coherer from the sky wire. It is difficult to explain in a few words; but if you think of the latter as being the effects of a very high voltage current, and the former as of little more than 1 or 2 volts, you will be able to understand why the effects produced by one are not the same as the other. The resistance of the coherer in its normal state is very great, and only the high potential current can overcome it. Once the new state has been brought about amongst the filings of the coherer by the passage of the first current, the resistance is lowered, and the battery current also easily passes over it. (2) Briefly, a transformer is an induction coil. It can be used equally well for transforming a current of high potential into one of low potential as the reverse.

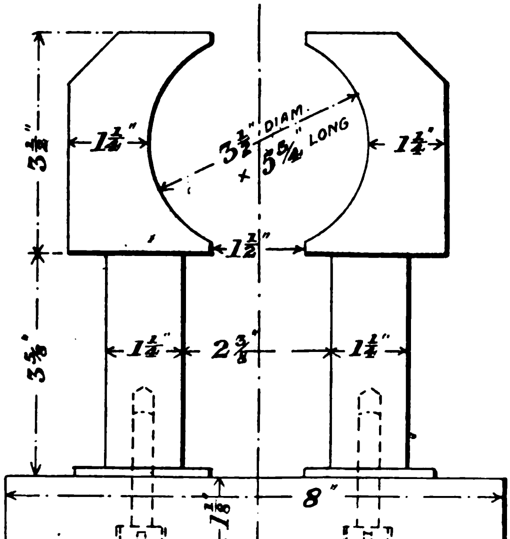
[5800] **H.-P. of Oil and Petrol Engines.** M. T. (Bristol) writes: When I looked through a certain catalogue I saw that a petroleum oil engine of 2-in bore, 3-inch stroke, gives ¼ h.-p.; but a 2¼-in. bore, 3-in. stroke, petrol motor gives 1¾ b.p. Can you tell me what difference there is in arrangement of valves, and whether a ¼ h.-p. oil engine, made from ordinary type of castings, could be changed into a petrol engine?

The pressures created by the explosion of the mixed gases in the cylinder of a petrol engine are much greater than those developed in an oil engine. The normal speed of a petrol motor is four or five times that of the ordinary heavy oil engine. If you will study the article on "Horse Power" in our issue of October 1st, 1900, page 221, you will see how the increase of pressure and speed adds to the horse-power of any given engine. You will not, we think, be able to run the oil engine, unless it is balanced properly, at nearly so high a speed as is usual with petrol engines. You must also experiment with the compression, and add a suitable carburettor in place of the vapouriser. For the proportions of a petrol engine see our recent article.

[5843] **The Management of a Gas Engine and Dynamo.** E. C. (Dublin) writes: There are two gas engines and dynamos for lighting purposes in the business house I am employed in, one developing 120 amps. of current and the other a normal amount of 50 amps. The latter is now principally only used for charging a storage battery of 54 cells. A new duty, which has been assigned to me, is that of acquiring a practical knowledge of engines, dynamos, cells, and current, so as to be able not only to superintend the man usually working them, but to be able on occasions to take complete charge myself. What book or books could you recommend me to help me to acquire a working knowledge of these subjects? The engines are Messrs. Crossley's, of Manchester, and the dynamo from Newtown Electrical Works, Taunton. I may also add that I cannot afford to get any expensive books.

We should regard it as only fair for your employers, if they expect you to do justice to your new work, to assist you to gain an insight into it. There are, of course, plenty of books dealing with the different parts of the undertaking, but you do not state whether you have any practical knowledge already. One of the annual electrical engineers' pocket books (two or three of which we have reviewed recently) would be useful for the whole thing, and "How to Manage a Dynamo" (1s. 2d. post free), or "Dynamo Attendants and their Dynamos" (1s. 2d.), which can be had from our Book Department, would be valuable. We believe Messrs. Crossley issue a card of instructions for the proper management of their gas engines. If you have no copy of this, you or your employers should write for it. Study the series of articles in THE MODEL ENGINEER on "Motor Cycle Construction," as far as relates to the petrol motor. Except that a petrol motor is supplied with gas made by vapourising a liquid, and that it runs at a high speed, the same principles apply to its action as to that of a gas engine. Many of the faults are likewise similar, and the above series will thus be generally useful. We shall be glad to assist you with further advice on any particular point.

[5884] **Overtype Dynamo (400 watts).** W. C. (Glasgow) writes: With respect to the dynamo shown by accompanying diagram, will you please give me the sizes of wire for 100 volts 4



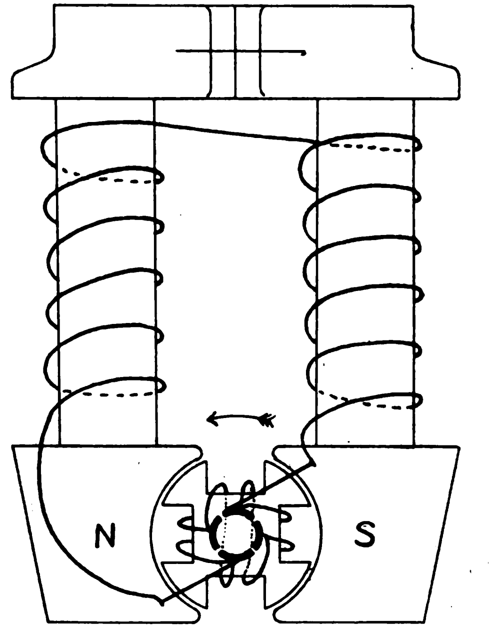
Query No 5884 *Model Engineer*

ampères output? The armature is of the cogged ring variety, 5¾ ins. long, with 12 slots. The magnets are of mild steel, and are bipolar overtype, 7⅛ ins. high over all, with winding space, 3⅝ ins. long. The bore of armature is 2-3rds of outside diameter.

It would have been an advantage to have given the sizes of slots in addition to quoting their number. Wind as a drum, not as a ring-type armature, which would be difficult with so long a ring. For the armature, 2 lbs. nett of No. 20 would be required, and for the field-magnets (connected in shunt) 6¼ lbs. No. 26. The dynamo is of good proportions, and should easily develop 400 watts.

[5980] **Undertype Dynamo (20-watt).** E. B. (London) writes: I have castings for a small dynamo of the form shown in the accompanying drawing (reproduced half size) The field-magnet cores are circular in cross section, and are of cast iron. I have also quadripolar armature stampings, 1⅜ ins. diameter, and sufficient to make an armature 1⅜ ins. long. I wish to wind these, however, as a drum armature connecting to a four-part commutator, and should be glad if you will give particulars of a suitable winding, also showing correct position of brushes and correct rotation of armature. The machine to be shunt wound, as it will be principally employed to charge a set of accumulators—four cells—preferably in series.

The correct method of winding and connecting up armature and field-magnets of your machine is shown in the illustration, these



Query No. 5980.

details having been added to your outline drawing. The direction of motion and position of brushes are also indicated. Wind the armature with No. 22 wire in four sections, the sections being either on top of one another or side by side in the slots. About 3 ozs. of the above wire will be required, and each section of the winding should contain 30 turns. The wire for field-magnets may be 14 ozs. of the same as indicated, or the direction of rotation given may not hold good. The dynamo should develop a maximum current of 2 ampères at 10 volts, the speed being 3,100 revolutions per minute.

The New Locomotive Valve Gear.

WHETHER or not the Marshall valve gear now undergoing trial on the Great Northern Railway is that described in the specification of Letters Patent No. 3761/1901 we have no means of knowing, but in view of the possibility that such is the case, that specification becomes of interest. It describes a gear in which the valve is operated from a rocking curved link as in the Walschaert gear, so common upon Continental locomotives. The link is rocked by an eccentric keyed on the crankshaft 180° from the crank; but instead of being given a mere motion of oscillation as in the Walschaert gear above mentioned, the link receives in addition a motion of translation, for it is pivoted in a die-block moved backwards and forwards in fixed guides by a second eccentric appropriated to that purpose and placed about 90° in advance of the crank.

By these means the link, whilst moved bodily backwards and forwards, is simultaneously oscillated. This gear will impart to the valve a motion of such a character that it receives rapid movement for admission and cut-off, due to the co-operation of the two eccentrics, whilst they will act in opposition to one another to produce a slow movement of the valve whilst the steam ports are closed, as for instance in gears of the Brock and Walschaert types.

There does not appear to be anything in the construction and operation of the gear which would justify the startling statements made on its behalf in the newspaper Press, if we are correct in identifying it with the Marshall gear of the patent above cited. Nevertheless, there are probably practical features of considerable value in the gear or it would never have been taken up by one of our great railway companies. The assumption commonly made with regard to this gear and to others of similar type, that they jerk the valve onward during part of its travel almost as would a trip gear, is a mistaken one.

Reigate and District Industrial Exhibition.

IN response to many enquiries from readers of our journal, resulting from the advertisement that appeared some months back, we are asked to state that entry forms in connection with the above exhibition (open May 14th to 21st) are now obtainable through the Assistant Secretary, Mr. Bernard E. Jones, Industrial Exhibition, Technical Institute, Redhill, Surrey. Entry forms, properly filled in, are accepted until April 15th, but not later, so it is necessary for intending exhibitors at once to make application for forms. Section A, for which forms cost 1s. each, is open to any workers in the United Kingdom, and it is just the section in which our readers may be expected to do themselves credit; this section contains classes for models, cabinet, carpentry, and joinery work, plumbing, metal plate work, drawing, photography, decorative painting, turnery, fretwork, wood carving, &c. Section B, entry forms for which cost 2d. each, has the same scope of subjects, but is for amateurs, and is restricted to residents in Surrey. In these two sections alone the ordinary prizes total up to considerably more than £100, besides which there is a number of special prizes, including two cloth bound volumes of THE MODEL ENGINEER, presented by the Editor. The exhibition will be opened on May 14th at two o'clock, by E. J. Halsey, Esq., the Chairman of the Surrey County Council, at the Technical Institute, Redhill, and it is confidently hoped that our readers will form a large proportion of the exhibitors.

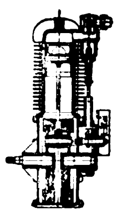
Amateurs' Supplies.

[*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.*]

Drawings for a Small Gasoline Motor.

There is good reason to suppose that as time goes on a small gasoline motor will come to be regarded as much an article of household furniture as a sewing machine now is. That such a time is not far distant seems to be indicated from the recent sales of an agent who deals in small motors—principally for launches, automobiles, bicycles, and such purposes. He has recently sold motors to private parties for many domestic purposes, among them the operation of a washing machine, a ventilating fan, butter churn, sewing machine, and a machine for polishing hardwood floors. Besides these, there are numerous uses that such a motor can be put to once it finds a place in the household. To amateur engineers who have facilities for constructing from drawings



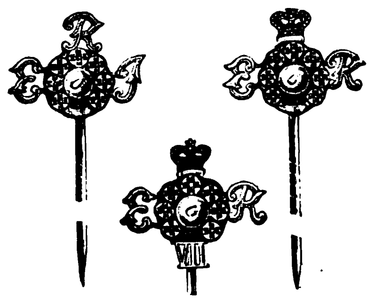
a small motor, 1¾ h.-p., of an old and well tried type, such as shown in the cut herewith, the opportunity to purchase the working drawings is offered by C. F. Schaeffer, Drexel Buildings, Philadelphia, Pa., U.S.A.

Castings of Steam, Gasoline, and Oil Engines.

We are informed that Mr. B. R. Wicks, of Bridgeport, Conn., whose small horizontal ¼ h.-p. high-speed steam engine was described in THE MODEL ENGINEER for August, 1900, has been designing and making castings of ten different sizes of steam, gasoline, and oil engines, and is now prepared to supply sets of castings and all the necessary blue-prints. In writing to him readers are asked to remember the letter postage to America is 2½d. per half ounce.

*A New Electric Scarf Pin.

We have received a sample of a new electric scarf pin, which has been specially designed for use during the forthcoming coronation festivities. The accompanying illustration shows this and two other slight variations in the same idea. These are supplied (silvered



or gilt) by Mr. Archibald J. Wright, 318, Upper Street, London, N., so that amateurs can fit them up themselves with lamp and wire, or they can be had fitted complete. Prices will be sent on application, THE MODEL ENGINEER being mentioned.

*A Useful Compendium.

A very handy little compendium of reliable workshop and other information is published by Mr. M. Cole, 195, Burton Road, West Didsbury, Manchester. It is hardly possible to enumerate any particular number of the items described, but we can assure MODEL ENGINEER readers that they will find it a good investment, the price being a penny, to which ½d. must be added for postage.

Catalogues Received.

R. de Brou, 16, Elm Street, Gray's Inn Road, London, E.C.—This firm of petrol motor manufacturers makes a speciality of supplying motors, either finished or in parts, to the trade or amateurs. These motors are imitations of the Panhard, De Dion, Minerva, Werner, and other popular patterns. A powerful motor-bicycle is supplied in different forms, and either finished or in sets of parts as desired. Readers should mention THE MODEL ENGINEER and send a penny stamp for descriptive catalogues of the above.

Direct-Coupled Engine and Dynamo (Stuart-Turner), Shiplake, Henley-on-Thames.—We have received a copy of Mr. Stuart-Turner's new illustrated price list giving particulars and prices of his coupled engine and dynamo described in our February 1st issue. Those of our readers who are interested in this design should send a penny stamp to Mr. Turner for the above list.

Notices.

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.

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THE

Model Engineer

AND

Amateur Electrician.

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How to Make a Powerful Bichromate Battery.

By J. PIKE.

ALTHOUGH bichromate cells are easily made and put together, as a rule—however suitable they may be for lighting purposes—if there is heavy work to be done, as in driving a small motor, or running a model electric car, they quickly fall off in power. The following method of construction may be followed with considerable advantage:—Briefly, the elements are made up of two zincs and three carbons for each cell, and I propose to describe two such cells, made to fit the well-known "Hartley" jam jars. These jars vary a little in capacity, and it will be well, therefore, to select them (referring to the 2-lb. size) of widest internal diameter.

Procure from electrical stores six carbon plates, 5¼ ins. by 2¾ ins.; this appears to be a stock size. I have tried to get larger plates, but without success. They should have two holes drilled in one end. Get from a dealer in iron and metal four pieces of stout zinc, 1-6th in. thick, and of size similar to the carbon plates—I find it easier and probably much cheaper to get these cut to order—they require to be drilled at one end, a hole ⅛ in. in each, centrally, and about ¼ in. from the end; and they must then be amalgamated

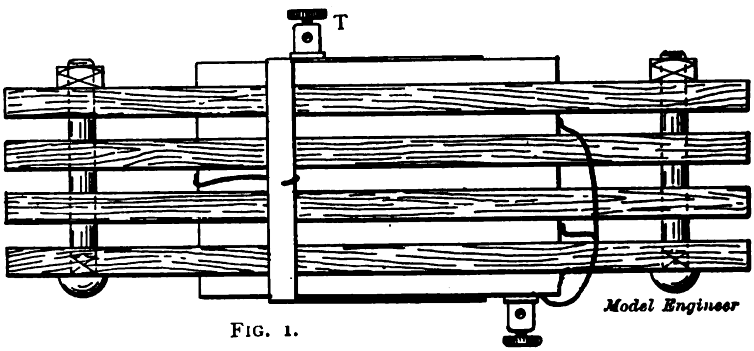


FIG. 1.

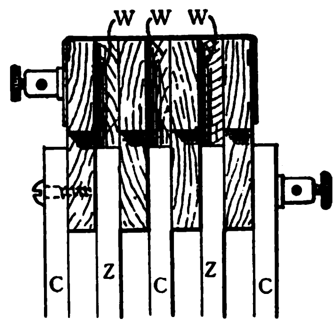


FIG. 2.

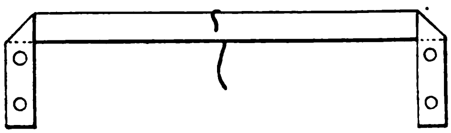


FIG. 3.

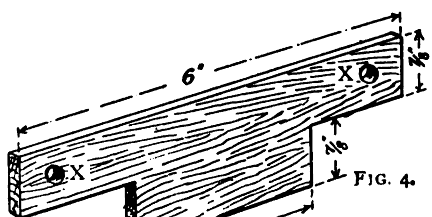


FIG. 4.

HOW TO MAKE A POWERFUL BICHROMATE BATTERY.

To amalgamate the zinc plates effectively, provide an ounce or two each of strong sulphuric acid and quicksilver; put a little water into an old soup plate, add sulphuric acid to make a strong acid solution (say about one part to two or three of water), and by the aid of an old tooth brush rub the zincs all over with this acid solution. Now pour the mercury into the dish, bring one edge of the zinc plate up to it, and with the brush sweep a little of the mercury on to the zinc plate. If the acid has been strong enough to really clean the surface of the zinc, the mercury will attach itself rapidly, and may be brushed all over, the amalgamation being completed very easily and effectively. Rinse the zincs in water, and set up to drain; pour off the acid from the mercury (if any remains), wash this in water, and bottle for future use.

In order to ensure that as large a surface as possible of zinc and carbon is available to the action of the bichromate solution, I provide pieces of wood (holders, in fact) of the shape in Fig. 4. Eight pieces are required of strong wood, that is to say, wood not easily split, and it should be at least 5-16ths in. thick, but need not be more. Having cut the eight pieces, clamp four of them together, and carefully bore a hole at each end, as shown in Fig. 4 at X. This may be done with a brace and small bit, or by the primitive method of a red-hot iron rod. The hole should be just large enough to take a 2¼-in. small iron bolt, the thickness of which is rather under ¼ in. An attachment of wire to the top of each zinc must now be made, and to do this clean about an inch of the top edge with a file, and solder thereto one end of a 6-in. length of No. 16 copper wire; bring the wire out straight, as it is to be bent up afterwards. Provide next four terminals, those with a sharp-pointed screw; and also two strips of thin brass cut and bent over as in Fig. 3, the holes in the ends being drilled to coincide with the holes in the outside carbon plates.

We may now proceed to build up the battery. By means of short wood screws attach a zinc plate to the tongue of one of the wood holders; cut a piece of thin wood the thickness of the zinc, and 3 ins. long by ½ in., and attach it with a drop of seccotine just above the zinc, bringing it up flush with the top. Now place another holder (adjust a carbon plate this time) and insert underneath the screws before making tight the end of a 6 in. length of wire. The end should be turned roughly round each screw, and the other end brought out in the opposite direction to the zinc wire. Fill up the space above the carbon with another piece of thin wood; adjust another holder and screw on a zinc plate; see that the attached wire comes out similarly to that on the other zinc, and fill up the space above as before. Now another holder, and we may insert the bolt at each end and screw up. The small wood insertions at the top of each central zinc and carbon are, of course, to take up the pressure when the bolts are screwed tight—a reference to the figures 1 and 2 should make this quite plain. The two outside carbon plates are screwed on from the outside, the thin strip of brass being adjusted and bent over to make the connection. One of the terminals should be used in place of a brass round head screw (see T in Fig. 1); the screw inserted into the zincs is central, and never near the screws used in the carbons, and, of course, must not be long enough to go right through the wood. The wire from the central carbon is brought up, turned round the brass strip, and soldered; and the two wires from the zincs also brought up, coiled round each other, soldered, and connected to a terminal, which may be screwed in on the opposite side to the carbon terminal—a sectional view is shown in Fig. 2—and looking down, the top of battery has the appearance of Fig. 1. Finally, soak the whole of the woodwork in shellac varnish—perhaps hot paraffin wax would be better—and when thoroughly dry and the battery dropped into chromic acid solution, they work admirably.

[NOTE.—By an error in the drawing, noticed too late for alteration, the terminal *a* in Fig. 1 appears to be driven into the carbon plate. It should, of course, be attached to the last wooden strip, as it is the terminal for the zinc plates.]

Hints on Making Moulding Sand for Small Castings.

By J. A. B.

A SMALL quantity of moulding sand is very useful to amateur fitters for casting the humble lead, or the more useful white brass, which can be melted in a ladle over an ordinary fire, and yet is sufficiently hard to turn and file up well.

Sand can be bought ready for use, but to make something for one's own use is better than buying it; also there is the knowledge and experience gained thereby.

From a builder's yard obtain some ordinary building sand. If he is friendly with you he will probably give you as much as you can carry home free of charge. Dry and sift it through a piece of 1-16th in. round hole perforated zinc, or wire gauze if required finer. Now throw on some water (but only sufficient to make it damp—not wet), and thoroughly mix it with a flat piece of wood.

To test if it is suitable for the purpose, try as follows:—Take a single handful and squeeze it as tight as you possibly can; then open your hand and notice if it stays in a lump and does not crack or fall to pieces; work it round in the palm of your hand, rub off the edges with your fingers and thumb, and try to bring it into the shape of an oval pebble; if you can do this without it crumbling to pieces, it will be suitable for moulding sand. But if it falls to pieces as soon as the hand is open, it is "weak," and must have about 4 per cent. of clay added to it.

Clay can be obtained from a builder, a grave digger, or at a brickfield for the asking, as only a small quantity is required. It should be thoroughly dried in the air (not baked or burnt), then pounded fine with a hammer, and sifted through a fine sieve.

Now weigh the dry sand; and suppose you have 16 lbs., also weigh off 10 ozs. of clay powder; spread the sand out in a thin layer, and then sprinkle evenly over it the clay powder, and thoroughly mix all together.

If the sand is to be used for casting zinc rods or plates for batteries, try to get brown sand for the purpose, as red sand usually contains iron.

The Aeronautical Institute and Club.

ON Friday, March 7th, at St. Bride's Institute, a paper was read by M. Auguste E. Gaudron dealing with the progressive improvements of the navigable balloon, from its inception in 1852 to date. Giving credit for the first practical design to Henri Giffard, who made his experiments in 1852, the lecturer dealt also in detail with the demonstrations of Dupuy de Lôme in 1870, Gabriel Yon in 1880, the Brothers Tissandier in 1881 (who introduced electricity as a motor power for balloons), and with the successful ascents made by Messrs. Renaud and Krebs in 1884. M. Gaudron did not express himself favourably in regard to the attempts of Herr Schwarz in 1898 to produce a metallic balloon, declaring that all such designs were doomed to failure, owing to the liability to fracture upon coming to earth. For a similar reason he discounted the merits of the Zeppelin airship of 1900, where stiffening was attempted by means of a lattice framework of aluminium. In conclusion, the lecturer instanced the demonstration at the Alexandra Palace in 1898, as the only occasion when a navigable balloon has been experimented with in public in this country. M. Gaudron was in charge; but the day was windy, and the motor not working well, consequently the results were not all that could be desired. The Hon. Secretary of the Aeronautical Institute and Club is Mr. O. C. Field, 20, Adelaide Road, Brockley, S.E.

The Society of Model Engineers.

London.

MODEL MAKING COMPETITION, 1902.

AS announced at the January meeting of the Society, a model making competition, open to all members of the Society, will be held on May 22nd. The entries for the competition, accompanied by one shilling entrance-fee, must be sent to the Hon. Secretary, Mr. HENRY GREENLY, 4, Bond Street, W.C., on or before May 5th, upon forms which will be posted to all members.

The prizes will consist of silver and bronze medals, and will be awarded in the following classes at the discretion of the judges: 1, Locomotives; 2, Marine, Stationary, and other Engines; 3, Electrical Apparatus; 4, Ships and Boats; 5, Best Model made by a member under 21 years of age; 6, Best Model exhibited by a provincial member; 7, Best home-made Tool; 8, Miscellaneous models.

The prizes will be awarded according to the number and quality of the exhibits in each class; and the judges, in allotting marks, will pay especial attention to originality in design and construction—*i.e.*, methods of constructing. Members who are users of metal-working tools in ordinary business, or who have had professional instruction in mechanical work, will be handicapped according to the nature and extent of their experience. Members who are professional model makers, cannot be entered for Classes 1, 2, 4, 5, 6, 7, and 8, and those who are engaged in electrical apparatus making as a livelihood will not be allowed to enter for Class 3. Only *bona fide* members of the Society are eligible.

Models which have gained prizes in the previous competition (1900) cannot be allowed to compete in the present one, and no model shall take more than one prize.

Provincial Branches.

Bolton.—A preliminary meeting for the promotion of this branch was held at Mr. C. A. Hays', 36, Gilnow Road, Bolton, on Wednesday evening, March 19th, seven intending members being present. Mr. Mitchell exhibited a beautifully finished model hydraulic press, which was much admired by those present, and Mr. Hays showed drawings and castings of a ¾-in. L. and S.W. locomotive he is about to build. A very enthusiastic and pleasant evening was brought to a close at 9.35. Intending members are requested to send in their names without delay to S. L. THOMPSTONE, Hon. Secretary, 27, Nelson Street, Broughton, Manchester.

Bradford.—The Bradford Branch had an exhibition night on March 3rd, 1902. The following models were shown:—Mr. Wilson, vertical boiler 7 ins. by 12 ins.; firebox 6 ins. by 6 ins., solid drawn copper fittings complete; also his prize model electric light engine, which is described in a back number of THE MODEL ENGINEER. Mr. Drake, a piston valve engine, 1 in. by 1½ ins. stroke; also a tender for a locomotive of S.E. & C.R., 3½ ins gauge; J. H. Lamb, a 100-watt dynamo of the "Leeds" type; Mr. White, a vertical engine, 1½ ins. by 2 ins. stroke; Mr. Rhodes, a model of a 6-cwt. steam hammer, ½ in. by 1 in. stroke; Mr. A. Barber, a locomotive, driving wheels 3 ins. diameter, cylinder 9-16ths in. by 1½ ins. stroke, boiler 2½ ins. by 8½ ins. long, length complete over all 25 ins., gauge 2⅞ ins.; also a traction engine boiler 2½ ins. by 8 ins. long, cylinder ⅝ in. by 1 in. stroke, driving wheels 5¼ ins. diameter, bogie wheels 3 ins. diameter, complete with winding drum and dynamo in front. All the models were of the best workmanship, neat, compact, and handsomely finished. The meeting was a complete success, the room being overcrowded with visitors.

The usual fortnightly meeting of the Bradford Branch was held on March 17th, 1902, at the Coffee Tavern, Tyrrell Street, Bradford. Mr. A. P. Drake presided, and after formal business Mr. Drake showed a Skinner engine, and Mr. Wilson a set of Whitworth taps from ⅛ in. to ½ in. This meeting closed at 10 p.m.—JAMES H. LAMB, Hon. Sec., Holly Bank, 109, Rushton Road, Thornbury, Bradford, Yorks.

Edinburgh.—On the evening of Friday, 7th March, a party of members and friends visited Chancelot Flour Mills, at Bonnington. These mills, which are the property of the Scottish Co-operative Wholesale Society, Ltd., are about the largest in Scotland, and are fitted with the most modern machinery. The party inspected every department, and saw the flour in every stage of its manufacture, and were impressed with the fact that in not one of these stages does the flour ever come into contact with the hands of the millers.

The usual fortnightly meeting of the branch took place on the 13th March, at the Society's rooms, at 13, S. Charlotte Street. Mr. Robert Kerr presided over a large turn-out of members. Four new members were admitted. Mr. Dodds delivered a very interesting lecture on "Steam and the Steam Engine," in which he traced the development of the steam engine from its earliest form down to the present time. A discussion took place at the close of the lecture, in the course of which Mr. Bissett gave a very interesting description of the Parsons steam turbine. At the close Mr. Dodds was awarded a very hearty vote of thanks. Mr. Anderson then exhibited his model 1-in. scale model G.N.R. locomotive. This model, which has occupied most of Mr. Anderson's spare time for a number of years, is a magnificent piece of workmanship, and was much admired by the members present. Much of the interest taken in this model was undoubtedly due to the fact that it is fitted with an entirely novel form of valve gear, worked by a single eccentric, which has just been patented by Mr. Anderson. Mr. Anderson was also heartily thanked for this interesting exhibit.—W. B. KIRKWOOD, Hon. Secretary, 5, North Charlotte Street, Edinburgh.

Leeds.—On Monday evening, March 18th, a meeting of the Leeds branch was held in St. Andrew's Church School, when Dr. Wear brought a very neat brass hand force pump, which was put to practical use in pumping water satisfactorily. Afterwards, Mr. Ramsden raised a discussion on the model boiler explosion recently reported in THE MODEL ENGINEER and the causes of boiler explosions. The meeting terminated at 9.45 p.m.—W. H. BROUGHTON, Hon. Secretary, 262, Carlton Terrace, York Road, Leeds.

Nottingham.—The first meeting of this Branch was held at the Gordon Café, Derby Road, on March 7th, 1902. The chair was taken by Mr. George Wilson at 8.30. There were a good number of members and friends present. The following officers were elected:—Hon. Chairman, Mr. George Wilson; Vice-Chairman, Mr. Philip Reader; Secretary and Treasurer, Mr. Reuben P. Reader; Committee: Mr. Doughty, Mr. C. Read, Mr. E. Williams. The subscription was fixed at 5s. 6d. per annum, payable in half-yearly instalments of 2s. 9d. each, payable in advance. The entrance-fee it was decided should be included in the first half yearly instalment. The rules were left in the hands of the committee for revision; and they have carried their work out well, leaving the rules at the present time in the hands of the printer. It was decided that the meetings should be held the first Friday in each month. The meeting was adjourned at 10 p.m., when a vote of thanks was extended to all those concerned in the origin of the Nottingham Branch.—REUBEN P. READER, Hon. Secretary, 4, Wellington Square, Parkside, Nottingham.

A Simple Working Model Locomotive.

By H. Greenly.

(*Concluded from page 156.*)

THE dome, it will be noticed, is applied for ornament only. It would not be advisable to take the steam from such an exposed position, and to provide an inner and outer dome would necessitate further complication and extra work, both of which it is very desirable in this instance, if not in most, to curtail. Even if this was not the case, the merit of the dome over the perforated pipe is a debatable point. The safety valve is not new to the readers of The Model Engineer, and needs no great amount of written description. The seating should be pinned to the barrel, and the holes in valve pillar leading to the main vertical passage should be 1-16th in. diam., and four in number, and should be drilled in a horizontal direction, as is shown on the drawings.

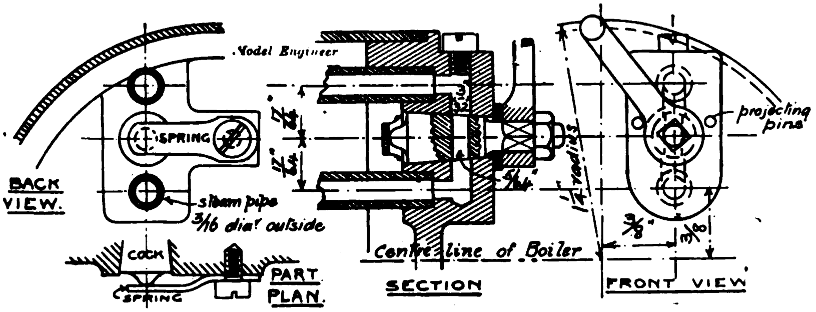
To further prevent the boiler ends from blowing out, two longitudinal brass stays, 5-32nds in. diam., may be fitted. These should be screwed into front ends and be filed off flush on the outside, and arranged with nuts at the back end. They may, however, be entirely dispensed with if the number of screw pins in the ends be increased from 6 to 10 or 12. The boiler would in either case be quite safe up to a pressure of 35 lbs. to 40 lbs.

The regulator, which, if a slide-valve cylinder is used, is practically indispensable, may be placed on the back end; the boss in which the plug moves should be cast solid with the end. This regulator, although slightly larger and more complicated, has been used by the writer in a large model with perfect success; it has proved to be always certain and free in action. In the Cab View a steam gauge is shown attached; this fitting may or may not be used according to desire of the maker, and in the latter case the hole in the top, which is necessary in drilling the upright passage, may be plugged by a brass set-screw, which, if the regulator refuses to move, after having been left many months unused, may be withdrawn, and a drop of thin oil, such as paraffin, injected. Such a treatment would effectually make the regulator work satisfactorily. Regulators, especially those of the plug cock variety, which are inside the boiler or in the smoke box, are very liable to stick, and, in the former case, are not capable of being eased without undoing some part of the boiler.

In the End View of the locomotive, a sector-plate stop for the handle is shown; this may be superseded by a simpler contrivance—shown in the detail drawing—consisting of a pair of pins screwed into the regulator boss on either side of the handle. The regulator and handle is shown in the full open position in all views. Behind the boss of the handle a thin washer or ring should be provided, and this may, with advantage, be split and bent sideways, so that on affixing the handle and screwing up the nut, the washer will be flattened again, and if it is, as it should be, of hard brass, it will resist this, and tend to keep the plug always pressing into its conical seating. A second spring should be placed inside to keep the plug always on its seating, and prevent leakage; the arrangement of this is clearly indicated in the full-size detail below.

The remaining details of construction of the regulator may be gathered from the full-sized drawing. The lower horizontal opening is fitted to the steampipe communicating with the cylinder, and the upper one with the perforated collecting pipe, which should have about a dozen pinholes in its top half. The end of this pipe should be plugged.

The casting for the water space at the back end of the boiler will have to be fitted before the construction of the boiler is proceeded with much farther than has been described. Now that castings of this design are being placed upon the market, there seems no need to describe the pattern-making necessary for this detail. To finish it ready for fixing to the barrel, the flanges may be either filed to a scribed line or blocked up upon the faceplate, and a cut taken across them. To the beginner either method will be found difficult, and the latter is practically out of the question if a slide-rest is not amongst the tools at his disposal. To scribe a line upon the flanges the radius of the barrel—viz., 1¼ ins., the casting should have its plane surfaces filed up and finished, care being taken that the sides are square with one another.

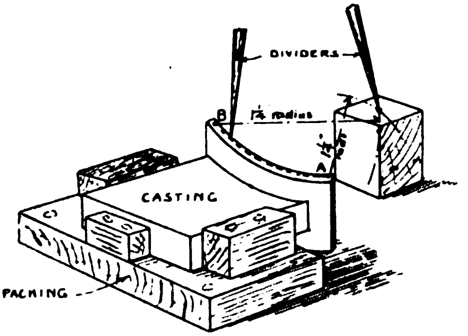


Regulator for Simple Working Model Locomotive.

The casting may then be laid flat on a wooden bench, with a piece of packing of sufficient thickness under it to lift the flanges clear of the bench. This packing should be nailed down. On three sides of the casting a block of wood should be nailed to the packing-piece, as shown in the sketch on the opposite page; these will enable the accurate reversing of the casting when marking the opposite flange.

Supposing the casting is of good shape and the pattern has been accurately made, the centre for striking the 1¼-in. radius may be found upon the block of wood, which must be of the same height as the flange, by taking A B as respective centres and scribing arcs as indicated. The point where these arcs cut will form the centre from which the line upon the flange may be marked. All that is needed to scribe the other flange is to turn the casting over. The time expended upon accurately marking out any piece of work in mechanical engineering is generally amply repaid, and the most impatient model engineer will, in this case especially, find that the preparatory trouble will enhance the quality of his work and reduce the total time occupied upon it to a greater extent than would be occasioned by fast and, perhaps, slovenly methods of procedure.

When the water space has been finished, the position it will occupy upon the boiler must be indicated by scribed lines, when to connect its cavity to the inside of the boiler, five 3-16th-in. holes may be drilled in the barrel. The water space or "down-comer" may be afterwards sweated on and secured by 3-32nd-in. screws, screwed pins, or rivets at about ½ in. pitch. The holes in the down-comer should, for convenience sake, have been drilled before fixing it to the barrel, and if the beginner has a 3 16ths in. screw-plate and tap, giving a fairly fine thread, the water tubes may be screwed in. This is not absolutely necessary, as, owing to the small amount of surfaces exposed to pressure, the fact of properly soft soldering them in place will prevent any failure. The tubes should be 3-16ths in. outside diameter, and about



Method of Marking-off the Firebox Casting.

⅛ in. inside. Holes must be drilled in the barrel to take the other end of the water tubes, which, after a preliminary annealing, bending, and annealing again before sweating in place, may be burred over on the inside. When this operation is completed, the joints should be thoroughly re-sweated to ensure their tightness under steam pressure.

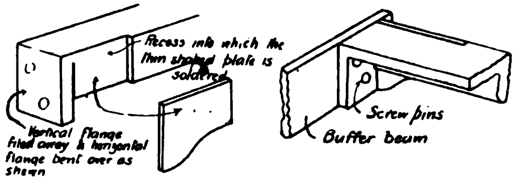
The flue and flame guard may be made out of tin plate. The flame guard, as will be seen by the Cab View on page 154, is affixed to the boiler at a fairly high level, and may be flanged, soldered, and secured from falling off—in case of accidental overheating—by two screws on either side driven through the flange and into the barrel. The flue may be soldered edge on to the barrel, and all holes should be provided for in cutting out the flue to allow the pipes to be fixed.

When the boiler is in place, and the saddle and other cover plates, which may be all made from tinned plate, is ready for fixing by soldering, these perforations may be made air-tight by the use of asbestos cotton, which, stuffed into the crevices whilst wet, will adhere quite firmly. Some is necessary between the flue and the footplate around the exhaust pipe and at the hole made in the flue at the steam pipe. The maker will note that the cylinder must be clear at the upper part of the front cover to oscillate freely. Care must also be exercised to prevent any cotton blocking up the flues.

The tanks and cab are relatively simple matters. The former are dummy structures and do not hold water; but in the design they present an advantage, in that they can be filled with asbestos cotton, and so prevent radiation over a good proportion of the surface of the boiler. They also provide a protection against burning the fingers when manipulating the model, as they are disconnected to a great extent from the hotter parts of the engine. The side and end of the tanks and cab are of one piece; a top may or may not be made as the maker decides. To protect the trailing wheels from the asbestos cotton, a splasher of tin plate should be provided. The weather-board of the cab should come nearly to the level of the footplating, and should be shaped so that it will, when finished, complete with the sides and roof, slide on to the boiler barrel from the back. The side tanks should have a piece of brass angle soldered along the inside of the bottom edge to enable them to be affixed by screws driven from underneath.

The cab windows, the curve of the cab, and the upright edges of the cab and back tank, between which the driver passes, should be edged with 1-16th-in. brass wire. The top edges of the side and back tanks should have ⅛-in. by 1-16th in. brass strip soldered on. The back tank should be attached by soldering brass angle to the inside of the lower edge, and it may then be drilled and tapped for three screws—one at each side and one at the back in the centre—to be driven from underneath the footplating. The handrails may be made from old bicycle spokes; those fixed to the side and back tanks are simply bent at each end in a horizontal direction and soldered into holes made in the plates. The handrail upon the boiler must be provided with three standards which can be turned from 3-16ths in. brass rod and afterwards sweated into the holes in the barrel. The end of the handrail may be arranged to receive some support by projecting into a hole drilled into the front end of the side tank.

Upon the top of the cab a dummy whistle should be attached. This feature, which can be easily turned out of a piece of 3-16ths-in. rod or other scrap metal, will give a realistic appearance to the model. Another point which, if properly arranged, lends an air of completeness to any model locomotive, is the edging of the footplating. In the engine now under consideration, the general drawing (see page 107, March 1st issue) gives the correct shape in dotted lines, whilst the accompanying sketch shews the arrangement pictorially. The edging



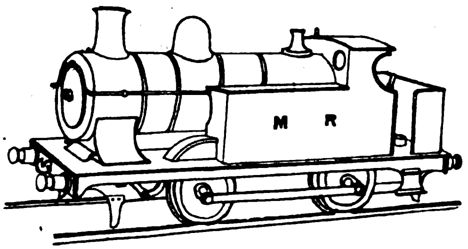
Outside Frame Edging.

itself is 5-16ths-in. by 5-16ths in. brass angle, and the shaped end at the front and the step-plate at the rear, both of which, as will be seen, should be flush with edging, may be constructed in the manner indicated upon the detail sketch of the foremost end herewith. The plate upon which the steps are soldered should be attached to the angle edging in a similar way.

To complete the description of this design for a model locomotive, it is necessary to refer in a few words to the spirit lamp. The firebox (or firing space) is large and more wicks than are shown may easily be arranged. Whether six or eight wicks are provided, the construction will remain practically the same, and if the latter number are found to be necessary, the strip of brass which is shown connecting the two conducting pipes may be soldered on in another position, and three pairs of wicks may be placed in front of the trailing axle instead of two as shown. Asbestos yarn will be found the most suitable for the wicks, because if at any time the supply tank becomes empty, the wicks will not char to any extent, and beyond refilling the tank and lighting up, the lamp will not require attention. The tank should be made of tin-plate and measures 1⅝ ins. by 2⅛ ins. by ¾ in. At the back two strips projecting upwards should be soldered on. Those strips should have a hole shaped like an inverted keyhole cut in them, so that each may be able to pass over the head of a slightly projecting roundheaded screw fitted into the rear buffer plank. The weight of the lamp will cause the shank of the screw to engage the slot of the keyhole when the head of the screw will keep the lamp securely in its required position. The 5/8 in. tubes forming the wick holders will need plugging at the bottom and drilling for the conducting pipes (1/8 in. diam.). The latter should be filed or drilled on each side to establish a communication for the fuel between them and the wick holders. The conducting pipes will also require plugging at their foremost extremities, and the plugs may, when fixed, be filed conical. This will ensure an easy entry into the holes provided in the front of the flame guard.

There are two points in the design which can only be decided upon by practical experiment. One refers to the distribution of the weight of the model and the other is a question of draught. The centre of gravity of the engine appears to be rather in front of the centre of the wheel base—in other words, there appears to be more weight overhanging in the front than at the back—and if it is found that there is any such tendency to topple forward a little slab of lead, say 1/8 in. by 5/8 in. by 1¾ ins., might be bolted to the underside of the footplate just in front of the filling tube of the spirit tank.

With regard to the necessity of any forced draught. If, with natural draught, whilst the engine is standing still, and therefore does not have the benefit of the exhaust, any tendency to extinguish or choke the flame appears,



A Simple Working Model Locomotive.—The Finished Engine.

a steam jet should be introduced into the base of the chimney. Only a small jet, about 1-32nd in. diam. need be used, and in case this contrivance is required, the writer will be pleased at any time to give a sketch of the method of fixing and other details necessary.

In submitting this design to the readers of the *M.E.*, the writer would ask them to remember that in describing the construction of such a model it is necessary to imagine some of the factors governing the exact methods. The conditions under which the prospective builders may make it will vary in every case; the tools at their disposal, their skill and professional training (if any) modify the methods of construction very largely. It must be noted that the locomotive is one of the most difficult models to make successful, and if this design appears complicated allowances must be made for the fact that practically everything upon it is required to make it work efficiently. It is doubtful policy to advise any absolute beginner to build a locomotive, but although to such the model now under consideration may look formidable, in reality it involves no very great amount of skill, especially if the parts requiring special tools, etc., are left for others to supply.

The model will suit two classes: those who have too little time to construct a complete model express locomotive, and those whose complement of apparatus and length of pocket will not warrant them attempting a ¾ in. scale "Dunalastair."

The Uses of Engineering Models.*

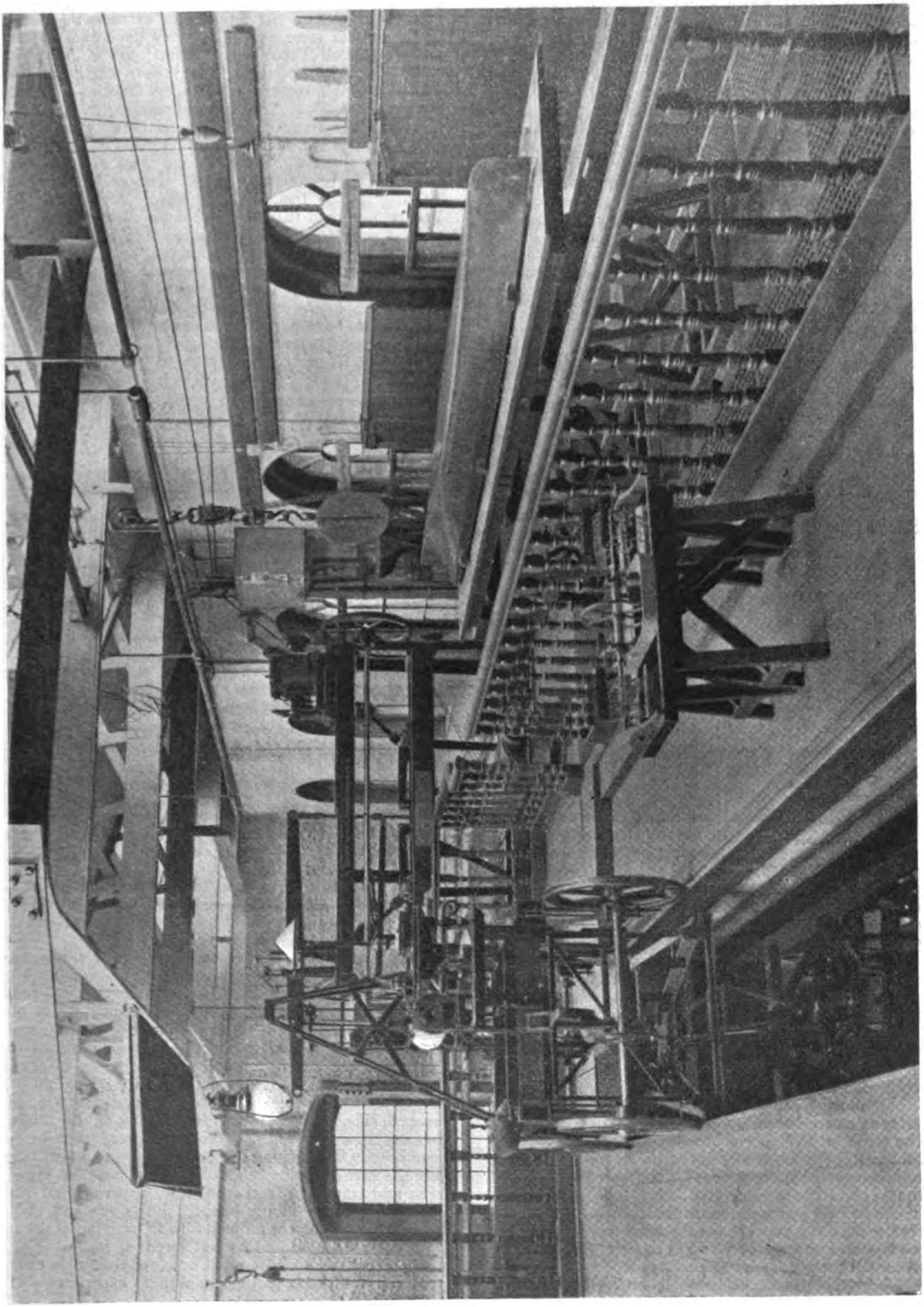
By Percival Marshall, A.I.Mech.E.

THE part played by models in the practice of engineering, though necessarily small in more senses than one, is yet, perhaps, of more importance than is generally recognised; and the fact that it has hitherto received but little public consideration and discussion by the various engineering societies, has led the author to venture to bring the subject before this Institution. Although it may appear a somewhat sweeping claim to make, the high-class condensing steam engine of to-day can trace its origin back to a working model of one of Newcomen's engines constructed in the middle of the eighteenth century, for history records that James Watt made his famous invention of a separate condenser and air pump as the result of some experiments with a working model of this type, which had been placed in his hands for repair. To prove the value of his invention, Watt constructed an experimental model of a separate condenser; and this identical model, together with another model of a condenser made by Watt at a later date, may now be seen in the Victoria and Albert Museum, South Kensington.

An examination of the extremely interesting collection in this museum shows that Watt made a number of models of engines and mechanisms of various kinds for experimental purposes, and there is no doubt that his many valuable inventions were much facilitated by the assistance he received in this way. For instance, the collection includes a model of a twin cylinder engine, in which both cylinders are of the single-acting type, the respective piston-rods being connected by a chain. The pistons working alternately naturally produced the same effect as a single double-acting cylinder, and this fact being fully demonstrated by the model, Watt was saved the trouble and expense of building a full-sized engine on this principle, which he probably would have done had he not experimented with the model in the first place. There are also to be seen at South Kensington several models of sun and planet gearing, connecting-rods, beams, and other engine details made by James Watt in the course of his numerous mechanical investigations. These examples serve to show that at a very early stage of modern engineering, models were found to be of great practical value.

From an historical point of view, models may be of much service in showing the successive stages of development of any particular class of machinery, such as locomotives, marine engines, ships, printing presses, tools, and indeed any product of engineering skill. The essential features of an engine or machine are grasped much more readily from a model than from a working drawing, especially by the non-specialist mind, although, of course, a drawing has its advantages for showing internal arrangements and details, unless the model be in section. The author suggests that present-day firms would confer a valuable benefit on engineering posterity, if they would make a point of presenting to the national collection at South Kensington a scale working model of all important novelties in engineering construction which they might introduce. The expense involved would possibly, in some cases, prevent this being done, but there are many firms sufficiently prosperous and wealthy to be able to act on this suggestion, and in this way a magnificent collec-

* A paper read before the Institution of Junior Engineers, at the Westminster Palace Hotel, on Friday, March 14th, 1902; Mr. Kenneth Gray, M.S.I., presiding.

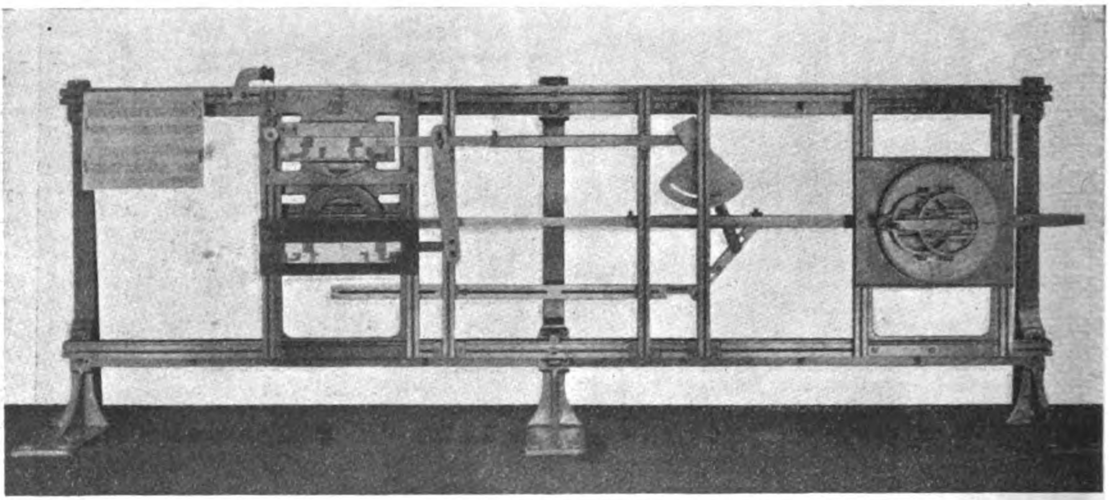


DR. FROUDE'S MACHINE FOR SHAPING SHIP MODELS, IN USE AT MESSRS. DENNY & CO.'S EXPERIMENTAL TANK.

tion might be formed, which would be a splendid witness to the engineering skill and resources of this country, as well as forming a most instructive and interesting permanent record for engineers and students of the future. The unique collection of the historical ship models brought together at the Glasgow Exhibition last year, is an instance of what might be done in this direction.

Turning now to the every-day uses of engineering models, they may first be considered from the scientific and experimental standpoint. Perhaps no more striking example of their value in experimental investigation can be quoted than their use for determining the speed resistances of ships about to be built. Briefly described, the mode of procedure is as follows :—A design having been prepared for a ship of a certain size, it is required to know what power will be required to propel that ship at a given speed. A model ship is built in wax, or in wood, accurately to the lines of the large ship, and is towed along in a specially arranged tank at a speed corresponding to that which is to be guaranteed for the full-sized vessel. The corresponding speeds of vessels having similar lines are proportional to the square roots of their respective lengths. The length of the full-size vessel and the length of the model being both known quantities, it is, therefore, an easy matter to determine at what speed the model must be towed to give corresponding results. The resistance offered by the water to the model; or, in other words, the power required to tow the model along, is accurately measured by suitable apparatus, and from the data thus obtained, the power required to propel the full-sized vessel at the guaranteed speed can readily be calculated. This method only holds good so far as the question of wave resistance is concerned, the frictional resistance of the ship following different laws and being the subject of separate calculations.

The credit for the introduction of this system of experimenting with ship models is due to the late Dr. Froude, who built a special tank for the purpose some years ago at Torquay, and did a considerable amount of work there for the Admiralty. After the death of Mr. Froude the use of the tank at Torquay was discontinued, and a new tank built at Portsmouth, which is now devoted entirely to Admiralty work under the superintendence of Mr. Froude's son. Messrs. William Denny & Brothers, of Dumbarton, were the first among private shipbuilding firms to appreciate the advantages of these model ship trials, and for some years past they have had a splendidly equipped experimental tank, 300 ft. long and 10 ft. deep, in operation. They have kindly allowed members of this Institution to inspect their tank on more than one occasion. The fine shipbuilding record of this firm, and the frequent public references by experts in naval architecture to the results obtained from these experimental trials, proves that the work done is of real scientific and commercial value. Indeed, at a recent meeting of the Institution of Naval Architects, Mr. Yarrow proposed that, in view of the undoubted advantages of such trials, the Institution should take steps to establish a model-testing tank for use by shipbuilders in this country generally — a proposal which was enthusiastically received and adopted for further consideration. It is interesting to note that the United States Government have gone into this subject very thoroughly, and have put down a magnificent installation of this kind in the Navy Yard, at Washington, at a cost of £250,000. This tank is 470 ft. long, 42 ft. 8 ins. wide, and 14 ft. 8 ins. deep. Some of the European Governments also possess similar experimental tanks.

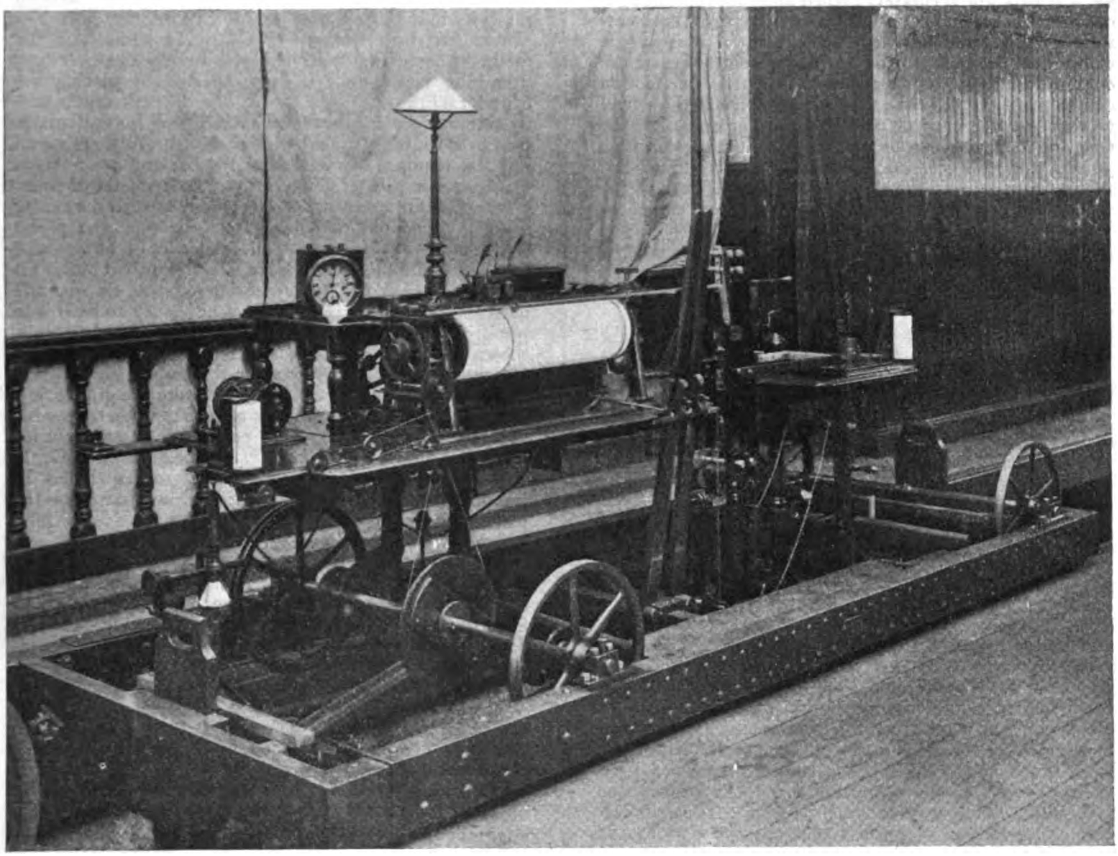


EXPERIMENTAL MODEL OF LOCOMOTIVE VALVE GEAR, IN USE AT CREWE WORKS, L. & N.-W. RY.

Another instance of the assistance of models in investigating questions relating to the propulsion of ships, is to be found in the experiments on cavitation conducted a year or two back by the Hon. C. A. Parsons. Mr. Parsons was then adapting his well-known steam turbines to steamship propulsion, and desired to investigate the subject of cavitation, or the hollowing out of the water into vacuous spaces and vortices by the blades of the propeller. To this end he fitted some model propellers in a closed tank of water, having plate glass windows on each side, through which the working of the propellers could be observed. Photographs were taken by intermittently illuminating the propeller from an arc lamp, and the cavities formed about the blades could be clearly seen and traced. Mr. Parsons also experimented with model propellers, taking note of the power and thrust with various widths of propeller blade, arriving at the instructive conclusion that for fast speeds at sea, wide and thin blades, and a coarse pitch ratio are absolutely essential. (Some further particulars of these experiments will be found in Mr. Parson's presidential address before this Institution in November, 1899).

In other branches of scientific investigation, models have been used with very satisfactory results. For example, in connection with the balancing of engines, Prof. W. Dalby has lately conducted a number of instructive experiments with models to demonstrate the existence of the unbalanced force and couple usually associated with four crank marine engines, and to show how they may be eliminated by a proper choice of crank angles and reciprocating masses. A brief description of these models, for which the author is indebted to Prof. Dalby, will perhaps be of interest. The four-crank model is designed for experimenting on the effect of setting the crank at different angles, and using different reciprocating masses. It is so designed that for the proportion of centre lines adopted in the model any setting possible may be tried. Thus the cranks and masses may be adjusted to show an engine arranged so that there is practically no unbalanced force, but a very large unbalanced couple, or *vice versa*. Driven by two small electric motors, and hung upon springs, it represents a four-cylinder marine engine; and by using a suitable rheostat to vary the speed gradually, the question of synchronism may be studied. It is easy to show in this connection that an engine may, in some cases, cause more vibration at slow speeds than at high speeds. The model may be arranged to be in balance both for forces and couples, so that it will run at any speed, supported on springs, without perceptible vibration. Placed in a horizontal position on rollers, it may be used to demonstrate and study the peculiarities of four-cylinder locomotives for different ways of arranging the cranks. It is entirely self contained, so that it may be supported in any way desirable, and the unbalanced effect studied. In a four-crank engine of this description there are, in general, nine variables to consider, and of these six are susceptible of independent variation in the model.

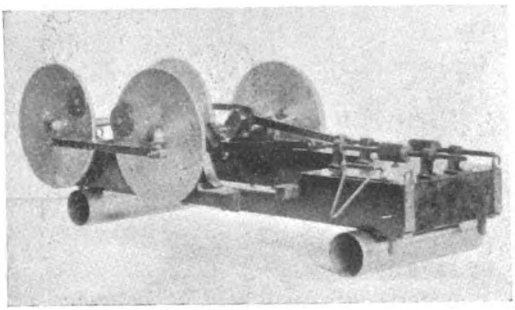
Prof. Dalby has designed a two-crank locomotive model with cranks at right angles. The centre lines of this model are made to scale, the same as those of an express passenger designed by Mr. T. W. Worsdell. There is no part which can be varied, except the magnitude of the attached balance-weights. These may be added to balance any assigned proportion of the reciprocating parts, and the effect in reducing the vibration of the model studied. This model can be suspended from springs to show the vertical effect of the balance-weight balancing the reciprocating parts, that is, the so called hammer blow; or it may be supported on rollers to show the effect on the tractive effort of the engine. When suspended, the effect of the horizontal couple may be shown by the swaying of the model from side to side. A coupled axle is added, so that the problems in con-



RECORDING APPARATUS USED IN MODEL SHIP TRIALS AT MESSRS. DENNY & CO.'S EXPERIMENTAL TANK.

nection with both single and coupled engines may be studied.

Mr. F. W. Webb has been kind enough to furnish the author with the following particulars of another model used in experimental investigations in connection with locomotive work:—This is a valve motion model, used in the drawing office of the Locomotive Department, at Crewe, and was designed and constructed for the purpose of trying over any particular valve motion that may be intended for use on the locomotives of the L. & N.W.R. Co., and also for experimenting with any other valve gear which might be designed or otherwise brought under notice. The framework of the model, which is all of cast-iron, is carried on three standards. All the horizontal and vertical bars are accurately planed and grooved throughout their entire length, so that the various parts representing the cylinders and valve motion can be put at any angle or position relatively to the horizontal centre line of the engine, which may be required; in fact, the valve motion can be placed in the same relative position which it would be required to occupy on the engine. The crank on the right of the frame can be adjusted to any stroke up to 30 ins., and the eccentrics also are adjustable for any throw up to 4 ins. With this model all the work of the valves can be accurately ascertained, the steam curves for



PROF. DALBY'S EXPERIMENTAL LOCOMOTIVE BALANCING MODEL.

any grade of "cut-off" being delineated on a sheet of paper fixed on a roller at the back of the model and actuated from the valve spindle. The valve motion shown on the model in the photograph is one designed by Mr. F. W. Webb for his four-cylinder compound express locomotives of the "Black Prince" and "Diamond Jubilee" type, in which the H.P. (piston) valves are worked from the L.P. valve spindle by means of a rocking lever, the L.P. valves being worked by Joy's gear. Thus, in this case only one set of gear is required for working the valves of two separate cylinders. The frame of the model is 16 ft. long, and stands 6 ft. high from floor to top bar.

In a lesser degree than the examples already quoted, models may be turned to good account by the draughtsman who is designing mechanism to produce certain required movements. Even if such models only consist of strips of cardboard linked together by drawing pins or paper fasteners, they will show far more clearly than any mere drawing the effects produced by combinations of levers, cranks, and other elements of mechanism.

(*To be continued.*)

Flux for Soldering.—Sir William Burnett's disinfectant will be found a most satisfactory flux for almost all purposes. It is extremely clean, and works well on brass, tin-plate, steel, or cast iron.—"THREE EIGHTHS."

Design for an Engine to Drive a Model Twin-Screw Steamer.

By W. BLANEY.

THE accompanying design is intended to fill a want expressed by many builders of model T.B.D.'s and other fast craft, inasmuch as it provides for an engine giving a maximum of power for a minimum of space and weight, with the additional advantage of driving twin-screws without gearing. Although, at first glance, it may appear rather difficult to construct, this is really not so, and any amateur who has already turned out a fair piece of model engine work ought to have no difficulty in making a good job of it.

The first novel feature that will be noticed is the method of actuating two crank pins in opposite directions from one piston-rod. This is effected by placing the cylinder midway between the centre lines of shafts, and by employing a crosshead sufficiently long for both crank pins to work in. Take two pieces of nickel steel round rod the requisite diameter and length, and space them apart a shade greater distance than the diameter of crank pins. Carefully measure the distance between the centre lines of each, and then mark out the two end pieces S, S; they should be of steel, and should be sweated together while the two holes are being drilled out. Fit them on at each end of crosshead rods, as shown, and hard solder them in place. It is necessary to fix this to piston-rod very firmly, and the best way to do this is shown in Fig. 5. Take a small block of steel (R), and file out two parallel grooves for the bars B, B to fit into very closely; they should stand out from the groove just sufficient for the plate *r* to get a grip on to when the screws *h*, *h*, are tightened up. Both plates are grooved out for the piston rod, which in turn has to be grooved at G, G, to clear the bars B, B. All these grooves should be carefully tried as the work proceeds, so that when the plate *r* is finally tightened up everything should bind together well.

The valve gear is worked in precisely the same manner as crosshead. Fig. 4 shows this. Round nickel steel rods, *b*, *b*, are spaced apart by the end pieces, *s*, *s*, and fixed to valve rod in the same manner as in Fig. 5. Each eccentric has a semi-circular groove turned in the rim, to allow *b*, *b* to work in nicely. The valve rod is guided by passing through a hole in the adjustable plate X.

The flywheels are shod with rubber tyres, and should just touch one another. The object of this is to facilitate starting the engine, should it have stopped on the dead centre. In such a case, if the flywheels did not touch, it would be necessary to give both the propellers a turn in opposite directions at the same time, to start it, and this might be very inconvenient and troublesome; as it is, it will be only necessary to touch one propeller. The best way to fit these rubber tyres will be to get a piece of good rubber tube, whose inside diameter is about ¼ in. less than the outside diameter of flywheel. A couple of slices or rings should be cut off this of the right width. These should be sprung into grooves previously turned in the rims of flywheels, and they may be cemented in place with advantage.

The bearings are in one piece for each shaft, and the holding-down bolts should be given some play, so as to allow the bearings a little side movement. This will enable us to give our rubber tyres just the requisite touch one upon another. The holding-down bolts can then be tightened up.

It will be seen that the piston-rod is made to act as the plunger of a bilge or feed pump as it passes through the bedplate, and the best way to fit this is as follows. Bore out the pump barrel a good sliding fit on piston-rod, and it will act quite well enough without stuffing-box or packing. Fit the valves, and bore holes for the screws which hold it to bedplate. Now put it aside until the engine is erected. When this is done, bring the piston-rod down to the full length of its stroke, and place pump barrel over it. See that the flange of pump fits well up to bedplate, and then lightly solder it there. Now turn the engine to see if the piston-rod binds in pump barrel; it should not do so if everything has gone right; but if unsatisfactory, now is the time to adjust matters. When it is right, drill holes through bedplate to take screws *a*, *a* (Fig. 1); fit these screws, and then unsolder the barrel, clean off all solder carefully, and screw up finally.

The cylinder is "built up," and is, therefore, much lighter than a casting. The supporting pillars P, P, (Fig. 2) are shouldered off at A, and are continued up through top cover, where they are screwed and fitted with nuts. The bottom cylinder cover rests upon these shoulders, and the cylinder fits into a groove turned in the upper face of the cover H, H (Fig. 1). The top cover, which is grooved in the same way, fits over the cylinder, and the four nuts are then tightened up. Thus we see that the four nuts not only hold both covers to cylinder, but hold cylinder firmly in its right place. These cylinder covers may be made in brass, but I prefer them in steel. It will be noticed that the bedplate narrows considerably between the flywheels, and it should certainly be of steel; it would not be amiss if it were hardened and tempered after being worked up.

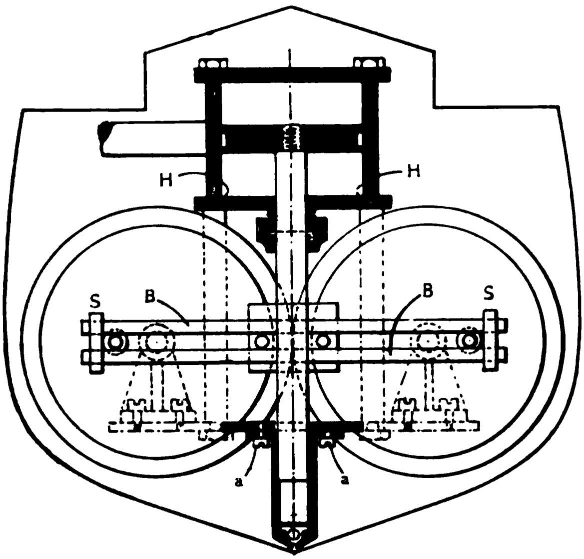


FIG. 1.—FRONT ELEVATION IN PART SECTION.

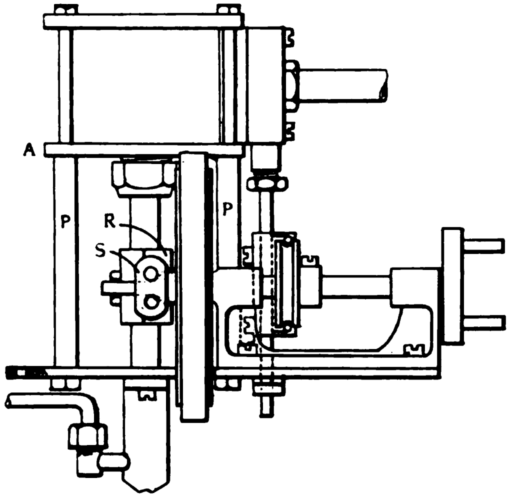


FIG. 2.—SIDE ELEVATION.

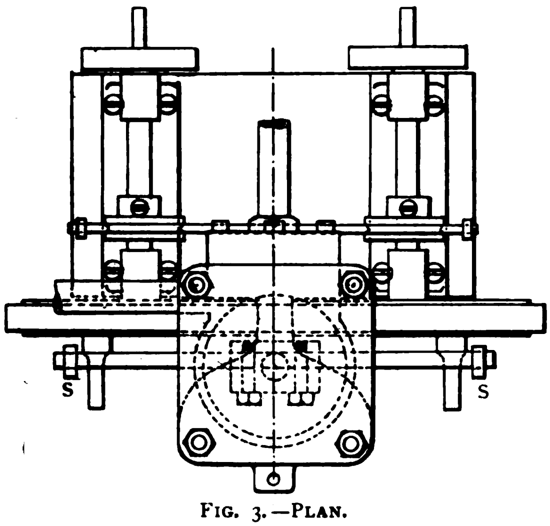


FIG. 3.—PLAN.

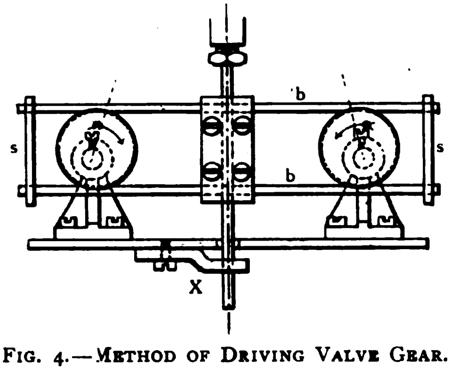


FIG. 4.—METHOD OF DRIVING VALVE GEAR.

DESIGN FOR A SINGLE CYLINDER ENGINE TO DRIVE A MODEL TWIN-SCREW STEAMER.

I am surprised to notice how many builders of model T.B.D.'s adopt wooden hulls. My own experience is that it is a most unsatisfactory material for the purpose. There is always a certain amount of heat and steam circulating about inside the hull of a model steamer, in spite of all the asbestos packing and lining. When we come to the confined boiler-space of a model T. B. D., the leakage of heat is at its worst. This plays havoc with the thin wooden walls, and must soon show its effect by altering the lines or by warping.

Those who have carefully followed the instructions given by Mr. Morriss in the March number of THE MODEL ENGINEER, for 1899, will see that it is quite possible to build a shapely hull from tin plate, and, as regards the so-called unsightly strakes of such a hull, I would point out to those who have advanced this objection, that this is precisely the same appearance that the original T. B. D.'s present; the way the real plating is put on, being much the same as Mr. Morriss describes. Why, therefore, should it be considered unsightly in a model? Of course, when soldering these plates to one another, care must be taken not to put on more solder than is necessary for the purpose. A hull with lumps of solder all along the strakes presents a sorry appearance. A tin hull has every advantage over its wooden rival. Even when the sides of a wood hull are reduced to ⅛ in., "which

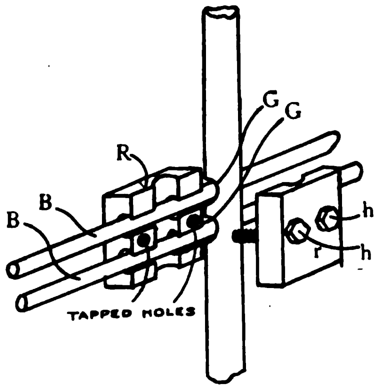


FIG. 5.—METHOD OF SECURING PISTON ROD.

is a daring experiment," the tin hull, when properly made, should compare favourably in weight.

By soldering the machinery foundations to the hull, we get a much more satisfactory fixture than small screws in pine wood presents, and as the sides of the tin boat are only about 1·64th in. in thickness, we get a good deal more room inside. This enables the weights to be brought lower, for stability. I would suggest that every plate, before being soldered in place, should have a row of small punch dots put in from the inside surface. These will look like the heads of rivets when the hull is finished. But they must be done very evenly and must be accurately spaced, or the effect will be quite spoiled.

No dimensions have been quoted for the engine here described, as the size will naturally vary with the design of hull. Built to twice the size shown by the drawings on page 179, the model should drive a four-foot boat with fine lines at a good speed.

[With respect to Mr. Blaney's remarks on building model steamer hulls, attention may be drawn to the article—"How to Build a Model Steam Launch Hull," which appeared in our March 1st issue. Although written quite independently, it will be seen that a remarkable agreement of opinion exists between the two articles, and as they are both the results of sound practical experience, should be of special value to those in doubt as to the better method to adopt.—ED., *M.E. & A.E.*]

Motor Cycles and How to Construct Them.

By T. H. HAWLEY.

(*Concluded from page 154.*)

XX.—THE EXHAUST VALVE LIFT, WATER-COOLING, FREE ENGINE, AND TWO SPEED GEAR.

IN my last contribution I mentioned some of the disadvantages of the ordinary air-cooled machine, and the additions requisite to overcome them. I shall now endeavour to put before the reader in a clear and concise manner the advantages to be claimed for, and the principles of construction, of such devices, which may be added to the quadricycle or tricycle without any material alteration in the structure of either as described.

The whole question of whether these additions should or should not be included in the machine is purely a matter of cost, and the incorporation is naturally of greater moment in the case of the quadricycle because of the higher-powered engine and the increased load upon it, added to which is the greater difficulty of starting by pedals with the additional weight of a second person occupying the front seat.

It may be argued that by the time the quad is fully equipped with water-cooled motor, free engine clutch, and two-speed gear, it will be almost as costly as a small voiturette; but, on the other hand, it will accomplish more than the voiturette at the same cost for petrol, etc., in running; in fact, apart from the conversational advantages derived from sitting side by side, the quadricycle is the preferable machine of the two.

It is the more economical and the speediest, for it offers less air resistance, and being much lighter a smaller engine will give all the speed desired. The real question, however, is—how far is it advisable to go in further improving the air-cooled motor quadricycle?

To this I must reply that all depends on circumstances, and the general use to which the machine is to be put; if it is to be devoted largely to long-distance or touring work, it will certainly be advisable, or even necessary, to at least fix a water-cooled head and free engine clutch, though the two-speed gear in addition would be in this case worth the extra expense; but so much depends on the skill of the driver, for one man will keep an air-cooled motor working all day, whereas another will be in hopeless difficulties every ten miles. However, I will take the items in turn, and endeavour to explain the advantages to be derived in addition to the method of construction.

In the first place we have a comparatively simple and inexpensive, yet vastly useful, fitment in the *exhaust valve lifter*. This is a device attached to the motor by which the exhaust valve may at any moment be opened wide and held there, the effect being that when running, the engine is suddenly robbed of power and the noise of the exhaust stops, so that it is in this sense particularly useful when riding in traffic or when passing restive horses. When descending long hills, opening the exhaust valve assists in cooling the engine and allows the piston to work more freely, or, in other words, it permits the machine to make a good speed down safe slopes, whereas in a motor as ordinarily fitted with the compression tap only, the piston acts as a powerful brake even when the compression is released.

The most important function of the exhaust valve lift, however, is in facilitating starting, for it may be kept open until enough way is got on the machine, then suddenly closed, when, if the "mixture" is right, the engine will work away at once. Consequently, I think that an exhaust valve lift should certainly be fitted in the case of the quadricycle, and once its benefits are experienced, the driver would not willingly forego them.

Simply described, the exhaust lift is a lever placed under the valve stem in such a manner that, by connecting-rods operated from the top bar or handlebar of the machine, the exhaust valve spring may be compressed, and the valve opened at any time quite independent of the action of the engine exhaust cam.

Fig. 88 almost explains itself. The slotted upright arm *a* is fixed by the nut *b* (this being one of the ordinary nuts on the crank gear case), at a suitable height, so that the arm *c* is brought out at right angles to the upright *a*, and sufficiently high enough to come just below the valve key on the exhaust valve stem below the spring, care being taken that the fixture in no way interferes with the

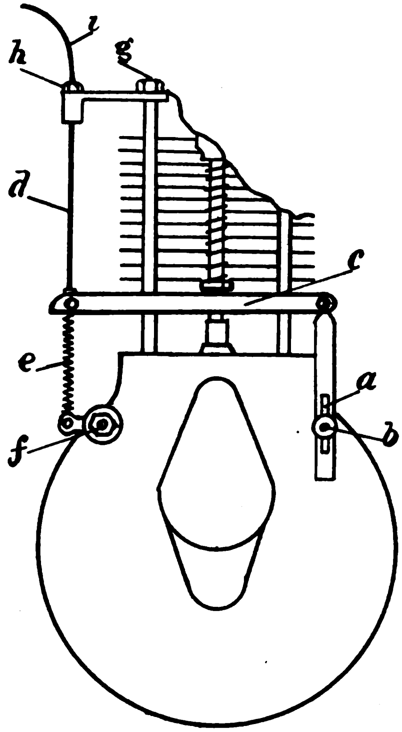


FIG. 88.—EXHAUST VALVE LIFTER.

free working of the exhaust valve, to which end it is advisable to give the lifting arm *c* some 1-32nd in. clearance when the exhaust valve is closed. The lifting arm *c* is held down out of action by the spring *e*, which is attached to the crank case by the nut *f*, which is another of the ordinary nuts on the bolts holding the crank chamber together, the spring *e*, of course, releasing the valve when the lever on the handlebar is released. The nut *h* forms a stop for regulating the action of the spring *e*, and is adjustable, so as to bring the arm *c* into the best position, and this works on a guide arm bolted to the top of the cylinder by one of the ordinary nuts *g*, which serve to hold the cylinder down to the crank chamber. The tension wire *d* is fixed to the arm *c* by a pin, or in any suitable manner, and motion is conveyed to the contrivance by the flexible wire *i*, which may be led to the handlebar round pulleys or by bell cranks, though by far the neatest and most efficient transmission is by the Bowden wire and a small ratchet quadrant on the handlebar.

We may next deal with the more difficult subject of water-cooling the cylinder; and in a machine like the quadricycle it *is* a rather difficult matter, by reason of the small amount of room at disposal for accommodating the necessary water tank and radiator, though one very good method of storing the cooling water was shown in Fig. 87 in the last article.

The object to be accomplished is a forced water circulation around the jacket of the engine cylinder, and the water must be in sufficient quantity in relation to the amount of heat extracted from the cylinder to maintain the bulk in the tank well below the boiling point; otherwise, of course, steam pressure would be formed. Experience teaches that to accomplish this by directly coupling the water tank with the engine the quantity of water required is altogether prohibitive on such a vehicle as the quad; hence, in order to reduce the weight and bulk of water to be carried, the *radiator* is introduced into the circuit, and according to the length and efficiency of the radiator, so will the necessary quantity of water vary, and on large cars the efficiency of the radiators has been carried to such an extent that a couple of gallons of water will keep a 16-horse car going.

The radiator is simply an adaptation and elaboration of the steam engine condenser; the object in each case is the same—that is, to rapidly reduce the temperature of the steam or water circulating through the pipes of the radiator or condenser; in fact, an ordinary marine pattern steam condenser makes a good radiator for a large car, the only difference between the two being that whereas in the marine condenser the cooling effect is easily obtained by contact with cold water, the motor radiator must be cooled by air.

The most simple form of radiator consists of a mere coil or spiral of thin copper piping connecting the outflow from the motor with the inlet to the water tank; but the effective cooling area is vastly increased by the threading of a series of metal discs or radial washers along the pipe at intervals of about ⅜ in. to ½ in. apart, the discs being stamped from very thin sheet iron and soldered to the copper pipe; thus, being in direct metallic contact with the pipe carrying the hot water away from the cylinder, the heat is rapidly dissipated by metallic conduction, and the action is further assisted if the discs are crimped or corrugated, so catching more air and exposing a larger surface.

The next factor controlling efficient cooling is the *position* of the radiator, which should be such as will expose it to the greatest amount of cool air, and in most cars the radiator is for this reason placed right in front; but this position is hardly practicable in the case of the quadricycle; and, moreover, it is advisable to have as few joints as possible in the water circulating system.

In a machine fitted with ordinary style of front seat (Fig. 86) the probably best arrangement is a triangular or wedge-shaped tank clipped to the back stays behind the saddle and as high up as can be conveniently arranged so that the cold water flow to the engine will be assisted by gravity. Another and most important point in a full water-cooled engine system in which a pump is a necessity, is that by placing the water tank well up, the pump is always "primed," and a less powerful style of pump may be employed—in fact, under these conditions, a very small rotary pump of simple construction is sufficient to maintain circulation, the chief thing to guard against being leakage at the pump. The capacity of the water tank to suit an engine of a given power will be variable, according to the cooling surface of the radiator coils, and it is obviously advantageous to reduce the quantity of water on account of its weight, but on the other hand, the space at disposal is somewhat cramped for much extension of radiators, so that a compromise must be made between the two, but on the whole, it is best to err on the side of a generous water supply.

The above remarks, however, apply to a completely water-cooled engine, and whilst they still hold good for the air-cooled type having a water-cooled head only, it is possible with the latter to dispense altogether with a pump, and rely on gravity and the thermo syphon principle for water circulation, whilst the cooling surface need not be more than a spiral of ⅜-in. copper tube from engine to water tank.

Fig. 89 shows our air-cooled motor converted to a water-cooled head by the "Brissard" water-cooled combustion chamber; this is probably the best thing of its kind on the market; it is entirely complete, and can be adapted to any size of De Dion type air-cooled motor without even altering the upright pillars.

Both inlet and exhaust valve are of larger area than usual, and are completely surrounded by water, and as the greatest heat is generated in the head of the cylinder, and in the neighbourhood of the valves where the effects of overheating are most injurious, it will be seen that for hilly country or long runs with the motor at full pressure that this method greatly increases the power and reliability of the motor, and, indeed, for small power—say, up to 2¾ horse—it may, on the whole, be considered as preferable to completely water-jacketing the cylinder when the extra cost and complication is taken into account.

The particular water-cooled head under notice is somewhat expensive—£5 10s.; but I have come across others which are a near copy at somewhat less than half the cost, though I am not able to say whether the workmanship is satisfactory. In connection with the "Brissard" water-cooled head, the makers supply a large combined water, petrol, and lubricating oil tank, with radiators and force pump complete, the combination being catalogued at £6, the agents for this country being the United Motor Industries, 42, Great Castle Street, Oxford Street, W., who would no doubt furnish any further particulars desired.

My experience with the aforementioned air-cooled quad of 2¾ h.-p., however, would certainly lead me, in the case of investing in or building another quad, to adopt water cooling in one form or another, and although in the case of an existing air-cooled motor I should advise the mere addition of the water-cooled combustion chamber, I think—always supposing the extra cost was not a fatal objection—the full water-cooled motor of not less than 3½ h.-p. would have to be my selection, and such an engine in combination with the free engine clutch and two speeds would render the machine extremely fast on the level, and quite capable of tackling all gradients, though, knowing that the majority of amateurs are not overburdened with cash, I did not incorporate those items in the general scheme, and as to making the water-cooled motor and the two speed-gear—well, I am afraid that each would be outside the scope of any amateur mechanic properly so-called.

However, having gone through the whole constructive details of the air-cooled motor, I am endeavouring to show how the machine may be improved by the addition of the appliances enumerated, and in order that the construction of the water-cooled motor may be made clear, I illustrate in Fig. 90 the genuine De Dion Bouton motor of 3½ or 4½ h.-p., in section. The general construction and proportion closely follows the air-cooled motor previously described in detail, with the mere addition of a water jacket completely surrounding the cylinder and combustion chamber.

A is the drain tap for crank oil; B the inlet valve; C the exhaust outlet; D the compression release tap; E the spark plug orifice; F the exhaust valve stem and spring; I is the outlet for the circulating water; J the entry for water.; K,K the balanced crank flywheels; L the piston; M the connecting-rod; N the crank-pin; O,O the motor axle. This engine makes 1,500 to 1,800 revolutions per minute.

The cooling of the 3½ h.-p. size can be effected by a 1½-gall. water tank, and about 15 to 20 ft. of efficient radiator piping, circulation forced by small rotary pump driven by round belt from a grooved pulley on the differential or other revolving part, according to design of other details.

Where it is decided to fit two-speed gearing and free engine clutch, the two may be incorporated in one piece of mechanism; but a word of warning is necessary anent fitting two-speed gears to air-cooled motors, for although the hill climbing difficulty will to an extent be overcome, it will be found that the overheating of cylinder, and consequent troubles, will be very much in evidence on long

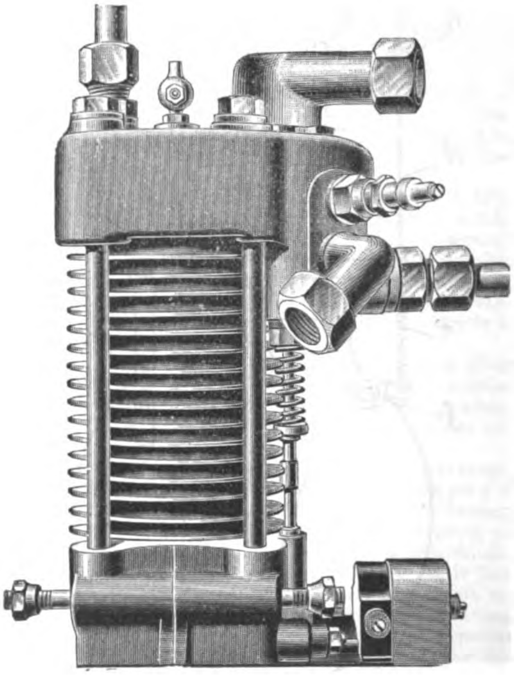


FIG. 89.—THE "BRISSARD" WATRR-COOLED COMBUSTION CHAMBER.

hills with the low gear in, the total result being that we are enabled to get somewhat further up the hill than we should have done without the two-speed gear; but it is when the engine is making the maximum number of revolutions in combinations with increased resistance, that the overheating trouble is greatest. Therefore, unless water cooling is adopted, I do not recommend a two-speed gear, but a free engine clutch is, in any case, a very valuable aid in starting the machine, and also assists in cooling the motor by stopping the latter, and throwing it out of gear on long down-hill runs.

Various devices have been introduced from time to time, and have been highly lauded by their inventors and manufacturers, but I have not come across any suitable change gear for a tricycle or quadricycle with the exception of the "Dupont," a French gear, which certainly does all that is claimed for it, but, like most other good things, it costs money. However, it is beautifully made, and answers its purpose, and I cannot better assist my readers than by describing its construction and method of fitting, especially so as those who wish to try their hand at making and fitting the free engine clutch only will be able to adapt this construction by simply omitting the change speed mechanism.

The gear is shown in section in Fig. 91, and consists of a main shaft J, upon which is mounted free to revolve the main engine pinion I, this shaft and pinion replacing the ordinary gear pinion, and one half of the engine crankshaft, as shown at O in Fig. 90. The change speed mechanism consists of the outer casing G, containing the

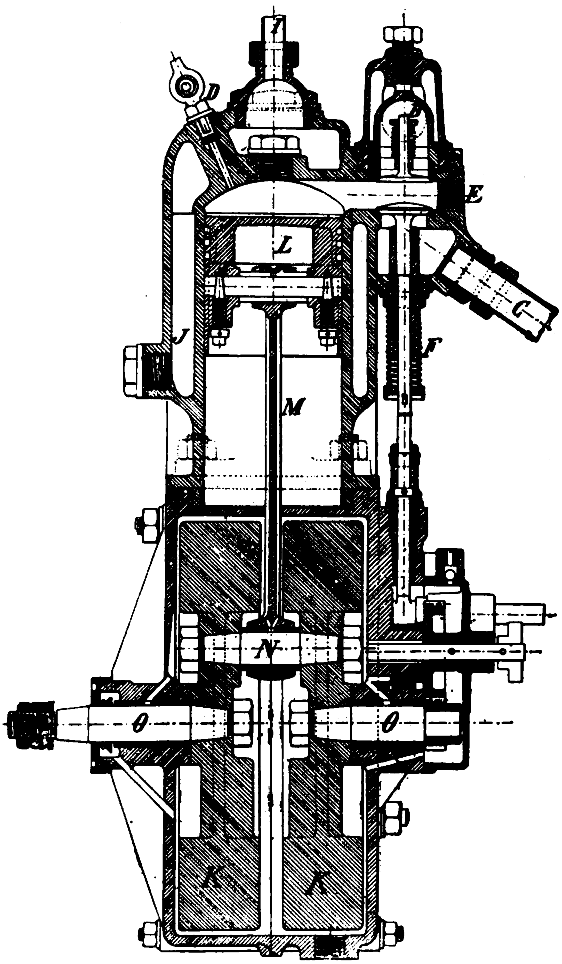


Fig. 90.—Vertical Section through De Dion Water cooled Motor.

bevel pinions K, K_1, K_2, K_3, which are mounted as follows:—K and K_2 are free to revolve upon the cross axis L,L, which in turn is supported in the blocks P, P, K_1 being firmly keyed to the main shaft J, and K_3 the pinion, which has a long bearing, is free to revolve upon the shaft J, but is keyed to the female portion of the clutch A by the key or feather N. The gear box G forms the male portion of the clutch B, and the main pinion I is also secured to G. The male and female portions of the clutch A and B are held up together by means of the spiral spring E mounted on the extension motor shaft J. The clutch is thrown out of action by lever mechanism arranged from the top bar of the machine to give end motion to the male clutch A by means of the recess M, thus contracting the spring E through the medium of the ball-bearing thrust block D, whilst the clutch can be kept stationary when not engaged with B by means of a band brake, which is not shown in the illustration.

In ordering this gear, it is necessary to state the size of engine or diameter of engine shaft. The gear is supplied complete with the standard sized 13-tooth pinion, and with the necessary outside extra ball bearing and support for the outer end of shaft J, together with starting pulley and change-speed quadrant and handle.

In proceeding to fit the gear it is necessary to disconnect the engine from the frame of the machine, and take the crank case and flywheels apart, leaving the crosshead pin attached to the flywheel on the pinion side; and having removed the existing pinion shaft from the flywheel, see that the coned end of the shaft J and its key fit perfectly in the female cone of the flywheel; then proceed by placing the proper half of the crank case over the end of J, after which replace the flywheel and tighten up the locking nut. Now swing the whole between the lathe centres to prove the flywheel true to the shaft J, and after seeing that this is correct, replace the engine connecting-rod and second flywheel on the crank pin, tighten up the lock nut, and place the whole between the lathe centres with the object of proving both flywheels true to each other, and true to the shaft J—a most important point to ensure the correct working of gear and engine. When the flywheels are made to revolve truly, then the two halves of the crank case can be bolted together, and the whole refixed to the cylinder and combustion head, and to the frame, the next point to ensure being that the new pinion meshes correctly with the large gear wheel, and that the extended shaft J is parallel with the driving axle of the machine. At the outer end of the axle J are two recesses, the outer of which indicates the position of the ball-bearing shelve, whilst the inner recess indicates the position of set-screw holding collar F in position. The spare arm to connect the axle casing with the shaft J is furnished with a ball-bearing end, which bearing should be adjusted in position on shaft J; then placing the clip with the swinging arm over the axle casing, bring the arm into position with the ball-bearing casing, mark off the holes in the former, drill, and secure in position; the outer end of shaft J is then supported, and it remains only to see that the shaft revolves freely in its bearing.

It is now necessary to fix the clip, to which is attached one end of the fork, by means of which the female portion of the clutch A is disengaged from the male portion B on the axle casing. Place the runners on the pins in the fork, and holding them centrally in the recessed portion M, mark off the hole in the other end of the fork arm from that already drilled in the clip for the bolt, which will form the fulcrum upon which the fork arm will swing. Having fixed the arm in position, adjust the fork arm so as to allow the spring F to press the clutch A well home, and tighten the clip in this position. By operating the lever the female clutch may now be withdrawn from the male portion, the spring E being at the same time compressed, and in this position the free motor is obtained.

The operating handle may now be fixed in any convenient position on the top tube of the machine, and the rod to connect it to the top end of the lever on the clip made to the correct length, so that when this rod is in position, on the operating handle being placed in the middle or upright position, the female portion of the clutch A should be clear of the male portion B, whilst the band brake should be clear of A to allow it to revolve freely. On the operating handle being locked in the back recess, the band brake should grip A tightly. To test the working of the gear, jack up the machine clear of the ground, place the operating handle in the middle position; in this position the motor-shaft J, driven by the engine, rotates the bevel pinion K_1, which in turn rotates the pinions K and K_2, and these cause K_3 to rotate in the opposite direction, carrying the female portion of the clutch with it. But as A is not engaged with B, no motion is transmitted to the pinion I.

Owing to the centrifugal force set up in G, and the slight amount of friction due to J and A travelling in opposite directions, there is a tendency for the shaft J to carry the whole gear box G round with it, and this may be sufficient to convey some motion to the road wheels, unless the brake is applied.

In placing the operating handle in the forward or high-speed position, the female portion of the clutch A is allowed to engage with the male portion B, thus preventing A from rotating in the opposite direction to J, and the whole gear is rotated in the same direction as J, and at the same speed.

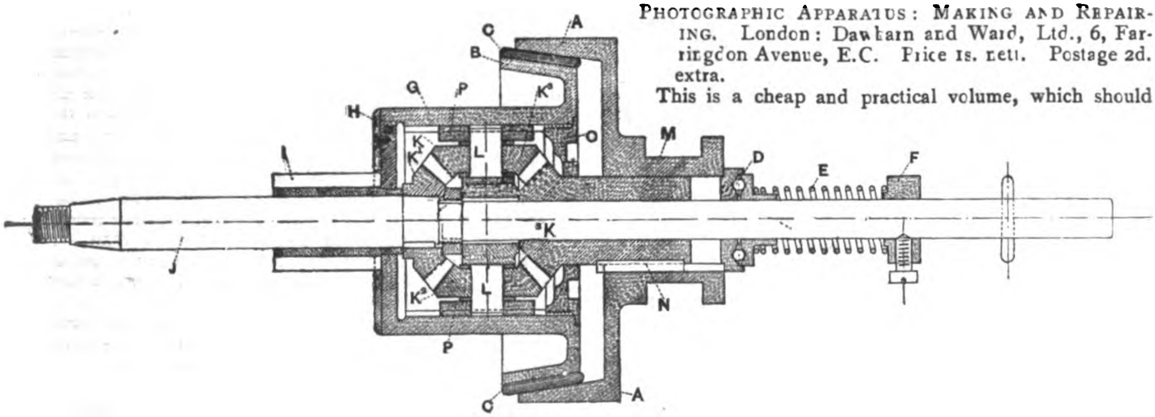


FIG. 91.—THE "DUPONT" TWO-SPEED GEAR.

On placing the operating handle in the rearmost or low-gear position, the two portions of the clutch are again disengaged, and the band brake caused to grip the portion A, thus preventing it from rotating. The motion of the engine shaft is then transmitted through the pinion K_1 to the pinions K and K_2, but owing to K_3 being held fast by the hand brake on A, the motion is transmitted through the cross axis L,L to the gear box G, carrying the pinion I with it, but at half the speed of the shaft J. When correctly fitted, this gear runs beautifully without shock or jar to machine or rider when changing speeds, and here is another suitable application for the Bowden wire, which does away with all the intermediate mechanism, and merely requires the three-positioned quadrant on the top bar of the machine. The connecting mechanism, although described, is not illustrated, but the principle will be understood, and the instructions will be perfectly clear to anyone actually fitting the gear. I have described the gear in detail for a double purpose, as it will be seen that the main features of the extension shaft J, and the additional ball bearing, with the male and female clutch A and B, the spring E, &c., and some slight modification, will, whilst doing away with the change-speed gear, form a very efficient and easily constructed free engine clutch.

I might continue to discourse on various little accessory attachments to the quadricycle in particular, which I have found useful, but I must now conclude the present series of papers, though I can promise my readers some highly interesting practical matter in a new series of articles dealing with "The Motor Bicycle."

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.]*

RAILWAY CARRIAGE AND WAGON REVIEW: A Quarterly Supplement to the *Locomotive Magazine.* London: The Locomotive Publishing Company, Ltd., 102A, Charing Cross Road, W.C. Price 6d. Postage 1½d. extra.

Those interested in the carriage and wagon departments of our railways will welcome a new quarterly dealing with the subject specially. The first number of the *Railway Carriage and Wagon Review* is exceedingly well illustrated and printed, and is full of articles of general interest. The publishers deserve success in their new venture.

PHOTOGRAPHIC APPARATUS: MAKING AND REPAIRING. London: Dawbarn and Ward, Ltd., 6, Farringdon Avenue, E.C. Price 1s. nett. Postage 2d. extra.

This is a cheap and practical volume, which should appeal to the amateur who takes a delight in manufacturing and repairing his own apparatus. It contains sound advice and good descriptive articles on many photographic accessories. Amongst others may be mentioned such items as studio backgrounds, and simple head-rests, as well as an entire portable studio itself, retouching desks, developing tables, racks, drying cupboards, cameras, enlarging apparatus, adapters, &c., and although this does not cover the whole contents by a long way, it shows the kind of fare provided.

THE ARITHMETIC OF ELECTRICAL MEASUREMENT. By W. R. P. Hobbs, R.N. Ninth edition. London: Thomas Murby, 3, Ludgate Circus Buildings, E.C. Price 1s. Postage 3d. extra.

This volume consists of a large number of questions and answers relating to electrical measurements, together with explanatory notes and definitions, based upon the all-important "Ohm's law." It is perhaps too much to expect the amateur electrician voluntarily to devote his spare time to working out numerical examples; but the book is an admirable text-book for science classes, and we do not think anyone need fear the mathematical side of electrical problems, who earnestly sets himself to master its contents. The volume has been amended and brought up to date by Dr. Richard Wormell, M.A., whose name is sufficient guarantee of its reliability and accuracy.

The Editor's Page.

WE have been very gratified by the number of entries received in our Prize Competition No. 20, the total considerably exceeding the entries for any previous competition. The only drawback is that the time taken to give proper consideration to the work of every competitor will necessitate a slight delay in announcing the awards. As far as we are concerned, however, we do not mind the trouble of examining so many entries, and we will publish the results in the earliest possible issue.

* * *

So many of our readers are interested in motor bicycles, that we feel sure our forthcoming articles on this subject, by Mr. T. H. Hawley, will meet with a very general welcome. Mr. Hawley will deal with the matter very fully, describing in detail not only the building throughout of a complete motor bicycle, but also the points to be considered in fitting motors to existing machines. As the author has recently been engaged in building and experimenting with a motor bicycle for his own use, our readers may rely on getting information based on a very practical acquaintance with all the difficulties and troubles which are likely to occur.

* * *

Our new sixpenny handbook, "Small Dynamos and Motors," will probably be on sale by the time these lines appear in print. As it gives drawings and scales for a number of machines, ranging from 10 to 500 watts, together with tables of windings for various outputs, and a considerable amount of practical workshop information, every reader interested in this class of work will find it most useful. The book has been specially written for this series, none of the matter having previously appeared in the pages of THE MODEL ENGINEER.

* * *

"G. W. H." (Santiago, Spain) writes: "In your issue for March 1st appears the description of my model steam launch. I hope anyone making it will like it—will be as pleased with it as I am. The hull is so strong, and it is so stiff; it requires no ballast, and it will carry a good weight of machinery. To those who may wish to make it a fast boat I would say, incline the shaft downwards aft, torpedo boat style, bringing it out at the level of the keel, so as to have half the propeller below the keel. Thus you can have a screw at least 5 ins. diameter, able to absorb any power. The boiler for my boat was described some time ago, as also the donkey, and the Editor has drawing, description, and photo of the engine, which is torpedo boat style, but has some novelties. Although an engineer by profession, and with plenty to do, I am an enthusiastic model maker, and if I do not burn my finger with our 10,000 volt current, I hope to have more time to amuse myself. Amateur work is backward here; but in spite of that I have got you three subscribers here, all Spaniards. In the description of my launch I notice a discrepancy: the butts are recommended to be made *à la* Harland and Wolff, facing aft; mine were butts with inside cover strips. In my little workshop here I have an electric motor, ⅓ h.-p., three-phase, 110 volts, alternating; it works very well."

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. 21.—A prize of the value of £2 2s. is offered for the best description and drawings of a small electro-motor, to work from continuous current supply mains at 60, 100, 110, 200, or 220 volts. The output of the machine should be about 1-10th h.-p. actual, suitable for working light machinery, a fan, or sewing machine, without heating. The particulars should include a description of the method of making patterns for all parts required to be cast, the best way to machine the parts, the construction and winding of the armature, and suitable windings for each of the voltages mentioned above. The article should also include details of the starting and controlling mechanism. The type of machine is left to the competitor's discretion, but due regard should be paid to simplicity, economy and safety in running. The drawings should show all details separately and clearly, as well as general arrangements where necessary. To ensure accuracy and clearness, it is desirable that all details, at all events, be drawn full size. The usual general conditions apply to this Competition. The closing date for receiving entries is June 15th.

The general conditions for these Competitions will be found on page 139 of the March 15th issue of THE MODEL ENGINEER.

Answers to Correspondents.

"ENGLISHMAN" (Melbourne).—Thanks for your letter, which we have perused with interest. We hardly feel warranted in giving it space in our columns, however, as your comments on the subject of export discounts apply rather to the wholesale trade than to firms in our pages, who are catering for retail purchasers. The question of the practical utility of models depends largely on their size. The very small working models cannot, of course, be expected to do much more than turn themselves round; but there are many articles sold by our advertisers which are capable of doing good work. We shall be pleased to advise you in the selection of any goods, if we can help you by so doing.

"P. VAN. A.S." (Brooklyn, N.Y.).—We quite agree with your comments on the postal incident you refer to. Most firms freely accept foreign or Colonial stamps for small remittances, as they can generally be realised at face value over here. Glad to hear the other applications were more satisfactory.

"R C." (Bournemouth).—Please refer to a book on the subject. The queries cannot easily be answered in brief, and lack of space does not justify extended replies to matters not of primary importance to amateurs.

Model Yachting Correspondence.

Travellers for Yachts.

To the Editor of *The Model Engineer*.

Sir,—In your issue of the 15th instant, "Silver Star" says that "in open racing boats up to 20 ft., when using lugs and racing canvas the traveller is discarded." But he does not add that, unless the point where the halyard is made fast (not "tied," please) to the yard comes up chock-a-block, a parrel is substituted. And this, I think, is the rule in decked and half-decked as well as in open boats.

My practice in my own boat, when using racing stuff, without a reef in, is to keep the parrel rove, but not hauled taut. Then, if it is necessary to take in a reef, the parrel is there ready for use, and is then wanted to prevent the sail sagging away from the mast.

I may mention the boat I refer to is a 16 ft. o.a., half decked, c.b., carrying 269 superficial feet of sail, and is raced on the open sea.—Yours truly, Ohiho.

Bridport.

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.*]

Wheels for Model Locomotives.

To the Editor of *The Model Engineer*.

Dear Sir,—Will you allow me to say a few words of criticism with reference to the method adopted by Mr. Greenly to secure the wheels on the axles of his simple model locomotive? Screwing the wheels on to the axles would do very well if the wheels were not coupled, but with coupled wheels it would be hard to get the bosses at the correct angle for the coupling rod pins. Would it not be better if the holes in wheels were slightly tapered after being bored and then secured by means of a set-screw inside of wheel as with those of "Dunalastair No. 3"?—Yours truly, James Stirling.

Bonnybridge.

Fitting New Leading Screw Nuts.

To the Editor of *The Model Engineer*.

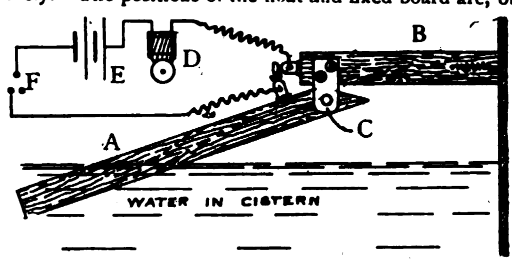
Dear Sir,—I noticed in the March 1st issue of The Model Engineer a letter from Mr. Andrew Black, in the latter part of which he mentions fitting square thread slide-rest screws into brass nuts. With regard to the brass nut, I found white metal a very good substitute for brass, and the method I adopted for making the nut did away with any screwing, as would be necessary in a brass one. I wanted to make a new nut for the parallel slide of my lathe, which is a 4 in. centre back geared one. The diameter of the square-thread screw was ½ in. I made a pattern for the nut, leaving prints on both ends for the screw. They were ½ in. long and ½ in. diameter. Clay was then put round the pattern, but cleared off flush with the ends of the prints. The mould was then cut in two with a small pen-knife, and the pattern taken out of the top part in which it had remained. The two parts of the mould were then put round the screw, and the white metal poured in by a small hole, which was made in the top of the mould. The clay was then taken off the casting. The nut was very tight, owing to the contraction of the metal, but after it was screwed off and cleaned up I put some fine sand from my grindstone and a little water on the screw, and worked the nut on it till it got easier. I then carefully wiped off the sand and water, and found the thread was very good. After fourteen months, during which time it has had hard and constant work, the thread of the nut is as good as when first made.—Yours truly, D. McM.

Glasgow.

An Electric "Tell-tale" for Cisterns.

To the Editor of *The Model Engineer*.

Dear Sir,—The following can be easily made by any amateur, and will be found very useful where cisterns, etc., have to be filled at some distance from the pumping station; and, of course, it can be used in many other cases where it is desirable to register the height of water. The contrivance is simply a piece of board, say, 6 ins. long, B, fixed to the side of the cistern, and carrying at its outer end a brass terminal; swinging on B by a hinge at C is another piece of wood, 2 ft. long, A, with another brass terminal fixed on it in such a way that when A floats upwards the two terminals come into contact. In connection with these two terminals are the two line wires, which have the usual arrangement in their circuit of the bell (or any other alarm), battery, and switch; these being indicated by D, E, and F respectively. The positions of the float and fixed board are, of



An Electric Water-level "Tell-tale."

course, arranged wherever the height of the water is wished to be registered. The action of contrivance is as follows:—As the water in the cistern rises, it causes A to float up till it comes into contact with B, thus completing the circuit and causing the bell to ring until switched off.—Yours truly, Francis Bacon.

London, W.

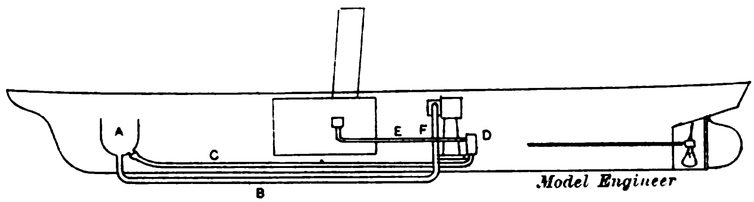
A Simple Condenser for Model Steamers.

To the Editor of *The Model Engineer*.

Dear Sir,—One of the greatest difficulties in the successful working of model steamers with boilers of any power, lies in the regulation of the supply of feed water. A simple arrangement, which is perfectly automatic, is here shown. It has been thoroughly tested; a model fitted with it works for an hour or two at a time without any alteration. It has the additional advantage that the boat may be run in salt or muddy water without fouling the boiler. The arrangement is as follows:—The exhaust pipe F from the engine is taken through the bottom of the boat, and forward, along the keel to near the bow, where it is brought through the bottom again, to the inside of the boat, being turned up vertically, and surrounded by the cup or hot well A. From the bottom of this, by means of the suction pipe C, which may be rubber tube, the feed-pump D draws its supply and returns the water formed by the condensation of the steam in the outside pipe B to the boiler through the feed pipe E. The same water is used over and over again, and the feed pump can get just what is used by the engine and no more. Of course, there is always a slight loss of water caused by impalpable leaks, but this can be compensated for by pouring a little water into the hot well A; but if all the workmanship is good this will seldom be required.

The following points should be carefully observed:—

(1) The feed pump should not be too large, or it will rapidly pump out the water in the hot well, and then draw air, when it may refuse to take hold when the hot well again fills up. It will generally get to work if a pet-cock is opened in the feed pipe to allow the air to escape.



A Simple Condenser for a Model Steamer.

(2) A cork float may be put in the hot well with a wire coming through the deck. Any failure of the feed-pump will be shown by the rising of the wire.

(3) Many modifications to fit various designs of steamers will suggest themselves; thus the condensing pipe B might be carried around the stern in U shape, bringing the hot well close to engine, and shortening the suction pipe.

(4) Of course there is no vacuum, but a slight back pressure required to raise the water an inch or two. This is very slight as a head of two feet of water is required to give a back pressure of one pound to the square inch. I have obtained a good vacuum by an air pump worked by the engine, but the result hardly pays for the complication.

(5) It is surprising how small a surface is sufficient for condensation. The pipe feels hot for only an inch or two along the keel when the boat is running.

I see a contributor criticises the steaming powers of the boiler used in my model cruiser *Tigress*; but as his deductions are drawn from a boiler in which he has modified the design to suit himself, it is possible he is mistaken.—

Charles L. Palmer.

Albany, N.Y., U.S.A.

How to Build a Coil Boiler.

To the Editor of *The Model Engineer*.

Dear Sir,—I enclose drawings of a pipe coil boiler, which may be of some interest to readers of The Model Engineer. The dimensions of this boiler, of which Fig. 1 is a section and Fig. 2 is a front view, are drawn to a scale of 1-12th size, and the boiler will develop full ¾ h.-p., having 13 square feet of fire surface. The coil should be made of 1¼-in. lap-weld pipe, six and-a-half turns, connected with the steam drum A above with the same size pipe and fittings. The steam drum is made of 5 in. pipe, 18 ins. long, headed at each end by welding in discs of iron ¼ in. thick.

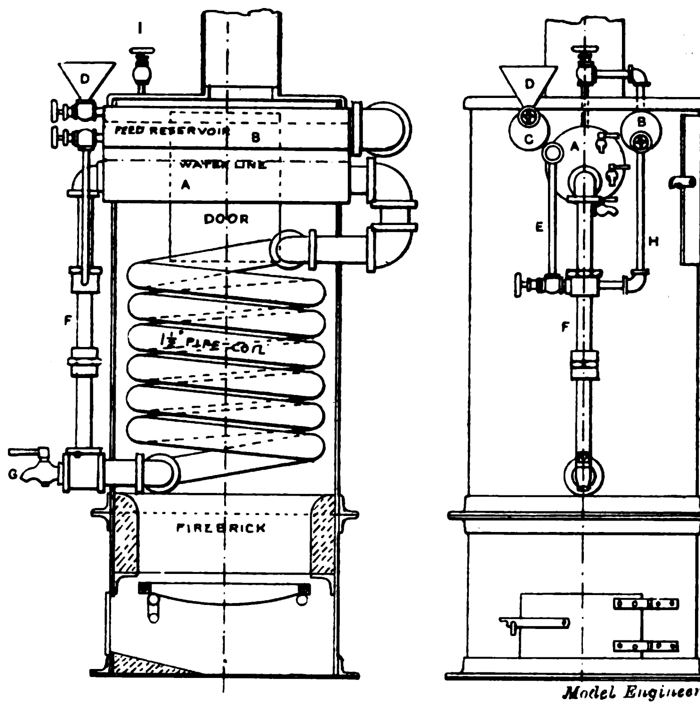


Fig. 1. A ¾ h.-p. Pipe Coil Boiler. Fig. 2.
Scale: 1 in. = 1 foot.

The feed-water reservoir B,C, which also answers the purpose of a heater, is made of 1½ in. pipe in two pieces, each 18 ins. long with welded heads at one end and connected together with two elbows and a cross pipe 5 ins. long. The return circulation F should be 1-in. pipe with a cross 1 in. by ⅜ in. placed at a suitable place in pipe F to accommodate the length of the water gauge glass and to which the ⅜-in. feed pipe H is also connected.

The circulation in this boiler is perfect, with a provision at the bib G for blowing out the entire contents when required. The valve at B on the feed pipe H is for regulating the feed and to close the feed-water reservoir when it requires to be filled.

The valve I and ⅜ in. pipe connections from the boiler to the feed-water reservoir is for equalising the pressure in the reservoir while feeding the boiler. When filling the reservoir, the valve B and I should be closed, and the valve at C and air cock I open when the reservoir may be readily filled through the funnel D. The safety-valve is ¼ in., and the gauge cocks ⅛ in.

The shell should be made of No. 12 sheet iron B. and S. gauge, in two sections, put together with hoops of small angle iron (1 in.) fastened with stove bolts. 4 ins. of the lower shell should be lined with firebrick or soap stone resting on a hoop angle iron on the inside; the back part of the grate is supported by a round bar of ⅝-in. iron passing through holes in the shell for support. The front of the grate rests on a double crank passing through holes in the shell for support, with a square on its end and a lever for shaking or letting down the grates. The upper section, for convenience, may be made in two halves around the projecting pipes with lugs and stove bolts, the reservoir being pushed through the holes after the shell is put together; the boiler, if put together with good cast iron fittings and steam metal valves, is perfectly safe for 130 lbs. steam pressure. The boiler between upper and middle gauge cocks and the reservoir holds 12 lbs. of water, and will furnish steam for a 2 in. by 3-in. engine, cylinder making 150 revs. per minute at 50 lbs. pressure for over two hours, or ⅓ h.-p. without refilling, and for one hour at 100 lbs. pressure, indicating ⅔ h.-p., with a pump connected at valve C, and a steady feed. The engine may be run to full 1 h.-p. I have one of these boilers which I made, which is running a 1 h.-p. trunk cylinder compound engine to its full capacity. The boiler may be varied in size according to the builder's ideas.

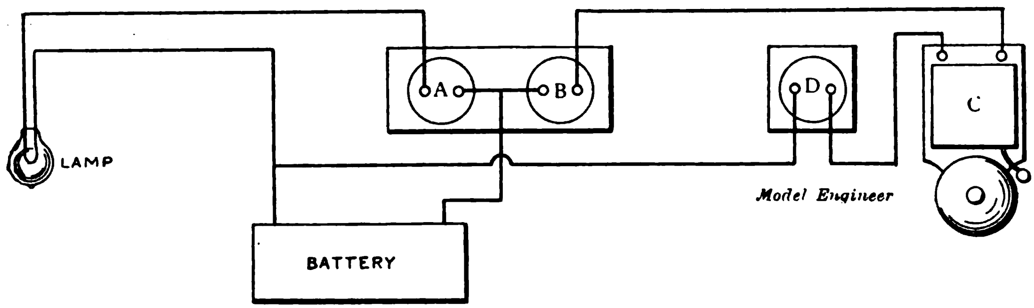
I have been a reader of THE MODEL ENGINEER for the past two years, and I must say it is the best paper of its kind published.—Yours truly,

FRANK N. WEBBER.

Cazenovia, N.Y., U.S.A.

An Electrical Winding Gear.

THE following details may be of interest to those of our readers who are connected with the mining industry. An electrically driven winding gear has just been supplied to the Heckmondwike Colliery, Yorks, to wind from a staple pit 50 yards deep. The gear is driven by a 4-pole open type motor, capable of working up to 50 effective h.-p. at a speed of 600 revs. per minute. At the end of the motor shaft an automatic electric brake is fitted, which sustains the load immediately the current is switched off. The coils of the electro-magnet of this brake are in circuit with the armature of the motor, and immediately the current is switched on to the motor the armature is attracted by the electro-magnet and releases the brake wheel. The motor drives through a train of gearing (the first motion pinion being forged steel, machine cut) into a machine-cut cast-iron spur wheel, which is supported by a countershaft, on which a pinion is carried, gearing into a spur wheel on the drum shaft. The drum is 3 ft. 6 ins. diameter by 2 ft. wide, lagged with elm, with strong cast-iron sides, a brake strap being fitted on one side which is controlled by the attendant. An indicator is provided, which shows the position of the cages in the shaft; this is driven by machine-cut wheels from the shaft. The whole gearing is mounted on a cast iron bedplate made in sections for getting down the pit and into position by the staple. The motor on the winding gear is controlled by a liquid reversing and regulating switch. The current is obtained from a 50-kw. multi polar dynamo at 500 volts 60 ampères at a speed of 350 revs. per minute. Our informant, who is a responsible engineer-in-charge at the colliery in question, is willing to show the apparatus to anyone in the district who cares to apply for permission (through the Editor of THE MODEL ENGINEER)



A COMBINATION NIGHT LIGHT AND ELECTRIC ALARM.

A Combination Night Light and Electric Alarm

TO THE EDITOR OF *The Model Engineer*.

DEAR SIR,—I enclose a diagram showing the connections for a combination night light and electric alarm which I have in actual use. It is intended for those instances where one person has to wake another, as in calling a servant, etc., and the arrangement is as follows:—The two switches A and B and the lamp are placed in a convenient position in the caller's room, the lamp being fixed so as to throw a light on a clock or watch face. Switch D and bell C are in the same room as the person to be awakened. If preferred (to ensure the second person getting up), switch D may be placed outside the room door. A light is thrown upon the clock face by turning the switch A, and if the proper time has been reached, A is turned off and B on. This sets the bell C ringing, and it can only be stopped by turning switch D. It should be observed that switches A and B are normally "off," and D should be turned on before retiring.

The batteries I use are Sac Leclanché, which require no attention for a considerable period after properly charging with sal ammoniac. I have three cells with which I light a 4-volt lamp, which shows a splendid light. It is to be observed that the light is only to be an intermittent one.—Yours truly, R. G. PARR.

Peckham.

WITH the increasing price of copper, aluminium is being used largely for conductors of electricity. It can also be used for roofing houses. There is no reason why it should not be used to replace the present heavy bronze coinage.

WITH reference to a statement which appeared on page 120, Vol. V, as to the tallest chimney in the world, we are informed by an American reader, Mr. Martin Hansen, that this is an error. Our correspondent, who is in a position to know, remarks that the Oxford Copper Co., to which firm the chimney in question was stated to belong, is in Port Johnson, Bayonne, N.J., on the opposite side of the river from New Brighton.

* * *

DRILLING HOLES IN GLASS.—In addition to the methods of drilling holes in glass, described in THE MODEL ENGINEER of September 15th, 1901, the following plan may be adopted:—The graver should be held between finger and thumb, by which it is rotated whilst the end is *lightly* tapped with a *small* hammer. A drop of oil should be put at the point of the graver to prevent the splinters of glass flying about, and the glass should be laid upon a folded newspaper.—J. A. BRAGG.

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.

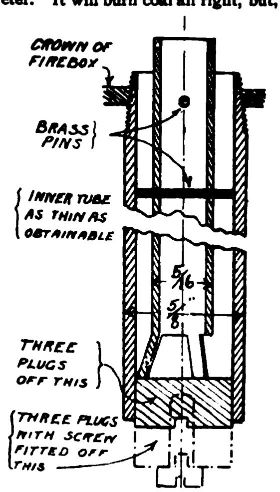
Queries on subjects within the scope of this journal are replied to by post under the following conditions:—(1) Queries dealing with distinct subjects should be written on different slips, on one side of the paper only, and the sender's name MUST *be inscribed on the back. (2) Queries should be accompanied, 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:—

[5877] **Steam Launch Queries.** E. I. (Penrith) writes: I have a loco type boiler, which I intend using to drive a boat. Would you kindly tell me—(1) What length and beam of boat could I drive? (2) What size bore and stroke of cylinder? Would 3 ins. by 3 ins. be suitable? (3) What distance should there be between engine and propeller? (4) Would I have to use force pump? The boiler is of mild steel barrel, 12 ins. diam.; tube-plates, ¼ in.; end-plates of firebox, ¼ in.; body, 3-16ths in.; and outside firebox is also 3-16ths in.; it has ten 1-in. tubes and ½ in. water space round firebox. I should like to work at 40 to 50 lbs. pressure. Firebox (inside), 11½ ins. by 7½ ins. by 14 ins. My idea is to drive a 15 ft. boat on Lake Ullswater (5 miles distant) with the before-mentioned boiler, using a 3 in. by 3 in. (or compound?) engine, at 45 lbs. pressure, and about 300 revs. a minute.

(1) A 14 or 15 ft. rowing boat, at about 5 miles per hour. (2) 2¼ in. by 2¼ in cylinder, at the most, should be used. (3) Depends upon the boat. (4) As the engine would consume over 10 cub. ins. of water per minute, and as the water in the boiler would only last 15 minutes, it will be necessary to provide a pump, which shall be constantly running. You can adjust the amount of water going into the boiler by a bye-pass valve turning the excess back into the tank. Propeller: 10 ins. diam., and 12 ins. pitch. Fit a steam blower to the boiler, and also turn the exhaust up the chimney

[5842] **Model Vertical Boiler.** E. F. R. (Penryn) writes: I have a small model boiler made of steel, 5-32nds thick, by a boiler-maker in our local foundry. The boiler is well rivetted, 12 ins. high, 6 ins. diameter inside firebox, with single tube or flue 1¾ ins. diameter. It will burn coal all right, but, for convenience sake, I fitted it

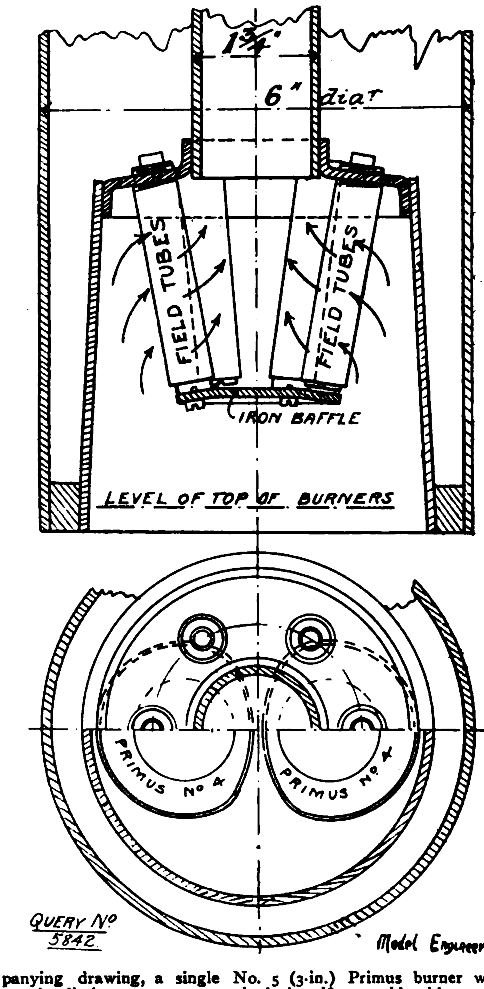


FIELD TUBES FOR VERTICAL BOILER.

Query No. 5842.

with oil burner as described and illustrated in your valuable periodical, THE MODEL ENGINEER, for October, 1899. I can get up steam in boiler quickly with it, but I find it difficult to maintain it when engine is working—in fact, the power dwindles, and gradually the indicator on pressure gauge drops back to almost nothing, although the burner continues to act whilst there remains steam enough to force the oil. The engine is only 1-in. bore, 2-in. stroke. Will you kindly oblige by informing me what you think is the defect and advise a remedy? Also please state if you think a No. 5 Primus would answer better and be powerful enough? What would be the safe working pressure of above boiler, which is in good condition?

The boiler, so far as we can judge from the particulars given, is strong enough for a working pressure of 75 to 100 lbs. This type of boiler is not very efficient, more especially in model sizes when worked with liquid fuels. In yours, barely 100 sq. ins. of heating surface is provided, and this would, with a good fire, evaporate not more than 1 cubic inch of water a minute. A 1 × 2 cylinder at 300 revolutions per minute, and 30 lbs. pressure requires quite 1¼ cubic inches of water per minute. To run such an engine at a lower pressure and speed would mean great inefficiency, and probably it would deplete the boiler of as much steam as when running faster, owing to increased cylinder condensation consequent upon the low speed. The burner may not be working properly, and we think that with the proposed improvements indicated upon the accom-



panying drawing, a single No. 5 (3-in.) Primus burner would supply all the steam you required; but if a considerable pressure is to be maintained, you might, with advantage, arrange two burners (Primus No. 4, 2½ diam.), with the flame spreading flanges bent inwards on their adjacent sides so that instead of appearing circular they are D-shaped in plan. The six field tubes should be screwed into the crown of the firebox, the outer tube having a fine taper thread chased upon it, so that it will screw home tight, and if smeared with red lead will not require soldering. A circular iron baffle plate should be screwed to the plugs of three of the field tubes. The plugs of these three tubes should be deeper than the others. The plugs should all be hard or silver-soldered into the outer tube, and should be provided with a slot for holding a screw-driver. The inner tubes may be kept central at the bottom by filing away part, leaving three legs, as shown; the legs formed should be spread out to fill the outer tubes. To ensure them being concentric at the top also two pins (ordinary brass pins) should be soldered through them at right angles to each other. They should project equally on each side and be just long enough to enter the outer tube easily. The field tubes cause the water to circulate very rapidly; the cooler water comes down the inner tube and up the annular space between the outer and inner one, during which time much of it is converted into steam. The power of the boiler will be increased some 40 per cent. The arrows indicate the passage of the heated gases. See *M.E.* for August st and October 1st last ("Dunalastair" articles) for full particulars of these burners and arrangements of tanks, etc. The tank may, with advantage, be below the boiler, but must be protected from radiant heat of the burners. Messrs. Melhuish will supply burners and some fittings for the tank—such as pump and non-return valve, filler, and release.

[5890] **Entering the Electrical Profession.** G. S. R. (Moor Row) writes: Would you oblige me by stating whether there is an electrical college in England where I could learn to become an electrical engineer? I have heard there is such a college somewhere in North London.

Your query is not altogether a simple one to answer. First of all, are you wise in desiring to change the course of life you have already entered upon? To become an electrical engineer it will be necessary not merely to study at a college, however good, but to go through a proper apprenticeship in the particular branch of the profession you may adopt. By making a change now, you have to begin all over again, and you must not expect either a more interesting or less laborious employment. However, if you are set upon the project, you have several roads open to you, one of them beginning with a year or two's instruction in a thoroughly good technical college (day classes), several of which are to be found in London. You probably mean the Finsbury Technical College, which is one of the most suitable institutes for your purpose. We hope to publish an article, in the near future, on the subject of entering the electrical profession, and would recommend you to study this before making any change.

[5902] **Casting Accumulator Grids.** P. S. S. (New York) writes: I would like to ask a few questions in regard to casting grids (see pages 23 and 24—"Small Accumulators"). If Fig. 6 is a sectional view of the grid, how can the grid be withdrawn from the plaster mould without spoiling the mould? (Fig. 1) The small sketch is a

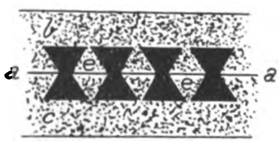
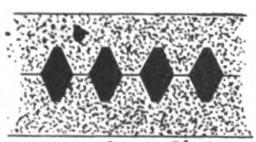


FIG. 1.



Query No. 5902

FIG. 2.

section of a plaster mould; *b* is one-half of the mould, and *c* is the other, and *a a* is the parting line. When the lead is poured into the mould it will fill the dark portion. Now when the sides *b* and *c* are separated the lead portion will break the projections off *e e*, thus ruining the mould. Now you say that the above can be adopted; I don't see how it can be done, so please answer in the next issue of THE MODEL ENGINEER.

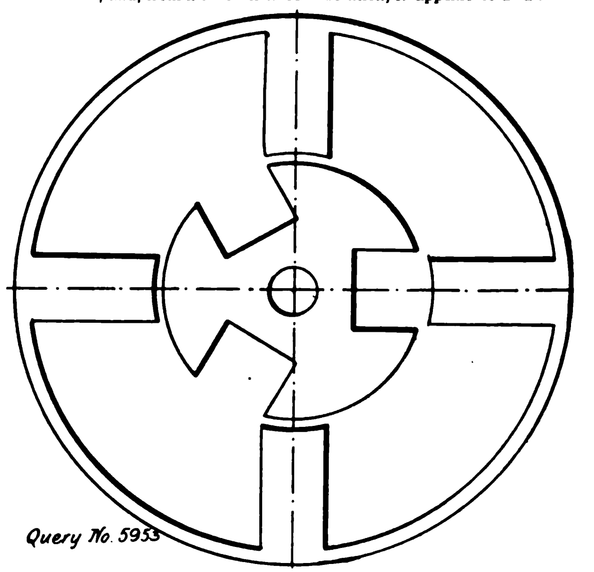
You have misunderstood the illustration (Fig. 6 in "Small Accumulators.") The dark portion is the lead, and the shaded part the paste in that figure, and a section of the plaster mould would therefore appear as in Fig. 2, from which you will see the lead grid can leave the mould easily.

[5903] **Model Boiler Queries—Steam Raising.** P. L. (Lavender Hill) writes: I should feel much obliged if you would kindly assist me with instructions for starting a fire of coal, charcoal, or coke in a model boiler similar to launch type, page 40, of "Model Boiler Making." I find the charcoal, if soaked in paraffin, after burning the paraffin, goes out, leaving the charcoal black as before starting. Should I shut the fire door or not? Are there any oils or fats more suitable than paraffin? When boiler is placed in boat and covered in, would two ventilators (¼-in. diameter) be big enough to carry air down, continuing the pipes under the deck to reach underneath the fire bars? What size should mouth of same be?

Your difficulty is a common one, and the way to overcome it and make boilers with small horizontal flue tubes "draw" well is very often not discovered, and leads to the condemning of boilers with flues of small diameters. In the first place, the ventilators proposed are utterly inadequate, and an area of 2 sq. ins. at least must be provided for an air inlet. You cannot burn fuel without air. If the air supply is stopped, the fire will go out. As the natural draught through tubes ⅜ in. diameter is very sluggish, some method must be adopted to bring more air through the grate and create a fiercer fire. The best one is the use of a jet blower in the chimney. As this is not available until steam is raised, an extension stack and bellows (shown in the issue of October 1, 1901) must be used; the bellows, however, may be re-placed by a bicycle pump with an air bag, consisting of a football bladder, between it and the stack, or by an indiarubber sprayer similar to those used by hairdressers for spraying various compounds upon the hair. Another way of providing draught in raising steam is to fit a Lucas cycle valve on a short pipe from the boiler. The short pipe may have a plug cock fitted to it, so that communication with the valve and the boiler may, when the arrangement is not in use, be stopped. A bicycle pump, preferably a foot pump, which are very cheap now, should be attached to the valve and the cock opened. The pumping of air into the boiler will provide a means of using the steam blower. The bicycle pump should be employed until steam is raised and available for working the blower. For model work, the induced system of forced draught is practically the only one possible, and care should be taken to obtain the draught with a minimum expenditure of steam, a small jet, combined with a fair length of chimney, the jet being as nearly as possible concentric with the chimney, will give the best results. For such a boiler as yours, and for locomotives up to ¾ in. scale, a jet 1-32nd in. diameter is ample. When running, however, the blower may be nearly shut off; a properly arranged blast (exhaust) pipe will effectively produce sufficient draught.

[5953] **A Small Four-Pole Dynamo.** R. M. (Glasgow) writes: I am making a dynamo (see sketch), the armature of which is tripolar (2 ins. diameter), and I want to know what amount of wire and what size to wind it with; what size wire to wind the field-magnets with, and how much. I prefer a shunt-wound machine, as it is for charging and lighting.

We have had no experience of a four-pole dynamo with tripolar armature, and, from a theoretical consideration, it appears to us un-



Query No. 5953

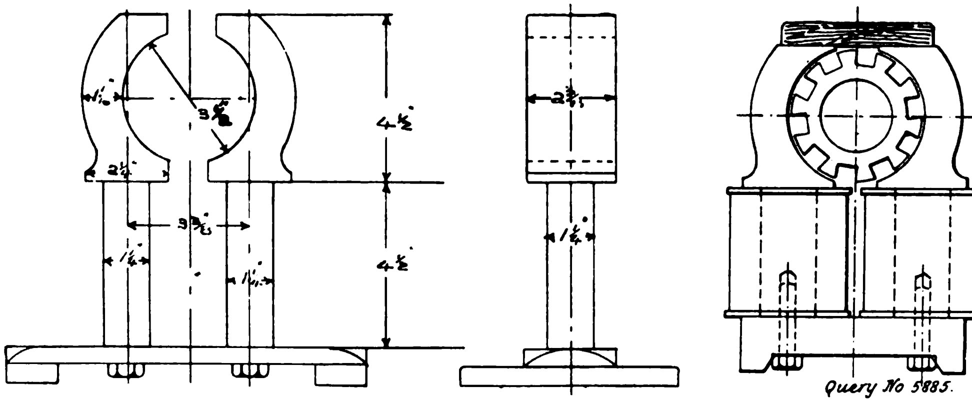
likely that you would get good results from such a machine. The principal difficulty lies in the commutation, as the angle of 120 degrees usually embraced by one segment of a commutator for a tripolar armature is too great for a four-pole machine, and would result in loss or reversal of current during a part of each revolution. Apart from this, the dynamo is provided with an absurdly small amount of iron in its field-magnet, as you will realise by comparing it with any ordinary machine. We advise you to build one of the ordinary types, unless you have some knowledge of the laws of dynamo construction, and desire to work out an experimental machine.

[5950] **The Spottiswoode Coil.** A. R. C. (Loughborough) writes: (1) I am given to understand that a spark that will make and break over an air gap of 1 inch, must have an E.M.F. of about 50,000 volts. This, of course, means that the terminals are at a distance of 1 inch (all along), and are not closed and parted as in an arc lamp. If we now take, for instance, the famous Spottiswoode coil, having primary 1,344 turns, secondary 341,850 turns, with 60 volts (20 Grove cells) across primary, we find a spark of 42 ins. in air was obtained. Now this coil must, therefore, have an E.M.F. of 2,100,000 volts according to the above formula. But in alternate current transformer, volts per turn of primary equal volts per turn of secondary, and if a transformer were wound to the same ratio as the Spottiswoode coil, with 60 volts primary, we should only get approximately 15,200 volts; why then do we get this great difference between alternating and broken continuous currents? (2) Can you please give me a formula that will tell me what voltage I should get by breaking the current of a medical coil (with only one winding) or the field-magnet of a dynamo when the rate of break, number of turns, and the total number of magnetic lines are known? What I want to know is the voltage due to self-induction?

(1) We are afraid your calculations are based on a mistaken suppo-

sition. It is not at all definitely known what voltage is required to spark over a certain distance, and it does not follow that the voltage must increase in the same proportion as the distance. Furthermore, the action of an ordinary induction coil is by no means as simple as the transformer, and is really not understood. (2) From the above you may gather that there is no such thing as a formula to suit this case, and the time has not yet come when there is a definite knowledge of the laws of the subject.

[5885] **Overtype Dynamo (100 watts).** W. F. A J. (London, N.) writes: Will you kindly answer a few questions relating to a small dynamo, for which I have field-magnet castings and armature laminations? I enclose tracing of same. The stampings are insulated from shaft by gunmetal spider and rods, and from themselves by tissue paper. I want to get as much current out of dynamo as possible for lighting purposes, and I also want to charge small accumulators with it. I should be pleased to receive answers to the following questions: (1) Size of wire for field-magnets and quantity required? (2) Size of wire for armature and quantity required? (3) How many wires per slot in armature? (4) What b.h.-p. required to drive dynamo and revolutions per minute required? (5) How many lamps would it light, and at what voltage? (6) Would drum armature be more suitable for above dynamo? If so, (7) give winding for drum armature as well as slotted ring.



IMPROVEMENT IN DESIGN OF OVERTYPE DYNAMO.

Before replying to the queries you put, we must say a few words in reference to the design of your machine. As it stands, it will no doubt work more or less well; but with a very little difference in the design—and none at all in the quantity of metal or trouble in building—it would have been made a very much better dynamo. In the accompanying drawing we have indicated the outline we should have given to the machine, and you will at once notice the following points of difference. The metal at pole tips has been reduced, as it is not only unnecessary, but assists leakage of magnetic lines of force: the cross section of the cores has been increased to 1½ ins. diam., and their length reduced to 3½ ins.: the yoke has been increased to 1 in. thick (a most important point) and all this, as above remarked, at no extra cost of metal. Our illustration is to the same scale as yours, namely, 3-16ths in. = 1 in. Replying to your questions: (1) The wire for field-magnets should be 3½ lbs. No. 24 connected in shunt; and (2) the wire for ring armature, as shown, 18 ozs. No. 22. (3) There should be 72 turns per slot. (4) About 1-5th to ¼ b.h.-p. would be required, and the speed of dynamo 2,250 revs. per minute. (5) We cannot guarantee the output, but it *ought* to be about 100 watts for a machine of this size, 2 ampères at 50 volts. This is equal to about 30 c.-p (6) No. (7) A little more wire of the same gauge would be required if a drum armature were used, slots being the same in both cases.

[5954] **Electrical Queries.** J. G. W. (Dublin) writes: (1) If a battery could heat 1 in. of No. 22 gauge platinum wire to redness, would the same battery heat more or less of No. 40 gauge wire to the same heat? I am puzzled, because I know that fine wire offers more resistance than thick. (2) Seeing an account of Edison's storage battery, and that the voltage is low (·7 volt) I would like to know whether it is charged by a correspondingly low voltage, or does it take 2½ volts per cell, like a lead accumulator? If it does, I do not think much of its efficiency. (3) Could you give me any particulars of voltage of the Chloride storage battery by the Chloride Syndicate?

(1) The battery capable of heating an inch of No. 22 platinum wire to redness would easily produce a like effect with twenty times the same length of No. 40. The effect is not easy to explain unless you have some considerable knowledge of the laws of electricity, and we recommend a thorough study of these, as all such questions really depend upon them. (2) No, a charging current at a proportionately lower voltage will be needed. Why do you remark you "do not think much of its efficiency"? (3) We believe the voltage of the Chloride cell is the same as that of the ordinary accumulator.

Amateurs' 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.]*

*Steel Forgings for Amateurs.

We have examined some excellent specimen forgings sent to us by Mr. R. C. Allen, 111, Vale Road, Parkwood Springs, Sheffield. They make up into well-finished crankshafts, &c., and we are informed that the maker is prepared to supply not only small forgings, but also larger ones, in the rough or finished, to customers' requirements. Mr. Allen submits also some specimens of tool steel for turning tools, drills, dies, taps, &c., in different sections, and states that he can supply steel for any other purpose. He solicits enquiries from readers, who should mention THE MODEL ENGINEER.

How to Charge Pocket Accumulators.

Some clear and simple instructions for the charging and use of pocket accumulators have been printed by Mr. Archibald J. Wright, 318, Upper Street, London, N., in leaflet form. We are informed that these directions are based on actual experience with small accumulators, and that a copy will be sent to any reader of this journal who sends a stamp to Mr. Wright at the above address for this purpose.

A New Agency.

We are informed that Mr. G. Wood, Duncan Street, Leeds, has arranged to take up an agency in that city for the sale of Messrs. Drake & Co.'s well-known goods; this will doubtless be a convenience to our Leeds readers. Mr. Wood is also undertaking the sale of THE MODEL ENGINEER and Handbooks, so that those who find difficulty in obtaining any of these through the usual channels will be able to get them without trouble.

An Acetylene Gas Searchlight.

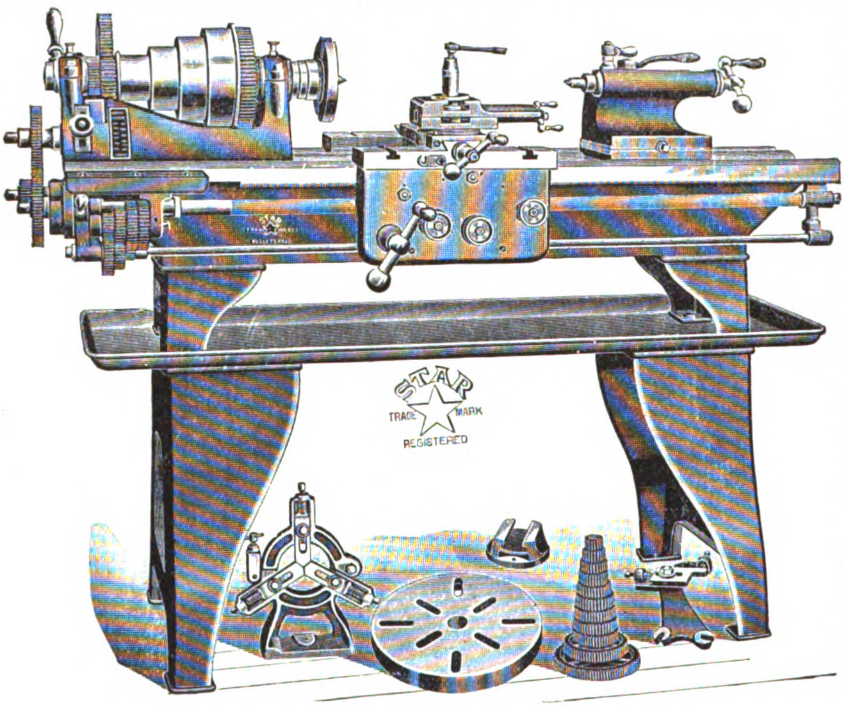
An apparatus that should meet with a good reception amongst the boating fraternity, is a new production of an American firm, the Riverside Light Company, Buffalo, N.Y., U.S.A. The article in question is an acetylene gas searchlight, which has been designed for boat and yacht use, and appears to have met with considerable success, if we are to judge from the testimonials published by the makers. It is stated that the searchlight is simple and certain in action and is very compact. Readers interested should mention THE MODEL ENGINEER when writing the Riverside Light Company for further particulars. Postage to U.S.A. 2½d. per half-ounce.

Gasoline Motors.

The "P-T" Motor Company wish us to announce that they have just moved into a new factory at Nos. 322—324, Seventh Avenue, corner of 28th Street, New York City, where they have installed a new plant, consisting of lathes, drill presses, and other special tools. They are now prepared to design and build all kinds of gas, gasoline, or electric motors, for bicycles, tandems, and light automobiles; mechanical and electrical experimental work will be a speciality. They have recently issued a new list of their "P-T" motors, automatic gasifiers, &c., a copy of which will be sent post free upon request, and have just designed a special motor for pacing machines, tandems, and high-powered motor cycles. This is a 3 b.h.-p. air-cooled motor, 17¼ ins. high, 8¾ ins. diam., and total width over all of 4⅞ ins. Their No. 5 motor is 1½ h.-p. 13½ ins. high; total width over all 4¾ ins. (23 lbs.). Their No. 6 motor is 14¾ ins. high and 4¾ ins. wide over all and is 2 b.h.-p.; weight about 25 lbs. Their No. 3 is 1 h.-p., is 20¾ lbs., and is sold in castings or complete motors. Nos. 5, 6, and 10 motors are sold complete only; no castings. The firm are bringing out a line of air-cooled automobile motors of 4, 6 and 8 h.-p. They want good agents in England and on the Continent. Mr. F. B. Widmayer, of 2312, Broadway, New York City, is the general selling agent.

The "Star" Tool Room Lathe.

We show in the accompanying cut, the "Star" tool room lathe, a new size and style recently brought out by the Seneca Falls Mfg. Company, 560, Water Street, Seneca Falls, N.Y. This addition



THE "STAR" TOOL ROOM LATHE.

completes their line of well-known "Star" foot and power lathes, and while designed for the tool room is also a first-class lathe for regular shop work. They are furnished with either plain, compound, or rise and fall rest, U.S. standard, Whitworth, or metric lead screw, and also with draw-in chuck, taper, gear-cutting and milling attachments, if desired. The headstock is of the web pattern. The hollow spindle is made from a crucible steel forging and runs in phosphor bronze bearings. The cone pulley has four steps and with the back gears gives eight changes of speed. The body of the tailstock is curved so as to allow the compound rest to swing around parallel with the ways and over the base of the tail stock, with room to operate the feed screw handle. The tailstock spindle is arranged with self-discharging centre, and has a spindle locking device, which ensures perfect alignment. The tailstock is further provided with an adjustable side movement for turning tapers. The carriage is formed with T slots for bolting on angle plates, &c.; is gibbed to the bed, and has a cam locking device for securing it to the bed when the cross feed is in use. The tool post has a collar and shoe which excludes all dirt and chips. If desired, an European tool post will be furnished in place of regular. The power is transmitted from the spindle to the feed rod entirely by gears, and is arranged with three different changes of speed. Changes can be made without stopping the machine, and both cross and longitudinal feeds can be operated independently or in combination as desired. The feeds are actuated by two phosphor bronze worms on the feed rod, thereby securing the proper graduations of speed of the two feeds. The feed rack and small gears are made from steel, and all small parts liable to be bruised are case hardened. The lathe will cut all standard threads from 3 to 64 inclusive, without compounding the gears, and nearly all threads by compounding them. The taper attachment is fastened to the back of the carriage, and is always in position ready for use. The countershaft is provided with improved friction clutches, and has adjustable self-oiling shaft bearing. The lathe swings 13 ins. over the bed, and is made with beds of 5, 6, and 8 feet in length.

Catalogues Received.

C. Nurse & Co., 182, 184, and 173, Walworth Road, London, S.E.—It is hardly necessary to emphasize the fact that the "Invicta" catalogue issued by this firm is as comprehensive as could very well be. When we mention the fact that there are some 330 pages in the list, and that on most of them there are half-a-dozen illustrations or more, it can well be imagined that the carpenter, joiner, or engineer would have no difficulty in finding any tool he required, or even any special variety of that tool. As a matter of fact, Messrs. Nurse have been established so many years that they may be trusted to know exactly what is required in the way of tools and machinery, and their new list to hand is their standard edition with a 1902 supplement of new goods and alterations in prices. It is bound in a flexible cover, and should be regarded as indispensable in the workshop. The price is 6d., post free, THE MODEL ENGINEER being mentioned.

Sneckner Motor Company, Stamford, Connecticut, U.S.A.—A neatly-compiled catalogue from this firm gives particulars of marine and stationary engines to work with gas or gasoline up to 12 h.-p., and also of steel launch hulls and complete vessels. The list is carefully illustrated and well printed. When writing for it English readers should remember that the postage to America is 2½d. per half-ounce.

De La Vergne Refrigerating Machine Company, Foot of East 138th Street, New York, U.S.A.—This firm are the sole manufacturers in the United States of the well-known Hornsby-Akroyd oil engines, and a well-printed catalogue to hand gives particulars of their extensive use in that country. A number of flattering testimonials prove that the engine has given general satisfaction.

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.

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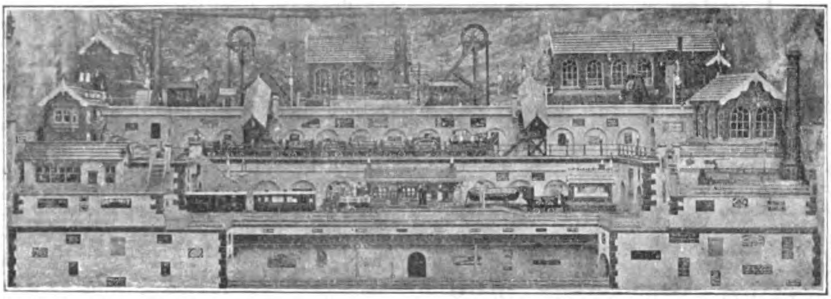
A Working Model Colliery.

THE working model colliery shown in the accompanying illustration was built specially for exhibition purposes by a Mr. William Brittain, a Staffordshire engineer, and has proved so attractive that, up to the present, it has been visited by over 250,000 people. It has already been exhibited in London, Edinburgh, Hanley, Sheffield, and Blackpool, and for the next few weeks may be seen at the Industrial Exhibition at Bingley Hall, Birmingham.

The model occupies a total space of 24 ft. by 8 ft. by 10 ft., and shows at a glance an entire colliery village in miniature, including the whole of the surface workings, a coal siding with screens and coal train complete in every detail, a goods station and goods train, a perfect passenger station and train, to say nothing of a large number of tiny buildings full of mechanical mites, all as busy as can be. In the foreground is a carefully planned ship canal, looking all-important with its various craft.



A WORKING MODEL COLLIERY.

In making this Lilliputian village, two years were spent in experiments, and then five years upon the actual work of construction. We are told that fully £2000 was expended upon the construction, the material alone costing over £1,200. In weight it is over 4 tons. The entire model is illuminated by upwards of two hundred electric lights, the installation of which cost £100.

The first item of interest in inspecting the model is the canal, a very picturesque portion of the model, and as realistic with its running water as Mr. Brittain could make it. Trees and hedgerows, the towpath, and various kinds of canal craft will be noticed.

Ascending the canal bank, and crossing either of the bridges that span it, we reach the passenger station, a correct representation in every detail of the passenger station we are in the habit of taking our journeys from. On the platform are noticed waiting passengers, porters, etc., together with various styles of barrows loaded with passengers' luggage. Lights shine from the booking-offices, waiting-rooms, signal-boxes, and other departments such as are found in a busy station. A passenger train, consisting of saloon, first, second, and third class carriages, luggage vans, &c., and drawn by a model of an express locomotive, steams into the station, and then leaves it again at a speed which leads the spectator to believe that it is off on a record-breaking journey. At the back of this station is the goods station. A goods train, consisting of trucks loaded with various kinds of merchandise, and drawn by a model of a powerful locomotive, is next seen to approach and then leave the station. Ascending the steps, walking a few paces, brings us to the general offices. Substantially built, with their broad approach, artistically-designed entrance hall, and the several rooms in the lower and upper storeys, they present a very bright and inviting appearance.

A few paces more, and down the steps, then we are outside the saw mill, with its circular saw driven by a horizontal engine. Retracing our steps, and going a little to the left, we reach the coal siding. It is interesting to watch the little model locomotive ever busy shunting loaded and unloaded coal trucks, passing and repassing with reversion of motion beneath the coal screens. Ascending the steps brings us to the fan engine house, which is supplying the mine with the ever necessary fresh air.

Continuing our tour along the high bank, we pass the lamp house, and arrive at the winding engine house. Here is machinery of very exceptional interest. You notice the pair of coupled horizontal engines (link motion) with drum, &c., either lowering its living freight in the cages to the bottom of the earth, or bringing to the surface its full measure of coal. On each side of the structure stands the headgear, with everything connected that is necessary for the lowering and raising of the cages. The checkweigher's offices are there, and a little further on stands the dynamo house, a very brightly lighted structure, in which a horizontal engine of a similar type to the fitting shop is busy driving a dynamo for the supply of electricity. The house, like the engine, is admirably constructed. Outside stands an imposing vertical engine and boiler, driving a mortar mill, which grinds away with a musical rattle, and doing its work with an appearance of great importance. The mill is underdriven, and in every respect a copy in miniature of a mortar mill of the most approved type. It is a complete plant in itself.

Descending the steps brings us to the fitting shop, a high structure with numerous windows, through which, in the brilliancy of many electric lights, is seen a gang of workmen. Each has his drilling machine or lathe, and there is an industrious hand busy at a circular saw bench. A perfect horizontal engine, fed by a Cornish boiler, is just outside, working with a full pressure of steam. The issuing of smoke from the tall chimney stacks, one of them rising above the assistant-manager's office, is a noticeable feature of the model. The railway lines are of a 3-in. gauge. The entire model is built in two sections—the one section embracing the colliery portion, and the other the railways, etc.

This interesting model is the property of Messrs. H. and E. Cadle, of 105, Strand, London, to whom we are indebted for the foregoing description.

The Society of Model Engineers.

London.

MODEL MAKING COMPETITION, 1902.

As announced at the January meeting of the Society, a model making competition, open to all members of the Society, will be held on Thursday, 22nd of May, at the Holborn Town Hall, Gray's Inn Road, W.C. The last day upon which entries can be received is Monday, May 5th.

Full particulars of the competition have already been published, and will be found on page 171 of the last issue of THE MODEL ENGINEER.

On Thursday, April 10th, the usual monthly meeting of the Society was held at the Memorial Hall, Farringdon Street, E.C., Mr. Percival Marshall presiding. About fifty two members and friends were present, and several new members were elected. It was announced that a set of patterns for a small lathe had been presented to the Society by Mr. Hildersley, who was cordially thanked by the meeting for his gift.

After the formal business was ended, the Chairman introduced the lecturer of the evening, the Rev. W. J. Scott, B.A., who proceeded to give his discourse on modern N.E. Rly. locomotives. The paper, which was delivered in a very happy vein, proved extremely interesting, not only to the locomotive enthusiasts of the Society but to all present. Mr. Scott traced the development of the express locomotives during the last decade, commencing with the famous "Tennant" engine, and criticising the attempts of the locomotive department in the earlier stages to increase the power of the locomotives by augmenting the cylinder dimensions only. As our members well know, locomotives, model examples more especially, cannot be made more powerful by enlarging the cylinder only, and Mr. Scott laid stress upon the fact that in his experience of locomotive working—which, as he has been privileged to travel many thousands of miles upon the footplates of express engines is worth consideration—he has found that the railway engine with a moderate and even small cylinder, coupled with ample heating surface, is better than one with a source of power of the same proportions and a large cylinder capacity. His motto is "use a small cylinder and fill it."

The lecturer concluded with a detailed description of two "runs" lately arranged by him by the courtesy of the N.E R. officials for the especial benefit of the Society with trains of 300 tons weight, "down" and "up" between Newcastle and York, the respective engines being Mr. Worsdell's latest four-coupled express, and one of the last of the 6 ft. 8-in. six-coupled engines. From Mr. Scott's observations it would seem that although there was not much difference in their remarkable performances, the six-coupled locomotives are, in practice, the most powerful. The lecture was illustrated by the aid of the blackboard, large photographs, and diagrams.

A vote of thanks to Mr. Scott for his kind efforts was moved by Mr. D. Corse Glen, seconded by the Secretary, and carried with much enthusiasm.—HENRY GREENLY, Hon Sec., 4, Bond Street, Holford Square, W.C.

Provincial Branches.

Bolton.—The second meeting for the formation of the above branch was held at 36, Gilnow Road, Bolton, on April 9th, there being seven intending members present. After discussion, it was resolved, and Mr. Hays kindly consented, to have the next meeting at the same address on May 7th, at 7.30 p.m., when officers will be appointed and a suitable room engaged to hold the future meetings. There was on view, brought by an intending member, a ⅝-in. scale Great Northern single bogie express locomotive, which was very much admired. Several applications for membership having unfortunately been mislaid, will the persons who made application and who have not received replies kindly communicate with Mr. Hays at the above address as soon as possible? Will the intending members make an effort to attend at the next meeting? The subscription will probably not exceed 5s. per annum. —S. L. THOMPSTONE, Secretary, *pro. tem.*

Cardiff.—The usual monthly meeting of the Cardiff branch was held at 7 and 8, Working Street, on April 1st. Owing to the holidays the attendance was small. A lecture had been arranged for, but fell through at the last moment owing to illness of the lecturer. The next meeting will be held on May 6th, when a suggested programme of visits will be submitted.—R. T. HANCOCK, Hon. Sec., 168, Newport Road, Cardiff.

Edinburgh.—On Saturday, 22nd March, a party of about twenty members and friends visited the Victoria Pit of the Lothian Coal Company at Newbattle. This pit, which is considered to be one of the largest and most modern pits in Great Britain, has a special interest, owing to the great fire which devastated the pit-head some months ago, and of which many traces are still visible. The party commenced their inspection at the pit head, where they examined the arrangements for sorting the coal from the different seams. The working of the automatic points on the tram roads was examined with interest. The party then proceeded down the shaft, falling 280 fathoms in fifty seconds, and went to the coal workings, examining on the way the different compressed air engines which are installed for working the ropes for haulage purposes, and also a set of electric pumps. On the return to the surface the dynamo house and engine house were inspected, and a visit was paid to the workshops. The visit, which occupied two hours, was a thoroughly enjoyable one, and to the majority of our members, was quite a novel experience.

The usual fortnightly meeting of the Edinburgh Branch was held at the Rooms, 13, South Charlotte Street, on the 26th March, at 8 p.m., Mr. F. R. N. Curle in the chair. There was a large attendance of members. After the minutes of the previous meeting had been read and approved, three new members were elected, bringing the membership of the branch to forty, eighteen members having been admitted since Christmas. Mr. J. Gillon Fergusson had very kindly brought down his marine engine and water-tube boiler, which he had exhibited on February 26th, in order to give those members who were unable to be present on that occasion an opportunity of seeing it working. Mr. Fergusson also brought a horizontal engine of his own construction which was supplied with steam with the "Yarrow" boiler. Mr. J. Bissett then delivered a very interesting lecture on "The Glasgow Electric Lighting Stations" illustrated by a large number of excellent slides. The lecturer confined himself almost entirely to a description of the Port Dundas Station, which is at present the largest and most important generating station in Glasgow, and gave a most graphic and interesting description of the equipment of the station. The slides gave one a very good idea of the arrangement of the engines and dynamos, and with their aid, and the skilful explanations of the lecturer, the audience were able to grasp even the intricacies of the switchboard connections and obtain an insight into the mysteries of the "three-wire system." The meeting closed with a most hearty vote of thanks to Mr. Fergusson and Mr. Bissett, and also to Mr. Hunter both for the use of his lantern and for his services in manipulating it.—W. B. KIRKWOOD, Hon. Sec., 5, N. Charlotte Street, Edinburgh.

Glasgow.—The monthly meeting of this branch was held in the Society's rooms, 309, Shields Road, S.S., on Wednesday, April 2nd, at 7.30 p.m., Mr. Beith in the chair, the minutes of the previous meeting being read and adopted and one new member elected. The Chairman announced that owing to Mr. Rogers leaving Glasgow, he had resigned his post of Hon. Secretary. Mr. Rogers' resignation was accepted, and the business of electing a successor took place. Mr. Beith proposed Mr. J. D. Macdonald as Hon. Interim Secretary. This was seconded by Mr. Ashfield, and the proposal was carried unanimously. The principal item of discussion was the lathe to be purchased for use of the Society. The Secretary intimated that he had received quotations from six well known machine tool makers in Glasgow for a 5-inch centre by 5 ft. gap-bed, self-acting, sliding, and screw-cutting lathe, with 8-inch Cushman's independent four jaw chuck. Mr. Beith, Mr. Macdonald, and Mr. Rogers had personally inspected three of the lathes offered, but they were found deficient in the most essential parts of a foot lathe. Mr. Rogers had also inspected "Barnes" and "Star" foot lathes at Messrs. C. Churchill's showrooms in Glasgow, and the "Star" lathe was the best finished lathe in every way. It was agreed to adjourn the discussion until further particulars of the lathes were received. A very hearty vote of thanks was accorded to Mr. Rogers for his work in the past in connection with the Society. Mr. Macdonald also received a vote of thanks for accepting the post of Secretary. The meeting adjourned at 10 p.m. The next meeting will be held on Wednesday, May 7th, in the Society's rooms. All communications should be addressed to J. D. MACDONALD, Hon. Int. Sec., 33, Rowallan Gardens, Crow Road, Glasgow.

Nottingham.—The Nottingham branch of the Society held their second meeting at the Gordon Café. The chair was taken at 8.15 p.m. by Mr. George Wilson. The minutes of the previous meeting were read over and passed, and seven new members elected. The business of the evening was the consideration of a workshop for the members. It was decided to start a workshop, and upon this movement being duly proposed and seconded, the Amateurs Casting Supply Company gave to the Society a complete set of lathe castings and a complete set of hand planer castings, to be fitted up by the members of the Society, and also a finished surface plate. A drilling machine was given by two members, a vice by another member, and several other necessary appliances of the mechanical workshop were forthcoming from different members. Business was concluded at 9.30 p.m., and all members adjourned to the Chairman's workshop to inspect several models under steam. The following models were exhibited :—A ¼ h.-p. horizontal engine, by Mr. P. Reader; a 1 h.-p. launch engine (partly finished), by Mr. Wilson; a horizontal engine, by Mr. Zoller; a small horizontal engine, by Mr. Doughty; a vertical boiler, by Mr. Wilson; a small engine, by Mr. Briens; several electrical appliances, by Mr. Ball; and a Great Northern pattern express engine, by Mr. L. Shaw. All models were working when the members arrived, and everybody was satisfied with the progress made by the Society.

Oldham.—The ordinary meeting of this branch took place on Tuesday, March 1st, at the Oriental Restaurant, when there was a good attendance, Mr. S. Tattersall in the chair. After the ordinary business had been dispensed with, Mr. J. Pollitt introduced a ½ h.-p. horizontal slide-valve engine. After the inspection of a set of patterns for a compound marine engine by Mr. G. Penlington, a lengthy discussion took place on the principles of the Corliss valve gear, which proved very interesting. The meeting closed at ten o'clock with a vote of thanks to the chairman.—R. L. COLLINGE, Hon. Sec., 15, Weddop Street, Westwood, Oldham.

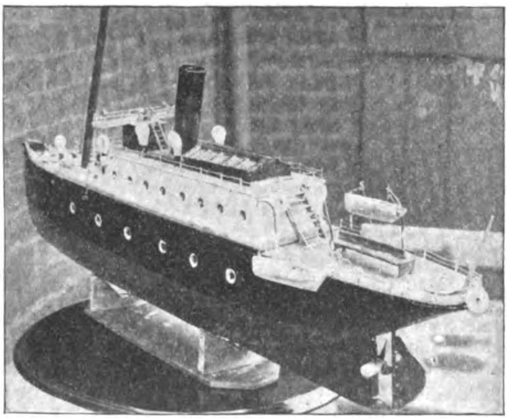
ELECTRIC traction as a substitute for steam has been introduced upon 81 miles of railways in Lombardy, Italy. These lines traverse the picturesque North Italian lake regions, and as the country is mountainous and water power abundant, says the *Engineer*, there are special economic advantages in the use of electric power.

BATTERSEA POLYTECHNIC.—A Conversazione was held in the Engineering Department on Saturday, March 22nd, to mark the opening of new Engineering Rooms, and in connection with the Polytechnic Engineering Society. A recent extension of the building has given new laboratories for mechanical and electrical engineering, and more drawing office and workshop accommodation. During the evening a meeting was held, when Sir Alexander Binnie formally declared the rooms open, and spoke of the value of technical training to the young engineer. Among those who also took part in the meeting were Mr. Charles Hawksley, the President of the Institution of Civil Engineers; Sir John Jackson, the President of the Institution of Junior Engineers; Professor Unwin, F.R.S.; Dr. Garnett, Secretary of the Technical Board; and Principal Wells. The expense of the building and equipment has been met by grants from the Technical Education Board of the London County Council. The Conversazione was very largely attended, and included an interesting exhibition of engineering machine tools and other apparatus, lent by different makers, and a good collection of models lent by the Society of Model Engineers; the Electrical Company, Limited; Messrs. B. J. Hall & Co.; the Daimler Motor Company; the International Pneumatic Tool Company, Limited; Messrs. C. A. Parsons & Co., engineers; Mr. W. H. Harling; Messrs. Smith & Stevens; Professor W. E. Dalby, M.A.; Messrs. Charles Nurse & Co.; Messrs. Charles Churchill & Co.

The Model Screw Steamer "Victoria."

By R. S. Marshall.

THE photograph here reproduced shows my model steamboat *Victoria*, and will give readers an idea of my first model in this line. The hull of this vessel was modelled from a block of red pine, 3 ft. 6 ins. by 7 ins. by 6 ins., and when finished measured 3 ft. 1 in. long 5½ ins. beam 6¾ ins. deep and ⅜ in. thick. I may say that the hollowing out was rather tedious. The deck is of ⅛ in canary pine and is in three parts, the middle part made so that it can be removed for inspection of engine and boiler ; the cabin and deckhouse are of mahogany, and the port holes are fitted with mica. The fittings are those generally used on this class of steamboats, and I have made all except the blocks, which I obtained from Messrs. Stevens. The engine is ⅝ in. stroke and ½ in. bore, and drives the boat at a fair speed with a 2-in. propeller and requires very little steam. The boiler is of my own design and is shown on the opposite page ; it is very



The Model Screw Steamer "Victoria."

simple to make and gets steam up quickly when fired with a Bunsen gas burner. The shell is of 1 16th in. copper, and the other measurements will be found on sketches. I may say I have got most of my experience from The Model Engineer.

[Note.—The boiler, which is shown half-size on the opposite page, is slightly modified from the design submitted by our correspondent. The original appeared to be unstayed, and this in a flat-sided boiler is a great fault. A few light stays of thin brass wire, screwed at ends and fitted with nuts would make such a boiler much safer, and by enabling thinner metal to be used in the construction of the shell, would considerably reduce the weight—Ed., *M.E. & A.E.*]

How to Oxidise Bronze Chemically. — Dissolve 10 parts cupric nitrate and 2 parts common salt in 500 parts water. Take 10 parts spirits of sal ammoniac and add dilute nitric acid until the solution turns blue litmus paper red ; add water to make the mixture 500 parts. Mix these two solutions, and cover the bronze articles evenly with the mixture ; allow them to dry, and brush well. If the desired shade is not obtained, repeat the operation until it appears.—"Jewelers' Review."

Hints on Testing and Repairing Small Dynamos and Motors.*

By F. E. Powell.

THERE is nothing more difficult than to give a satis factory answer to the not infrequent question—"I have a dynamo which will not work. Can you tell me what is wrong with it?" A question only to be answered by a compendious reply, which may possibly be useless after all. It is intended in this article to enumerate all the most likely failings the dynamo (and motor) is heir to, but it must be assumed the reader is conversant with at least the elementary laws of electricity, and is possessed of a little of that instinct which is essential in the practical electrician. To simplify matters, the writer will take the various complaints of model dynamos and motors in the order of frequency as he has observed them.

"I cannot get my dynamo to work at any speed although it runs well enough as a motor from—so many—cells," is perhaps most often heard. Sometimes the maker adds the information that he has tested it in every way, and is sure all is right, winding and connections correct, etc. The most probable reason why the machine will not act *as a dynamo* in this case is that the residual magnetism in the field-magnets is of wrong polarity. The remedy is simple. Reverse the direction of the exciting current through the field-magnet coils by reversing their connections to the brushes, or reverse the polarity by passing a current from a battery through the coils. If it does not affect the position of the brushes, it will be sufficient merely to run the machine in the contrary direction. The cause of a failure of this character may lie in the extreme softness of the iron of the field-magnets. This is, however, only likely to occur when charcoal iron stampings are employed for that purpose.

If the fault is not to be found as above, the winding should next be considered. Small dynamos, especially with field-magnets cast from unusual qualities of iron, may refuse to work with a field-magnet winding of "average" resistance. Indeed, it is a good plan not to finish off the field-magnet winding until some experiments have been made to determine the quantity of wire which will give the best result. Mistakes sometimes occur in the gauge of wire supplied, and an error of this kind would almost certainly be fatal to the efficiency of the machine. The connections of the armature windings to commutator should be examined, in case any mistake has been made, and to see that the brushes rest on the bars connected with wires conveying the maximum current. If a dynamo refuses to "build up," the brushes may be given a slight backward lead, when the armature will tend to produce its own field. As soon as the machine starts working, however, the brushes must be advanced, and in no case should they be moved far from the neutral line. A number of other reasons depending on the small amount of magnetism retained by soft metal may be mentioned. A slightly wide air-gap—more than the average, but still not excessive—may be quite sufficient to account for the failure; the weak magnetic flux is unable to bridge the air-gap sufficiently to produce an appreciable current in the armature wires, and if these happen to be too thickly insulated, so that the influence of the iron core of the armature is diminished, it will be quite enough to account for the refusal of even a fairly well-designed generator to develop current. It should be

* This article is reproduced from the new Model Engineer Handbook, No. 10—"Small Dynamos and Motors," of which it forms a chapter. It will, besides being of use to the majority of amateur electricians, serve to show the practical nature of our latest handbook.

remembered that when the machine is running as a motor, supplied with an ample current, the magnetic lines of force are numerous enough to overcome wide air spaces and thick insulation, and to render slightly disproportionate windings of little account.

A method of overcoming this defect has been given to the writer by an electrical engineer who has had great experience in designing and working small dynamos. It is to wind *soft* iron wire of any suitable gauge from end to end of the armature so as to completely cover it, securing the ends of the wire by soldering or otherwise.

One entire class of failures is due to the breakage of a conductor, either in the field magnet coils, armature winding, or connections. The effect is refusal on the part of the dynamo to generate at all, or to cause a pulsating or intermittent light when the machine is supplying current to lamps. In the case of a motor, it may entirely refuse to work or may work with varying and irregular speed. Fortunately the location of a fault of this character is not a very difficult matter, and involves only the use of a battery of any ordinary kind and a small galvanometer such as can be purchased for a shilling. A battery of *small* cells and many in number, will be found most useful for testing, especially if the dynamo is built for any fairly high voltage.

The field-magnet winding should first be tested by disconnecting the ends of the coil, connecting one end to one terminal of galvanometer, the other terminal of galvanometer to one electrode of the battery, and then joining the free end of field-coil to remaining electrode of battery. If all is well, the galvanometer needle will be deflected. If no deflection occurs, proving that a wire in the circuit is broken, the separate coils of field-magnet should be each tested if there is more than one.

A failure in the armature is a more troublesome matter both to test for and to repair. With armatures of the "open-coil" type, the test consists in making contact through galvanometer, battery, and two commutator segments, all the segments being tried in turn. With a broken wire, as before, no deflection will be observed. The armature connections to commutator bars should be particularly well examined; these are fruitful sources of trouble. The only way to test for a broken wire in the armature coils is to disconnect (unsolder) the junctions both between one coil and the next, and between the wires and commutator. Then each coil can be tested separately. It is useless to test from one commutator segment to another for a break in a wire on a "closed coil" armature (drum and ring types), since the current has two routes open to it, and the breakage of a wire does not appreciably affect its flow.

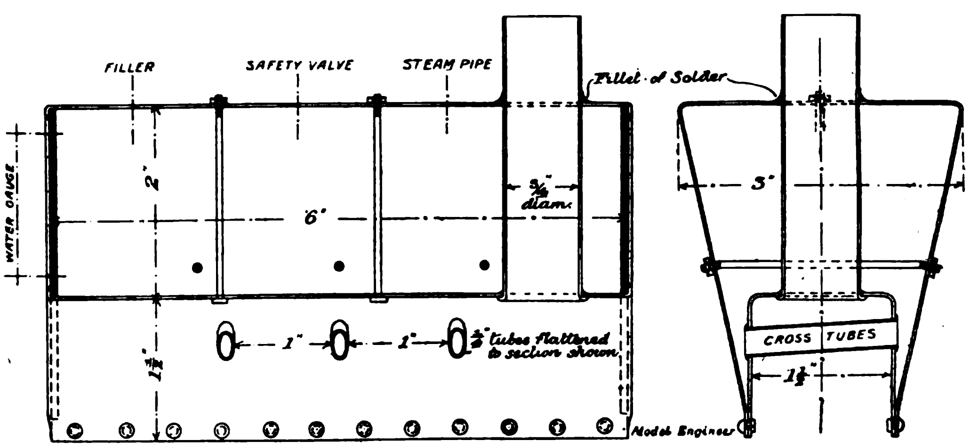
Occasionally a dynamo is found to supply a fluctuating instead of a steady current, or a motor to run in a jerky fashion. This is usually traceable to a partial break, where the two ends of the wires are not entirely separated but scrape together when the machine is running. A test can be made for this defect with battery and galvanometer, by striking any part of the carcase with a light hammer, which will cause the imperfectly joined wires to jar and set up oscillations in the galvanometer needle. Tests must be made to locate the fault exactly.

A very troublesome class of failures is that in which the symptoms are evident when the machine is running but cease when the armature is still. Tests usually show in these cases a leakage from armature coils to the frame of machine, and it will be found that the cause is centrifugal force and a slack or loose turn of the armature wire. This latter is bulged all the time the dynamo is running and makes contact with the poles of field-magnet. Possibly, however, the bearings are to blame, and these should be examined if the armature is running not quite centrally. If they are too large the fact will be indicated by noise as well as by considerable vibration.

Violent sparking at the commutator, which cannot be reduced by altering the lead of the brushes, may be due either to overloading or to a short circuit in the armature. It is easy to prove whether the former is the case, and if this is not the cause the fault must be attributed to the second possibility. Under the head of "short circuit," however, must be placed (in amateur-made machines) unequal numbers of turns of wire in each coil of the armature. This will produce much the same result, and as sparking of small machines is often somewhat excessive for their size, it must not be too readily assumed that the more serious fault exists.

It should always be remembered that a shunt-wound dynamo will refuse to "build up" with a very low resistance in the outer circuit. Thus, if a few cells of a new (uncharged) accumulator form the external circuit, a small lamp should be inserted at first in this circuit, or the electrician may be surprised to find no trace of current in the cells after an hour's steady "charging."

It is unnecessary to emphasise the fact that non-adherence to any of the rules or methods laid down in "Small Dynamos and Motors" may lead to failure. If an armature is being wound it must be wound according to instructions, or it may prove useless.



BOILER FOR MODEL SCREW STEAMER "VICTORIA." (Half Size.) (*See opposite page.*)

Leakage of current is a very common trouble with small dynamos. If well made in the first place, the insulation being thorough and wires firmly bound where necessary, each part being tested with galvanometer and battery before fitting together, there is no likelihood of current leakage unless the machine meets with an accident, or is overloaded. Should the trouble arise, it must be tested for by means of a battery and galvanometer in the following way. First lift the brushes clear of commutator and disconnect the brush leads from terminal board. Then test each brush holder to rocker or bearing. If no sign of leakage is to be found here, test between commutator and shaft, and then between field winding and frame. If the fault is found in the brush holders and rocker (a very likely place) it can soon be set right by taking the holders to pieces, cleaning thoroughly, and making sure—when putting together again—that the brush holders are efficiently insulated from the rocker arm. In the event of the fault appearing in the field-magnet winding, a test should be made to find which coil (if more than one) is responsible, by disconnecting the exciting coils from one another. The faulty coil will have to be rewound, but it will be well to observe first that the trouble is not due simply to a loose turn or a bared connecting wire in contact with the carcase of the machine.

The most serious case is when the armature winding is found to leak to the armature core. The same observation should first be made to see that no outer turn of wire is at fault. The writer has also come across a bad case of leakage (in a small motor) which was found to be caused by the fine binding wire employed to retain the armature coils in place. The maker in this instance had simply wound on a few turns of fine brass wire (bare) very tightly, without placing any insulation between them and the armature wires. The fine wire evidently cut through the cotton covering of the coils and established a too familiar acquaintance with the conductor wires inside; the cause was only discovered by making a test after the binding wires had been removed and before proceeding to unwind the armature. If the latter has to be done, the connections to commutator must first be broken, and the commutator then be tested, each section separately with the shaft. If it is still found necessary to attack the armature winding, begin by untwisting all the connections from coil to coil, and test each coil separately; this method, and, in fact, the method of testing step by step methodically, is certain to save time and ensure finding the cause or causes of failure. It should not be forgotten also, that the finding of one fault by no means precludes the possibility of another occurring in the same machine; and if a leak is found at all, all parts of the dynamo should still be tested, even if the very first attempt locates a fault.

A large number of dynamo and motor failures are due to excessive current. A small dynamo is very easily, and therefore very often is, overloaded. Even its normal limit of temperature is high, implying a heavy current in the armature, and when this is doubled, the natural result is a rise of temperature in the lower coils of the armature sufficient to char the insulation. With small motors the case is even worse. The rush of current from a fairly powerful battery through a motor at first starting is very great, but this ceases as soon as the machine has picked up its speed and opposed its back E.M.F. to the supply current. When, however, so great a load is put on the motor that its speed is brought very low for any considerable time, it is likely to heat up, generally with disastrous results.

It is very important to have the brushes well pressed on the commutator, but not heavily enough to create undue friction. To get satisfactory results the shaft should be a good "running fit" in the bearings, not slack; the commutator should be true and round, with no flat places or grooves, and the armature truly balanced. By these means, "sweet" running is assured, and this is essential, as the consequence of slackness in the bearings, &c., is a loss of current, excessive sparking, worn places on the commutator, and noise.

Heating sometimes takes place in the field-magnets. It is generally due to "eddy" currents set up by the cogs or slots in armature being few in number and rather wide. The only remedy is to overwind the armature with soft iron wire as already described; but as prevention is better than cure, as large a number of cogs should be employed in the armature as possible.

We have now enumerated practically all the failures usually met with in a dynamo or motor which is not inherently useless by reason of design or construction. A dynamo of excellent constitution may "go wrong" and the foregoing hints are intended to show what should be done to test and to remedy it. If, however, it is a machine which always works badly, or can never be made to give current at all, the case is more serious, and only a personal examination will quite satisfactorily solve the problem. The windings may be entirely disproportionate or the design, *i.e.*, the quantities and distribution of the iron, bad, and the reader whose dynamo is a failure should compare the machine with those described in "Small Dynamos and Motors," when he will doubtless discover the whole cause of the trouble.

To indicate the difficulty under which the expert adviser works when his experience is sought, a few of the cases which have come to the personal knowledge of the writer may be mentioned. There is first the instance—which has been more than once repeated—of an undertype dynamo very carefully mounted on an *iron* baseplate; as certain a means of short-circuiting the poles as a piece of wire across the terminals will short-circuit the current. Then there have been numerous cases of wrong winding of field magnets—resulting in two north or two south poles, as the case may be. This can easily be detected by means of the magnetic needle of a cheap galvanometer. Armature coils are often wrongly wound, the output being thus diminished or nullified, whilst the employment of plain armature stampings in small models, overwound with several layers of wire, is responsible for many more inefficient machines. In these cases, almost without exception, the makers were satisfied there was "really nothing wrong with their work," and laid the blame on the designers; but what is to be said of the budding electrician whose design and construction were excellent, his armature properly wound and connections faultless, yet whose machine would produce no current? He had had his field-magnets cast and beautifully finished in the best gun-metal!

It has been computed, says the *Engineer*, that some 50,000 internal combustion engines working on the Otto cycle have been made and sold in this country alone. On the Continent the number is about 35,000. The average power may be taken as about 10 horses, so that not less than 500,000 h.-p. is now at work in gas engines in Britain, and not less than 300,000 h.-p. on the Continent.

* * *

Compressed Air says that, according to *Popular Science Notes*, the Montreal Board of Trade has lately had on exhibition a model for a contrivance to brake ships, so that they can be stopped almost instantly in case of threatened collision, or when a person falls overboard. The device consists of two or more doors on each side of the ship beneath the water line, attached outside to the sheathing and opening outward. The doors can be operated by electricity, steam, or compressed air.

Hints for the Amateur Boiler-Maker.

By P. E. W.

I PROPOSE in this article to deal with a few of the difficulties I met with in making model boilers, in the hope that my experiences may be of use to those readers who contemplate building their first boiler. Mr. Pearce's book on Boiler-Making for amateurs is excellent, but does not deal with all the various mistakes and difficulties that are made and met with at the first attempt at boiler-making. The commonest types of boiler being the vertical and locomotive, I will take these, as, having made them, I can speak with some experience of the mistakes and difficulties that will arise. I will suppose the drawings have been made, size of the plates worked out, number of tubes and number of rivets required. The next thing is where to get them, so that you can

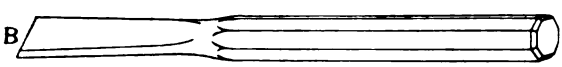


FIG. 1.—"FULLERING" TOOL FOR CAULKING BOILERS.

depend on the quality of the copper, an important matter where much flanging is to be done. I should advise a wholesale copper merchant or large coppersmith, giving the sizes of the plates, etc., and stating they must be of the best H.C. copper (*i.e.*, high conductivity, which means ab ut 99·9 per cent. pure copper guaranteed), which is about the best copper made; state also that you want plates and rivets finished off (*i.e.*, annealed).

Having got your plates and marked them out with centre lines, cut them to shape with an old tenon saw with fine teeth and rubbed with a tallow candle (this will be found to cut copper or brass easily, and for plates over 1-16th in. thickness is preferable to tinman's shears). The first job is bending the shell plates for the barrel and firebox. The easiest and cheapest way to do this is to send the plates to the local plumber or tinsmith and ask him to run them through his tinman's rolls and bend them to the sweep required. This makes a better job of anything over 4 or 5 ins. diam. than bending them round a wood mould, and costs less in time and money, and you also know that the plates will be bent to a true circle and

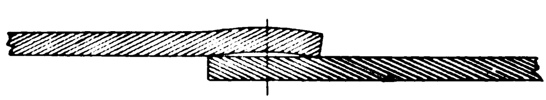


FIG. 2.—EFFECT OF CAULKING BOILER PLATES.

not on a skew as often happens in bending by hand round a mould; besides which, to bend a plate of ⅛ in. thick by hand is a tedious and difficult job.

We will take next the shell crown and the firebox crown. These can be flanged on a bar of iron shaped to the right radius at the end, and working the plate round on a pivot through its centre as the flange is knocked down; but a piece of hard wood will do as well and is often easier to get than an iron bar of the required thickness, besides which the wood is easier and more quickly shaped. In using wood, the radius should be struck *across* the grain. One piece of wood can be made to do for both crown plates, if it is made shorter than the diameter of the firebox crown plate.

In flanging we come to the first difficulty of keeping the plates soft and softening them when hard. Where the plates are, say, 10 ins. square or under, they can be heated in an ordinary fireplace, with top portion closed with an iron plate or piece of wood to induce a draught. Be careful to have a clean hot fire without smoke, or the copper will get "sulphured," which leads to cracks in flanging; heat to a dull red and plunge in cold water. Be careful not to get them too hot, or the plates will be burnt and become brittle and useless. Always reject a plate with irregular pit marks in it, as this means the plate has been burnt in the annealing. Three heats should be sufficient for plates 1-16th in. thick, one heat between each partial flange; but in no case should flanging be continued when the plate has gone hard, rather take another hour over annealing. Where the plates are over 1 16th in. and under 3-16ths in., five or six heats may be required. When the plates are too large to be heated in an ordinary grate, build a fire out of doors, surrounded with a row of bricks, then lay the plate on top and use a bellows to get the heat. If this is not practicable, take the plates to the local blacksmith and get him to heat them—only, mind he does not burn them. Having finished flanging, dress the edges with a file or where there is much to come off, as when the flange is too deep, for instance, saw it off with the tenon saw.

When riveted, mind the plates are close together, or the rivet will spread between the plates and prevent them coming together; the rivet should project beyond the plate about the length of its own diameter to form a neat head when snapped. In riveting, the heavier the holding up hammer the quicker and easier it is to knock the rivet down, but do not overdo it with the riveting hammer, or

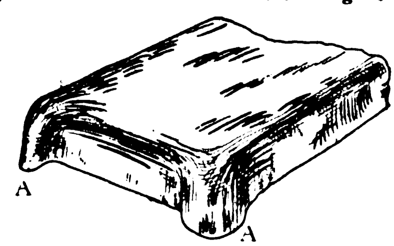


FIG. 3.—FLANGING A FIREBOX PLATE.

you will spread the rivet head so that the snap will only touch the sides of the head, and leave the crown untouched; the head should be slightly conical, and then snapped. For ¼-in. rivets I use two snaps—a blunt-edged one for snapping, and a sharp-edged one for removing any burr round the edge of rivet head. In snapping care should be taken not to injure the plate round the rivet head.

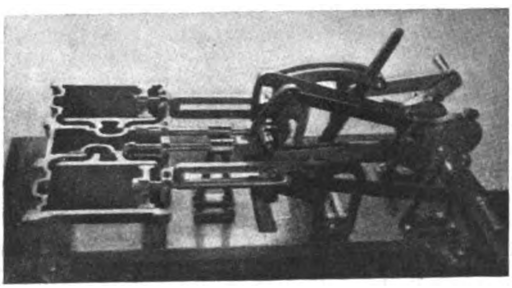
The following is an easy method of making a snap where no lathe is available: procure a steel ball from a bicycle shop, the same diameter as the head of the rivet; drill a hole in the end of the snap the same diameter as the shank of the rivet, and of a depth equal to the depth of the finished rivet head; countersink it with a rose bit, heat to a red heat, place the snap on the steel ball, and hammer it till the ball is driven about half-way in; temper to dark straw colour, grind the edge and the snap is ready for use. When snapping the rivet heads three rivets should be knocked down first, and then the first rivet snapped, then another rivet put in and knocked down, and the second snapped, and so on. By this means an unsnapped rivet is kept between the rivet last finished and the one being knocked down, so that the finished rivets are not spoilt by accidental blows of the hammer. The hammer used for riveting should have the sharp corner of the face ground off so that in the not unlikely event of the plate being hit instead of the rivet, the plate will not be marked.

Plates an ⅛ in. thick and over can be made tight at the joints by "fullering" the edges, for which a tool shaped as in Fig. 1 is required. The face B is square across and ¼ in. wide or less. It is ground to a bevel of about 70 degrees, and should be about twice the thickness of the plate to be fullered. The action on the plate edge is somewhat as in Fig. 2, only not so exaggerated.

I have used this method with success on a locomotive boiler of ⅛ in. plates. To make doubly sure, I sweated the firebox seams which could not be got at, in case of leakage, after the boiler was finished.

Tubes should be solid drawn, never brazed. The brazed tube is never quite round, and is difficult to make water-tight in consequence. The tubes should be softened at the ends, the holes in tubeplates tapered, and the tubes expanded in the holes by driving a taper drift (of the same taper as the holes) into the tube ends. If this is done carefully no sweating will be required, and the tubes will not draw through the plates. The above remarks apply to locomotive boilers except that the flanging is rather more difficult. When flanging the firebox front and back plates, it will be noticed that the flange at the top corner becomes deeper and thicker as the flanging proceeds, as in Fig. 3.

The corners A A, should be sawn off level with the rest of the flange or they will buckle and crack as the work proceeds. When the flanging is finished, the plates should be carefully flattened on an anvil with a blacksmith's flatter to take any buckles out. Wrapper or cover plates can be easily bent both for inner and outer fireboxes: in the former case by shaping a piece of hardwood to the cross section of firebox top, and in the



G.E. Ry. Valve-Gear Model for Instruction of Locomotive Drivers and Firemen.

latter by bending the wrapper-plate over the boiler barrel. Take care the centre lines of both wrapper-plates and moulds are exactly in line or the plate will be on the skew.

In staying the firebox crown of locomotive boilers, I prefer using cast brass girders, with bolts, and resting on the top edges of front and back plates of firebox. Mr. Pearce's method of direct staying from the outer wrapper-plate is the neatest and easiest for Belpaire fireboxes, where the outer firebox is flat-topped as well as the inner one; but in the case of an ordinary boiler, I should think the fitting of the tapered washers under the heads and nuts of the stay bolts a somewhat difficult matter. Bolts and nuts are about the simplest for stays, as there is no room for riveting the heads in a small boiler's firebox, and there would be a chance of buckling the plates of the inner and outer fireboxes together. In attaching the front tubeplate, I use a cast brass ring one-half to one-third thicker than the plate, and faced and bored to diameter of barrel, the front tubeplate is flanged to take the smokebox. In conclusion, I should advise amateurs about to make a boiler to watch a gang of riveters at work, if possible, and they will see how it *ought* to be done, and probably learn a wrinkle or two as well.

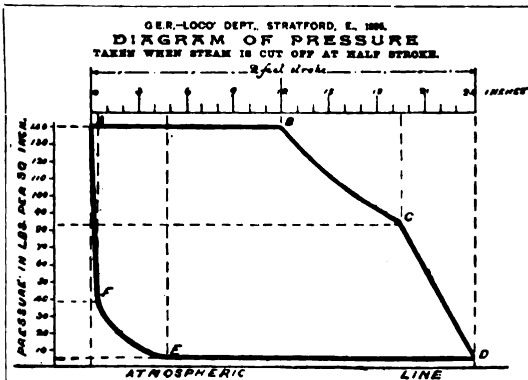
The Uses of Engineering Models.

By Percival Marshall, A.I.Mech.E.

(Concluded from page 178.)

(Concluded from page 178.)

FROM a purely commercial point of view, models have certain distinct advantages—as, for instance, in the case of exhibitions. There are many classes of engineering work, such as ships, docks, piers, bridges, which cannot be represented at exhibitions by the real article; but firms desiring to take advantage of the publicity afforded by the exhibition can readily bring their work to the notice



A.B. Is the steam line, the steam port being open during this portion of the stroke.

B.C. Is the expansion curve, and shews the fall in pressure after the steam port has been closed at *B*.

C.D. Is the exhaust line, and shews the further fall in pressure after the steam port has been opened to the exhaust at *C*.

D.E. Is the back pressure line, and shews the pressure against the piston on its return stroke (the steam port being still open to the exhaust). If there were no back pressure of steam this line would be as low as the atmospheric line.

E.F. Is the compression curve, and shews the rise in pressure against the piston, due to the compression of the steam left in the cylinder after the steam port has been closed to the exhaust at *E*.

F.A. Is the admission line and shews the further rise in pressure due to the steam port being opened before the piston is at the end of its stroke.

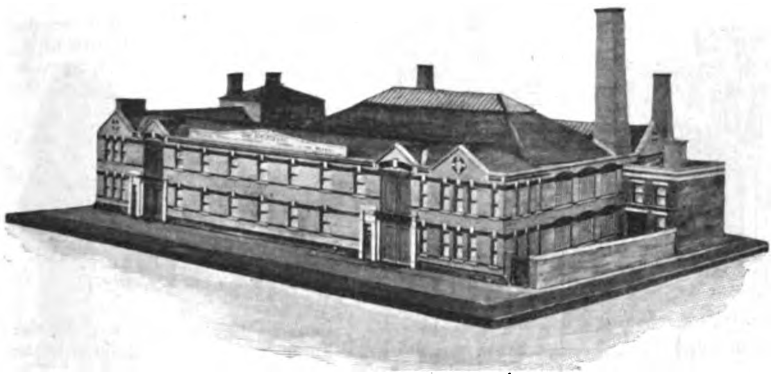
The amount of opening of the port when the piston is at the end of its stroke is termed "lead."

The amount by which the slide valve covers each steam port when it is in its central position is termed "lap."

Instruction Card Issued to G.E. Ry. Locomotive Drivers and Firemen.

of the visitors by exhibiting models of the various undertakings they have executed. Also, in the case of large and heavy machinery, models can be exhibited in place of the larger product, thereby effecting a considerable saving in the cost of transit and erection as well as in cost of floor space required. Moreover, a firm can thus show examples of special machinery they have built in the past when the actual machines are no longer available for exhibition purposes. That models of this kind are found to be a valuable and convenient means of advertisement is proved by the large number of them which are to be seen in any important industrial or technical exhibition.

In a similar way, models of new inventions have a distinct commercial value. It may be that a machine is invented which would be a costly affair to construct full size; and, in order to perfect his ideas, the inventor first makes a working model, which he alters and improves until the idea is perfected. He is then in a position to embark on the more costly production of the full size machine, with the practical certainty that the desired results will be obtained. Inventors who wish to induce capitalists or manufacturing concerns to adopt their ideas also find models of use in many ways. Possibly the inventor may not have the means to construct a full-sized plant or machine, or he may not wish to incur so large an outlay until he is assured that there is a market for the particular device he is interested in, in which case a model will probably serve to demonstrate his ideas equally well at a far less cost. In other cases, the inventor may have to travel about the country in order to submit his idea to possible customers, when the increased portability of a small-scale model will be of no little advantage. This consideration of portability is also one which appeals to firms who may have to canvass for orders through travellers, for which purpose a model is often a great convenience.

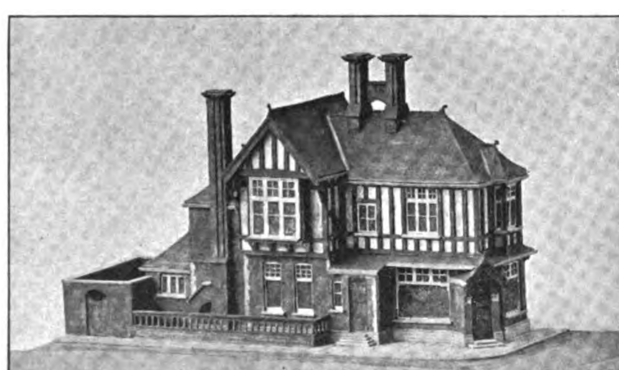


EXHIBITION MODEL, TO A SCALE OF 4 FT. TO AN INCH, OF THE PREMISES OF MESSRS. HENRY ROBERTS & CO., MILE END (COOPERS AND VAT MAKERS). (Made by the London Drawing and Tracing Office.)

In the earlier days of railway development new systems of traction or propulsion were frequently proposed, and the inventors usually brought their ideas before the public through the medium of working models. Sometimes these were exhibited privately to those specially interested, but in many cases the public were invited to see or to try a trip on the model railway at a small charge per head. Among recent railway novelties which have attained the stage of public exhibition in the form of a successful working model, may be mentioned the Halford Gradient Railway, of which a model was shown at the Glasgow Exhibition of 1901, the Behr Monorail Electric Railway, and Mr. Britain's system of collecting and delivering parcels from express trains.

In civil engineering and architectural work, models are frequently employed to show the exact nature of new undertakings. Sometimes these are of considerable size, such as the one constructed to show the Manchester Ship Canal a few years ago. This model was some 30 ft. in length, and was in relief—showing all railways, streams, roads and towns in the immediate vicinity of the canal. Models of this kind are, of course, very different in character from the working models of engines and machinery previously referred to, and they are usually made of such materials as plaster, cardboard, or wood. Models of bridges, docks, harbours, sluices and similar undertakings are frequently made before the actual work is put in hand, so that the general appearance and proportions of the finished work may be studied. This is of special importance in the cases of buildings where the architectural effect of the work has to be considered, because it is impossible to judge this satisfactorily from drawings alone. Even if the buildings are drawn accurately in perspective, one view only is given, and this sometimes from a standpoint which cannot be obtained in reality through the proximity of other buildings. If, however, a scale model of the building or group of buildings in wood, or even in cardboard, is first constructed, it can be regarded from all possible points of view and its general effect carefully noted.

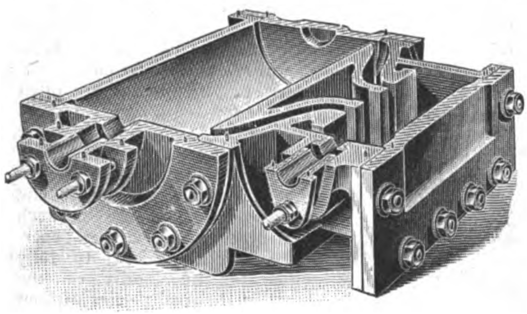
Models of buildings are often prepared for use in law courts and for arbitration purposes, where light and air and party-wall questions, or similar matters of dispute have to be decided. The advantages of models in such cases are obvious, as they generally enable the Court to fully appreciate the merits of the claims of the rival parties without the necessity for adjournment to enable the judge and jury or the arbitrator to go and personally inspect the buildings involved in the case. An interesting instance of the value of models in legal dispute occurred a few years ago, when a scheme for the water supply of Birmingham was being discussed in the House of Lords. The plans were being opposed by some of the Glamorganshire authorities, when Mr. Mansergh, who appeared in support of the promoters of the scheme, produced a model illustrating the nature of the work he intended to carry out, with the result that the opposition case collapsed in a very few minutes. In law cases concerning the validity or infringement of patents, models play an important part, and are of the greatest possible service to the parties engaged. As a further example of the legal uses of models,



MODEL OF PRIVATE HOUSE.
(Made for an Architect's client by the London Drawing and Tracing Office.)

it may be mentioned that at the inquest on the recent electric railway catastrophe, at Liverpool, a model was brought into Court by Mr. Cottrell, the manager and engineer of the company, to explain how the driver of the train could cut off the current in various ways.

One of the most widespread and important uses of engineering models is in connection with educational work. In every technical school where engineering subjects are taught, models are used in the drawing classes, in the laboratories, on the lecture table, and in the workshops. For teaching mechanical drawing, full-sized models of en-

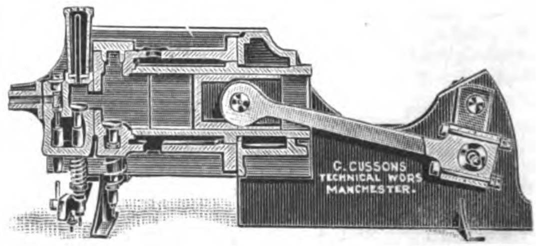


EDUCATIONAL MODEL OF CYLINDER & VALVE CHEST.
(Made by Mr. G. Cussons, Manchester.)

gine and machine details are generally used, and for cleanliness and convenience in handling, are made of wood, the different metals being indicated by different colouring. Models are also very helpful in teaching solid geometry. In the laboratories the models partake of an experimental character, and while the general principles of the real thing are adhered to, the details are often varied or simplified to facilitate adjustment and manipulation.

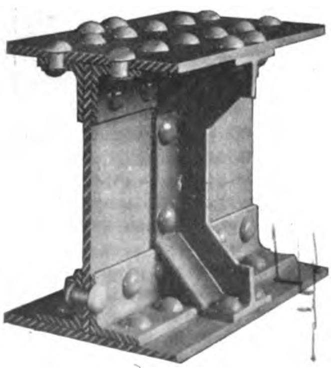
Models are a very valuable aid to the professor in the lecture-room, enabling him to show clearly the working of various kinds of gearing for the transmission of motion or power, valve gears, and similar mechanical devices. Similarly, electrical models can be used to illustrate the generation of an electric current, the production of the electric light, or the transmission of electrical power. Apart from the great assistance such models are to the lecturer in enabling him to make his subject clear to his audience, they are far more interesting to the student than ordinary wall diagrams or blackboard sketches, and by attracting his closer attention, enable him to more easily remember the information which is being imparted to him.

Model-making in the technical college workshop is not so generally encouraged as the author thinks it deserves.

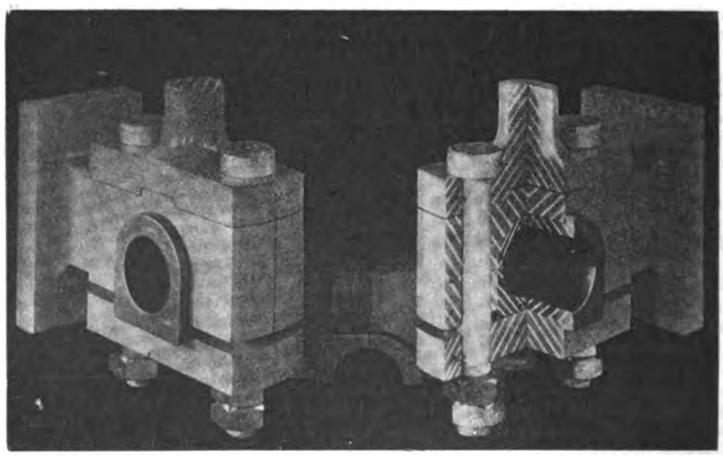


EDUCATIONAL MODEL OF GAS ENGINE.
(Made by Mr. G. Cussons, Manchester.)

The student is too often put to do larger and heavier work, with the result that he covers less ground in the course of the session than he otherwise would do. The average student would learn more about the construction and working of, say, a horizontal engine by making a complete model himself, than by making one or two parts only of a large engine; and, moreover, would take a far greater interest in doing something which would be entirely his own work when finished. The author suggests, of course, that the model should be of good design and of reasonable size, say to a scale of not less than 1 in. to the foot. A model of such a size would call for more delicate and accurate workmanship than a larger engine, which is an advantage in the right direction, and at the same time it would not be so fatiguing to the student as the heavier work. An interesting example of model making has recently been completed in the workshops of the Regent



EDUCATIONAL MODEL OF BUILT GIRDER.
(Made by Mr. G. Cussons, Manchester).



EDUCATIONAL MODEL OF CROSSHEAD.
(Made by Mr. G. Cussons, Manchester.)

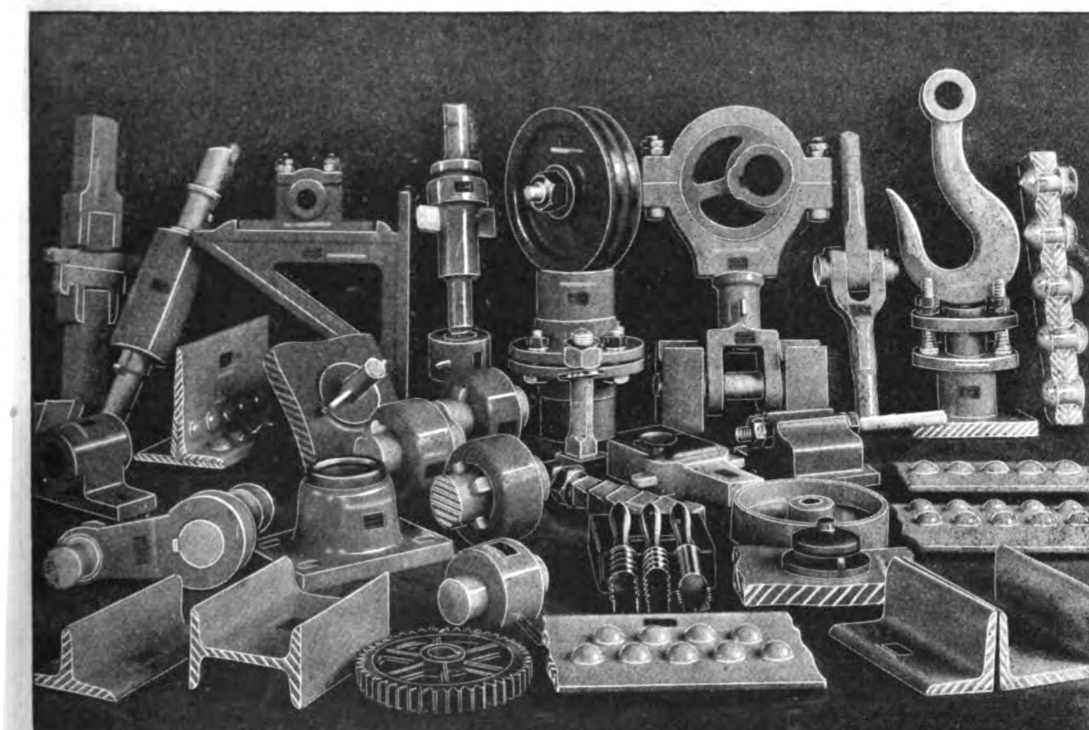
Street Polytechnic School of Engineering, this being a model of a Great Northern Railway express engine and tender, built to the scale of 3 ins. to the foot.

Some of the railway companies use models for the purpose of instructing their locomotive drivers and firemen in the mechanism of the locomotive. On the Great Eastern Railway, for instance, a model, representing approximately the motion of a locomotive, is kept at each of the principal locomotive depôts. The models are supplemented by theoretical diagrams of pressure, printed with explanatory notes, which are given to the men.

A somewhat curious example of an engineering model was shown in the last Glasgow Exhibition. It was a model of a portable engine, built by a Burmese native boy, who wished to get into the works of the Burma Railway Company, as an apprentice, and who showed it to Mr. C. E. Cardew, the company's locomotive and carriage superintendent, as proof that he was a suitable candidate for admission into the works. The lad, who was entirely self-taught, had actually constructed with home-made tools a successful and well-proportioned working model from odds and ends of scrap metal. It is hardly necessary to add that the ingenuity of this born mechanic received its due reward. Instances are not unknown in this country where the exhibition of a self-made model has similarly secured the entry of a budding engineer into the workshop of his choice.

While dealing with the educational aspect of model making, the author would like to refer to the large amount of this class of mechanical work done by amateur engineers, and by professional engineers too, as a hobby. By many people model engines are looked upon as mere toys unworthy of any degree of serious attention. When, however, it is remembered that many clever mechanical inventions have been made by people who have taken up engineering merely as a hobby, it will be clearly seen that this notion is a mistaken one. It has been the author's privilege to inspect a large number of engineering models and appliances made by amateur mechanics, and he has frequently seen examples of both workmanship and design which would compare favourably with any professional productions which could be placed against them.

In conclusion, the author regrets that the limited time available has prevented his entering into the constructional details of many of the models to which reference has been made, for they contain much that is ingenious and interesting. It has, however, been his object in preparing this paper to direct attention to some of the many uses of engineering models, and he hopes that in doing this he has possibly suggested points which may be of service, either scientifically or commercially, to the members of this Institution in the practice of their profession.



Group of Models for Machine Drawing Classes. (Made by Mr. G. Cussons, Manchester.)

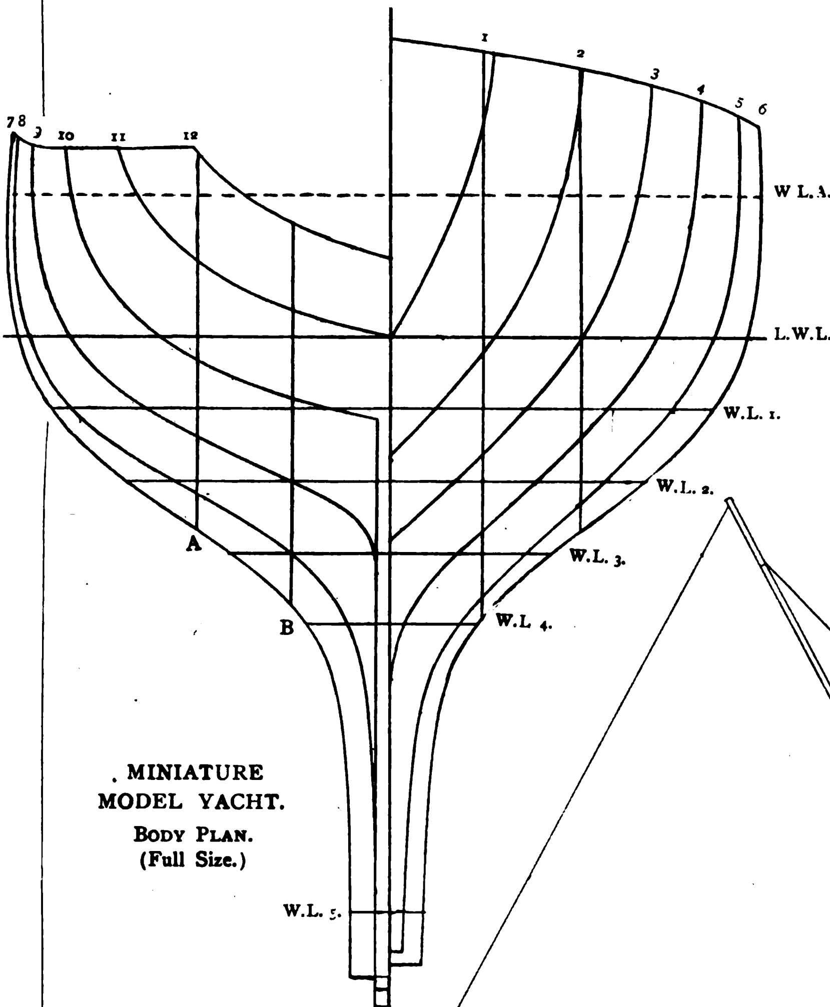
[The Author desires to gratefully ac nowledge his indebtedness to the following gentlemen for supplying him with information and photographs :—Mr. Archibald Denny, M.I.N.A. (Messrs. Denny & Co.), Prof. W. Dalby, M.A., Hon. C. A. Parsons, Mr. F. W. Webb (L.N.-W. Ry.), Mr. Jas. Holden (G.E. Ry.), Mr. J. B. Thorp (London Drawing and Tracing Office), Mr. G. Cussons, Prof. Hy. Spooner; and also to members of the Society of Model Engineers and others who have been kind enough to lend Models for Exhibition on the occasion of the reading of this paper.]

Design for a Miniature Model Yacht.

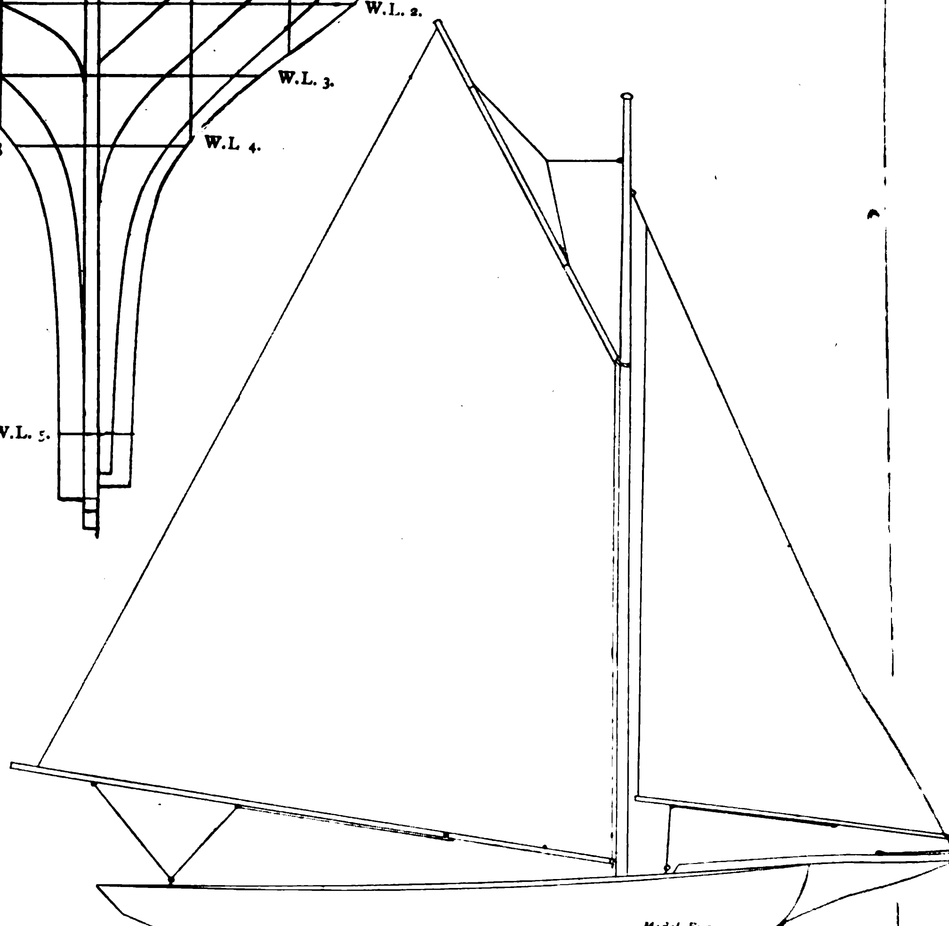
By W. H. Wilson Theobald, M.A.

In accordance with a desire expressed by a number of model yachtsmen, a design is here given for a miniature model yacht which should prove especially interesting to younger readers. The design represents a boat 12 ins. on the water line and of small enough displacement (exactly 1 lb., as a matter of fact) to be easily carried about. She is a "large" boat for her length, with plenty of beam, but this is necessary with so small a model.

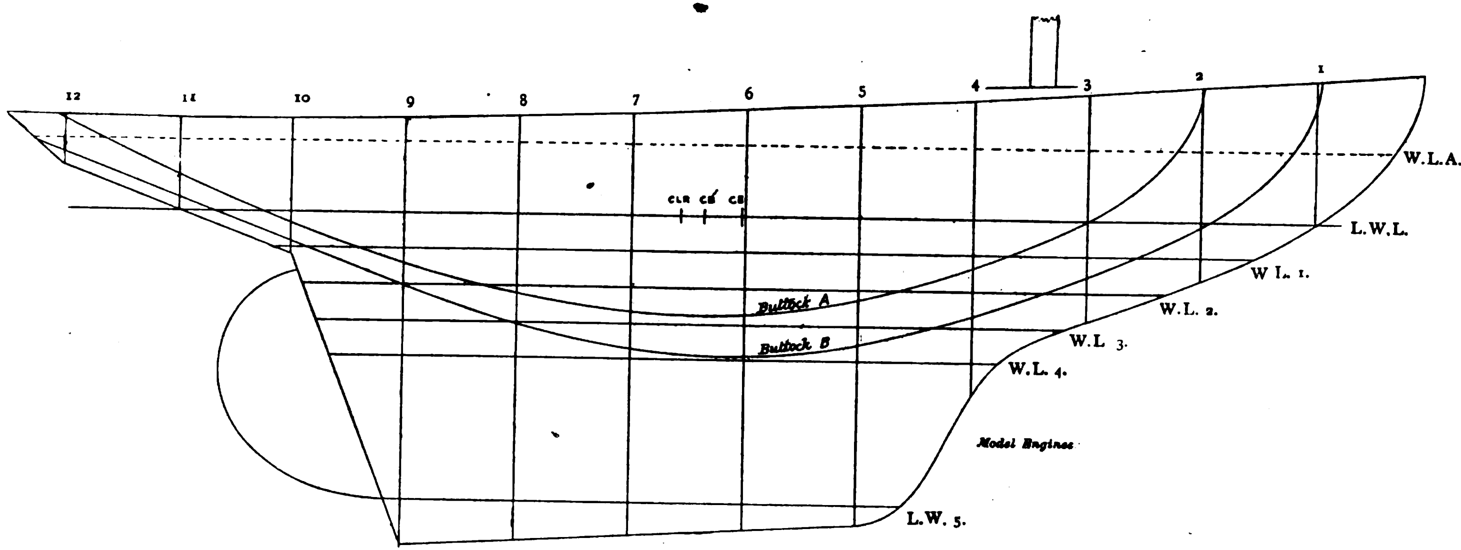
The water lines have been spaced ⅜ in. apart so that the yacht could well be built from ¾ in. or 1½ in. layers. The sheer and half-breadth plans are exactly half size, the body plan



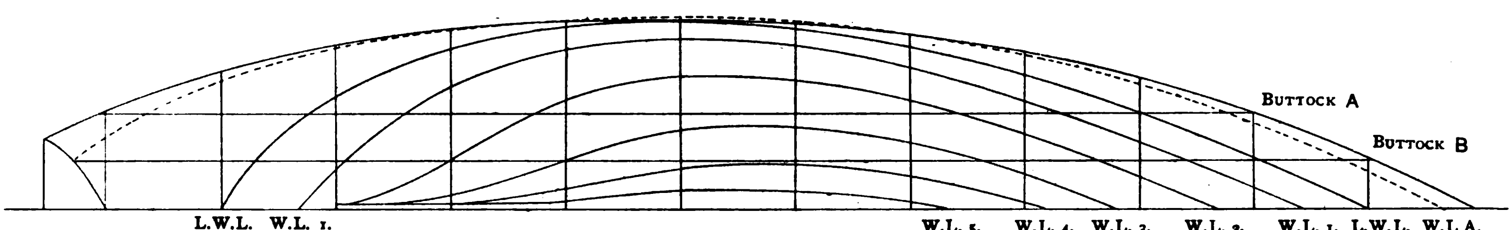
MINIATURE MODEL YACHT.
Body Plan.
(Full Size.)



Sail Plan.
(Quarter Full Size.)



SHEER PLAN.



HALF BREADTH PLAN.

L.O.A. ...	15 ins.	L.W.L. ...	12 ins
Overhang forward	1·125 ins.	Draught, extreme	3·5 ins.
" aft	1·875 "	Beam "	4 "
Displacement	1 lb.	" on L.W.L.	3·9 "
Sail Area (S.A.) ... ... =	166 sq. ins.	Sections spaced	1 2 ins. apart.
Rating, $\frac{S.A. \times L.W.L.}{6000}$ =	·3	Buttocks "	·5 " "
		Water lines "	·375 " "

DESIGN FOR A MINIATURE MODEL YACHT.
BY W. H. WILSON THEOBALD, M.A.

(*For description see page 204*).

(*Scale of above drawings, half size*).

load traversing the express route was at the rate of 100 feet in 30 seconds from start to stop.

The cuttings, tunnels and bridges were designed and modelled out of clay and moss, by Mr. G. Bailey. Most of the rolling stock and permanent way was supplied by Messrs. W. J. Bassett-Lowke & Co., Northampton. The whole line was made for Master James Bartholomew, Blakesley Hall, Northamptonshire, by his father, for his amusement during the last Christmas holidays.

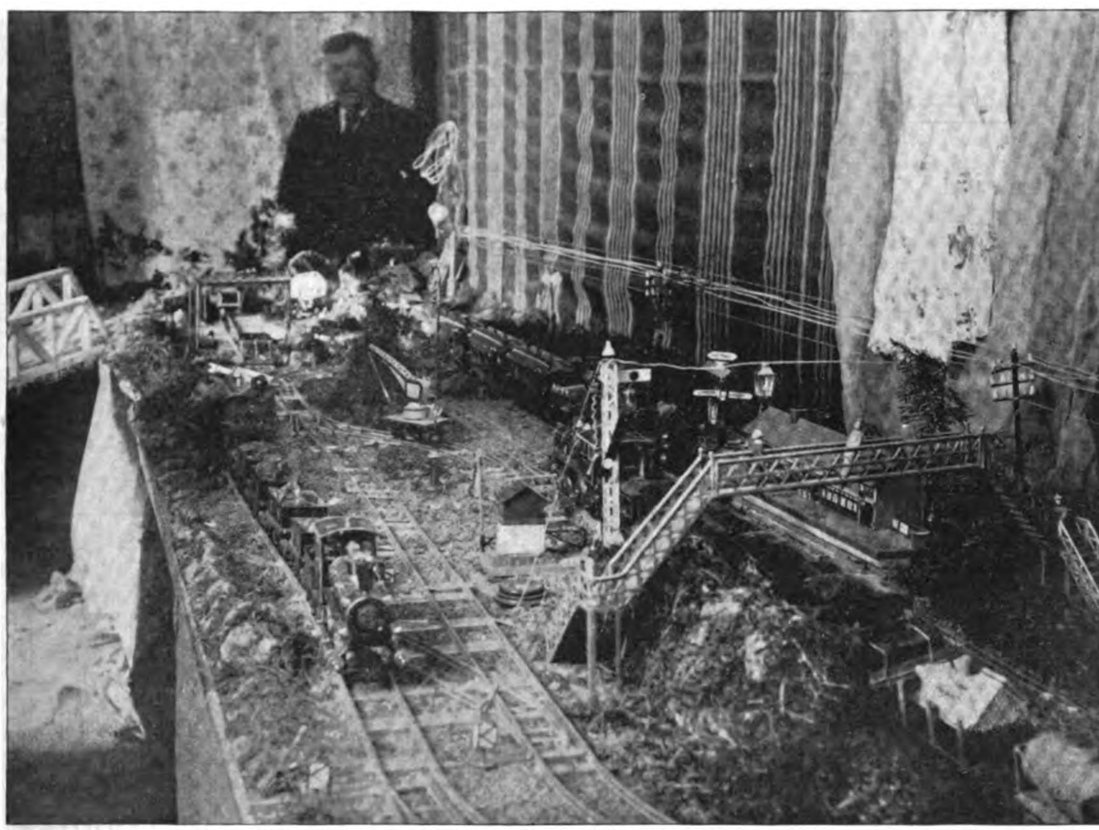
Heat of the Incandescent Electric Lamp.

THE temperature of the electrical incandescent lamp, has been determined by the French physicist Janet of the Paris Academy of Sciences. To preserve the heat radiated from the carbon filament of the lamp is a matter of great difficulty, since the filament is separated from the atmosphere by a vacuum. Janet has determined, from investigations made with four different lamps, that the filaments attain a temperature varying from 1,610° to 1,720° C. It is remarkable that so high a temperature in an incandescent lamp radiates so little heat. Nevertheless, the radiation is sufficiently pronounced to bring water to the boiling point. For instance, it has been found by experiment that on immersing a 16 c.-p. lamp (100 volts pressure) in half a pint of water the water boils within an hour, and in proportionately less time when a 32 c. p. lamp is substituted. If the lamp be buried in cotton wool, the wool ultimately bursts into flames.—*Mechanical Engineer.*

Explosions of Small Boilers.

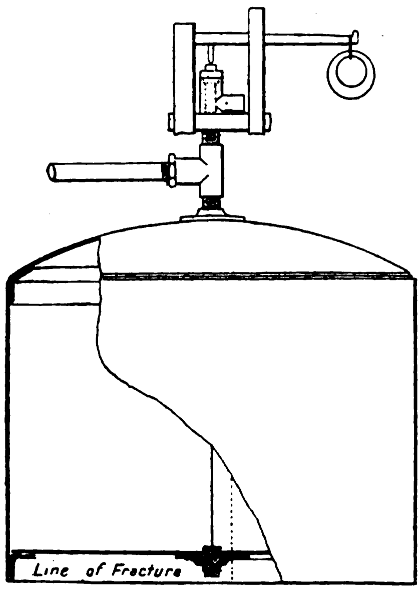
OUR contemporary, the *Mechanical Engineer*, makes a feature of reproducing particulars of all the most important and interesting Board of Trade reports on boiler explosions. Amongst those recently published are two cases referring to small boilers, and in view of their importance we extract the following details of the accidents in question.

The first (Report No. 1,347) deals with a formal inquiry respecting the bursting of a small boiler used for scalding food for pigs, which occurred at Oldham on October 31st, 1901. The boiler, if it may be designated by that title, for it was little more than a tin can, measured 2 ft. 3 ins. diameter by 1 ft. 8 ins. high, and was made of sheet iron ⅛ in. thick. It must originally have been made for some other purpose, though its history could not be traced. All that could be learned of it was that it passed through several hands, and was finally sold by a greengrocer for 5s. 6d., the purchaser, in his turn, selling it again to the unfortunate owner for 12s. He was a working man, and used it to supply steam to cook food for some pigs. Steam was got up about twice a week to 25 lbs. The suitability of the vessel for the pressure was supposed to have been demonstrated by the fact that the man from whom the owner bought the thing got up steam once to 32 lbs. On the day of the explosion steam was being raised in the usual way, and the owner,



MODEL CLOCKWORK RAILWAY—VIEW FROM THE OTHER END OF LINE.

with two friends, was sitting near, when the bottom of the vessel was blown out, with the result that the shed in which it stood was wrecked, a pony therein killed, while the three men were badly scalded, one of them so badly that he died about a week afterwards. The report comments strongly and justly on the ignorance and recklessness displayed by owners like the one in question in working a vessel like this for steam raising purposes, as well as the reprehensible practice of ignorant men trafficking in them. As the owner as well as the man from whom he bought the vessel were poor working men, it was impossible to inflict upon them the costs of the inquiry; but the Commissioners expressed the hope that "casual steam users" like the one in question will take



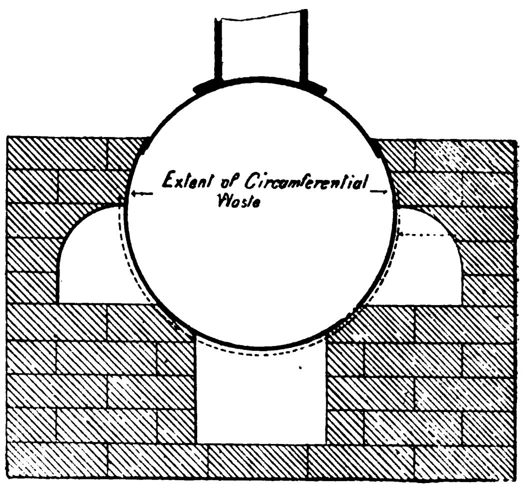
REPORT NO. 1347.—SECTIONAL ELEVATION OF BOILER, SHOWING LINE OF FRACTURE.

warning from the case, and religiously avoid using vessels for steam raising purposes until they have been properly examined by some competent authority and their working pressure properly determined.

Report No. 1351 refers to a formal inquiry respecting the bursting of a small cylindrical boiler used by a pork butcher in connection with his business at Ruabon on November 25th, 1901. The boiler was only a tiny thing, being a plain horizontal cylinder measuring 3 ft. in length by barely 2 ft. in diam., but it was capable, nevertheless, of causing considerable mischief. About half the bottom was blown out, when the remainder was projected about 150 ft., the shed in which it stood being demolished and an adjoining wall wrecked, while the owner was very severely scalded. As is often the case with these little boilers used for casual steam raising purposes by small tradesmen and others, no attempt was made to secure its careful periodical inspection. It was of unknown age, and had been picked up second-hand some years ago for a £5 note, and set in brickwork by a local bricklayer, who so built it that the greater part of the plates were hidden; and corrosion, due to leakage percolating through the brickwork, went on unseen until at length the boiler became so thin that it was incapable of standing the working pressure of 30 lbs. on the inch, and burst with the results stated. As the owner was a comparatively poor man, and had been personally and pecuniarily injured by the explosion, the Commissioners did not make any order on him in regard to costs, but they held that the bricklayer who set the boiler had also been guilty of contributory negligence in using brickwork and mortar instead of proper seating blocks and fireclay, and marked their sense of his blame by ordering him to contribute towards the expenses of the inquiry.

The Induction Coil.

AS an instance of the fact that the action of the induction coil is as yet very little understood, Lord Rayleigh mentions that there is no *à priori* calculation determining from the data of construction and the value of the primary current even the order of magnitude of the length of the secondary spark, says an abstract in the *Electrician.* This remark applies, of course, only to induction coils worked by a break, and not to transformers. This incompleteness of the theory is due to several causes, such as the departure of the iron from theoretical behaviour, the length of time occupied even by the most rapid break, and the capacity of the secondary coil. But for these circumstances the theory would be very simple. Lord Rayleigh advances some new principles, which he proves by somewhat novel means. After pointing out that the energy of charge at the moment preceding the secondary spark cannot exceed the energy of the primary current before break, he goes on to state that the available energy of a highly magnetised core of iron is insignificant, especially if the magnetic circuit is nearly or completely closed.



REPORT NO. 1351.—CROSS-SECTION OF BOILER, SHOWING EXTENT OF WASTING.

The only use of a condenser in conjunction with the ordinary break is to quicken it by impeding the development of an arc, so that when a sufficient rapidity of break can be obtained by other means, the condenser is worse than useless, operating, in fact, in the reverse direction, and prolonging the period of decay to the primary current. To prove this, the author has tried to blow up a portion of the primary circuit by electric discharge, but succeeded better by cutting the circuit with a rifle bullet. At a distance of 90 mm. between the terminals no spark could be got when the condenser was in connection. When it was disconnected a spark was observed nearly every shot.

The Editor's Page.

WE are now able to announce the decision of the judges on the articles submitted for our recent Competition, No. 20. Owing to the unusually large number of competitors, the task has been very heavy, especially as many of the articles were very even in point of merit, the majority, we are glad to say, showing that our readers possess considerable ingenuity and constructive talent. The Competition, it will be remembered, was for two prizes, consisting of lathes offered by Messrs. S. Holmes & Co., of Bradford, for "the best and second best articles describing a model made by the competitor without using a lathe." The judges selected five of the articles for special consideration, and as these were all of a high order of merit, we have decided to add three intermediate (supplementary) prizes to those offered.

* * *

The names and addresses of the prize-winners are:

(1) GEORGE LAMPEN GRIFFITHS,
24, Mazenod Avenue,
W. Hampstead, London, N.W.
(Prize—An "Anglo" Lathe, by Messrs. S. Holmes and Co., value £3 10s.)

(2) ERIC E. TEMPLE,
Avenue Lodge,
High View Road, Upper Norwood,
London, S.E.;

and

GEO. W. STEAD,
70, Mount Street,
Cleckheaton, Yorks.
(Prizes—Treadle Lathes, by Messrs. S. Holmes & Co., value £2 2s. 6d. each.)

(3) S. COOPER,
2, Mansfield Place, Edinburgh.
(Prize—Gap bed Lathe, by Messrs. S. Holmes & Co., value 22s. 6d.)

(4) GEO. H. ATKINSON,
Peterboro' Avenue,
High Wycombe, Bucks.
(Prize—Lathe, by Messrs. S. Holmes & Co., value 17s. 6d.)

* * *

The following are the comments of the judges in this competition:—(1) The first prize is given to an article describing a small electro-motor of the Griscom pattern. The drawings might, perhaps, have been better; but the article is an exceptionally good and practical one, and contains many useful hints to electrical amateurs. (2) Two competi ors have been bracketed for second place. The first of these has chosen for his subject a model battleship, which he has executed principally in wood and cardboard. Under these circumstances a lathe is hardly as necessary to the construction as in most of the other competitions. The article is, however, an excellent one, and the drawings are as good as any submitted. The other article describes the construction of an electric indicator for use in connection with an electric bell installation. The drawings and photographs in this case are also excellent. (3) The third prize is awarded to an article with excellent drawings, describing the construction of a model vertical marine engine of good design. (4) A great amount of ingenuity has been shown by the winner of this prize. He describes the construction of a model horizontal engine, most of the parts of which are made from odds and ends of material. The drawings in this instance might easily have been made more satisfactory had they been executed in *black* ink. Many competitors appear to regard anything in the nature of ink as black enough for the purpose, but this is a great mistake. In our opinion, the appearance of the model under consideration could have been improved by the use of other materials or parts quite as simple as some of those actually employed, since it is desirable that the model should approach as nearly as possible to the appearance of the original.

* * *

Amongst the other competitors the following have been very highly commended for their work, and the names are given in the order of merit:—

Percy C. Jones (Stretford), Chas. Ridgway (Edinburgh), W. Hudson (Hull), Charles Widdas (Leeds), Alfred E. G. Hepworth (Manor Park), E. W. Dove (Poplar), W. E. Coles (Chippenham), Leonard Levy (West Hampstead), T. E. Dutton (Gloucester), E. J. Watkins (Upton Park), T. L. Foulston (Stroud, Glos.), H. J. Tapping (Hampstead), Percival King (Wawanesa, Manitoba), T. Attwater (Preston Park), J. G. Drummond (Fallowfield), George Carter (Bradford), G. H. Fouracre (Leamington), M. Brown (Hornsey), Stanley Grimsde (Acton), and C. R. Fursdon (Lynton).

* * *

The following are commended:—H. E. Hodgson (Kensington), Geo. Hutchinson (Galway), A. J. Goodwin (Gloucester), E. W. Evans (Wantage), W. E. Holmes (Gainsborough), Oswald Ward (Sheffield), J. Game (Kensington), A. Nelson (Bury), R. Kuenemann (Manchester), J. W. Tracy (Crouch End), Harry Smith (St. Helens), T. W. Kennington (Leeds), S. J. Adams (Ramsgate), James Brodie (Glasgow), James Treloar (Bolton), R. Mantle (Penge), W. H. Scrimshaw (Grimsby), R. Gaspard (Paris), Herbert Miller (Newcastle-upon-Tyne), A. G. Carter (Dulwich), J. Sharman (Haywards Heath), W. Smeddle (Dulwich), A. W. Cooper (Preston), J. L. Hall (Studley), T. Hawken (London, W.), J. S. Wilson (West Stanley), C. Rhodes (Bradford), D. Greenlees (Ayr), C. Willson (Halifax), A. E. Gelston (Lower Broughton), A. Cooper (Forest Gate), P. Cottrell (Staplecross), T. Hunt (Leicester), R. Matchett (Paisley).

* * *

Now for a new prize competition, which will test the ingenuity and inventive capacity of those readers who feel disposed to enter. We offer two prizes, of £2 2s. and £1 1s., respectively, 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 competitors, 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 problem set for solution in the above competition is not so difficult as it may appear at first sight, and it is certainly far simpler than the designing of a full-sized flying machine. This will be readily apparent when we point out that the real machine has to generate its own power of propulsion, and, moreover, has to carry the additional weight of its passengers or navigators. In the model the propulsion may be effected by the simpler sources of power afforded by such devices as small electric motors, springs, clockwork motors, or even the homely piece of twisted elastic. The competitor may, if he chooses, construct what is really a self-propelled balloon, or he may tackle the more complicated problem of producing a self-raising and self-propelling machine. At any rate, the subject should be an attractive one to the many ingenious mechanics numbered amongst the readers of THE MODEL ENGINEER. The resulting models will, of course, hardly rank as anything more than toys, but they may be clever and interesting ones for all that. The closing date for entries will be June 30th, and our usual general competition rules will apply. Entries should be marked Competition No. 22.

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. 21.—A prize of the value of £2 2s. is offered for the best description and drawings of a small electro-motor, to work from continuous current supply mains at 60, 100, 110, 200, or 220 volts. The output of the machine should be about 1-10th h.-p. actual, suitable for working light machinery, a fan, or sewing machine, without heating. The particulars should include a description of the method of making patterns for all parts required to be cast, the best way to machine the parts, the construction and winding of the armature, and suitable windings for each of the voltages mentioned above. The article should also include details of the starting and controlling mechanism. The type of machine is left to the competitor's discretion, but due regard should be paid to simplicity, economy and safety in running. The drawings should show all details separately and clearly, as well as general arrangements where necessary. To ensure accuracy and clearness, it is desirable that all details, at all events, be drawn full size. The usual general conditions apply to this Competition. The closing date for receiving entries is June 15th.

Competition No. 22.—For particulars see Editor's Page, above.

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.

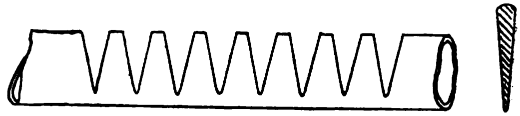
Practical Letters from Our Readers.

[*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.*]

How to Make a Bend in a Small Steam Pipe.

TO THE EDITOR OF *The Model Engineer*.

SIR,—In your issue of April 1st Mr. Greenly shows how to make a right angle bend in a small steampipe, but the result is what I should call a sharp elbow. If, instead of making one cut, several cuts should be made, say four for a quarter bend and eight for a U bend, a much better



Model Engineer

METHOD OF MAKING A "U" BEND IN A SMALL STEAM PIPE.

result is obtained, and one brazing operation fills all the eight cuts just as readily as one cut. The cuts appear as shown before bending. They are saw cuts, each filed out a little with a sharp edged file of the section shown at the right in above drawing. I send you two samples of tubes treated in this way.—Yours truly, HENRY LEA.

Birmingham.

[The samples enclosed by Mr. Lea are particularly neat examples of the satisfactory results obtainable by this method.—ED. *M.E.*]

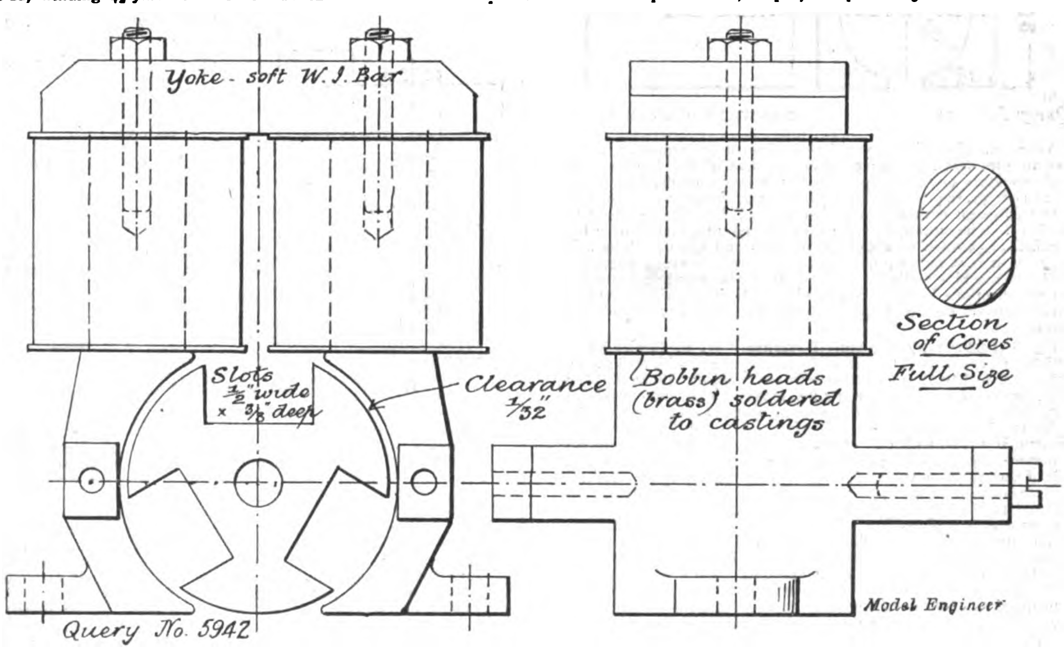
Queries and Replies.

[Attention is especially directed to the first condition given below, and no notice will be taken of Queries not complying with the directions therein stated. 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:—

[5942] **Motor for Model Boat.** T. A. (Brighton) writes: Would you kindly let me know the best sizes and quantities of wire to wind the motor of which I enclose a sketch? The motor is made for a model torpedo boat destroyer, and is to be driven by a 4-volt 6 amp. accumulator (horizontal). I wish to get the greatest possible power from the motor, using the above accumulator. The pole-pieces are of cast-iron, with a wrought-iron yoke, fixed together with 3-16ths steel studs and nuts. The armature is tripolar, of best soft iron laminations.

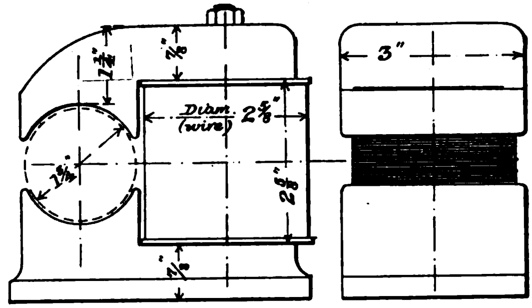
Your machine will make a powerful and efficient little motor to work at 4 volts if wound as follows: For the armature use 1¾ ozs. No. 22, winding 4½ yards on each of the three limbs. The field magnet cores will require 7 ozs. No. 18, winding 10 yards on each limb, and connecting in series. Let the motor run at as high a speed as possible, when it should take about 2 ampères.



MOTOR FOR MODEL BOAT. (Full Size.)

[6004] **Simplex Dynamo (60-watt).** E. W. (Twickenham) writes: I have a small dynamo, of which I send sketch, which I wish to convert into a charging dynamo. Should feel obliged if you could answer me following questions. The dimensions of the machine are shown in the drawing. At present an H armature is fitted, and is filled with No. 20 S.W.G., D.C.C., wire. I do not know the depth of winding in armature, nor the size of the field-magnet core, which is wound with No. 22 wire. The dynamo in its present condition lights two 30-volt 8 c.p. lamps. My engine will not drive it at any higher speed than 1,500 revolutions per minute. (1) What should be output with present winding, and also what b.h.-p. to drive same? (2) What kind of armature would be most suitable, and quantity and size of wire to convert into a charging dynamo? (3) What speed to drive, b.h.-p. required, and output when completed?

In this case, the best we can do is to make an estimate of the winding—it cannot be calculated on the ordinary lines, and, consequently, the output cannot be guaranteed. The machine appears



Query No. 6004. 60-WATT SIMPLEX DYNAMO.

to be doing well at so low a speed, but it will require to run faster to get equally good results from the new winding, although this does not necessarily imply that more power will be needed. The power required should be about ⅛ b.h.-p. (1) We cannot very well say. (2) A slotted drum with 8 slots, 5-16ths in. wide × ½ in. deep, wound with 4 ozs. No 24 in 8 sections. (3) Speed, 3000 revolutions per minute; output, 2 ampères at 30 volts.

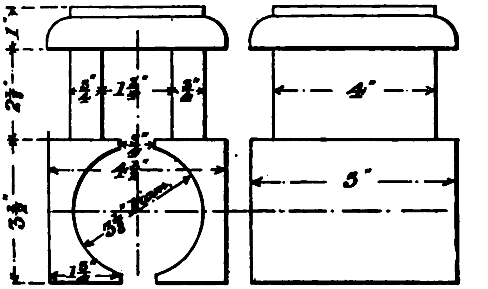
[5987] **Resistance for Charging Accumulators from Mains.** A. W. B. (Nechells) writes: I have a 65-volt current available, and I want to reduce to about 8 or 10 volts, for charging small 4 or 6-volt accumulators. Will you kindly tell me what resistance it is best to use—lamp or wire? If lamp, what voltage; and if wire, what kind, and how much? I should like to use the latter, if possible, and make a resistance board with switch.

We advise the use of a resistance consisting of a lamp or two, according to the current required. Thus a 65-volt 16 c.p. lamp will pass barely one ampère; an 8 c.p. lamp half that amount. You do not state the proper charging current, so that we are unable to give a definite reply *re* a wire resistance. In any case a lamp is both more convenient and less costly. See the wire tables published in our January 1st issue, 1901, from which you should be able to work out a proper resistance, with the aid of Ohm's law.

[5958] **Accumulator for Electric Reading Lamp.** G. B. (Clapham) writes: Would you kindly inform me of some means of preserving a fairly permanent light for a 4-volt lamp for reading? I have a 4-volt accumulator, but I do not find it efficient, as, after I have had it re-charged once, I find it does not keep up a light for more than a few minutes, and it then goes out, until switched off and then relighted, when it often only goes red hot. If you could tell me of some way in which I might get it to burn properly for a few hours at a time, I should be much obliged.

There must be something wrong with the accumulator, and it is probable that it is too small for the work. If this is the case, the remedy is obvious, and the best we can advise is that you obtain a much larger accumulator for the purpose.

[6006] **Undertype Dynamo (200-watt).** W. R. W. (Dowlais) writes: I am thinking of building a small dynamo, as enclosed drawing. Would you kindly tell me what size wire to use for the field coils and armature? I have some No. 22 D.S.C., could I use that? Would you recommend me to make any alterations in the design? I should like to compound the machine. What will be the probable output, and what speed would it have to run at? (I expect about 150 to 200 watts).



Query No. 6006. 200-WATT DYNAMO.

Your best plan will be to adopt a plain drum armature, turned exactly ½ in. less in diameter than the bore of the field-magnets. This armature should be wound with two layers of the No. 22 wire in 12 sections, requiring about 9 yards per section, or a total of 14 ozs. The field-magnets should be wound with 3¾ lbs. No. 24, connected in shunt. The output, at 2,400 revs. per minute, should be 3 to 4 ampères at 55 volts, or about the amount you specify. The field-magnets are not nicely proportioned, but are not wrong enough to make the machine really inefficient. As to compounding, you might try the effect of a layer of No. 14 wire on both cores, connected in series, but we do not think you will find this any considerable advantage.

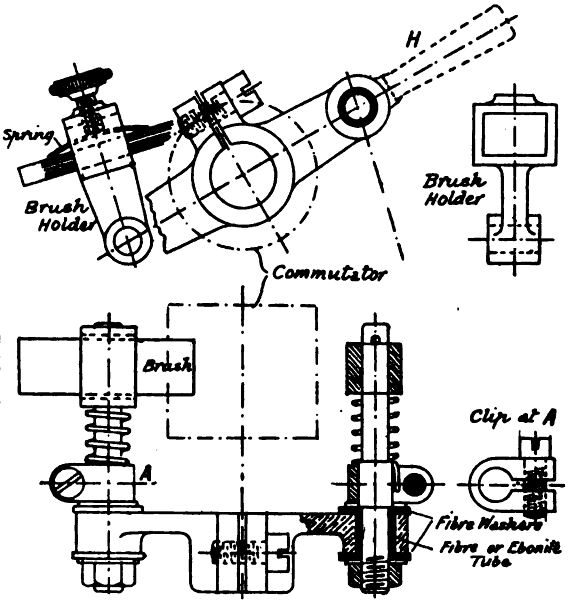
[6013] **Improving a Small Dynamo.** W. B. (Twickenham) writes: I have a small Crypto undertype dynamo, with an H armature, which I wish to convert into a charging dynamo. The armature is 1¾ ins. diameter, 2¾ ins. long. Field-magnet cores are 1 in. thick, 2 ins. wide, and the winding space is 2⅛ ins. high. The yoke is 1⅛ ins., and pole-pieces 1 in. thick. (1) The dynamo, at present, is wound with 1 lb. of No. 22 D.C.C. wire on each limb, and armature is wound with 4 ozs. No. 20 D.C.C. wire, and gives an output of 5 amps. at 10 volts. What would be most suitable armature and size of wire for same, with present windings on the fields? (2) What quantity of wire would be required? (3) What would be output when completed?

This dynamo can very well be changed into an efficient charging dynamo to give the same output as at present. (1) The armature should be made up of slotted laminations, 1¾ ins. diameter, with slots ¼ in. × ¼ in., and should be wound with No. 21 wire. (2) The quantity of wire required will be about 3½ ozs. It should be wound in either 4 or 8 sections, in the first case making 20 turns, and in the second 10 turns per section. (3) As above stated, the output would be the same as at present, namely, 5 ampères at 10 volts.

[6079] **Electro Magnet to Lift 140 lbs.** C. W. H (Hull) writes: I intend making an electro magnet to sustain a weight of 10 stone, and shall be glad if you will state—(1) Dimensions of cores and yoke; (2) Size and amount of wires; (3) Is it necessary to put paper between the layers of wire? The power I have is an 8-cell bichromate battery.

Without knowing *exactly* the quality of iron to be used for field-magnet and armature, it is impossible to give accurate details as required. The following is, therefore, an approximation only. Make the magnet of good soft wrought-iron bar (round), 1 in. diameter, bent to a horse-shoe form, and having 1½ ins. between the poles. The straight part of poles should be 2¾ ins. long. The armature should nowhere be less than 1 sq. in. in cross-section, and the poles must be finished off quite flat and level. Wind the limbs with 1 lb. of No. 26 if all the cells are to be used in series, or with 1 lb. of No. 20 if the cells are large and two or three only need be employed. In either case, there should be a surplus of power, and if anything exact is required, experiment alone will decide the right winding. There is no need to put layers of paper between the several layers of wire, but the coils should be soaked in shellac or sealing-wax varnish.

[6001A] **Brush Rocker for Dynamo.** A. Y. (London, S.W.) writes: I am building a model dynamo on the lines of that illustrated on page 92 of the February 15th issue, making my armature (which is a slotted drum, 6 slots) 1¼ ins. diameter and 2⅛ ins. long. I am winding it with 24 yards (3 ozs.) No. 22 D.C.C. wire in six sections, and the field-magnet with 14 ozs. of the same wire. I have calculated these proportions as carefully as possible, but should be glad if you will verify them, and state what you consider a maximum safe output. I have calculated on a basis of 10 volts, which is the amount I require. As I wish to make the machine as perfect in appearance as possible, that is, to represent a big machine accurately, I would be glad if you will give me a drawing of a practical brushholder rocker for it.



Query No. 6001a.

BRUSH ROCKER FOR MODEL DYNAMO.

Your calculations are very near the mark, and you would find the dynamo would work well, provided the amount of wire you specify could be got on the field-magnet. On this point we are doubtful, and think you would be well advised in making the winding space on cores a little longer than strict proportion would suggest. There would be an advantage in getting on 16 ozs. of No. 22 wire instead of 14 ozs.—it would provide a better field with less current, and as your machine is as nearly as possible two and a-half times the size of the drawing from which you are working, we should make the winding space, say, 2¼ ins. high, which is about ⅜ in. more than "scale," and would accommodate the extra amount. A drawing of a suitable brush-rocker and holders is here given, full size, for your machine. This drawing shows a simplified form of a rocker in common use on big dynamos, and is sufficiently clear to demand little explanation. The brushes are pressed on the commutator by means of the spiral springs, the tension of which is adjusted by the clamping arrangement A. Of course, the brush-holders are carefully insulated from the rocker. A handle, H, makes a neat (and useful) finish. It should be cast in one piece with the rocker, and should be turned and polished.

[6086] **Boiler Queries.** A. H. S. (Jersey) writes: I have a plain cylindrical boiler, 12 ins. by 15 ins. It has cast brass ends with a turned flange to fit ends of boiler tube. These ends are secured by a ⅜ in. iron stay passing right through centre of boiler, and are soldered all around the flange to make them steam-tight, as per sketch (not reproduced). The shell of the boiler is 1-16th in. thick and has a brazed joint; the ends are ⅛ in. thick. I wish to alter it as advised in Query No. 5690, and would like to know—(1)

How are the up and water tubes to be fastened together and into boiler, as brazing is beyond me? (2) What size water tubes, and whether brazed or drawn? (3) What pressure would it be safe to work at; would 50 lbs. be too much? (4) Will a safety valve with an orifice ¼ in. diam. be large enough to relieve boiler in case of over-pressure? (5) Will the boiler be large enough to keep an engine with a cylinder 1 in. by 2 ins. bore at about 300 revolutions per minute, and what power would it develop? I wish to work a 3½-in. centre lathe from it. (6) When a glass water gauge is in use, and the tap handles straight up and down, which taps are open and which are closed? I should think that the steam and water taps should be open and the waste closed. Will you please tell me if I am right or not? Will ordinary glass tube (as bought at the chemist's) do?

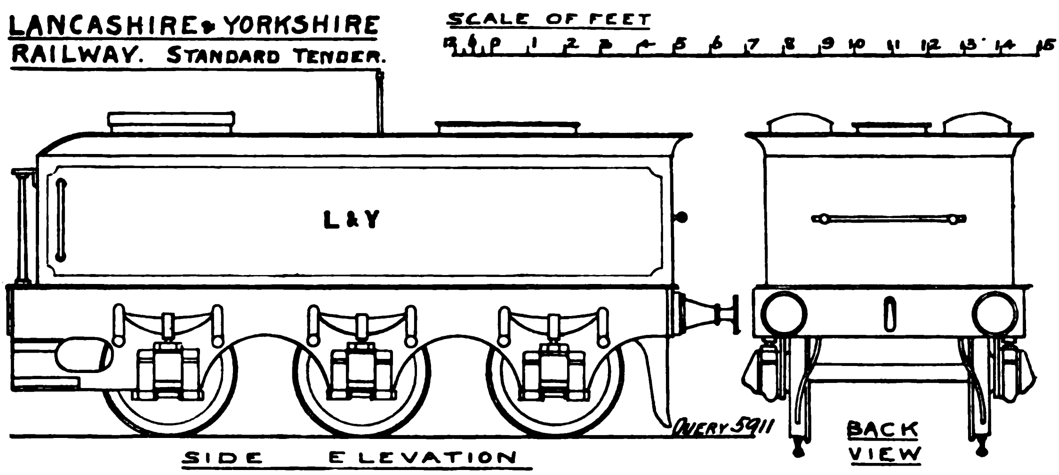
(1) The down tubes should be screwed in and soldered. If possible, a fine taper thread should be chased upon them. The water tubes may be screwed into the down tubes and soldered into the boiler. (2) Use the same size of down and water tubes. Of course, solid drawn are the best, but brazed may be used. (3) We would rather not say, as the construction of the boiler is not the best. We do not think the boiler would actually burst at the pressure named, or even at one much above that; but it is quite within the range of possibility that at a high pressure the joint of the shell and ends would open. The iron stay will in time rust. Such stays should not be used as the main source of strength, but only as a safeguard and to prevent flat parts bulging. (4) Yes. (5) Yes, but the power (about 1-16th h.-p.) will not be sufficient to work the lathe. (6) In real practice all handles are down when the gauge is in working position, the waste being closed and the rest of passage open. In

then, as the temperature rises, seems to thicken again. A still greater rising temperature results in the material becoming liquid again, and it is then ready to pour. (6) The proportion we do not believe to be very important. You may take it that the proportions given in our instructions in "Electric Batteries" on this point are sufficiently correct.

[5911] **Tender, L. & Y.R. Locomotive.** A. J. B. (Stalybridge) writes: Could you forward me a diagram of the tenders used on the L. & Y.R. locomotives? My locomotives are constructed out of sheet tin to a scale of ¼ in. to a foot, and go by clockwork.

We give below a scale outline of the required tender. The wheels, which are 3 ft. 7½ ins. diam., have 10 spokes. The total wheel-base is 10 ft. 6 ins.; overhang of frame at leading end, 4 ft. 3 ins.; at trailing end, 3 ft. 1 in.; width over tanks, 6 ft. 9 ins.; width of foot-plate, 7 ft. 6 ins.; and distance between frames, 5 ft. 9 ins.

[6060] **Accumulators.** C. T. (Ardingly) writes: (1) I am making some accumulators, the plates are seven in each cell, size 8½ × 6 × 3-16ths ins., and will be pasted with red lead and litharge. What would the right specific gravity be for the acid when first to be put in cells when going to form plates? (2) What should the specific gravity be when cells are fully charged? (3) What B.W.G. of wire, and how much of same would be needed for resistance to cut 14 volts down to nil, to carry not more than 6 amps.? (4) And where would the resistance be inserted in the diagram of the switch board you so kindly drew for me in reply to Query 5712? (5) What is the number of ampères that a 5 c.-p. lamp of 8 volts should consume (H.E.)? (4) Would you give me an address of people that can supply low voltage lamps with c.-p., as I find that where some people supply such lamps they do not supply them with



model work generally, where the blow-off tap is a separate fitting, it works the other way about. No, you must get proper glass tube, which can be obtained from Messrs. Bassett-Lowke & Co., Stevens's Model Dockyard, and other advertisers [illegible]

[6035] **Primary Batteries.** E. S. (Broadstairs) writes: I should feel obliged by answers to the following queries—(1) In "Electric Batteries" it is stated that to copper-plate a carbon rod or plate "one carbon must be suspended," &c., and that the time varies from "three to eight hours." I want to do several small carbons, 4 × ⅜. How can I copper-plate, say, six or eight at one time? (2) Suppose a terminal is screwed into top of carbon (dry cell) and seal thoroughly effective, does the creeping take place in the interior of the plate, or how can the salt destroy contact if the seal is perfect? (3) How can I determine the correct thickness of copper deposit on carbon to effect a good solder joint? (4) Is a mixture of three parts resin and one pitch as good as sulphur for sealing dry batteries? (5) What is the best method of melting sulphur? (6) In the March 1st issue of THE MODEL ENGINEER *re* dry cells, it does not mention the necessity of 25 per cent. sal ammoniac in the carbon mixture. Do you think it is good to add that amount for small cells, 3 ins. × 1¼ ins., or is it too much; if so, what do you think a good proportion?

(1) Several small plates can be done at the same time, as long as they are placed equi-distant from the copper anode, and the other end of each carbon securely held by a metal clamp, so as to provide good contact. (2) The creeping takes place inside the carbon plate unless the top is saturated in paraffin wax. (3) It is a matter of judgment; the thickness should be equal to ordinary writing paper, or thereabouts. (4) No; but it would do very well. (5) Sulphur is best melted in a deep ladle over a gas flame, and considerable care must be used, as it readily breaks into flame. The temperature should be such as to make it perfectly liquid. You will find that as the sulphur is melted it becomes very liquid, and

candle-powers? (7) Will a hydrometer registering from 1·075 to 1·300 for measuring specific gravity of above cells, as I find that some people say that the acid ought to be one specific gravity and some another? (8) I think of making a volt and ammeter as described in page 144 in Bottone's "Guide to Electric Lighting." For a voltmeter to register 15 volts, what wire should the solenoid be wound with? (9) And should I have to have any German silver wire as a resistance as described in Bottone's "Electrical Instrument-making" for such? (10) And also what wire should I wind the solenoid with for an ammeter to register up to 6 ampères?

(1) The acid should be of specific gravity 1·185 or thereabouts. (2) When fully charged the specific gravity may be as much as 1·195. (3) This cannot be done as "nil" current implies infinite resistance. You can have resistances to reduce the current by steps down to any reasonable figure. If 6 ampères are flowing with 15 volts pressure a resistance already exists to the amount of 2⅓ ohms, which is, of course, calculated from Ohm's law $\left(E = \frac{C}{R}\right)$. You can calculate for yourself the resistance required for any particular result from this law. Suppose you require the current to be 1 ampère. Then $E = 14$, $C = 1$. Transforming the equation, $R = \frac{E}{C} = \frac{14}{1} = 14$ ohms. If the previous resistance, 2⅓ ohms, is still in the circuit, the new resistance will require to be 14 − 2⅓ = 11⅔ ohms. You then decide on the kind of wire to be used, and see which gauge will safely carry the maximum current. Usually in resistance wires a higher degree of heating is allowed than in copper wires. Having decided on the gauge, you turn to a list of resistances and note what resistance is offered by a yard of the particular wire chosen. Divide your desired resistance by the resistance of one yard and you have the *number* of yards required. (4) Insert the resistance wherever you wish the current to be cut down. (5) A 5 c.-p. lamp of high efficiency would require about 15 watts. Watts = current × volts.

Therefore, 15 = C × 8, and C = 15 ÷ 8 = 1⅞ ampères. (6) The Universal Electric Supply Company give this information in their catalogue. (7) Yes, if sensitive enough. (8 and 9) See an article on the subject in April 1st issue. (10) No. 14 copper wire.

[6095] **Model G.N.R. Locomotive.** M. B. (Hornsey) writes: I wish to build a ⅜ in. scale model of 4-coupled bogie express G.N.R. No. 400. Could you tell me—(1) Length and thickness of side frames, also sketch showing shape of same? (2) Which do you think will be best—two cylinders ⅜ in. bore by ¾ in. stroke, or one cylinder ½ in. bore by ⅞ in. stroke? (3) Would a boiler similar to that described in reply to Query 4724, December 1, 1901, do, and also height of centre line of boiler from rails?

We are afraid you will be unable to arrange two (slide-valve) cylinders between the inside frames of a ⅜ in. scale model without widening the engine unduly. To this scale the boiler barrel would be smaller than advisable. You may, however, adopt 7-16ths in. scale and 2½ in. gauge, and use inside cylinders with the valves on top. The boiler on page 251 (Dec. 1st issue) is very suitable. Two cylinders, 7-16ths in. by ⅞ in. stroke may be used, or one 9-16ths in. by ⅞ in. stroke. A sketch of this type of G.N.R. locomotive may be found in the *Locomotive Magazine* for August, 1900. The centres of bogie wheels apart, 6 ft. 3 ins.; distance from rear bogie wheel to centre of driving axle, 6 ft. 9 ins.; coupled wheel base, 8 ft. 3 ins; overhang of frames in front, 2 ft. 5 ins.; at rear, 3 ft. 11 ins.: total length between buffer planks, 27 ft. 7 ins. Boiler diameter, outside lagging plate, about 4 ft. 9 ins. Centre of barrel from rail, 7 ft. 5½ ins. For your model the above figures will require modification. The driving wheels, which are 6 ft. 6 ins. in the real, may be 2¾ ins. diameter, and the distance apart of the coupled wheels may, with advantage, be extended to 3¾ ins. Centre line of boiler from rail, 3 7-16ths ins.

THE first completely equipped motor fishing boat has recently made her trial trip most satisfactorily at Lowestoft. This is the first fishing craft which will rely upon petrol to generate the force required for all purposes—hauling her nets, hoisting sails, working the capstan, and driving her pumps. The motor is of 24 h.-p., and is fitted in a case 4 ft. by 2½ ft. It is only 3 ft. high, and the top cover serves for a table. The motor is of the three cylinder, two-cycle type, and self-starting and reversing.—*Engineer.*

Model Yacht Clubs.

Sheerness Conservative Model Yacht Club.

ALTHOUGH the above club was only formed in the latter part of last year, too late to gain a large number of adherents for that season, it has had a fair measure of success, and strong efforts are being made to make the present season a very successful one, and it was with that end in view that a Model Yacht and Nautical Curios Exhibition was recently held in the Conservative Club.

The exhibition was opened by Capt. G. C. Langley, R.N., Captain-Superintendent of Sheerness Dockyard, who arrived shortly prior to half-past seven, being received by Mr. S. Chittick (President of the Yacht Club), and Mr. A Seymour Baskett (Secretary of the Conservative Club), and Mr. G. Searle (Secretary of the Yacht Club).

The following are the officers of the club:—Messrs. S. Chittick (president), G. Searle (hon. secretary), J. Parrett (hon. treasurer), G. House, R.N. (commodore), Jordan (captain), G. Searle, senr., Palmer, Bostridge, and G. Milner (committee).

Bristol Model Yacht Club.

AT the annual general meeting of this club, held recently under the presidency of Mr. F. Leader, it was stated that the year 1901 had been very successful, although there had not been quite so many boats competing in some of the races. The making of the pathway round the lake interfered with a couple of the events in July, which were, however, sailed off later in the season. Mr. H. S. Warren has been very successful, winning six events, including the three challenge cups; he also won the aggregate prize (presented by Mr. Averay Jones, commodore) for having scored the greatest number of points during the season. The sailing of some of the events produced very keen competition, and some of the closest racing the club has ever had. With the addition of eight new members, the majority of whom are going to compete, it was hoped to make better progress in the future. The first race of the season was held on Saturday, March 22nd, and there will be sailings twice a month during the summer, the last fixture being dated October 11th. The boats are divided into classes, as follows:

24 ins. L.W.L. Class boats from 22 to 26 ins. L.W.L., draft not to exceed 9 ins.

30 ins. L.W.L. Class boats from 28 to 32 ins. L.W.L., draft not to exceed 10 ins.

36 ins. L.W.L. Class boats from 34 to 38 ins. L.W.L., draft not to exceed 11 ins.

42 ins. L.W.L. Class boats from 40 to 44 ins. L.W.L., draft not to exceed 12 ins.

The sail area to be carried is as follows:—Multiply L.W.L. Class by 2, deduct actual L.W.L., square the remainder and add 10 per cent., which gives sail area in square inches. Spinnakers and flying jibs are not included in sail area; but flying jib must not lap head sails.

The sailing station is at lake at St. George's Park, and the Hon. Secretary is Mr. J. W. Millier, 50, Heath Street, Eastville, Bristol.

The Institution of Junior Engineers.

ON the 15th March, this Institution held its annual conversazione at the Westminster Palace Hotel, the guests being received by the President, Sir John Jackson, and Lady Jackson, and by the Chairman, Mr. Percival Marshall, and Mrs. Marshall. There was a crowded attendance, and all the arrangements were carried through in a very successful manner. Prominent in the exhibition of models &c., were some fine examples of the work of members of the Society of Model Engineers; a steam and an electric track were erected and model locomotives run upon them. Amongst other features of interest were the Stroh violin—shown by its inventor, Mr. Charles Stroh—and the Pianotist; and in the lantern room a lecturette, entitled "Engineering in Miniature," was given by the Chairman. Band selections were rendered in the large hall; in the music room there were short concerts by the Occasional Pierrots, and a number of electrophone instruments were installed for the use of the guests. Sir Charles Hartley, Mr. J. T. Wood, Messrs. Thornycroft, Messrs. Yarrow, the Great Eastern Railway Co., Mr. G. Cussons, Mr. J. B. Thorp, the Power Gas Corporation, Messrs. David Joy & Son, the Parsons Marine Turbine Co., Messrs. Lobnitz & Co., Professor Dalby, the Empire Roller Bearing Co., and the Hulburd Engineering Co., were amongst those who contributed to the exhibition of models, &c.

A visit was paid by the members on the 22nd March to the Victoria and Albert Museum, South Kensington, to inspect the collection of Naval, Mechanical and Scientific Models, &c. Mr. W. J. Last kindly conducted the party round, and pointed out the features of special interest. To some old Maudslay's men the sight of the beautiful models which used to be on view in the board room at Lambeth proved particularly attractive, and gratification was expressed that they were thus preserved as a complete collection. Mr. Last showed the members the workshop for the making and repair of models and plant for compressed air by means of which, at a pressure of 5 lbs. to the square inch, some of the models are actuated.

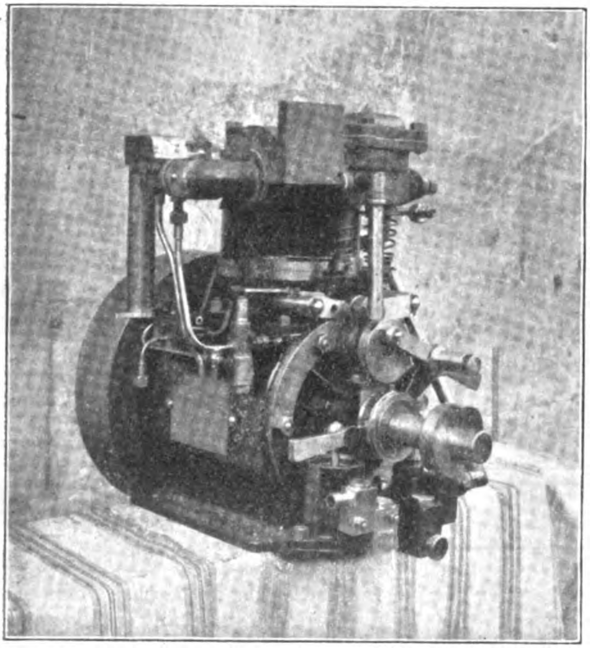
For the courtesy extended the Institution, cordial acknowledgments were conveyed by the Chairman at the conclusion of the visit.

Amateurs' 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.*]

An Oil Engine for Launch Work.

The photograph here reproduced gives a very good idea of the appearance of an oil engine, castings for which are being supplied by Messrs Goodman & Co., East Hayes, Bath. This motor is designed to work with ordinary petroleum, and is safe and economical. It can be used for stationary work, such as pumping, grinding, chaff-cutting, electric lighting, ventilating, or for any ordinary purpose of power. The engine can also be had as a gas engine and is, of course, simpler in that case. As an oil motor,



fitted in a launch, we have no doubt it will prove a very handy machine, a fact which is attested by some most favourable testimonials in the possession of the makers. We strongly recommend those who would like to make up a set of oil engine castings to communicate with Messrs. Goodman, and the same if it is a finished engine that is required. THE MODEL ENGINEER should BE MENTIONED IN THIS CONNECTION.

Important Change of Address.

Will all those readers interested please note that Messrs. Spon and Chamberlain, the American agents for THE MODEL ENGINEER, after fifteen years in Cortlandt Street, have moved into more convenient offices in the Liberty Buildings, 123, Liberty Street, New York, where they will be pleased to see old friends.

Engineering Correspondence Classes.

There must be many amongst the young electrical and mechanical engineers and others who read this journal who feel the need of some assistance in their work. Possibly they wish to pass certain examinations, or they may desire to know more of the theory of the practical work in which they are employed. In most cases they hope to rise in their professions whilst seeing no very easy way of accomplishing that object. To all such a system of correspondence classes, such as that carried out by Professor Andrew Jamieson, should come as a boon. This system—now a well-tried and highly successful one—appeals especially to those who live far from centres where classes are held, or who cannot go regularly to them, and has also the advantage that progress depends on the energy of the pupil himself We need hardly remind readers of Professor Jamieson's fitness for the conduct of such classes, but are content to draw attention to his prospectus of electrical and mechanical engineering science taught by correspondence, exercises, drawings, and instructions, which can be had on application to him at 16, Rosslyn Terrace, Kelvinside, Glasgow, N.B. A charge of sixpence is made for this prospectus, which will be sent post free for that amount.

A New Agency for "Vic" Injectors.

Mr. W. Eaton, whose "Vic" model and small power injectors have earned so good a reputation, informs us that the very great increase in business has necessitated his granting a license to Messrs. W. Lawson & Co., brass founders, Newton-le-Willows, to undertake the whole of the manufacture and supply of the apparatus. This firm will make a special feature of prompt delivery, and will manufacture the "Vic" injectors correctly to Mr. Eaton's designs, patterns, and templates, so that they can be fully relied upon as heretofore. Mr. Eaton will confine his attention to the designing and improving of small injectors, so that all correspondence relating to them should in future be directed to Messrs. W. Lawson & Co., as above.

Catalogues Received.

The Britannia Electrical Works Company, 43, St. Martin's Lane, Charing Cross, London, W.C.—We have received from this firm their trade price list of English-made accumulators and ignition coils. The former comprise pocket cells of various sizes and qualities, and accumulators for lighting, motors, testing and for motor ignition purposes. All these are in considerable variety, and several types of ignition coils for motor work are also listed. Accessories and lamps for use with accumulators are quoted, and we are informed that any reader mentioning THE MODEL ENGINEER will be supplied with a copy of this list free on application.

W. Bravery, "Woodlands," Upper Grosvenor Road, Tunbridge Wells, Kent.—A price list of powerful bicycle motors, finished, or in separate castings, is to hand from this firm. Each part is priced separately in the first place, and the cost of a complete set, or of a finished motor, is then given. Working drawings are supplied, and prices are quoted for bicycles and tandems fitted with 2 h.-p. motors. All the work sent out by the firm appears to be fully guaranteed, and readers who are interested should certainly apply for a price list, not forgetting to mention THE MODEL ENGINEER when so doing.

W. P. Bond, 245, Euston Road, London, N.W.—Mr. Bond issues a very handy list of electrical apparatus, for which he makes a charge of a penny. As this catalogue includes many useful notes and instructions for the proper use of the various items enumerated, it can only be regarded as exceptionally good value to any electrical amateur. Practically all the ordinary requirements of such readers are met, the contents ranging from accumulators, right through the alphabet to zinc battery plates. The list is particularly well-arranged, and is provided with an excellent index. Readers will do well to procure it, not forgetting to mention this journal 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.

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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.

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Models Made Without a Lathe.

I.—An Electro Motor and How to Make It.*

By G. L. GRIFFITHS.

THIS motor has been specially designed to obviate the use of a lathe or castings. It is of simple construction, and but few and inexpensive tools are necessary to make a good model, if only the following description and diagrams are faithfully carried out.

Articles required :—

12 ft. of strip iron, ¾ in. wide.
2 Nettlefold's stove screws with countersunk heads and nuts, 3-16ths in. diameter, ¾ in. long, 24 threads to inch.
2 ditto ditto, but 1½ ins. long.
1 piece of silver steel, 9 32nds in. diameter.
A piece of brass tube, 6 ins. long, 9-32nds in. inside.
" " ¾ in. long, 1 in. diameter outside.
1 ft. of brass, ¾ in. wide, ⅛ in. thick.

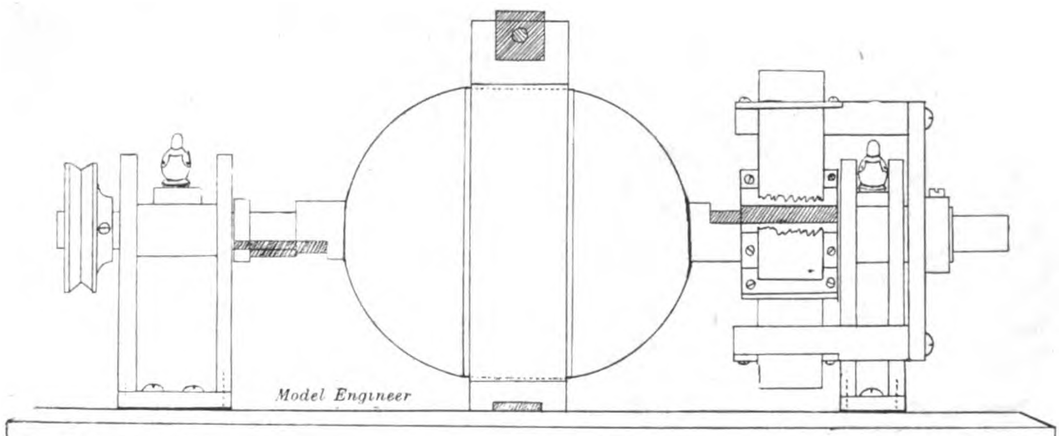


FIG. 1.—AN ELECTRO MOTOR BUILT WITHOUT A LATHE. (Side View.)

Tools used.—Only the following tools were used, but, of course, with more tools at our command, an easier, I do not say a better, job can be made of it. One screwdriver, one three-cornered file, one half-round file, one fretsaw frame, and a few fretsaws, one brace, and two Morse drills, two or three clamps, one vice (for only the first part of the job), one hammer, one soldering iron, and a steel rule.

The clamps had to take the place of the vice, and the files to enlarge the holes the drills were too small for.

A piece of round wood, 2¼ ins. diameter, 6 ins. long.
" " about 15-16ths in. diameter, ¾ in. long.
3 doz. laminations, 2¼ ins. diameter, with 8 slots.
About 1¼ lbs. No. 24 D.C.C. copper wire.
Two pennyworth of shellac varnish.
A few odd pieces of brass and a few screws.

Start by making the *field-magnet*. For this procure about 12 ft. of strip iron, such as is used for packing-case binding, ¾ in. wide. It is proposed to wind this into a coil with a centre of 2 5-16ths ins. To do this a piece of circular wood, about 6 ins. long 2¼ ins. diameter, is required. Cut this, as shown in Fig. 2; then by means of

* This article gained the first prize in our recent Competition, No. 20.

two or three thick screws fasten it to a piece of 1 in. board, which can be clamped to a table or bench, leaving about 3 ins. of the circular part projecting over the edge of the table. Next, with a saw, make a cut *a* (Fig. 2), about ½ in. deep.

Everything is now ready for winding, but before doing so, beat the iron well with a hammer on both sides (using a flat iron in default of an anvil), both to erase any inequalities and to free the iron from "scales." Take end of iron, and bend over a good ½ in. at right angles ┌. By inserting this short end in the slot, and hammering well home, a good start can be made. If great care is taken with the first two or three turns (not that great care should not be taken with all parts), hammering well as we proceed, a good inner circle can be obtained.

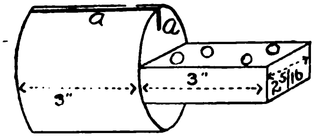


FIG 2.—FORMS FOR FIELD-MAGNET.

Continue winding and hammering until the coil is just over ½ in. thick; then hold end of iron by screwing up in a vice fixed to the table. Next, four holes must be drilled full 3-16ths in. diameter, as shown in Fig. 3, holding the nuts and screws. Drill right through into the wood, and hammer in four French nails; then spare iron can be cut off. Unscrew the circular block of wood from the piece which is clamped to the table, and put iron and wood into a small but bright fire overnight. The wood will be burnt out, and next morning the iron

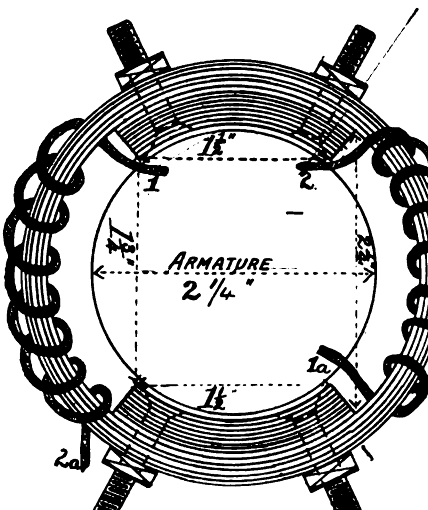


FIG. 3.—FIELD-MAGNET.

can be removed, when it will be nice and soft. The four screws can now be temporarily put in, and nuts screwed up tight. Take out one nail only, and get screw in and fastened before touching another nail.

The process of cutting out the pieces to make room for the wire comes next. A No. 8 German saw, procurable at "Hobbies," Aldersgate Street, London, fitted in a small fretsaw frame, will do this to perfection. This being done, un crew the two nuts on one side, take out the screws, remove two of the pieces of iron that form the pole-pieces, and countersink the holes, then replace iron and screws. After screwing nuts up firmly, file the face of the one pole nice and smooth. Countersink the holes in the other side, but do not file up the face of that pole-piece. File the rest of the iron nice and smooth. Cover places where the wire is to be put on with silk ribbon or thin tape, put on with shellac varnish.

The winding of the wire must be done later on; the object of this will be seen presently.

The Armature.—For this a piece of silver steel 9 32nds in. diameter is required. This is sold in 13-in. lengths of two "fittings." Buy the loose fit, and cut off 9 ins., but length is left to the maker's discretion for

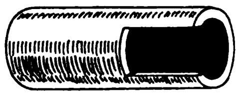


FIG. 4.—BRASS TUBE FOR ARMATURE.

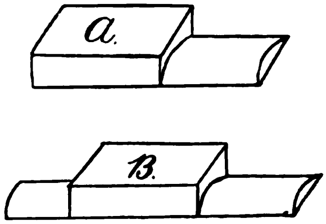


FIG. 5.—KEYS FOR ARMATURE.

whatever purpose motor is required. In case the length is altered, other dimensions will have to be altered to correspond. Three dozen laminations, 2¼ ins. diameter, with eight slots, are also needed. The central hole will be about 11-32nds in. diameter, so a piece of brass tube which will be a tight fit in this, will be found to be a loose fit over the steel rod. This tube is to be 3½ ins. long. A slot ¼ in. deep, 3 16ths in. wide, will have to be fiied in one side of this (Fig. 4). Do this at both ends, but at opposite sides. Force all the laminations on to the centre of the brass tube, all the slots being in perfect

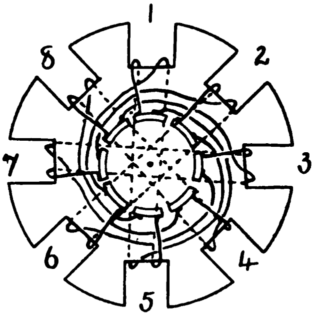


FIG. 6.—DIAGRAM OF ARMATURE WINDING.

truth next to one another, and the slots in brass tube in line with these. Then fix, by soldering, three turns of brass or copper wire (stout) on to the tube close to the laminations; then clamp the latter up in a vice, or, as I did (having at this point broken my vice) with two clamps to a small fret-cutting table; the tube can go through the hole in the table end, with the wire on downwards, and the stampings be clamped rigidly to it. If three more turns of wire be made a tight fit to the tube, and slid down the same on to the stampings and there roughly soldered, the whole can then be released and finished off with a file, leaving no sharp edges to cut the wire to be put on. Next cover the sides and tunnels of stampings with silk, put on with shellac varnish. When dry, start winding with No. 24 D.C.C. copper wire in the manner indicated in diagram, and fully described in No. 20, Vol. ii, of THE MODEL ENGINEER. My experience is that to wind right across the slot and half fill it is the easier method. Take great care to wind the wire tightly and evenly, and it will be found that each coil will consist of five layers of eleven turns, so that there will be 110 strands in each slot.

A hint as to the method of winding. Anyone unused to this, will find it will pay them, in the end, to wind slowly. Wear an old glove (thick) on the right hand. Let the wire run under the thumb with a strain always upon the forefinger, so as to bend the wire somewhat convex towards the part of the iron being wound upon. Thus the wire lies flat and tight, which is absolutely necessary to get the wire on evenly. The convexity causes the centre part of the wire to lie down snug. Whereas concavity of the wire towards the iron makes the middle of each turn rise up from the magnet, the only snug fits being where it bends round the edges. In doing mine, I tested each layer for leakage, but found none through the whole job. If the wire is of good quality, and the watchword "care" be borne in mind, no mishap of this kind will occur.

To test for leakage, bare the wire at the end of the coil of its covering and join to one terminal of a good cell, or battery of several cells for preference; join the other terminal to one terminal of a galvanometer by means of a

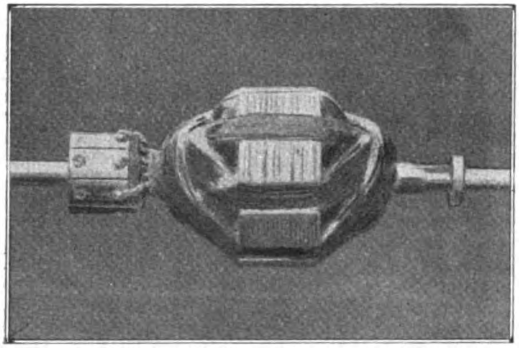


FIG. 7.—THE ARMATURE COMPLETE.

short length of wire. To the other terminal of galvanometer join another piece of wire. If, on touching the brass tube or a cleaned part of the laminations with the other end of this wire, a deflection is noticed on the galvanometer, unwind the coil until deflection is removed; then examine the wire at that point and improve the insulation by winding a *small* piece of thin silk round it, covered with a *little* shellac varnish. Recommence winding when varnish is nearly dry, and if no deflection, then proceed.

To be able to identify the beginning and ending of the different coils cut out sixteen pieces of thin metal of some sort, about ½ in. by ¼ in.; drill a hole in one end of each, and mark them off in pairs, 1 In, 1 Out, or 1B(eginning), 1E(nding), 2B, 2E, and so on up to 8, and fasten these on to the respective ends of the coils as you proceed to wind, else a hopeless muddle will result. Now for keying the brass tube on to the steel spindle. At 1¼ ins. from one end file the steel flat for the distance of 1 in.; then at 3 ins. from the other end, but on the opposite side of the shaft, file it flat for a distance of ¾ in., both places 1-16th in. deep.

For the keys file up a piece of brass 2 ins. by ⅛ in. by 3-16ths in. Cut off a piece long enough to *exactly* fit the longer slot, and file a half-round shoulder at one end ½ in. long (Fig. 5, A) which will just go under the brass tube. For the short key cut off a piece to exactly fit the other keyway, but put two half-round shoulders on this (Fig. 5, B)—one ¼ in. long, the other ⅛ in. The ¼-in. shoulder is to be a snug fit under the tube, as before; the other to be flush with the face of shaft. Now cut out a circular washer, ⅛ in. thick by ½ in. diameter with a 5-16ths in. hole. I cut this out of a piece of brass and filed it up circular and to size. This will fit over this shoulder and keep the key from jumping.

Commutators.—A piece of brass tubing ¾ in. long 1 in. diameter is filed up nice and true at the ends. This is put on a piece of round wood. The barrel of a cotton reel that is a snug fit will do well; but a harder wood is preferable, such as a piece off a cheap round ruler. Such an one can be bought for twopence. If you have a piece of wood large enough, plane it up square, then eight-sided, then circular, finishing off with a file and glasspaper. This is not as difficult as it appears. The writer has made a 12-ft. fishing-rod this way, and found no difficulty in getting the wood out to the required size. Drill or burn a hole through the centre large enough for the shaft to go through but be a tight fit; then with a file cut the hole, as shown in Fig. 8.

Now mark off the brass into eight equal parts. I did this by drawing a 1-in. circle on paper, and equally dividing it into eight parts; then placing the paper on one end of the commutator, and notching the edge of the brass with a file where the marks came, making sure to get the

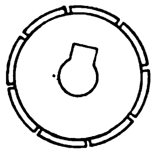


FIG. 8.—COMMUTATOR.

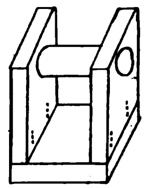


FIG. 9.—BEARINGS.

square part of the central hole exactly in the centre of one of the portions. With a square scratch lines across the face of the brass from where the notches are.

Two holes are now to be drilled in each section, one on either side near the edge—one countersunk for a counter-headed screw, the other for a round-headed one, under which the ends of the wires will come when finishing up. As I had no vice, and it was obvious I could not hold the commutator in my hand and drill at the same time, I had to devise some other method; so I clamped the drill-stock firmly to the table. At the end of the drill, and just under it, I placed a piece of wood thick enough, when the commutator was on it, to bring the point of the drill level with the spot to be drilled; then I turned the handle of the drill with the left hand and fed the work with the right. By this means another difficulty was overcome, and the holes were truly in a line round each edge.

None of these screws must be so long as to come through into the centre hole or to touch those of any other section. Having put in the sixteen screws, cut where the marks were made with a fretsaw (No. 8, as before, will do) right through the brass and a little way into the wood. When the eight pieces are cut through run some fine instrument through the slots to clear out any stray pieces of brass, and fill in the slots with thin strips of mica, ebonite, or some hard wood covered with glue or shellac varnish.

Test now to see if any one segment is electrically connected with another. If not, push on to the shaft the square part of the hole going over the long key, the end with round-headed screws next to the wire. The whole should be a tight fit; no rocking to one side or the other must occur. Again test to see that no screws are touching the shaft, thus joining two segments.

Commence to join up by taking the two ends, 8E and 1B, cutting down to length required, uncovering the ends, scraping clean, twisting them together, and joining to the segment opposite the slot where coil 1 began. Working to the right, 1E and 2B comes next; treat them in the same way and join to the next segment, and so on.

After brightening all the brass parts up, and giving the wire several coats of shellac varnish, letting each dry before another is put on, the armature is finished.

(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 fortnight before its actual date of publication.]*

London.

MODEL MAKING COMPETITION, 1902.

AS announced at the January meeting of the Society, a model making competition, open to all members of the Society, will be held on Thursday, 22nd of May, at the Holborn Town Hall. The models are to be judged during the day, and the exhibition will be open to members and friends at 7 p.m.

The competing models must be despatched in *proper packing cases*, and addressed to—

The Hon. Secretary,
Society of Model Engineers,
Holborn Town Hall,
Gray's Inn Road, London W.C.,

so that they arrive by the morning of the 22nd. The carriage should be paid in both directions; and the case should bear the name of the competitor, and contain an addressed label for the return of the model. London members who will personally deliver and take away their models, will please note that they must be removed from the Hall by 12 o'clock on the 23rd—the day after the exhibition.—HENRY GREENLY, Hon. Sec., 4, Bond Street, W.C.

Provincial Branches.

Edinburgh.—The usual fortnightly meeting of this branch was held at No. 13, Charlotte Street, on Thursday, 10th April. Mr. Curle presided over a record attendance of members. After the minutes of the previous meeting had been read and approved and three new members had been admitted, Mr. J. M. Heron exhibited a model steamer, constructed by himself, of which the following are the leading dimensions: maximum beam at water line, 9 ins.; maximum length, 4 ft. 10½ ins.; length at water line, 4 ft. 6 ins.; draught aft, 6¼ ins.; forward, 5 ins.; propeller (two blades), 4½ ins. diameter. The engines are compound condensing, arranged tandem fashion, being 11-16ths in. and 1¼ ins., by 1 in. stroke. The boiler is of the water-tube type of the "Clyde" pattern, 12 ins. long, 6½ ins. high; it is fired by two "Primus" burners, and its 350 inches of heating surface supply sufficient steam to drive the engines at an approximate speed of 1,500 revolutions, the speed of the boat being between four and five miles per hour. The engines were shown running and worked exceedingly smoothly at a very high speed.

Mr. Heron then proceeded to describe the construction of the engines of this model. In the first place, he claimed for model marine work as compared with model locomotive construction, this manifest advantage, that, while in the construction of model locomotives finality is practically reached, so far at least as one particular model is concerned, with the completion of its construction according to the plans of the builder, in the case of marine work the only limit to further improvement and addition is that fixed by the dimensions of the hull and the ingenuity of its designer.

Mr. Heron then described the developments in the machinery of his model during the five years that he had been at work upon it. He described in turn the compounding of the engines, the addition of condenser, feed-water heater, superheater, etc., and showed an exceedingly ingenious device for keeping constant the height of the water in the boiler.

A most interesting evening was brought to a close with a very hearty vote of thanks to Mr. Heron.—W. B. KIRKWOOD, Hon. Sec., 5, N. Charlotte Street, Edinburgh.

Gateshead.—A few letters have been received from likely members in this district, and a branch of the Society will accordingly be formed. Will any other interested readers send word to the Acting Secretary, who will call a meeting to discuss preliminary matters?—R. BAMFORD, 7, Noble Terrace, Gateshead-on-Tyne.

Leeds.—On Tuesday evening, April 8th, the members of the Leeds branch paid a visit to the works of the Kirkstall Forge Company, by the kind permission of H. M. Butler, Esq., one of the partners of the firm. Through the courtesy and kindness of Mr. Bannister, who took us round, everything was fully explained, commencing with the puddling process, where steam-driven puddlers were used. The manufacture of iron bars, rods, etc., from the pig to the finished article, was watched with the keenest interest. One part of the works differed much from another, as here one saw an undershot waterwheel, a hundred years old, working a hammer, whilst near by could be seen a modern marine-type of engine, 700 horse-power, not only working rolling mills, but also driving an alternator, which, in its turn, supplied not only arc and incandescent lamps, but also the current for a 50-horse under-driven shears cutting 6 ins. square iron cold, and six strokes to the minute. The contrast between the old and the new was very great. There was a large number of members present, and they all expressed themselves pleased with their visit, and acknowledged their indebtedness to Mr. Bannister.—W. H. BROUGHTON, Hon. Secretary, 262, Carlton Terrace, York Road, Leeds.

Stroud.—On Friday, March 7th, a meeting of the Stroud branch took place at the School of Art, when an interesting lecture was given by Mr. Crowe assisted by Mr. Newsome, on Coal and Mining Machinery. At the conclusion a hearty vote of thanks was given Mr. Crowe and Mr. Newsome, the meeting terminating at 9.30. On the evening of Friday, April 11th, the usual monthly meeting of the Society took place at the School of Art. Mr. C. Gripper showed a small force pump worked by eccentric, which satisfactorily pumped water. Mr. E. A. Drew was then called upon to read a paper on Model Locomotive Design, which had been kindly lent by Mr. Greenly. It was well illustrated by lantern slides, and was highly appreciated by the members. At the conclusion, Mr. Gripper proposed a vote of thanks to Mr. Greenly for the use of his paper, and to Mr. Drew for reading it. Mr. Hatton seconded and a hearty vote was accordingly given.—T. NEWSOME, Hon. Sec., School of Art, Stroud.

WILL the Secretary of the Norwich Branch of the Society of Model Engineers forward his name and address to the Editor?

A New Design of Model Tank Locomotive.

¾ in. Scale and Standard Gauge.

WE are, in this issue, able to give a full description of one of the first—if not the first—¾-in. scale model locomotives which has run upon the Society of Model Engineers' track to the standard gauge of 3½ ins. The engine was constructed for Mr. William Eastabrook, the Vice-President of the Cardiff Branch of the Society of Model Engineers, to the design and specification of Mr. Henry Greenly. The model is an adaptation of the 2½-in gauge model locomotive in The Model Engineer for December, 1900, and was designed in February, 1901, and completed at the end of the same year.

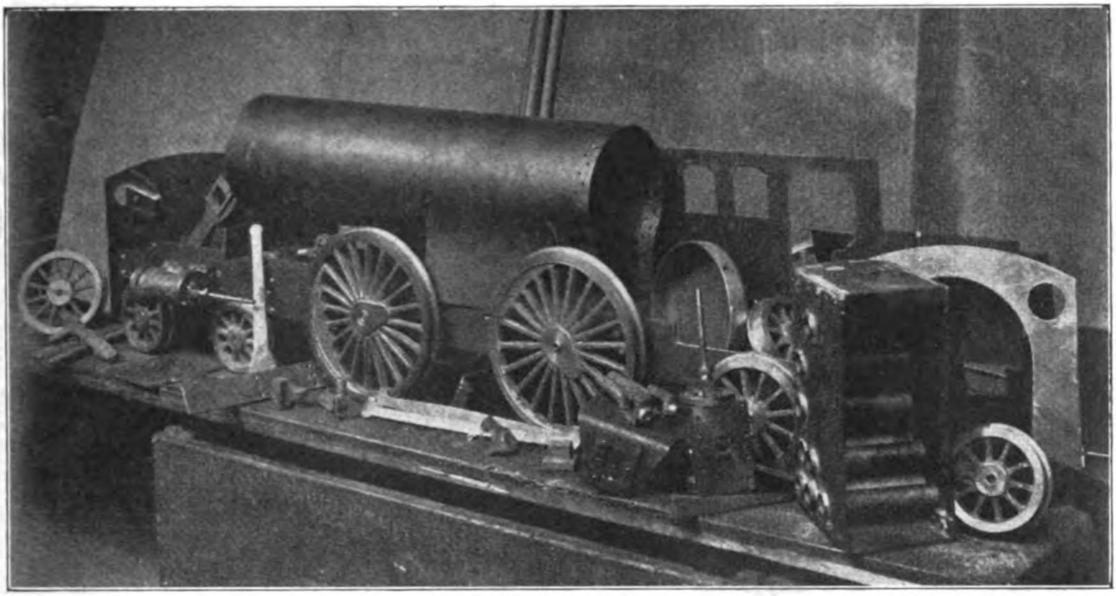
The owner, in instructing the designer, made several stipulations, the chief of which being the maximum cost and size of locomotive, and, during the preliminary stages, decided the main features from various small scale outline sketches submitted to him. It will be noticed that the most apparent change from the original design of December, 1900, is that the present engine is a ten-wheeled tank locomotive instead of a tender engine. The reasons for the difference are that a tender engine to ¾-in. scale is a very large and costly model; and also a separate vehicle is not always an advantage—oil and water connections have to be arranged in a suitable manner—a task not very easily accomplished.

The leading dimensions of the model are as follows:

Cylinders—¾-in. bore by 1½ ins. stroke.
,, centres apart, 4⅛ ins.
,, ports, 3-32nds in. and 3 16ths in. by ⅜ in.
Wheels—bogie, 2⅛ ins. diameter on tread.
,, trailing, 2¾ ,, ,, ,,
,, driving, 4⅞ ,, ,, ,,
,, width of tread, ⅜ in.
Weight of locomotive, about 45 lbs.
Length over all, 30¼ ins.

As may be seen by the front view accompanying this description, the model represents in miniature the endeavours of locomotive engineers of to-day to build the largest and most powerful machine within the given loading gauge—*i.e.*, limit of height and breadth. In the construction of the model, everything was made as simply as possible and the number of patterns required to be made was reduced to a minimum. Nothing, however, was spared to make it an ultimate success and to allow it to be, as a steam engine, an efficient machine.

The frames are of mild steel, 3-32nds in. in thickness, this being greater than otherwise necessary by reason of the reduction in depth over the trailing coupled axle. The firebox being long and sitting on the top of the frames—the only limit to its width then is the distance between the wheels—makes the frame comparatively weak at this point, and to give it its original strength before cutting away for the foundation-ring of the firebox, the ⅛-in. brass plate forming the hornplates, which is riveted on the outside is made to pass over the axle-box, and is supplemented by a strip of steel about ⅜ in. by ⅝ ins. on the inside of the framing. At this otherwise weak spot the frame is turned into a *bar* framing 5-16ths in. by ⅜ in. in section, which neglecting the support from the hornstay under the axle-box would in itself prevent the framing failing at this point.



The Locomotive in Course of Construction.

The hornstays and axle-boxes are of unusual construction; the sketch on the next page will, however, make clear the design of this item. In making the model, the axle-boxes were cast in a strip, and the two "rebates" were milled out, the strip then being cut into pieces of the required length.

The connector steam chest is bolted to the main frames and with the various transverse stretcher plates, motion plate, etc., makes a very rigid job of the whole. At the trailing end, the frames are canted inwards to 2¼ ins., just behind the radial wheel, when they remain parallel until arriving at the buffer planks.

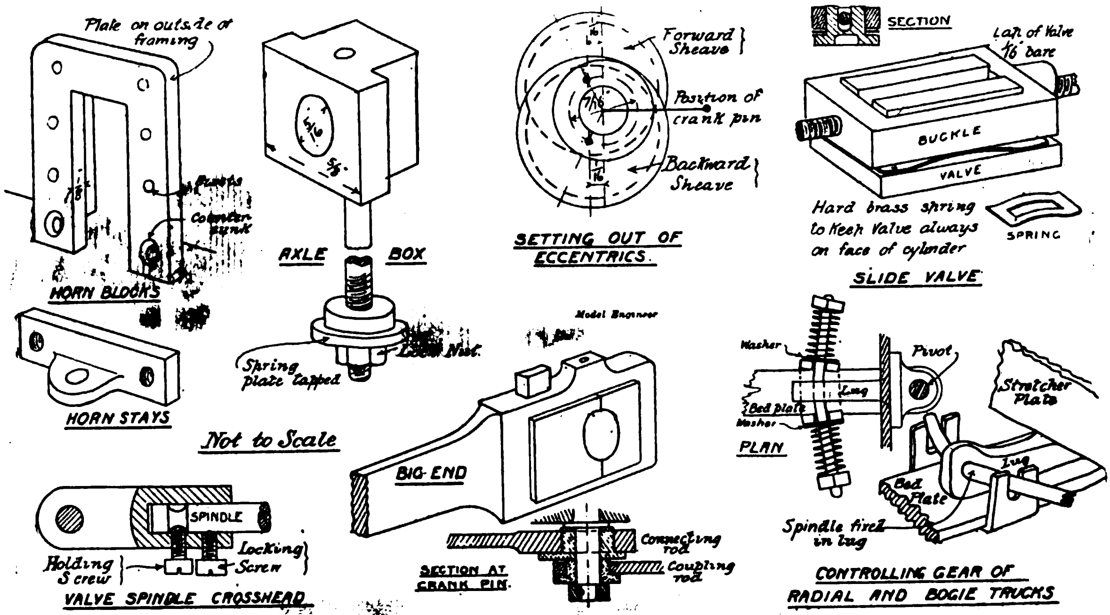
The bogie frame consists of a steel bedplate and two side frames, 2½ ins. apart, which are connected by strong cast brass angles, and is pivoted in a similar manner to the famous Bissel type of bogie, behind the trailing wheel, so that instead of the combined turning and sliding movement of the ordinary Adams' bogie, the truck swings in the direction of the curve with one movement, and is controlled from moving too far by a pin on the sliding surface provided on the underside of the steam chest, and is constrained to return always to its normal position by a pair of spiral springs attached to a lug on the motion-plate, as shewn in the drawing annexed. The valve gear is Stephenson's link. In the engine just completed, the rods are crossed—an expedient it is not wise to adopt, if possible—owing to some difficulty in arranging the rods, which was not overcome until afterwards. The following may be culled from the specification, a document which is about twenty five foolscap pages in length, and from this extract it can be judged that nothing was left to chance, and that the builder was provided with proper instructions before commencing.

mounted on a mandrel or rod of the same diameter as the sheaves, they can then be all drilled and broached together and their accuracy assured.

"The eccentric sheaves to be of *cast iron*, bored to fit the 5 16ths in. axle, each pair to be in one piece. The throw is to be 7-16ths in., with an advance of 1-16th in. They are to be secured by a pointed set-screw."

The weighbar shaft and the rest of the motion is wholly in steel, and constructed in as durable a manner as possible. The valve spindle crosshead is made as shewn in the sketch herewith, and may be put on to the valve spindle after the eccentric rods, quadrant, etc., are all in place. It also allows the valve to be set by turning the valve spindle, the set-screw running in the groove preventing an inward or outward movement, when the second set nut is slackened during the operation of valve setting.

The crosshead is of gunmetal, and of the overhead single bar type. In this design, as in any outside cylinder leading bogie engine, the diameter of the sharpest curve



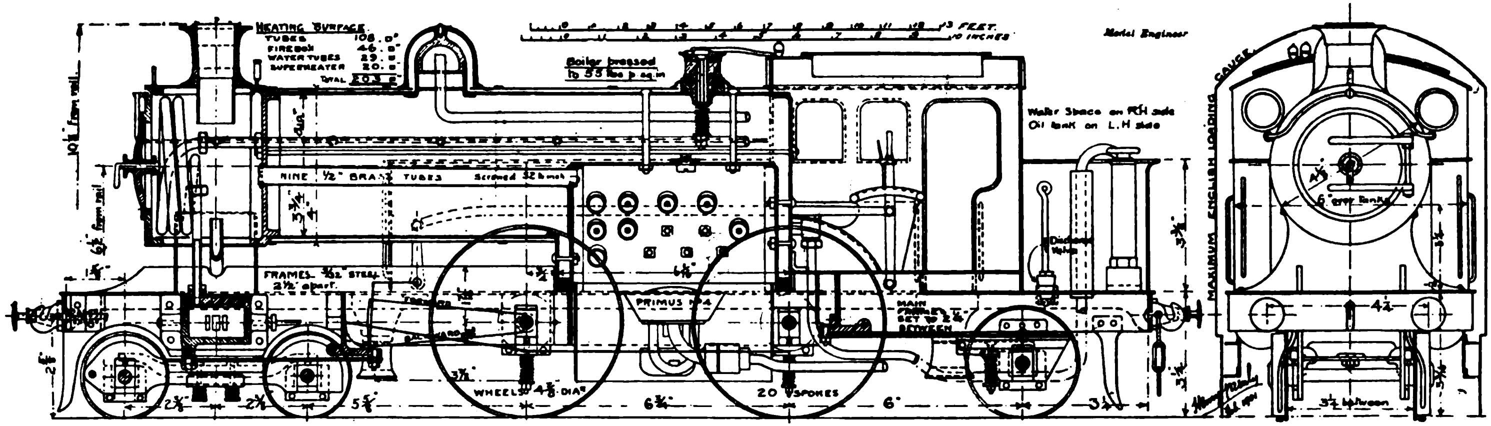
Details of ¼-in. Scale Model Locomotive. (Drawings not to Scale.)

"The valve spindle to be of *hard* brass or bronze, 5-32nds in. thick, and is to be tailed right through the steam-chest and run into the dummy gland. The hole in the dummy gland to be bored to the outside and stopped by a short set screw. A flat must be filed in valve spindle at the tail-end, to allow of the escape of trapped water, and the other end is to pass through the provided boss on the motion plate. The V.S. crosshead to be of mild steel, case hardened, and forked to allow the curved link—which is ¼ in. wide—to slide in it. The quadrant block to be of steel, case-hardened, and affixed by a set-screw with head outside, or a taper steel pin driven in and secured by a centre pop in its smallest end after fixing."

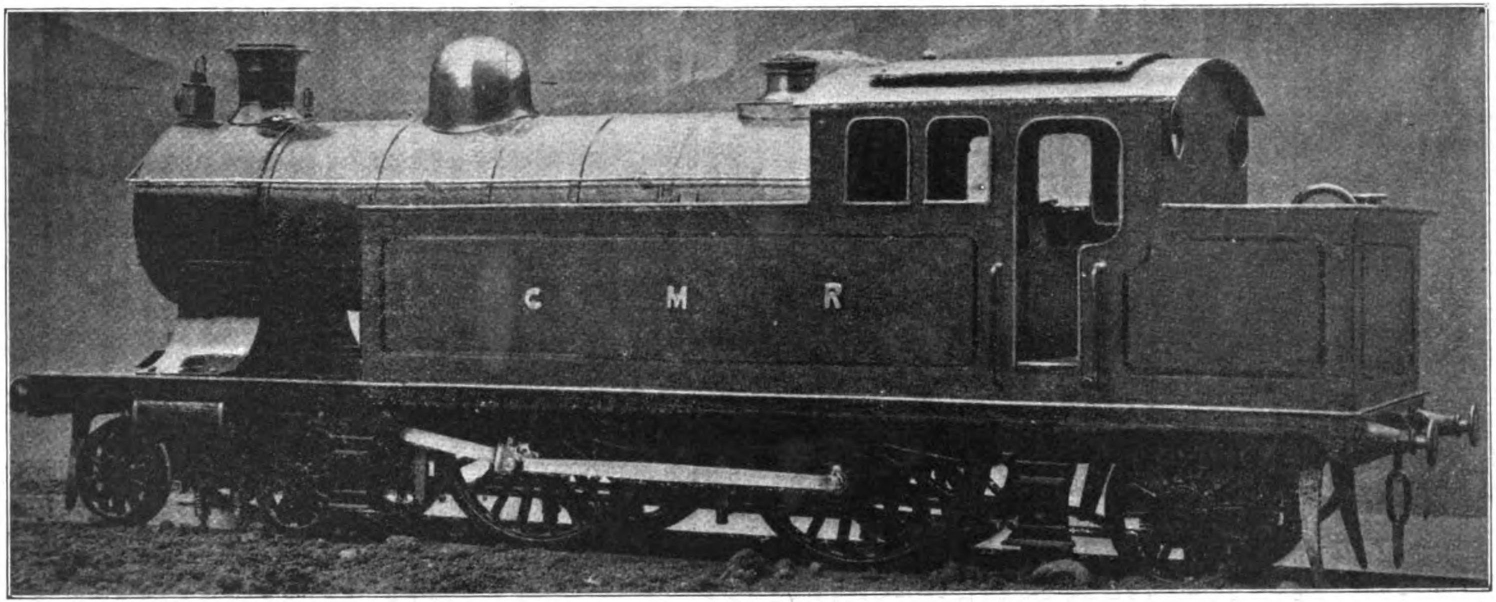
"The steel eccentric rods (out of 3-32nds in. plate), to be riveted to the gunmetal straps, and must be of exactly the same length when finished. The backward eccentric rods must be set, the forward ones being straight and in a line with the valve spindle. If the rods, after setting and fitting to the straps, are

around which the engine will pass is in some degree limited by the distance both the bogie wheels can travel laterally without coming in contact with any other part of the engine, and such curve would be larger if in the present engine a bogie wheel of greater diameter than 2⅛ ins. or a two-bar crosshead were employed. The frames are also cut away at both the bogie wheels for the same purpose, *i.e.*, reducing the diameter of the minimum curve of railway.

The connecting-rod is of *mild* steel, and the little end is case-hardened with yellow prussiate of potash; the big end is shaped as shown in the sketch to enhance its appearance, and is fitted with a solid bush in brass with a square face, to imitate the brasses used in the real engines. The coupling-rod is out of 3-32nds plate, the ends being enlarged by a brass bush. The crank pin is 3-16ths in. diameter, driven into the boss of the wheel and riveted over. It is turned with a collar next the wheel, and is shouldered down to ⅛ in. at the outside, and fitted with a loose collar and a taper pin in the approved fashion.



Longitudinal Section and End Elevation. (The End Elevation shows also the Maximum English Loading Gauge to same Scale.)



A 3/4 IN. SCALE MODEL TEN-WHEELED TANK LOCOMOTIVE.
(For description see pages 221 to 224.)

The axles are 5-16ths diameter, reduced to ¼ in. at the wheel seats. These dimensions may seem small, and they are somewhat below scale, but it has been found that the axles are amply strong enough for the purpose, and the reduced size lessens the friction to some extent. One of the reasons for the smallness of the axle is that the firebox can be made to the present dimensions. At the front end it can be placed very near the driving axle —it would have to be further away if the sheaves were increased in diameter by a similar increase of axle dimensions—and at the rear it can pass over the frames and trailing coupled axle in the manner before described.

The axles, except the bogie and radial wheels, which were to be screwed, were specified to be driven on to the wheels and to be secured by a set-screw. In the driving wheels, owing to the temporary fitting together, the specified method gave a little trouble, and so all the other wheels were screwed on, and those which required it were secured by a set screw as aforesaid.

The foot-plating in front of the tanks is in one piece, and is supported by the foot-plate or "frame" edging on the outside. The detail of the shaped ends of the "frame" edging is the same as that in the simple model locomotive described in a recent issue. The frame edging is supported near the centre by the steel bracket to which the end of the slide bar is affixed.

The buffer castings are of brass and the heads of steel. The spindles pass right through, and just behind the buffer plank they are fitted with a collar and spiral spring, which engages a bracket formed out of the same piece of steel the guard iron is shaped from, which projects at right angles to the main frame and parallel to the buffer plank. The trailing (radial) wheel is mounted upon a separate truck, which is pivoted at the stretcher plate, just under the cab, and rests at its axle centre upon a horizontal brass plate, ⅛ thick, which is turned up at each end, riveted or screwed to the frame. This plate has a pin projecting downwards from it which engages a slot in the bedplate of the truck. Double nuts are fitted to this to prevent the truck falling away upon the engine being lifted. The slot allows the radial wheel a total of ¼ in. lateral play.

(To be continued.)

A Curious Phenomenon in Combustion.

A FRENCH scientist, M. Trillat, reports the discovery of a curious phenomenon in connection with the glowing of metals in gases, analogous to some extent to the luminous effect produced when a piece of spongy platinum is immersed in a jet of hydrogen or coal gas. If a spiral of platinum be placed in a glass tube, and an electric current passed through it so as to raise its temperature to a certain point, say a dark red heat, then if alcohol vapour or vapour mixed with air is passed through the tube, the wire will continue to glow without the aid of the current, simply as a result of the presence of the gas in contact. The peculiar point about the matter, however, is that if, instead of being raised to, say, a dark-red, the temperature be raised to, say, a cherry-red, by the aid of the electric current in the first instance, it will, after the current is turned off, remain at this higher temperature. It is this selective influence as regards temperature that seems so strange and so far difficult of explanation, and the fact that when the phenomenon has been started at a given temperature several times in succession, it is not necessary to use the current at all in commencing the reaction, which then takes place, as it were, automatically at a fixed temperature. According to the authority quoted, the effect is not confined to platinum, but may also be produced with wires of silver, iron, and copper.—*Mechanical Engineer.*

How to Make Permanent and Electro Magnets.

By T. G. JAMIESON.

MAGNETS may be divided into two distinct classes—viz., permanent magnets and electro-magnets. The former are those which retain in their atoms the magnetism imparted to them, and the latter those which only exhibit magnetic phenomena when a current of electricity is traversing their coils. Speaking generally, permanent magnets are used for experimental purposes and electro-magnets for practical purposes.

There are two kinds of permanent magnets, namely, natural magnets or lodestones, and artificial magnets or those made by artificial means.

Natural magnets or lodestones.—These are certain hard black stones, found at Magnesia in Asia Minor, and a few other parts of the world, which possess the property of attracting to them small pieces of iron or steel. They have also the remarkable property of pointing North and South when suspended by a thread.

Artificial magnets.—If a piece of hard iron or steel be rubbed with a lodestone, it will acquire the properties characteristic of the magnet—it will attract light bits of

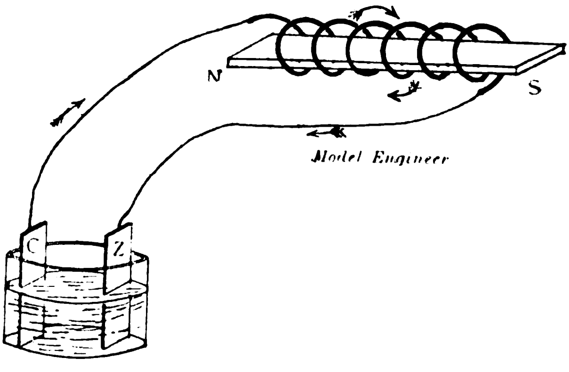


FIG. 1.

iron, and if hung up will point North and South. The attractive power of a magnet appears to reside at two regions, called poles. These poles are usually at the ends, and are called North and South respectively. The North pole is that end which will point to the North of the earth when the magnet is suspended and free to move through space. The South pole will point to the South under similar circumstances. The letter N is usually engraved on the North end for the sake of distinction. The portion of a magnet which lies between the poles is apparently less magnetic, and half way between the poles there is no attraction at all. The method of making artificial magnets described above is not convenient, neither is it possible by this means to make a magnet of very considerable strength. Other methods, however, have been devised whereby steel magnets of almost any strength may be easily and quickly made. Of these methods there are several, each perhaps being specially adapted to certain cases. To make permanent magnets successfully requires not only a little experience, but also a little experiment. The steel from which the magnets are made should be the best and hardest obtainable, and free from flaw. If special attention be given to its selection, and a good hard metal insisted upon, the resulting magnet should prove very satisfactory. A good piece of tool steel, which is not sufficiently hard, can be rendered so by heating to bright redness and then plunging into cold water, where it should be allowed to remain till cold. In the case of horseshoe-magnets the steel must be bent to shape before magnetising. The best steel to use for horseshoe-magnets is German spring steel; tool steel answers well, if hardened and drawn to a straw colour.

Before setting to work, let us consider the various methods of magnetisation, and the formulæ for predetermining the approximate lifting power of the finished magnet. The first method, and that which appears to be in general favour, is to hold the piece of steel to be magnetised across the pole-pieces of a dynamo or motor, each pole of the magnet touching one of the pole-pieces. If the magnet is large enough to reach across the pole-pieces of the dynamo, it should be held in contact with the two pole-pieces while the machine is in operation. If the steel magnet does not reach across the gap between

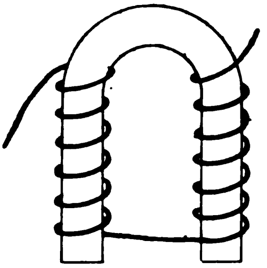


FIG. 2.

the pole-pieces, the two legs may be magnetised separately by holding them successively to the two pole-pieces for a short time, or one leg may be held in contact with one pole-piece and a bridge formed from the other leg to the other pole-piece by a piece of soft iron. Care should be taken not to touch the armature of the dynamo in doing this, as it may ruin the machine. If the horseshoe is pulled off the pole-pieces while the dynamo is in operation, its magnetism will be greatly impaired. If possible, the machine should, therefore, be shut down before the horseshoe is taken away. The best way to magnetise steel bars is by inserting them into coils traversed by a strong current (see Fig. 1). The end of magnet held against the north pole-piece will have south magnetism induced in it, and the other end north magnetism. If no dynamo or motor is at hand, the magnet can be polarised by sending a battery current through a coil wound

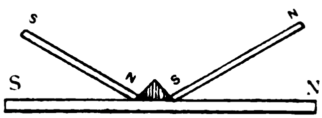


FIG. 3.

around one or both of its legs. The more turns in this coil, and the greater the current passing through it, the stronger will be the magnetisation. That is, up to a certain limit. There can, of course, be no formula as to the number of turns of this coil and the size of the wire used, as both depend on conditions different in each case. A good rule to follow is to use as many turns as possible of such size wire as will carry, without undue heating, the current to be employed.

Any type of slowly polarising battery, such as the Edison-Lalande, and the bichromate of potash cell, may be employed to furnish the magnetising current. Send the current through the coil continuously for about an hour; then turn off the current and let magnet be undisturbed for an hour or two. The current should then be once more turned on for about one half-hour. If the number of ampère-turns (that is, the product of the number of turns in the coil times the current strength) is high enough, the above procedure will be sufficient; if not, it has to be repeated a number of times. When polarising a steel magnet by a coil, the poles should be connected by a piece of soft iron. The number of ampère-turns should be at least one hundred times the length of the magnetic circuit in inches, including the soft iron pole-piece. Preferably, two or three times the number so obtained may be used. When properly magnetised, the approximate lifting power, in pounds, of permanent magnets may be calculated as follows:—

$$P = a \sqrt[3]{W^2}.$$

P being the lifting power in pounds, W weight of magnet in pounds, and a, a constant depending on the goodness of the steel and the method of magnetising it. In a few cases the value of a has been carried very high, as, for instance, in the best steel magnets made at Haarlem by V. Wetteren, and also Breguet's magnets, made from Allevard steel. The value of the constant a in these cases being from 19·5 to 23. The "portative force" or lifting power of a magnet depends both upon the form of the magnet and on its magnetic strength. A horseshoe-magnet will lift a load three or four times as great as a bar-magnet of the same weight will lift. The lifting power is

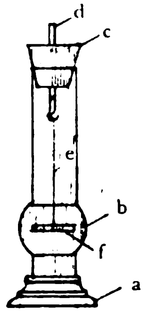


FIG. 4.

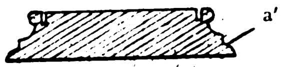


FIG. 5.

greater if the area of contact between the poles and armature is increased. It will be easily seen from the foregoing that the value of the constant a in the above formula will differ in magnets of different form. This difference, which is considerable, is as follows:—

Bar-magnets (each pole separately) $P = 7{\cdot}5 \sqrt[3]{W^2}$

Horseshoe-magnets (both poles together) $P = 20 \sqrt[3]{W^2}$

These being the maximum values in each case.

The following examples show how to apply the formula, and how it may be transformed and applied to the solving of other problems:—

1. Required the maximum "portative force" (lifting power) of a bar-magnet weighing 7 lbs.

Solution—

$$\text{Maximum } P = 7{\cdot}5 \sqrt[3]{W^2} = 7{\cdot}5 \sqrt[3]{49}$$
$$\text{Log. } 7{\cdot}5 = 0{\cdot}875061$$
$$\tfrac{1}{3} \text{ Log. } 49 = 0{\cdot}563399$$
$$\text{Sum} = 1{\cdot}438460 \qquad \text{Antilog.} = 27{\cdot}4$$

$\therefore$ *Answer* = 27 lbs.

2. Required the maximum "portative force" of a horseshoe-magnet weighing 7 lbs.

Solution—

$$\text{Maximum } P = 20 \sqrt[3]{W^2} = 20 \sqrt[3]{49}$$
$$\text{Log. } 20 = 1{\cdot}301030$$
$$\tfrac{1}{3} \text{ Log. } 49 = 0{\cdot}563399$$
$$\text{Sum} = 1{\cdot}864429 \qquad \text{Antilog.} = 73{\cdot}2$$

$\therefore$ *Answer* = 73 lbs.

3. It is desired to construct a horseshoe-magnet which shall have a maximum "portative force" of 125 lbs. What will be its dimensions—approximately?

Solution—

$$\text{From } P = a\sqrt[3]{W^2} \text{ we have } W^2 = \left(\frac{P}{a}\right)^3$$

$$\therefore W = \sqrt{\left(\frac{P}{a}\right)^3}$$

Hence, substituting the numerical values of P and a, we have

$$W = \sqrt{\left(\frac{125}{20}\right)^3}$$

$\frac{3}{2}$ Log. 125 = 3·145365
$\frac{3}{2}$ Log. 20 = 1·951545
Difference = 1·193820 Antilog. = 15·62
∴ *Weight* = 15·62 lbs.

Now, as steel weighs about 0·288 lb. per cubic inch, there will be 54 cubic inches in our magnet. This volume may be divided between length, breadth, and thickness, as desired; but regard should be had with respect to certain proportions which may, with advantage, exist between the three dimensions. The breadth should be from two to three times the thickness, and the length from six to fifteen times the breadth. The smaller proportion between length and breadth being used in the case of bar-magnets, and the larger proportion in horseshoe-magnets. The exact dimensions are found by a method of trial, and corrections made if the results are out of proportion. Assuming the thickness in the foregoing example to be 1 in., the breadth will then be 2 ins. Dividing the cubical contents—54 cubic inches—by the thickness—1 in.—we have left 54 square inches to be divided between length and breadth. Again, dividing this number—54—by the breadth—2 ins.—gives the length as 27 ins., or thirteen and a-half times the breadth. The three dimensions, therefore, are:—Length, 27 ins., breadth 2 ins., and thickness 1 in. Now, if this bar be bent into the form of a horseshoe, the length will be reduced to about 10 ins, and the complete magnet will have very good proportions. A bar magnet having the same cubical contents as the above should be somewhat broader—say, 3 ins. This would reduce the length to 18 ins., which would be about right. Another example of this description is given below.

4. A bar-magnet is required for experimental purposes, which will be capable of attracting and lifting, with comparative ease, iron balls weighing from 1 to 30 lbs. each. What should be its dimensions?

Solution.—Weight of largest ball = 30 lbs.; therefore, 30 lbs. = minimum lifting power. Allowing about 5 lbs. for loss of magnetism, jerks, shocks, and ease in lifting, the total minimum power will be 35 lbs. Now, as it is quite probable that the value of the constant a in the formula will not be so high in the steel used as that given above, we may compute for a maximum value of 40 lbs. From 3 we have

$$W = \sqrt{\left(\frac{P}{a}\right)^3},$$

Substituting the given values of P and a, we can write

$$W = \sqrt{\left(\frac{40}{7 \cdot 5}\right)^3}$$

$\frac{3}{2}$ Log. 40 = 2·403090
$\frac{3}{2}$ Log. 7·5 = 1·312592
Difference = 1·090498 Antilog. = 12·32
∴ *Answer* = 12·32 lbs. = 43 Cu. in. = 14 ins. long, 2½ ins. wide, 1¼ ins. thick.

The dimensions are computed from the cubical contents, as explained above.

If the reader is unacquainted with logarithms, he may work out any of the above examples by direct arithmetical methods. We have next to consider the length and size of wire to be used for carrying the polarising current. This will entirely depend upon the strength of current to be employed, and the degree of magnetism to be imparted.

Supposing the current employed to be 2 ampères; then referring to a table of wire resistances, we shall find that No. 20 B.W.G. will carry this current safely. Supposing, also, that the bar of steel to be magnetised measures 14 ins. long, 1 in. wide, and ⅜ in. thick, the magnetic circuit will be about 30 ins., including a soft iron bent armature, and the ampère turns will be 6000—that is, 200 times the length of the magnetic circuit.

Now, as an ampère-turn is the product of the current times the number of turns in the coil, and the average length of one turn would be about 3 ins; the total number of turns is $\frac{6000}{2}$ = 3000. The linear surface covered by the coils should be about 13 ins., and as twenty turns should be got on one linear inch of surface, the number of turns in a complete layer will be 13 × 20 = 260. Therefore, eleven layers will be sufficient. With a greater current the wire would be thicker, and the number of turns fewer, and if the current be doubled the number of turns is reduced to one-half. The wire may be wound in either direction; but in the case of a horseshoe-magnet the winding must be reversed when passing from one leg to the other (see Fig. 2). To find which end of the magnet will have north polarity, let us suppose ourselves to be swimming in the current, and to face towards the centre of the coil where magnet is. The North pole will be on the left. To begin with, the student should make a couple of good bar-magnets, capable of lifting about 1 lb. each, and with these he will be able to polarise magnetic needles and other small magnets in the following simple manner:—The needle to be magnetised is laid down horizontally, and a small thin wedge-shaped piece of cork or wood placed centrally upon it (Fig. 3); two bar-magnets are brought down upon the needle, their opposite poles touching the piece of cork or wood. They are then both moved backwards and forwards along the needle several times. The needle is then turned over, and the operation repeated, taking care to leave off at the middle. The simple magnetoscope shown in Fig. 4 can now be made, and by its aid it will be a very easy matter to ascertain whether a body is magnetised. It is also used to find the poles of a magnet. The base a and a' is of walnut, grooved to take the glass cover b. This cover is a straight lamp chimney, 8 ins. long and 2 ins. diameter, with bulb near the bottom. A large cork c is fitted with a glass rod d, terminating in a hook. From this hook is suspended a light magnet f, by means of a very fine silk fibre e. The whole system is fitted to the upper end of the glass cover, and the instrument is complete. The magnet is a piece of watch spring, a little shorter than the diameter of the glass cover, and is hardened by heating to bright redness, and then quickly plunging into cold water. The magnet should be held in the flame of a blowpipe or Bunsen burner by means of a piece of light iron wire turned round its middle. To magnetise the piece of spring the "double touch" method, described above, is used. The end of the magnet stroked with the North pole of the stroking magnet, will have south polarity, and that stroked with the South pole, north polarity. A single drop of electric cement should be allowed to fall upon the magnet as centrally as possible, and the end of the silk fibre plunged into the cement before the latter has time to set. The magnet must hang quite horizontally, and to ensure this position a little red paint or sealing-wax varnish may be applied to the light end. It is advisable to have the North end a little light, so that by applying a small quantity of the red varnish, a truly horizontal position may be obtained. The colouring also serves the purpose of distinguishing the poles.

(To be continued.)

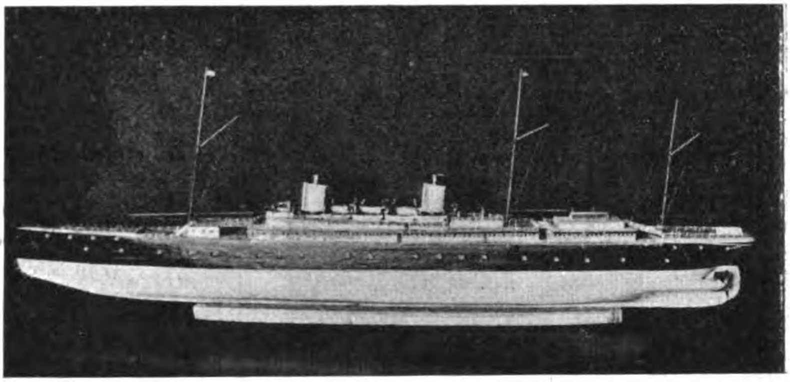
A Model of the R.M.T.S. "Teutonic."

By J. D. Adamson.

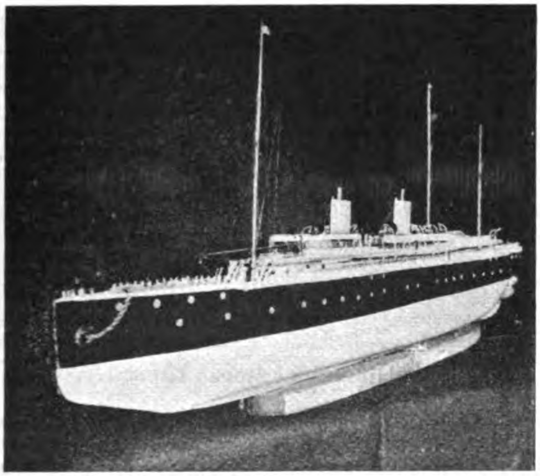
For some time past I have been a constant reader of this excellent paper, and having often profited by the capital idea of inserting photographs and description of work turned out by model engineers, I offer the following contribution, trusting that it may be of interest.

The photographs represent a model I have made of the White Star liner *Teutonic* to the approximate scale of 3-35ths of an inch to the foot. My first measurements and notes were made from a model in the billiard room of Mr. Imrie, chairman of the line, and from a subsequent visit to the vessel herself; since then I have had to manage with what photographs or prints I could get hold of.

The model is 4 ft. long with a beam of 5 ins., and a depth of 4⅛ ins., built of wood in the "layer" fashion, each layer being 1 in. thick. The hull was the most tiresome part of the work, the twin shaft tunnels requiring great care, especially as in the prototype the propellers overlap; this I at first imitated, but subsequently reduced the shafts to the same length, as by my arrangement the steering was interfered with.



Model of the White Star Liner "Teutonic."



The Model "Teutonic."

The various deckhouses and superstructures are of wood, with windows of mica, painted black on one side. The port holes are boot eyes, let in and backed with mica. The rudder is of wood, and is worked by a spring tiller, which is covered by a removable deckhouse, the scale being too small to admit of other steering gear. To get at the boilers, part of the hurricane deck can be taken off, while above the engines is a glass-roofed deckhouse, which is also removable, as are also various hatches throughout the vessel.

The boilers, of which there are two, need no description, as they are inadequate, being too slow in raising steam and incapable of maintaining a head of steam sufficient to supply the engines at a high speed. The latter are also not to be recommended, being double cylinder D.A. oscillating (1 pair to each screw). My experience of these is in accordance with the views of other model engineers, which I have since read—namely, that they use too much steam. I wish when this part of the work was under consideration I had been as familiar with The Model Engineer as I am now, so that I might have profited by the many excellent suggestions on this very point.

There is a small hand bilge pump aft of engines, working from a tank into which all chance water from the engines or boilers is drained. The exhaust at first can be blown through the side of the vessel to get rid of all superfluous water, and then can be directed up the funnels, which also cover the safety valves. These, together with a manhole and water-tap to each boiler, form the only boiler fittings besides the steam taps, the handles of which project through the deck. Each of the three masts is fitted with two derrick booms and one overhead jib, with accompanying gear.

The ventilators, of which there are eight, are carried through the deck to provide air for the lamps, which are of the ordinary methylated spirit kind.

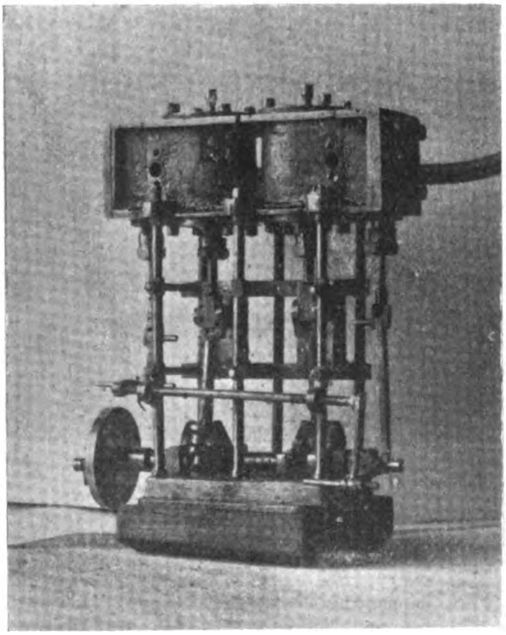
Though I regret to be unable, as many model engineers can do, to parade abnormal performances on the part of the model, no doubt on account of the inferior boilers and engines, yet, on the other hand, I hope the photographs may be of interest to readers of The Model Engineer.

Induction Coils should not be used for both sparking and shocking purposes. The two matters are quite distinct, and it should be remembered that the use of a powerful coil for shocking may be attended with serious consequences. There is, too, considerable difficulty in leading out the wires for the shocking powers without destroying the perfect insulation so imperative in a good sparking coil.

Design for a Model Launch Engine.

By Geo. W. Halpin.

IN the March 1st issue of The Model Engineer appeared a description of the method of building a steam launch hull in metal. The original, from which that description is taken, is fitted with a simple boiler (already described in these pages) and an engine which is here illustrated and described. This engine, as will be seen by the drawings, is of the type generally used in the Navy



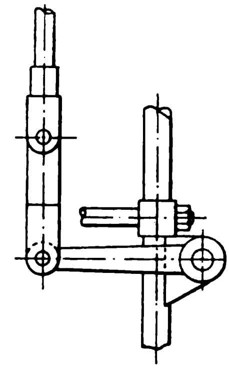
A Model Double-Cylinder Launch Engine.

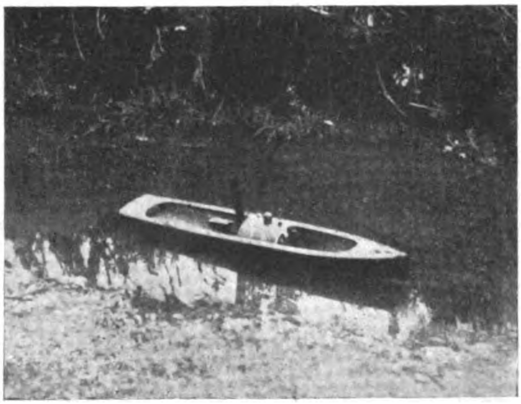
pinnaces and vedette boats of the smaller class—in fact, it is a scale model of a pair of 6 in. by 6-in. engines, only altered in certain parts to make it a working model and simplify the construction. In the front elevation and end view, I have left out some parts that ought to be seen in projection so as to make the drawing less confused. Also I have only given the principle dimensions, leaving the others to the fancy and skill of the maker. I may say here that the whole engine, including boring the cylinders, was made on a 3-in. lathe without slide-rest. The cylinders were bored with a flat drill, forced up by the back centre, as is usual in Manchester. The drawings are detailed and do not need much description.

The principal departure from ordinary practice, is the manner of driving the valves. As eccentrics absorb a deal of power, I looked about for some other method, and used that shown; it is drawn to double the scale of the rest to show it clearly. The pin that drives the valves also serves as a set-screw to fix the sliding part, so as to suit the stroke of the valve, whatever it may be. Mine is somewhat less than ¼ in., and the whole can turn round the shaft, so as to get the necessary advance. The valve on the forward cylinder is driven direct, the after through a weigh shaft on front of engine, with two levers at right angles, and both from the same pin. The crank-shaft was made as described in The Model Engineer, the webs with balance weights being first filed up and drilled, and afterwards brazed on a steel shaft, turned up, and the pieces between the webs filed out; it is 3-16ths in. diameter. The two main bearings are also out of the common, being solid, and screwed to the web of the bedplate. The stuffing-boxes have outside glands, and are ¼ in. tap thread, those for the valves being separate from the casting, and fixed by two screws. The screws used were Nos. 29 and 33 for the cylinders. The columns were made of square iron wire, the corners being filed off before turning. The engine weighs 1¼ lbs.

The total weights of the launch are as follows: Hull, 7½ lbs.; boiler 5 lbs.; engine, 1½ lbs.; water, 1¼ lbs.; lamp and spirit, ½ lb.: total, 15¾ lbs. The displacement is, length on load water line, 48 ins.; beam, 9½ ins.; mean draft, 2¾ ins.: total, 1,524 cubic ins., and taking the co-efficient of a boat of that class at 0·35 we get

Rocking Shaft and Levers for Left-hand Slide-Valve shown on Opposite Page.—End View. (Full Size.)



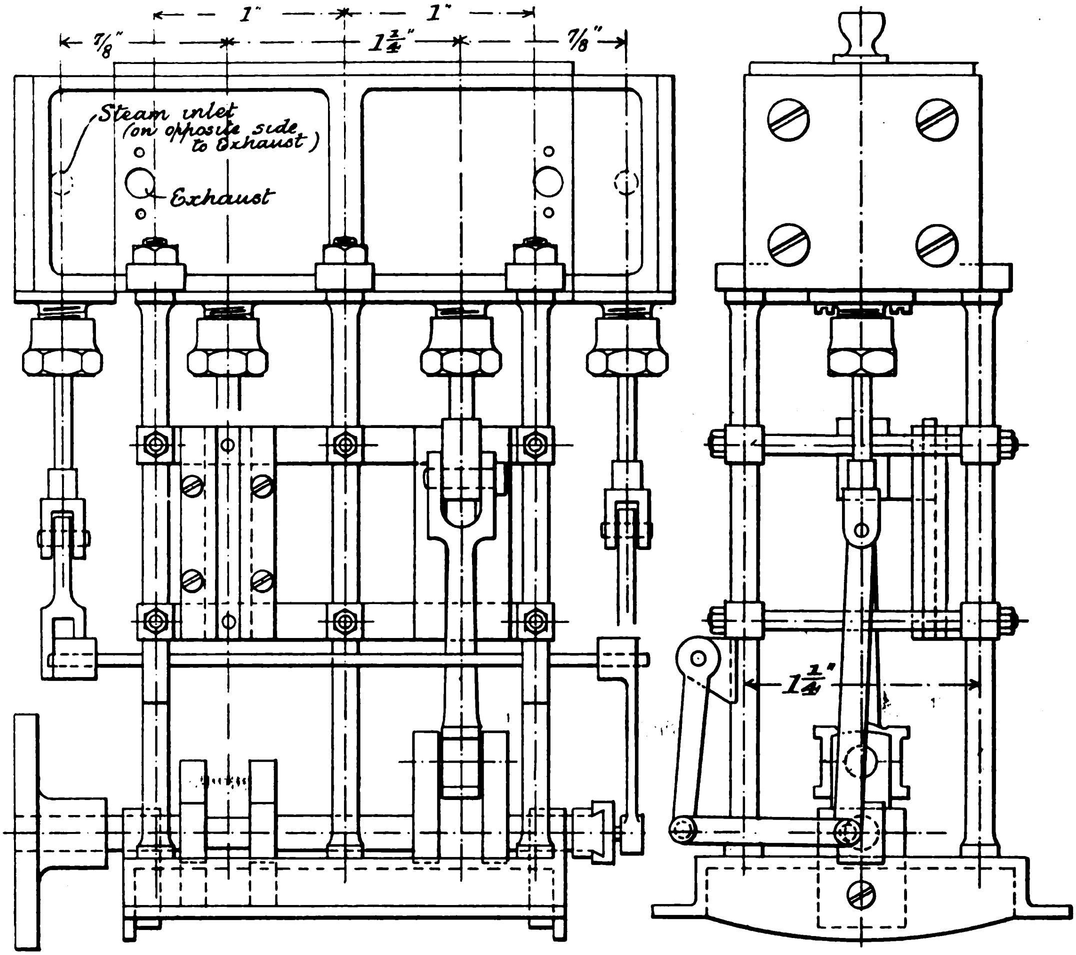


Mr. Halpin's Model Launch.

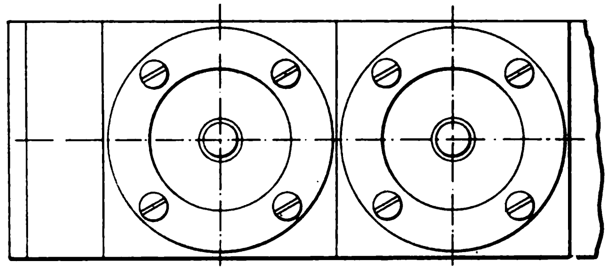
438·9 cubic ins., which × ·036, the weight of a cubic inch of water, we have 15·8 lbs.

I am now at work on another engine for a fast launch, and when I have tried it, with the Editor's permission, I will send drawings and description. I consider it the ideal engine for the purpose; it is easy to make; those who prefer it can build it up, as I am doing. It is light, perfectly balanced, has no dead points, no valves, guides, crossheads, or stuffing boxes.

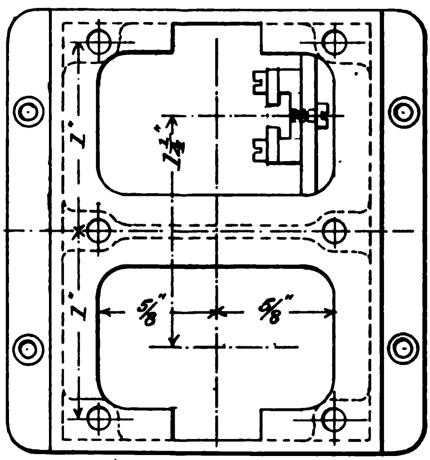
I forgot to say, when describing the engine here illustrated, that the cylinders were cast separate, the same pattern serving for both, and after boring and facing, were soldered together, care being taken to get the bores



FRONT AND END ELEVATIONS
(Left-hand Connecting-Rod Omitted to show Slide Bars).



PLAN OF TOP CYLINDER COVERS.



PLAN OF BASEPLATE.

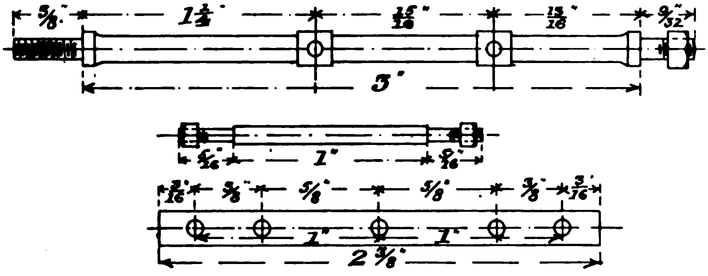
A MODEL DOUBLE-CYLINDER LAUNCH ENGINE.

Cylinders: ¾-in. Bore, ¾-in. Stroke.

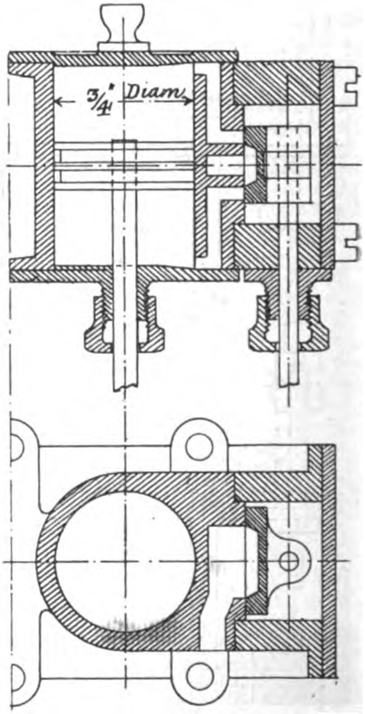
Scale: FULL SIZE.

perfectly parallel. The propeller is of brass 3 ins. diam., 4½ ins. pitch, three blades, got up bright all over. The shaft is of hard drawn brass wire with taper and nut for screw.

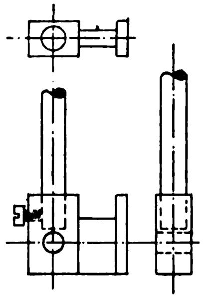
I also enclose photograph of launch as she might appear on the Thames waiting for the "Model Engineers," where one can spend a very pleasant time, as I have done many a time when there were only three launches on the river—our own, the first "Yarrow" ever built, and two others, one a small paddle boat at Windsor, the other, the *Ariel*, a fast launch with diagonal engines. Ours had a single cylinder, 4½ ins. by 4½ ins. with vertical boiler. Out in this part of the world (Spain, N.W.) model engineering is not much in vogue; it is impossible to get anything—screws, tools, etc., having to come from Paris or London, and it is very difficult to send small sums. However, there are two people here who are true amateurs—one, who likes your paper so much that he has become a subscriber, has a 3-in. screw-cutting lathe, but his tastes lie in the electrical line, dynamos, motors, etc. The other, to whom I give my copy of the paper, is a most enthusiastic worker, whose taste is for steamboats, of which he begins a great number, but they do not always get finished. His shop contains a 3-in. screw cutting lathe, drill, shaping machine and forge, power-driven, as he has two steam engines and a gasolene motor. He also thinks a lot of your paper, although he does not understand a word of English.



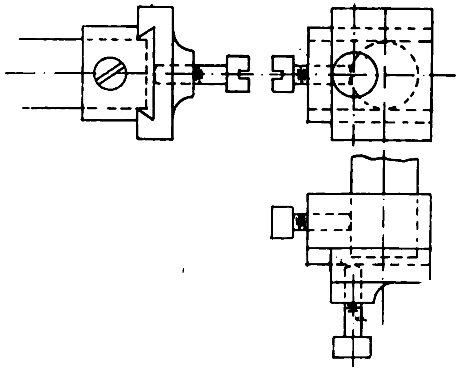
STANDARDS AND CROSS-BARS. (Full Size.)



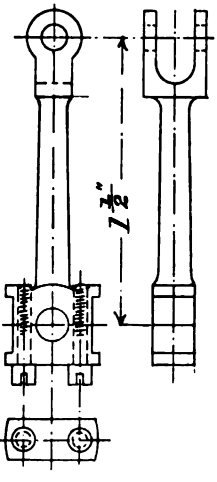
CYLINDER (SECTIONS). (Full Size.)



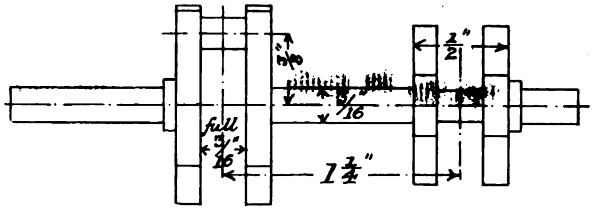
CROSSHEADS.

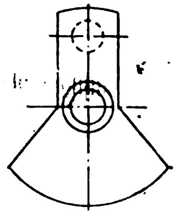


CRANK TO ACTUATE VALVE (In place of Ordinary Eccentrics). (Twice Full Size.)

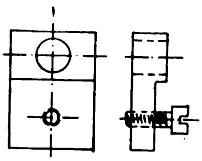


CONNECTING-RODS. Full Size.)

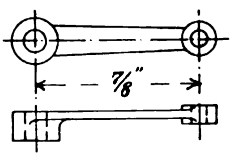




CRANKSHAFT. (Full Size.)



BEARINGS. (Full Size.)



VALVE LEVERS. (Full Size.)

An Amateur's Compact Workshop.

By Arthur Green.

Being an amateur mechanic and much interested in The Model Engineer, I send you a photograph of a very useful bench I made some years ago at a very slight cost, thinking that if you feel disposed to reproduce it, with the following description, it would enable other needy amateurs to build a similar structure, and

An Amateur's Compact Workshop

thus not only enable them to work in comfort, but to produce work that cannot be done in a shed. As will be seen by reference to the illustration, the bench is designed to fill a corner in the kitchen, and is not unsightly, although originally I intended to fix a blind roller at the top, so that the blind could be drawn down as far as bench top, and a door fitted so that underpart could be closed in, but this has not been done for the reason stated.

The bench top is of inch flooring, on two sewing machine standards, the fly-wheel being used to drive lathe. The lathe is a 2¼ centre, made by Stiffin, of Homerton, the cost of lathe being 12s. 6d. The whole of other woodwork is of ½-in. match-lining. I believe the whole cost of construction was under 5s. I should have said drawers are made from empty chocolate boxes, faced with ½ in. deal and painted to match other woodwork in kitchen. These answer the purpose very well. They are in good condition now after being in use about four years.

Of course, my bench was made to fit a corner, and anyone thinking of making one similar would make it to fit a corner or recess in his house, so that the dimensions would probably have to be modified. I give below dimensions, which I think should be sufficient to enable anyone to copy the idea; but I will describe in further detail if any reader finds it desirable.

The height is 6 ft. 6 ins.; width, 2 ft. 7 ins.; depth, from floor to six inches above bench top, 18 ins. above, 12 inches (this is simply three boards wide at bottom and two at upper part). Battens, 2 ins. by 1 in., are nailed to the sides, at the top, bottom, level of bench top, under top shelf, and under shelf carrying the four drawers, the shelves and top cover being nailed down to these. The other shelves are nailed to sides. A piece of ordinary OG. moulding (as used round doors), nailed on to a piece of match-lining, 4 ins. wide, is fixed at top (the moulding is not heavy enough without this to look well at this height), and a strip, 1 in. square, is nailed down the front —inside—to make a finish.

About 90 ft. of 6 ins. by ½ in. match-lining, 24 ft. of 1 in. by 2 ins. battens, and 8 ft. of 6 ins. by 1 in. flooring (for top of bench), will be required. A square of matching, viz., 100 ft., will cost 3s. 6d.; battens, about 6d.; and flooring, about 8d.; nails and paint, about 1s.: total, 5s. 8d.

A rack and two shelves are provided for tools, and a shelf above these for the electric instruments, partly finished work, etc. At each side of this shelf three terminals are provided, the three on left being connected with those on right with three insulated wires; this is for convenience when testing, as wires can be brought down to bench from either side.

The wire from the positive pole of a 3-cell battery is brought to No. 1 terminal, from the negative to No. 3, to which is also connected one terminal of instruments. From the centre or No. 2 terminal a wire is carried to switch fixed at right-hand side above the terminals, and from the switch to volt and ampère meter, galvanometer, and also a telephone circuit, to my bedroom. This latter arrangement is made for testing telephone transmitters, the transmitter being fixed in bedroom, and a musical box or clock used. The receiver, being connected to Nos. 1 and 2 terminals, closes the circuit. In testing for faults, the wires from coil or other instrument under test are also connected to Nos. 1 and 2 terminals, either volt, ammeter or galvanometer being switched in, and a fair idea of the resistance can be obtained by the drop in volts if voltmeter is used. In testing condition of a battery cell, either primary or secondary, the positive pole is connected with No. 2 terminal, negative to No. 3; this cuts out the other battery and registers results on instruments. The wires from switch to instruments are carried in casing for neatness

The volt and ammeter, both of which are of my own construction, are in one case, to save trouble in making separate cases, the top of dial being marked off for volts and the bottom for ampères, and both are of the solenoid type.

Although it would appear from photograph that there is a considerable amount of work to be done, I am sure it will be found very simple, and when made and fixed in corner of room, will give the maker facilities for work that he could not otherwise obtain. The tools are within reach of his hand, the work in hand can be left on bench until following evening, and all work—even turning—can be done sitting down comfortably in a chair, thus resting after the day's work; and instead of turning out into a cold, dirty, dark shed, he can work in comfort and warmth and with the society of his wife and family.

There is no doubt the possession of a bench of this description would help amateurs, who will find that some very good work can be done on it. I have just finished a switchboard with ammeter to 5 ampères, voltmeter to 20 volts, an automatic cut-out wound with shunt and main coils, mercury contact, etc., and also a lamp socket—all the work being done on this bench and lathe. I have also built several dynamos and motors, the last dynamo being a 60-watt Avery-Lahmeyer type, and the last motor working now in a shop window here off mains. A short time since I cut a wheel to shift date circle in a grandfather's clock—sixty-six teeth—in home-made machine, and I have done other important work which need not be detailed. I may say that I have done a great deal in experimenting with primary and secondary batteries, telephones, etc.; hence the electric installation.

Lightning Rods.

A CORRESPONDENT of the New York *Electrical Review*, having had a lightning rod fixed to his house, began to be alarmed when he found it was uninsulated therefrom. He protested against this method, but was told that "science had demonstrated that insulators were unnecessary." Unwilling to accept this statement, he sought the advice of our American contemporary in the matter, the reply being substantially to the effect that we really do not know—scientifically, at all events—just what part a lightning-rod does play in the matter of protecting a building.

The correspondent in question is told that he is "reasonably safe with his lightning rod apparatus in the winter time! but that the present state of science is such that no man can tell whether a lightning-rod does more good than harm or more harm than good. It is likely that if the copper tube is big enough and sufficiently well grounded, and the lightning flash is aimed directly at the house, that some part of it, or possibly all of it, may go to the ground over the lightning-rod. This is all that can be said. If the house has a tin roof it is reasonably safe anyhow. If it has a steel frame construction, or is full of water pipes, it is still safer. If it is a frame house with a shingle roof, entire safety can be secured by building a copper house outside of it. This," our contemporary states, "is the only absolutely efficient lightning protection. The whole matter of lightning-rods was conceived in ignorance, and has been exploited in folly. It is not now believed that the ordinary lightning-rod does any good, or, on the contrary, that it does any particular harm. Insulators will not help it, nor will they harm it."

ACCORDING to *Le Figaro*, Edouard Branly has carried out an improvement on the coherer. Under the present system the coherer consists of a glass or ivory tube half filled with nickel and silver filings, and inserted in the electric circuit. It appears that Mr. Branly has discovered that a contact between an oxidised piece of metal and a polished piece possesses the property, like the tube of filings, of not letting any current pass unless an electric spark occurs within a certain radius. This new radio-conductor, it is claimed, is very sensitive and simple in construction.

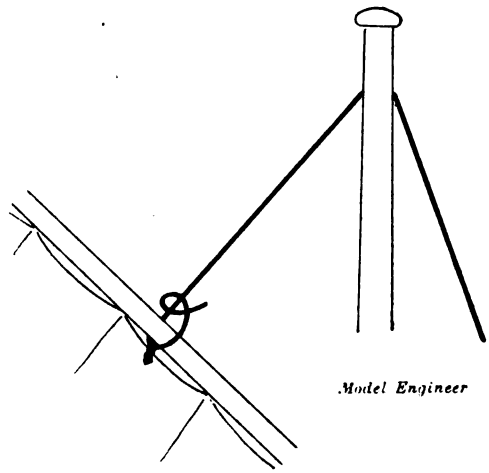
Model Yachting Correspondence.

Travellers for Model Yachts.

TO THE EDITOR OF *The Model Engineer*.

DEAR SIR,—In reply to "Ohiho's" letter *re* travellers, I do not dispute what he says.

I have done a fair amount of open boat racing, and have seen a good many open racing boats, and in nearly every case, when racing under racing canvas, the traveller is discarded and the halyard simply passed through the mast and *made fast* to the yard in any position the skipper may think fit; thus:—



the fastening on the yard is then hauled up close to the mast.

The majority of racing lug sails have no reef point or cringles, so reefing is impossible.—Yours truly,

Blackburn. SILVER STAR.

IN a recent issue of the *Iron Age*, Mr. H. G. Tyrrell gave some interesting figures upon the cost of making drawings in connection with bridge and structural work. During the 40 weeks in which the record was kept, 1,693 sheets of drawings were made at a cost of £4,963, making the average cost per sheet 58s. This cost includes the making and completing of shop drawings only. Strain sheet, general designs, and estimates were all made in another department. Neither does it include the taking of outdoor measurements. In conclusion, Mr. Tyrrell says: "Further investigation of the records showed that drawings made by the more experienced men who were paid from £18 to £25 per month, cost much less than those made by younger and less experienced draughtsmen. While the average cost of drawings for the whole office was about 58s. per sheet, the cost of those made by some of the more experienced men went down to from 32s. to 40s. per sheet. This quite disproved the theory that cheap men meant cheap work. On the contrary, the cheapest work was done by men who knew their business best and consequently were paid the most. The reason for this is largely due to the fact that drawings properly made at first require but very little checking."

THE sand moulds used for casting aluminium should be rammed very softly. Soft ramming will very often prevent the breakage of castings when they "set." The reason for this is that aluminium, just after it solidifies, is very weak and crumbly and will scarcely bear its own weight.

The Editor's Page.

WE have, on more than one occasion, commented on the advantages derivable from a free and intelligent criticism of the various examples of model-making which are illustrated in our pages from time to time. As we have said before, and there is no harm in repeating it, because a model is considered sufficiently good to warrant our inserting a description of it in our pages, it does not necessarily follow that that particular piece of work is held up by us as an example for other readers to copy. Sometimes a model is good in its general design and appearance, while lacking in the completeness or suitability of its details; sometimes the reverse holds true, the details being good in themselves, but the finish and proportions of the whole are unsatisfactory. So in other cases, neither the details nor the general appearance may gain entire approval; but the model may still be meritorious by reason of its performances, or by some ingenious methods or tools employed in its construction.

* * *

While inviting criticism, for publication, of the various models we describe, we wish to take this opportunity of emphasising the fact that it is intelligent and well-informed criticism which we desire, and not merely letters, well-intentioned though they be, only intended to verbally pull a particular model to pieces. Some of our readers who have sent letters of this kind may wonder why their communications have not appeared in print, and we trust our present remarks may serve to enlighten them. We always welcome letters, however, which supplement honest criticism by practical suggestions as to how the points objected to should, in the writer's opinion, be remedied; for from such letters as these, especially when they are founded on actual experience of the subject under discussion, all readers may learn something.

* * *

"J. K." (Birkenhead) writes that he would be interested in accounts of model steamer races run by any model yachting club other than the Wirral M.Y.C., of which he is a member. We do not ourselves know of any other club which has a steamer division, but should such exist, we should be glad to have particulars of their doings. We should also be pleased to have authentic information of fast performances by model steamers which any of our readers may have built. We believe that many owners of model steamers imagine their boats to be faster than they really are, their estimates being very largely guess work, and it would be interesting to have statistics as to what actually can be done in the way of really fast model running. Perhaps some of our readers who are model steamship owners will give their vessels some accurately-timed runs, and let us know the results.

* * *

The entries for our Competition No. 18, though not so numerous as usual, include some very good work, and are now under consideration. As the subject set was a more complicated one than the usual, and involved a good deal more work on the part of the competitor, a longer time is necessary to give the entries the careful examination they deserve; but we hope to announce the result in our next issue. We might, perhaps, point out that as Messrs. Swete and Lyster, who originally offered the prizes in this competition, have found themselves unable to carry out their promise, we ourselves have assumed the responsibility for the amounts offered.

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. 21.—A prize of the value of £2 2s. is offered for the best description and drawings of a small electro-motor, to work from continuous current supply mains at 60, 100, 110, 200, or 220 volts. The output of the machine should be about 1-10th h.-p. actual, suitable for working light machinery, a fan, or sewing machine, without heating. The particulars should include a description of the method of making patterns for all parts required to be cast, the best way to machine the parts, the construction and winding of the armature, and suitable windings for each of the voltages mentioned above. The article should also include details of the starting and controlling mechanism, and it is desirable that all details, at all events, be drawn full size. The usual general conditions apply to this Competition. The closing date for receiving entries is June 15th.

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.

For the general conditions governing these Competitions see page 210 in the last issue of THE MODEL ENGINEER.

Answers to Correspondents.

"D. J. D." (Queensland).—Our publishers have sent you Vol. V as requested. If you wish to purchase goods from our advertisers, you can either order direct, enclosing post office money order, or, to save sending a number of small remittances, you can, if you prefer, send us the total amount together with a detailed list of the goods required and the names of the firms supplying same, and we will distribute the orders and money for you. If this is done, an extra amount of one shilling in the pound should be included to cover our postage and incidental expenses. We shall be glad to have photographs and description of your model loco when completed.

"W. S." (East Griqualand).—If you will peruse our little handbook—"The Slide-Valve Simply Explained," we think you will have no difficulty in setting the slide-valve of the present and any future model engine you may make. The matter is rather too long to explain by correspondence.

"R. D." (Glasgow).—We are pleased to hear from you again and think your industry in your hobby is very praiseworthy. We should like to have a photograph and description of your models when completed.

"J. B." (Ayr).—Thanks for your interesting letter. We will bear in mind your wishes as to articles on lathe matters and see what can be done. Glad to have so good an opinion on "Practical Lessons in Metal Turning."

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.]*

Painting Model Locomotives.

To the Editor of *The Model Engineer*.

Dear Sir,—Anent answer to Query 5684, "Paint for Models," I can give your readers the latest tip.

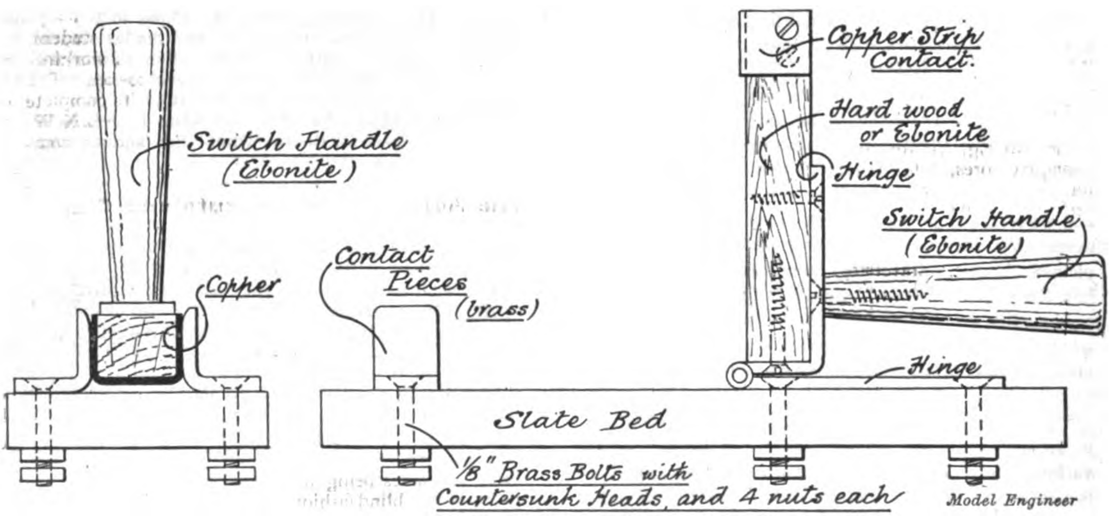
Maurice's Porceleine Company will make up any special shade for 5s. I have just got the *real* Midland Red, made by them. "T.T." can get from the Porceleine Company a tinlet of their "Hibernian Green" for 7d., which appears to be the sort of thing he requires.—Yours truly,

Glenties. (Col.) W. Hamilton.

How to Make a Simple Double-Break Switch.

To the Editor of *The Model Engineer*.

Dear Sir,—It may be of interest to some of your readers to know how to make a simple but reliable switch for small switchboard work.



A Simple Double-Break Switch. (Full Size.)

"A. H. W. (Toronto).—A number of very simple models suitable for beginners are described in our two sixpenny handbooks—"Simple Electrical Working Models" and "Simple Mechanical Working Models." We also frequently publish articles intended for beginners, although they may not be so labelled. As recent instances of this, we would quote the articles on "A Simple Working Model Locomotive," by Mr. Greenly, "An Invertible Electric Night-Light Set," "Home-made Dry Batteries," "Hints for the Amateur Boiler-maker." We have some other elementary articles in hand for early publication.

"R. H." (Bury).—See the article on the subject in our April 1st impression.

"J. T. J." (Manchester).—See editorial remarks in this issue.

"A. G. K." (Worcester Park).—Thanks for your offer of photographic help. If there are a sufficient number of volunteers forthcoming, we will publish a list.

I do not think the sketch needs much explanation, but the main point about the switch is the employment of a hinge of the type used for writing desks—long and narrow. One arm of the hinge is bent up at right angles to take the switch arm, as clearly shown in the right hand view. This bending must be very carefully done, or the metal may be cracked, and it will be safer to soften it first by heating to redness and quenching in water. The switch arm is secured, as shown, and bears a copper strip, very carefully fitted round three sides, at the outer end. The screws used to secure this strip must be well countersunk. Two L-shaped contact pieces of stout brass should be nicely fitted, so that the copper piece slides down with a certain amount of friction between them—making good contact, in fact. The little bolts which secure the brass contacts to the base act also as terminals—no current, of course, passes through the hinge portion of the switch. A slate bed is best, but for small installations other materials may serve, the principal point to remember being that any material liable to warp may quite spoil the "set" of the contacts and perhaps render the switch useless.

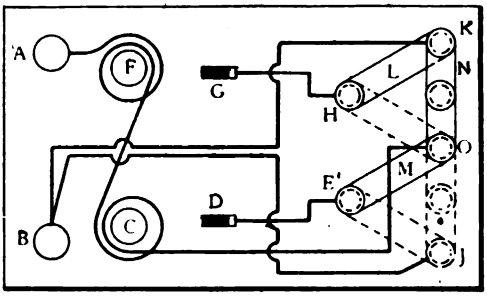
If made about the size given in the illustration, this switch could be safely used for currents up to 10 ampères at low voltages.—Yours truly, C. N. T.

Ardingly.

A Simple Reverser for an Electro Motor.

To the Editor of *The Model Engineer.*

Dear Sir,—The accompaning diagram shows a simple reversing switch for model electro motors of the ordinary series-wound type.



Model Engineer

A Simple Reverser for an Electro Motor.

In the drawing, AB are the battery terminals, CF the field-magnet cores, DG the brushes, and LM a double switch, the two brass arms L, M, being held together by a piece of ebonite (N).

To one of the battery terminals (B) two wires are fixed—one running to K and one to J; the wire from the other terminal, after traversing the field magnet cores, goes to O, and the brushes are connected up to H and E.

When the switch is in the position shown, the current will flow in one direction; but when it is in the position shown by the dotted lines, the current will flow in the opposite direction in the armature, which will then reverse its direction of rotation.—Yours truly, J. H. Hyde.

Stratford, E.

Licenses for Motor Bicycles and Cars.

As we have had several enquiries from readers who are interested in motor work on the subject of the amounts of duty to be paid for the privilege of owning a car or bicycle, we have had the following information prepared to indicate the costs of licenses for the different types of vehicles in use.

A motor bicycle is subject to a charge of 15s. per annum. A motor tricycle pays the same license of 15s. per annum. A trailer, drawn by either bicycle or tricycle (motor propelled), requires a two guinea license. In the event of a user taking out a 15s. license and afterwards adding a trailer, he may have the license exchanged by paying the difference of 27s. A quadricycle is subject to a charge of two guineas. A rider, having paid the 15s. license of a bicycle or tricycle, and afterwards going in for a quadricycle, may pay the difference on exchanging licenses. Motor cars of the voiturette class pay a two guinea license where the weight does not exceed one ton; from one to three tons the duty appears to be three guineas, but the matter is not clearly defined as to whether, in the case of large cars, the Locomotives Act of 1896 applies, or the Customs and Inland Revenue Act of 1888.

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.*]

Developments in Locomotive Practice. By C. J. Bowen Cooke. London: Whittaker & Co., 2, White Hart Street, Paternoster Square, E.C. Price 2s. 6d. Postage 2d.

This little volume by the author of "British Locomotives," Mr. C. J. Bowen Cooke, one of the assistant superintendents in the locomotive department of the L.N.W. Railway, is really two lectures upon "Recent Developments in Locomotive Practice," read before the Royal Engineers' Institute, and now reproduced in book form. Upon reading it, however, in the latter state, it does not strike us as being so good as it might be, although it was, no doubt, of excellent value as a lecture, and was very well appreciated by Mr. Cooke's audience at the R.E. Institute. We also think that, upon publication, some of the drawings should have been executed in a more workmanlike manner, and more fully dimensioned. To give an idea of the recent development of the locomotive, a few complete working drawings of modern examples might, with much advantage, have been introduced amongst the plates. In spite of these defects the book, with its 75 pages, 12 plates, and 52 illustrations, will give the student, at a small cost, a good idea of the construction, working, and repairing of the railway locomotive of to-day. The work includes results of dynamometer tests, with complete diagrams, of express and goods locomotives of the L.N.W. Railway, and deals with, in detail, the various component parts of the machine.

The Aeronautical Institute and Club.

At the monthly general meeting held at St. Bride's Institute, Ludgate Circus, E.C., Mr. Wm. Dick in the chair, papers were read by Dr. Barton, of Beckenham, and Mr. P. L. Senecal.

Dr. Barton said that he had been engaged some twenty years in balloon designing, and his present model was the outcome of many experiments. The prominent features of this—the three sets of triple aeroplanes—he explained would obviate the loss of gas and ballast; 970 lbs lifting or depressing force could be exerted at will. The propelling arrangements consisted of sets of double-bladed screws (the blades being further trip'ed one behind the other, Venetian blind fashion), arranged three on each side in different planes. They are to be driven by three "bucket" motors, each of 45 h.-p., which it was estimated would drive the airship 25 miles per hour in a calm. Petrol would be carried for a 48-hour run, and the balloon would be manned by a crew of five. The length of the balloon will be 180 ft., and the car 104 ft. The latter is fitted with an automatic balancing device actuated by a pendulum.

Mr. Senecal prefaced his paper with a short account of some early attempts to solve the problem of flight. He had paid a great deal of attention to the problem of the stability of bodies in air or water, and gave the meeting much data. He described the balancing devices with which flies are provided by nature. Mr. Senecal claims to be the first to direct attention to the latter, which he did some years back in a paper read before the Aeronautical Society of Great Britain.—Hon. Sec., O. C. Field, 20, Adelaide Road, Brockley.

Do not use paraffin wax for dynamo windings, the wire being liable to heat up during working and to melt the wax. Shellac varnish is the best for this purpose.

Queries and Replies.

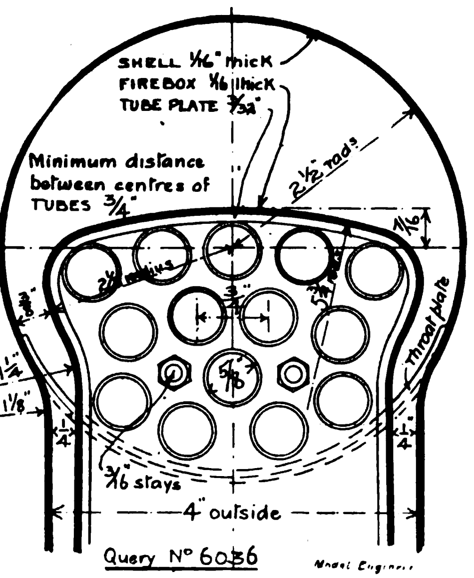
[Attention is especially directed to the first condition given below, and no notice will be taken of Queries not complying with the directions therein stated.

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 :—

[6036] **Boiler for Model L.B. & S.C.R. Locomotive, "Emperor."** A. H. T. (Cranleigh) writes: I intend shortly to commence building an inch scale model of the L.B. & S.C.R. express engine "Emperor," and enclose herewith a drawing showing the general appearance of same. I shall be greatly obliged if you would answer the following queries in reference to same—(1) How many tubes (and what diameter) can I get into the boiler, which will be 10 10-12ths ins. by 5 ins.? (2) What would be the total heating surface? (3) What would be the correct diameter of the cylinders?

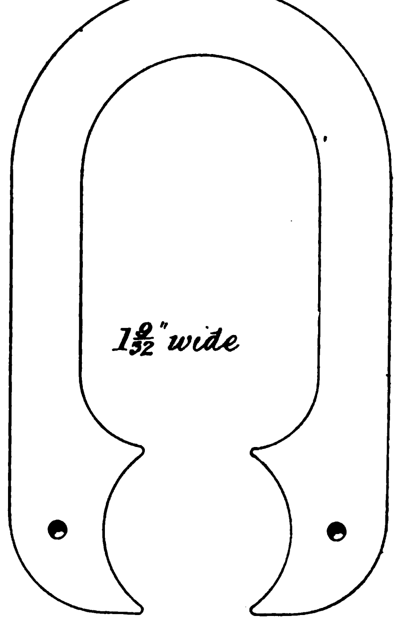
We give below a drawing of about best arrangement of tubes and tube-plate possible for your locomotive. If the firebox is placed on top of the frames its width can be 4¼ outside, when some other arrangement of tubes may be possible. Tubes should



not be less than 9-16ths or greater than 11-16ths outside diameter. The heating surface of tubes would be within a fraction of 300 sq inches. For an inch scale locomotive this is the minimum *total* heating surface advisable, so you will see that with the heating surface of the firebox (some 100 sq. inches) added, you will have ample for cylinders of 1⅛ ins. by 2 ins., or even 1 1-16th ins. by 2 ins., stroke. This latter dimension should *on no account be exceeded*, and only used if you employ water tubes (either cross tubes or field tubes) in the firebox, and two Primus No. 5 (three inch) burners. For continuous steaming you will find that 1⅛ by 2 cylinders will give the better results. The boiler should be well made, and capable of working at 50 lbs. per sq. inch. When using smaller driving wheels the cylinders should be reduced, for 6-inch wheels, 1⅛ by 2 is about the maximum; for wheels of less diameter than 6 inches, 1 by 2 is the largest size which should be employed. In your case, where the drivers work out to 6¾, a larger cylinder than otherwise could be used successfully. In place of 1 3-16ths by 2 stroke, 1¼ by 2⅛ is a very good proportion. A system of staying roof of firebox is given in the recent L.T. & S.R. article (Jan. 1, 15, and Feb. 1), which, by the way, will be found useful in other matters.

[6039] **Dynamo with Permanent Magnet.** D. W. B. (Albany, U.S.A.) writes: I have a permanent magnet, size 3⅛ ins. long by 2 ins. in height, core 1 in. in diameter, as shown full size in the drawing herewith. (1) How had I better place magnet—horizontal or vertical? (2) Amount and size of wire to be used on magnet? (3) Amount and size of wire to be used on armature? (4) What kind of armature should I use? (5) How should I wind armature and magnet? (6) What would be output of dynamo? (7) Used as a motor, what speed would it attain and h.-p.? Please answer above questions and add other information that you think I would require.

It is a very difficult matter to answer your queries satisfactorily, since it is evident from their nature that you are not well acquainted with the subject. Before you attempt to do anything with the machine, you should read up the subject, as it would be impossible for us to make all the points clear in the space available in THE MODEL ENGINEER. You do not state what kind of output you expect from the machine, and, under the circumstances, we can only give you brief replies to each of the queries, and must ask you to make the best of them. (1) It is immaterial. (2) If the magnets are of the permanent type, they do not need



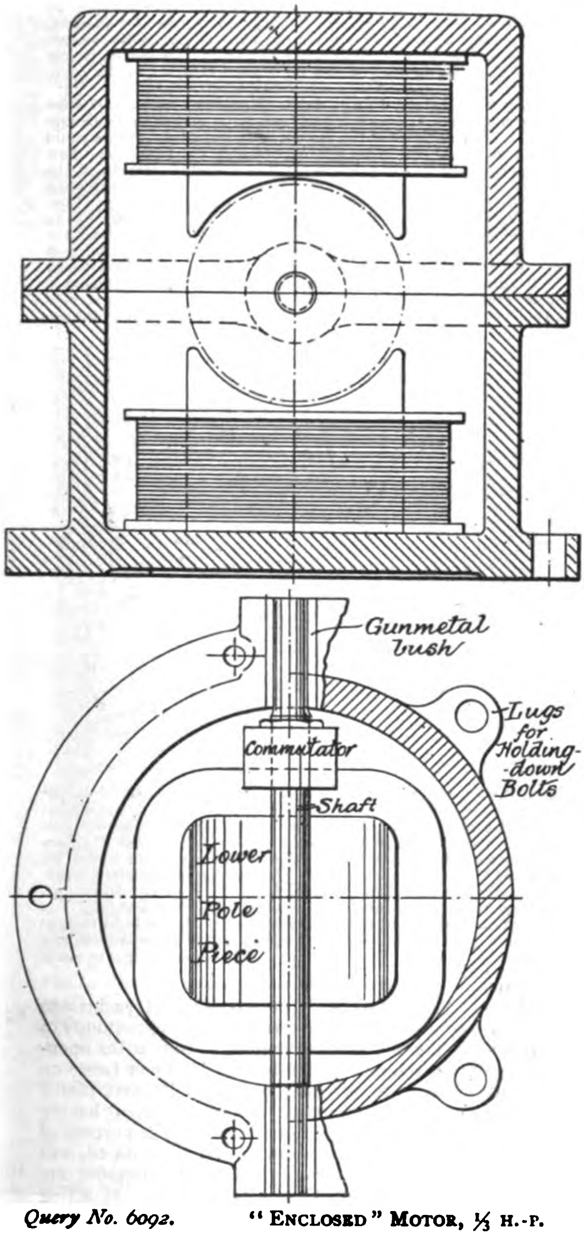
Query No. 6039.

PERMANENT MAGNET FOR DYNAMO. (Full Size.)

any wire wound on them. (3) Wind the armature full of No. 30 wire, about 2 ozs. would be required. (4) A simple H armature should be used. (5) This type of armature is wound lengthwise. Please refer to our little handbook—"Small Dynamos and Motors," for the method of doing this. (6) The dynamo would probably light a small 10-volt 2 c.p. H E. lamp, if run at 4000 revolutions per minute. (7) It would run at 2000 or 3000 revolutions per minute if driven from four bichromate cells, but the horse-power could not be estimated.

[6092] **Electro Motor, ⅓ b.h.-p.** H. E. (Eecloo, Belgium) writes: I wish to construct an electric motor to drive a 5-in. back-geared screw-cutting lathe, and should be very glad if you would let me have a reply to the subjoined questions. I should prefer the motor to be of the "Ironclad" type, with a tooth drum armature, and to work with a current of 110 volts from an electric lighting circuit. I trust you will excuse the rather "large order" involved in the answering of these questions—(1) How many ampères will the motor use? (2) Dimensions of field-magnets? (3) Dimensions of armature and number of sections? (4) Should motor be shunt or series wound? I understand, in a dynamo, the advantage of shunt over series winding; but what is the corresponding advantage in a motor? (5) Quantity and gauge of wire for field-magnets and for armature, for shunt or series winding, as the case may be.

Of course, lathes vary as regards the power required to drive them, and as this also depends upon the work being done, no exact figure can be stated as the right horse-power. Probably a motor capable of a continuous output of ⅓ h.-p. would be amply powerful, and the following are details of such a machine. We need hardly say that a motor to run on a 110-volt circuit must be of unexceptionable construction, and should be protected by the usual starting resistance and fuses. (1) About 3⅔ ampères at full load. (2) The drawing shows the motor one-third full size. This field-magnet is of the cylin-



Query No. 6092. "ENCLOSED" MOTOR, ⅓ H.-P.

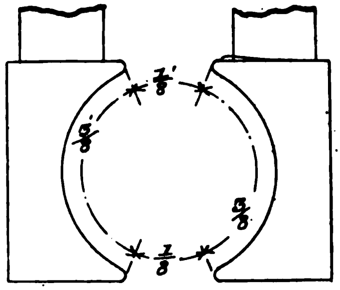
drical type with poles top and bottom inside, both of which are to be wound with exciting coils. (3) Armature 3⅛ ins. diameter, 3 ins. long. It should have 24 slots, ⅛ in. × ⅜ in., drum type, but a ring armature would be easier to get in a machine of this type. (4) This is too big a matter for discussion here. All that need be said is that a series-wound machine will best suit in your case. (5) The wire for field-magnets will be 5 lbs. No. 18 D.C.C. wire, and that for armature 18 ozs. No. 24, wound in 12 sections.

[6096] **Manipulating Gas Engine.** J. T. (St Ives) writes: I have a gas engine, 1 h.-p., 8 ins. stroke by 4 ins., and cannot get it to work. There is no maker's name on it. I enclose sketch (not reproduced). I have tried ignition tubes, 5 ins., 6 ins., 7 ins., 8 ins. and 9 ins. long, ½ in. inside diam. The hole in casting for tube is screwed to ⅜ in. gas thread. What can I do to make engine work? The compression is good. I get tube hot enough, so that if I turn out gas and again turn on it lights without a match to it. I have turned on gas to engine from a little to full on, but without the slighest effect in its working. The inlet valve is automatic.

We indicate below the remedies of possible defects. Not being able to inspect the engine, of course there may be something wrong with it which we cannot, upon the information given, diagnose. Although faulty compression does not seem to be the cause of failure in your engine, the remedy is obvious, only you must find out where the compressed mixture escapes. Perhaps in your case the compression, although you think it good, is not high enough to cause an explosion. See that valves are ground in and perfectly tight. The following is the usual method of testing the ignition of a gas engine:—The proper position of the chimney, or rather of the Bunsen burner, must be found by trial; if the engine will not work, *i.e.*, if no explosion takes place, the ignition-tube is heated too high (unless the gas and air is not properly mixed; see below). Loosen the set-screw which holds the chimney to the bracket, and lower the burner with chimney ⅛ in. at a time, until you get an explosion: then fix the chimney in this position permanently. Should an explosion take place before the piston has completed the compression stroke, *i.e.*, should the engine "fire back" then the ignition-tube is heated too low. Raise the chimney till you get the explosions at the right moment. It is advisable to always turn the gas of Bunsen off while these alterations to the height of burner are made, and thus allow the ignition tube to cool down. See that all passages are clear, and that the valve stems are clean and work freely. You may have a weaker spring than advisable fitted to the inlet valve; or, on the other hand, it may be too strong. The mixture of gas and air should be as 1 to 6, and must be found out by trial. Turn on gas supply tap about three-quarters full and give engine a few turns rather quickly, holding the admission valve open; then let this close up; continue turning the engine. If the mixture is right, and all other conditions fulfilled, explosion should take place and continue doing so at every second revolution. If explosions occur and the engine afterwards stops, not enough gas is admitted; if no explosion takes place, too much gas is drawn in. While the engine is running, open the gas tap a little more, when the power and revolutions will increase, and *vice versa*. Referring again to the spring of the admission-valve, should the spring exercise a stronger pull it would not allow the valve to open sufficiently, in which case hardly enough gas and air would be admitted into the cylinder. If you are unable to judge the strength of the spring you could find out whether enough gas and air is being drawn in by the following means:—Put piston of engine in the position which it would take at the beginning of its first or intake stroke; draw in gas and air, *i.e.*, make the first stroke; open the exhaust-valve by pushing the exhaust-valve stem in; apply a lighted match to the mouth of exhaust-pipe and turn the spindle back, which causes the piston to push out the charge through exhaust-pipe. If this charge lights up you get sufficient gas and air through the inlet valve. If not the spring is too strong, and must be weakened by cutting off one or two spirals. A weak spring may allow some of the charge to be driven out by the retreating piston during the first part of the compression stroke, the sluggish action of the spring keeping the valve open until the exit of the mixture attains a speed which, by its outward rush, shuts or helps shut the valve. The spring of the exhaust-valve may not be of sufficient strength to make the valve close readily upon the release of the lever, and if this is so the valve may be allowing air to enter during the admission stroke.

[6098] **Undertype Dynamo (50 to 60 watts).** J. S. (Battersea) writes: I wish to make a small dynamo, as in the diagrams enclosed. Will you kindly criticise following particulars? The armature is 1¾ ins. by 3 ins; drum (laminated), wound 45 yds., No. 22. B.W.G. 8 sections; F. M.'s cast iron (series wound) 36 yds. 18 B.W.G. (18 yds. each limb, making about 3 layers); speed about 2,700 revs. per minute. What would be the output in ampères, volts, and candle-power? What would be the largest size accumulator it could efficiently charge? Any information, suggestions, etc., will be gratefully received and acted upon. May I suggest as one of THE MODEL ENGINEER Handbooks one on "Designing and Making Small Dynamos and Motors"?

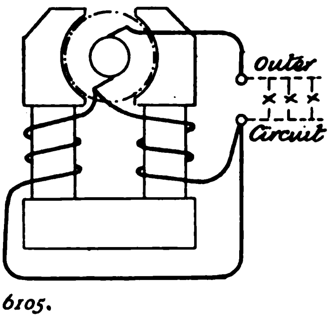
Your design embodies some of the most common faults met with in small machines. In the first place, although you recognise the necessity of an ample cross-section in the field-magnet cores, you make the yoke only about half that section. It should be *at least* as thick as the cores. With regard to the pole-pieces, these approach a little too closely. A fairly safe rule is to make the arc of the pole-pieces embrace about ¾ of the circumference of the armature, as shown in our sketch. Also the tips should be made rather thin, instead of ⅛ in. thick, as you make them. If you make these alterations you can expect a good result from the machine. The field-magnet winding is insufficient. Six layers (about 2 lbs.) of No. 18 are required—of course, to be connected in series. The armature winding will do, but, theoretically, a machine of this size would carry a heavier winding—say 5½ lbs. No. 22, with a corresponding increase in output. However, with the present armature and above-mentioned alterations, you should obtain from 2 to 3 ampères at 30 volts, when running at 3000 revolutions per minute, and 20 volts at the speed you specify. At the higher rate the c.p. of the machine would be about 10 to 20. The number of cells in series which can be charged from the dynamo depends upon the voltage. It is necessary



Query No. 6098.

to allow 2·5 volts per cell, so that at 30 volts 12 cells can be charged. The usual charging rate is 4 ampères per square foot of positive plate surface, so that allowing 2 ampères as the output, your cells should each have plates amounting to 72 sq. ins. surface. This would be the case with cells having one positive and two negative plates, 6 ins. by 6 ins, and this is the *minimum* size. You can, of course, make the cells as much *larger* as you like, and will not lose any efficiency by so doing. We are obliged for your kind expressions, and can assure you that we endeavour to help every reader as far as we possibly can. You will, of course, have seen by now the advertisement of our new book—"Small Dynamos and Motors." This is intended for those who cannot go through the mathematical part of dynamo designing, and to that end it gives the actual "lines" of a number of types of dynamos for 10, 20, 30, 40 watts, and so on up to 500 watts output, with windings to suit each case. We think you will find it a really practical little book.

[6105] **Dynamo and Accumulators.** T. C. P. (Burton-on-Trent) writes: Will you be good enough to answer the following queries? (1) I have a small dynamo wound for 50 volts, but I wish to rewind for 100 volts. Armature core is a drum made of laminations and is 6 ins. long 3 ins. diam., and I think of winding 2 lbs. of 22 wire, which should give 100 volts and 4 amps. I want to wind fields for series, as I want full output all the time she is running. Machine is overtype; pole-pieces, or rather winding space is 1¾ ins. thick 4⅛ ins. wide and 4⅛ ins. deep. I have plenty of 18 gauge wire; how much is it necessary to put on fields? (2) I wish to run three 5 c.-p. lamps through the night, say nine hours,



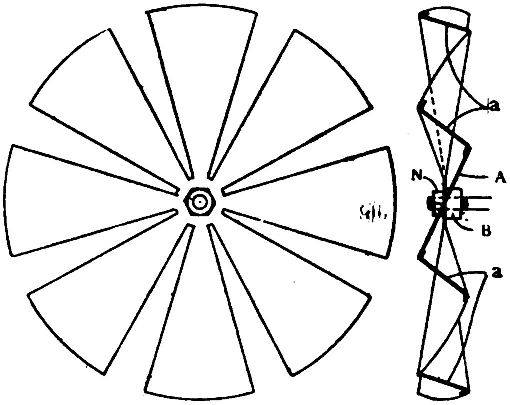
Query No. 6105.

and I wish to construct accumulators that will do the work well and with little trouble. I work it out thus: 15 c.-p. requires 60 watts; 60 watts require 5 ampères at 12 volts, which should be supplied easily by six cells with 1½ ft. superpositive plate in each cell. Will you tell me if this about right? (3) If I make up accumulators with red lead and litharge, that is red lead for one and litharge for the other plate, what is the probable length of first charge, and is it bound to be continuous, or would it do if switched in for two or three nights while light is running? I have read somewhere that it must be one continuous run until charging is finished. With 25-volt dynamo, how must I reduce voltage to charge six cells?

(1) The proposed winding is rather too heavy. About 1⅛ lbs. No. 22 should give the required 100 volts. To wind the field-magnets in series with your No. 18 wire the plan shown in accompanying sketch should be adopted. 9 lbs. of the No. 18 wire should be used, 4½ lbs. on each limb. The two coils are connected in parallel with one another. (2) With regard to the accumulators, your calculations are correct, and the cells, if of good make, would run the lamps well for the time. We should advise a somewhat larger battery, to avoid running the cells down too far. (3) The first charge should never be less than 12 hours, and the cells should not be discharged but go on charging at the earliest time until quite 24 hours charge has been given. It would be best to give the 24 hours charging right off, but the above method will do. (4) To reduce the voltage to a suitable figure a resistance should be introduced. You should provide an ammeter in the circuit if the exact current is required to be known. If the cells in No. 2 are those to be charged, they should receive a maximum current of 6 ampères. In all probability you would find a resistance of 4 yards No. 24 iron wire a suitable amount in this case. Part of this should be cut out, as the charging goes on and the "back E.M.F." of the accumulator rises.

[6149] **Ventilating Fan.** A. R. (Rochdale) writes: (1) How would you make a fan for a ventilator to be worked by an electric motor? The diameter of the fan not to exceed 8 ins. Where could I get such a fan? (2) What size of motor should I need, and how much would the cost be? (3) What would be the strength of the current required to work the motor and fan? The building to be ventilated will be about 14 ft. by 7 ft.

(1) You can make the fan very easily by cutting out some No. 26 or 28 gauge hard brass sheet as here shown (half size). Bend the blades to the angle shown in the side view, the blade A being at about the correct angle, viz., from 20 to 25 degs. The blades may be steadied one to another by pieces of brass wire, *aa*, soldered to them, or rings of wire may be put on each side of fan, being secured to each blade. The middle of fan is strengthened by a little brass



Query No. 6149. VENTILATING FAN.

bush B, soldered or brazed on and drilled and tapped to run on the end of shaft as shown. A nut on the other side, N, acts as a lock-nut and secures the fan. We do not know whether these little fans can be bought separately from the motors, with which they are usually associated. (2) A very small, well-made motor would do. It should have a laminated drum or ring-wound armature, somewhere about 1½ ins. diameter × 1½ ins. long, if of the drum type. You must consult the catalogues of advertisers for prices. (3) You omit to state the source of supply current. This is important, as there is a great difference between public supply and private supply (from battery, &c.). The amount of energy required might be about 30 or 40 watts.

MODEL YACHTING AT ILFORD.—Model yachtsmen in the Ilford district will have an excellent opportunity of seeing a display of their own and other craft at the opening regatta in the new "South Park" (Green Lane) on May 10th. We are informed by Mr. P. Bennett that a club is in course of formation, substantial support having been obtained and a committee formed for the purpose of enrolling members. The subscription, it is stated, will be a merely nominal amount, and those interested are urged to communicate with Mr. Bennett, who is acting as Hon. Secretary, *pro. tem.*, at 60, Balfour Road, Ilford, Essex. The lake in the new park will present a gay appearance on the opening day, and many of the yachts belonging to members of the Highgate Club will be present as well as those of the local yachtsmen.

A Trial Run was recently made with a steam omnibus which has been constructed by the Thornycroft Steam Wagon Company, Ltd., Chiswick, for the Belfast and Northern Counties Railway Company. The motive power of the omnibus is on the ordinary locomotive principle, with various modifications. The omnibus holds 14 persons. Welsh coal is used, and 5 cwt. suffices for a run of 50 miles; but a fresh supply of water is needed about every 20 miles. A speed of 12 miles an hour can easily be obtained, and the trial from the Automobile Club, Whitehall Court, to Hampton Court showed that the vehicles can be steered with ease through crowded or narrow streets, that it runs with smoothness, and that when stationary there are none of the tremors associated with ordinary motor-cars. Some double omnibuses, says the *Mechanical Engineer*, carrying 36 persons inside and out, or 10 more than the ordinary London horse omnibus, have been built on the same principle by the Thornycroft Steam Wagon Company for the London Road Car Company, and are already being worked by them.

Amateurs' 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.*

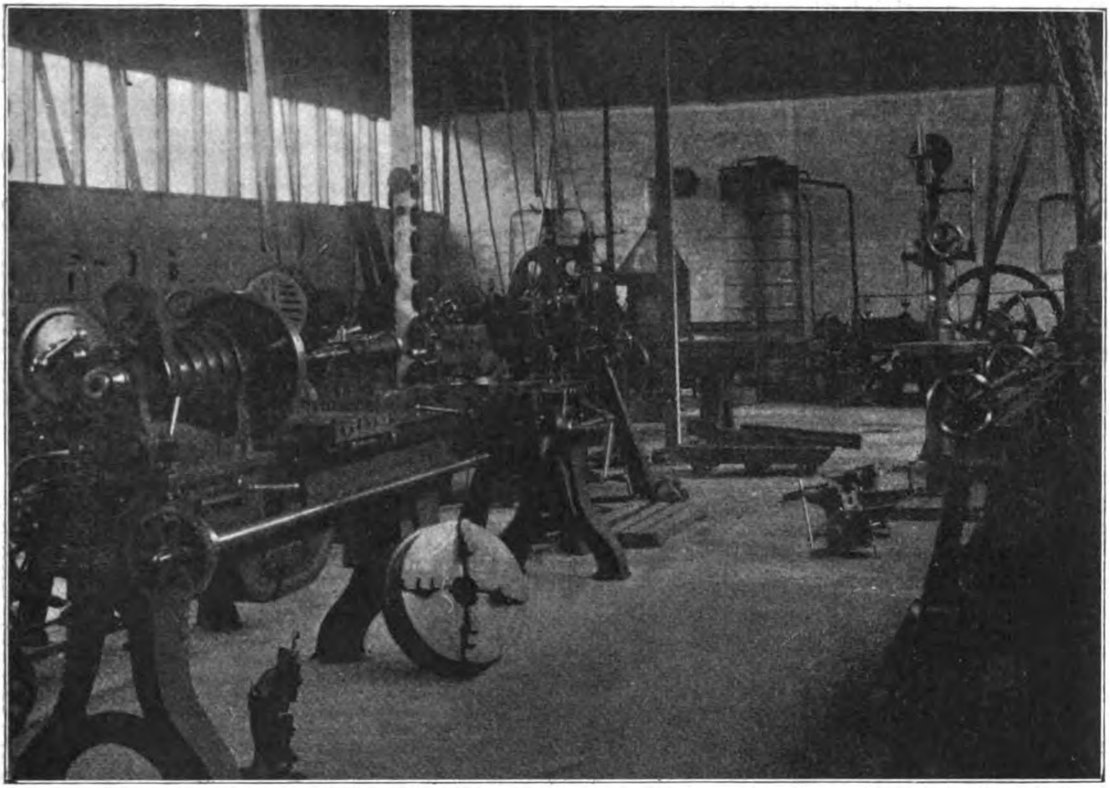
**Reviews distinguished by the asterisk have been based on actual editorial inspection of the goods noticed.*]

Coronation Illuminations.

Appropriate devices for Coronation purposes will be in great demand for a few weeks, and it will be of use to some readers to know where they can be procured. Messrs. J. T. Lowke, 18, 19, and 20, Kingswell Street, Northampton, are supplying well-made apparatus for this purpose, consisting of gas-burning devices of various kinds, all properly constructed with Bray burners and finished in a substantial manner. The apparatus is on a new principle, which ensures an even and steady illumination over the whole of the design. Prices and designs will be submitted on receipt of requirements, The Model Engineer being mentioned when writing.

Enlargement of Premises.

When a firm has to move to much larger premises, it may be taken as a healthy sign. Messrs. Drummond Bros. have done this, and have also become a limited company, owing to the very considerable increase in their work. These alterations, combined with an augmented plant and staff will shortly enable the firm to keep pace with their orders and supply from stock. We are glad to be able to illustrate a portion of the new works, in which machines of the most suitable kind have been installed for the manufacture of the lathes and planing machines which form Messrs. Drummond Bros.' specialities. The new building is right on the main road, but the address remains unaltered and all enquiries should still be directed to Pink's Hill, near Guildford, Surrey. Messrs. Drummond Bros., Limited, inform us that they have some interesting novelties which they will shortly be placing on the market.



A Portion of the New Works of Messrs. Drummond Bros., Ltd.

*Castings for Model Midland Locomotives.

Those readers whose favourite branch of miniature engineering is model locomotive making, should take advantage of Mr. F. A. Thomassin's latest production, which takes the shape of castings and parts for the construction of a model "Midland" single-wheeled express locomotive. The scale of the engine is ½ in. to the foot, with a gauge of 3 ins. With a view to spreading the outlay for materials over a longer period, the castings are obtainable in three sets—comprising (1) frames and appurtenances with wheels; (2) cylinders and all motion details; (3) boiler parts and fittings complete. Mr Thomassin, whose address is Broadway, Streatham, has sent us set No. 1, and a blue-print of the drawings supplied. In point of number, the parts are very complete. The frames are cast in brass, a method of construction of which we, in common with many others, do not approve; but, however, those of the bogie truck, judging from the sample, are capable of easily being finished with less trouble than making up from plate in the usual way. A list may be had by sending a stamped envelope to Mr. Thomassin, giving particulars of the component parts supplied and the prices.

Cheap Electrical Lines.

A "clearance sale" of electrical goods does not often come in the way of the amateur. Such, however, is in course of progress at Mr. Archibald J. Wright's Electrical Works, 318, Upper Street Islington, London, N. A special list of new and second-hand goods is to hand, and gives the reduced prices of bells, indicators, pushes, alarm clocks, wires, switches, batteries, dynamos, and motors, telephones, lamps, and even phonographs. Possibly this list does not comprise *all* the details offered, but it is sufficiently comprehensive to indicate the variety of goods obtainable at advantageous terms. Readers should not delay sending a stamp for this list, and should, at the same time, quote the name of this journal.

*A Novel Vice.

A patent vice, which combines in the same tool a number of useful adaptations is here illustrated. In its simplest form it appears as in Fig. 1, from which it will be seen that in addition to the usual moving jaw, the other jaw is also adjustable along a toothed rack which gives an opening of 12 ins. if required, as shown in Fig. 2. This loose jaw can be entirely removed when the top surface of the vice becomes an anvil having a surface 11 ins. by 3 ins. By a further adjustment of the jaws, pipes can be firmly held for cutting or screwing, and again by the addition of two extra parts a drilling machine is obtained, able to do heavy work with ordinary square shank brace drills, with hand-feed. This arrangement is indicated in Fig. 3 where an ordinarily difficult job is being drilled without any special trouble. We have examined one of these vices and are satisfied with its strong and sound construction. It should prove a useful tool for country shops especially, and amateurs who have occasional heavy work would also find it

FIG. 1.

FIG. 2.

a good investment. Enquiries should be directed to John S. Moffatt, Tool Merchant, Hexham, THE MODEL ENGINEER being quoted at the same time.

Catalogues Received.

The Silver Queen Cycle Company, Limited, 18L, Gray's Inn Road, London, W.C.—The cyclist who is looking out for a new mount should consult the catalogue of "Royal Ajax" and "Silver Queen" Cycles issued by this firm. It will be sent to any reader of THE MODEL ENGINEER, post free, on application. Cycles of every grade are listed and are all guaranteed. They can be had on a strictly private system of monthly payments, which will doubtless be a boon to a number of people. Issued by the same firm is a little booklet of "wrinkles" which cyclists will find handy. It is called the "Cyclist's Enquire Within," and will be sent free on application.

Stuart Turner, Shiplake, Henley-on-Thames.—It will be remembered that an excellent class of vertical model or small-power steam engines is the speciality of this firm, one of these types being arranged to drive, direct, a small multipolar dynamo by Mr. A. H. Avery. We are glad to announce that this combination has proved extremely satisfactory, the No. 2 Stuart engine (2 ins. bore, 1½ ins. stroke) driving an 80-watt dynamo easily, being 4 amps. at 20 volts, speed 1,200 revs. per minute. This should prove a popular model amongst those who want a practical installation and yet require it to be neat and self-contained. Either castings or finished engines and dynamos are sold, and it should be remembered that apart from turning the flywheel, all the machining can be done on a 3-in. lathe.

J. Christopher & Sons, 35 and 35B, Clerkenwell Road, London, E.C.—Almost everything in connection with belt, pulley, and shafting requirements is sold by this firm of leather belting merchants. Their excellent catalogue comprises, in great variety, hydraulic packings, belt fastenings, lubricators, oil cans, and drip trays, shafting in all sizes, plummer blocks and hangers, pulleys, and all kinds of tools in connection with such work. This list should be invaluable to the machinist, whether in large or small work, and it will be sent free to MODEL ENGINEER readers who post two penny stamps to Messrs. Christopher & Sons to cover postage.

Clyde Model Dockyard and Engine Depot, Argyll Arcade, Glasgow, N.B.—Proof sheets of a new list, which will be ready before these lines are read, have been received from the Clyde Model Dockyard. In this list will be found particulars of some of the latest developments in model yachts, especially those of the "built" variety. They comprise straight keel bulb and fin, double fin, and other types, and look speedy craft altogether. Another part of the list is electrical as to its details, which include fan motors, reading lamps, cycle lamps, voltmeters and ammeters, and batteries. Many readers will be glad to avail themselves of this catalogue, which can be obtained by mentioning THE MODEL ENGINEER and enclosing a stamp for postage.

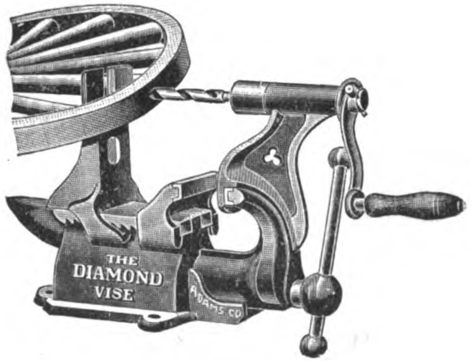


FIG. 3.—A NOVEL VICE.

Joseph Adamson & Co., Engineers, Hyde.—Particulars of some of this firm's excellent electric cranes are given in well-printed and carefully illustrated pamphlets to hand. One of these is descriptive of a 75-ton four-motor travelling crane, whilst the subject of the second leaflet is a 10-ton "Goliath" crane constructed for Messrs. Horsehay Company. Both are reprints from engineering journals and well illustrate the excellent services to which electric power can be turned for crane work generally.

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. VI. No. 74. JUNE 1, 1902. PUBLISHED TWICE MONTHLY.

An Acetylene Generator and Reservoir.

By J. McINTOSH.

AN apparatus to generate acetylene gas need be but a very simple contrivance, but if the supply of gas is to be delivered with regularity, and if the unused gas and carbide are to be stored for future use, the conditions become more complex. The carbide should be kept cool by being surrounded with liquid while generation is proceeding. The amount of gas generated should automatically adjust itself to the requirements of the burner.

The supply of water to the carbide or of carbide to the water should cease when the light is extinguished, and the quantity of gas generated after the light is extinguished should not be more than the generator will accommodate, and should only be sufficient to give an initial start when the light is again required.

When small quantities of water are allowed to drip upon a mass of carbide, or when a basket containing a mass of carbide is allowed to dip into a reservoir of water and immediately raised from it, the carbide becomes overheated, does not yield the full proportion of gas, and that which is generated is delivered in an impure condition.

The best form of generator on the market appears to be that in which small quantities of carbide are automatically delivered into a large body of water. Generators of this type are not well suited for home construction. The necessary valve can only be properly made under workshop conditions, and an imperfect valve is worse than useless: it is a constant source of annoyance, and even of danger.

An apparatus which the writer has designed meets the requirements laid down, may be constructed by anyone who can use a soldering iron or will be made by any tinsmith for a few shillings, and has proved itself reliable in use. It consists of three cylinders, all open at one end and all 12 ins. high. The respective diameters are 7 ins., 5 ins., and 3 ins. The outer cylinder has an overflow pipe and tap inserted 6 ins. from the bottom. It should be of at least ½ in. clear aperture in the tap, and may have a flexible tube leading to a sink or large pail.

The middle cylinder, which has the open end downward, has a gas tap fitted to the top. From this the gas is delivered, and it should be soldered in its place to ensure close joints. Three radiating arms with slots in them

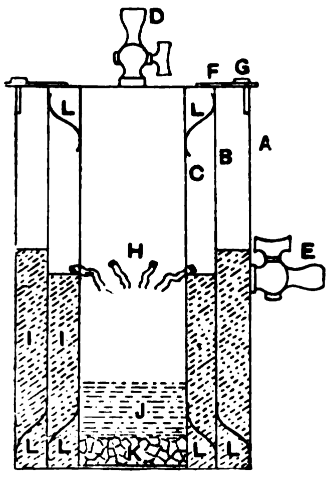


FIG. 1.—SECTIONAL VIEW OF THE GENERATOR.

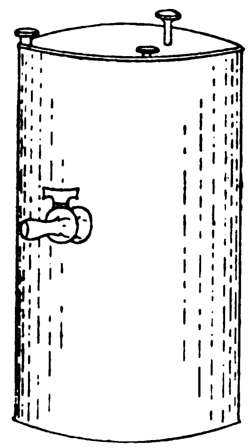


FIG. 2.

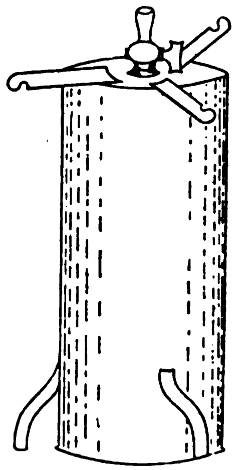


FIG. 3.

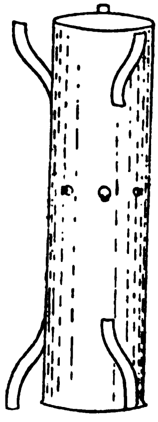


FIG. 4.

extend to the rim of the outer cylinder, and lock under flat-headed studs soldered to the latter.

The inner cylinder, which stands with its open end upward, has no fittings. Round the circumference are bored six holes about 1-16th in. diam., each about ½ in. above the other, and the lowest a little higher than the outflow tube in the outer cylinder.

If a quantity of carbide is placed in the inner cylinder, the parts put together, and water poured into the outer cylinder, the resistance of the air inside will prevent the water rising in the middle cylinder. As soon, however, as the gas tap is turned on, the water will begin to rise in the inner jacket, and if sufficient is fed into the outer cylinder it will flow through the small holes in the inner cylinder, and moisten the carbide. It will be found almost impossible to adjust the size of the holes so as to regulate the flow of water to that which is required. If made very small, the water will not pass through except under pressure, and if larger the flow of water will generate more gas than the burner can consume.

To overcome this difficulty, two or three strands of the cotton wick used in spirit lamps are twisted round a thin wire, a knot is tied at one end, and the other is thrust through the hole. The water will now enter by drips only, and if the delivery is insufficient for the burner in use the water as it rises will enter by the second hole, similarly fitted with wick, and so on till the sixth is reached, by which time the inflow of water will be sufficient for two or more burners of the largest type.

When the gas is generated in larger quantity than the burner can consume, the pressure drives the water below the level of the holes, and, of course, upward in the outer jacket. In practice, it is found that the water hovers at or just below the line of the inflow hole, and the gas is delivered under a pressure of a few ounces only, yielding a steady light, which does not fluctuate, but which burns with an even brilliancy.

From what has been said, it will be seen that the outer and the middle cylinders are locked together to provide the pressure which automatically regulates the inflow of water.

It may be objected, as has been done with other apparatus, that the locking of the middle cylinder constitutes a source of danger. Such fears arise from an over lively imagination. Under no circumstances can the pressure upon the gas exceed 5 lbs.

By way of experimentally proving this, the writer has on several occasions after generation has started turned off both the outflow tap and the gas tap, and allowed the water to rise to the top of the outer cylinder. On turning on the gas and igniting it, a larger flame than usual was obtained; the water, however, speedily sank to its usual level and the flame to its normal size.

So far it has been assumed that the water has been dripping upon carbide under conditions deprecated in the opening statement as undesirable. In the apparatus described provisions are made, however, to keep the carbide cool.

It is, of course, impossible to do so by covering it with water, but there are other liquids in which it may be immersed without decomposing it.

If the carbide is covered with methylated spirit, a slight generation of gas will take place till the water in the spirit is exhausted, after which the carbide will remain unaffected till more water is added. In doing so, however, the water quickly diffuses itself throughout the bulk of the spirit, and unless large quantities of water are added the gas is generated too slowly for practical purposes. If large quantities are added, the gas will continue to generate for hours after the supply of water has been cut off, and in the absence of an enormous reservoir a practical inconvenience is the result. Turpentine is equally useless, as it permeates the fibre of the carbide so intimately that the water cannot do its work.

In paraffin oil we have a liquid which meets the case exactly. It keeps the carbide cool, it protects it from moist air, and it permits the water to act the moment it is present.

A few practical instructions may now be given to ensure success in the use of the apparatus. The strands of cotton in the holes should be so adjusted that from three to four ounces of water will trickle through each in an hour. Approximate measurement only is necessary, as so long as the water is not allowed to pour in at the first starting the pressure of gas will speedily regulate the inflow. This being done, the carbide, from an ounce or two to a pound, is placed in the inner cylinder. It is well to experiment with an ounce only on the first occasion.

Sufficient paraffin is now poured in to cover it by an inch or so. The three cylinders are next placed in position and locked together, and the gas tap is connected to the burner with a flexible tube. The gas tap being open, water is poured slowly into the outer cylinder till it is level with the outflow tube, and, of course, as it is at the same level inside the middle tube, it will be a fraction below the level of the inflow holes in the inner cylinder. The water should be poured in slowly, to allow the air time to escape. The gas tap is shut off, as also the outflow tap, and another inch of water poured into the outer cylinder. The gas tap is then turned on, and the water will drip upon the carbide. As the gas is generated, it will escape from the burner mingled with air.

Although there is no danger whatever with a properly constructed burner, it is well to allow the combined gases to escape into the open air before applying a light. As soon as the gas is pure, it will continue to burn steadily till the supply of carbide is exhausted. If it is kept burning very long, another inch of water may be added to the outer cylinder to make up for that consumed by the carbide.

If it is desired to stop generating gas before the carbide is exhausted, turn off the supply tap and allow the water to rise by the pressure of the gas till it reaches the rim of the outer cylinder, and draw it off by the overflow tap. If the gas is again ignited, the pressure of gas will be relieved and the water will sink to within 3 ins. of the bottom. The gas should be allowed to burn out, by which time any moisture in contact with the carbide will have been absorbed. The taps may then be turned off and the apparatus put away with the certainty that the carbide will remain unaltered till a new supply of water is poured into the outer cylinder.

It will be found that the residues are nearly white in colour, and quite free from the black patches resulting from overheating.

As the apparatus takes to pieces, it is easily cleansed, and there are no concealed parts where unsuspected corrosion can take place. The writer's apparatus was made for him by Mr. Phillips, of 4, Compton Street, Clerkenwell, at a total cost of 8s. 6d., not including the flexible tube and burners. These last can be obtained through any oilman from Falk Stadelmann & Co., at from 1½d. to 2s., according to the pattern.

Following are the detailed descriptions of the illustrations shown on the previous page :—

Fig. 1: A, outer cylinder; B, middle cylinder; C, inner cylinder; D, gas tap; E, overflow water tap; F, arms (there are three of these) locking with G, the flat-headed studs; H, cotton wicks; I, water in the outer and inner jackets; J, paraffin oil; K, carbide; LL, light spurs to keep the cylinders central.

Fig. 2, outer cylinder, showing locking studs and overflow water tap. Size, 12 ins. by 7 ins. Open at top.

Fig. 3, middle cylinder, showing radial arms to lock with studs on the outer cylinder, and light spurs at bottom to hold the cylinder central. Size, 12 ins. by 5 ins. Open at bottom.

Fig. 4, inner cylinder showing spurs to hold it central, and inflow water holes with cotton wicks. Size, 12 ins. by 3 ins. Open at top.—*Photography.*

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, June 21st.—Visit to Mr. H. A. Bennett's House and Model Railway. Trains to Ashford from Waterloo (2.10 p.m.), and Richmond (2.35 p.m.)

Provincial Branches.

Bolton.—The third meeting of the Bolton Branch was held at 36, Gilnow Road, Bolton, on May 7th, eighteen members being present.

After the inspection of models and the discussion of various matters, the rules for the Society were read over and the officers for the session were appointed. The subscription was fixed at 5s. per annum, and an entrance-fee of 1s. 6d., payable on application for membership.

All the members were very enthusiastic, and it is anticipated a very strong branch will result.—S. L. THOMPSTONE, Hon. Sec. *pro tem.*, 27, Nelson Street, Broughton, Manchester.

Edinburgh.—The usual fortnightly meeting of the Edinburgh Branch of the Society of Model Engineers was held at 13, South Charlotte Street, on April 23rd. Mr. J. M. Heron presided over a smaller attendance than usual. After the minutes of the previous meeting had been read and approved, it was intimated that Mr. L. Knoblauch had promised to send periodically to the reading room a parcel of magazines and scientific journals. Mr. Knoblauch was heartily thanked for his welcome gift. Mr. James Hunter then proceeded to read a paper on—"How I made my 4 in. Spark Induction Coil," contributed by Mr. H. Hildersley of the London Society of Model Engineers. A long discussion followed upon the reading of this interesting paper, and the meeting terminated with a hearty vote of thanks to Mr. Hildersley and Mr. Hunter.

The new 5-in. screw-cutting lathe has been placed in the workshop, and has given great satisfaction to all who have used it. A scheme to acquire a planing machine or a shaper is now under consideration, and it is probable that either one or the other will be added to the workshop equipment before the end of the year. All readers of THE MODEL ENGINEER resident in Edinburgh who are not already members of the Edinburgh Branch of the S.M.E., are requested to communicate with the Hon. Sec., who will be delighted to give them any information regarding the branch.—W. B. KIRKWOOD, Hon. Sec., 5, North Charlotte Street, Edinburgh.

Leeds.—On Tuesday evening, April 29th, the Leeds Branch of the Society of Model Engineers, by the kind permission of the managers, paid a visit to the Leeds Steel Works at Hunslet, there being about twenty members and friends present. After seeing the furnaces, we observed the casting of the metal into ingots of about 34 cwt., which were afterwards rolled into tramway rails. We inspected the powerful engines which turned the mills; also several large blowing engines and a very neat pair of high-pressure horizontal engines (by Roby, of Lincoln) turning the dynamos for supplying the electric light for the works. The visit, on the whole, was highly interesting, and the best thanks of the members were given to the manager on our leaving at 10.30 p.m.

A meeting of the Leeds Branch of the Society of Model Engineers was held, in St. Andrew's Church Schools, on Tuesday evening, May 6th, when Mr. Broughton showed a 7-inch four-jaw chuck made from Messrs. Hughes, Fawcett and Co.'s castings and stampings, and Mr. Scaife brought a set of indicator diagrams taken from a triple expansion engine, when a discussion ensued on the relative proportions of the cylinders in compound and triple expansion engines. The meeting terminated at 10 p.m.—W. H. BROUGHTON, Hon. Secretary, 262, Carlton Terrace, York Road, Leeds.

Liverpool.—The third annual general meeting of this Branch of the Society was held at the Balfour Institute on Wednesday, May 7th, at 7.45 p.m., Mr. Croker in the chair. After the minutes of the previous meeting had been read over and passed, the balance-sheet for the year was read over. Mr. Thorp then proposed that the balance-sheet be passed. This was seconded by Mr. Orme, and carried unanimously. Officers and Committee were then elected as follows: Chairman, Mr. Croker (proposed by Mr. Thorp, seconded by Mr. Kirby); Vice chairman, Mr. J. Kirby (proposed by Mr. Stewart, seconded by Mr. Thorp); Hon. Secretary and Treasurer, Mr. Stewart (proposed by Mr. Reeves, seconded by Mr. Thorp). Committee: Messrs. Bootle, Jackson, Meadows, Reeves, and Thorp (elected by ballot). The Chairman then made a few remarks, and several papers, etc., were promised by the various members, the meeting terminating at about 9.45 p.m.

The next meeting will be held at the Balfour Institute on Wednesday, June 4th, at 7.45 p.m., when Mr. Reeves will give a paper on "Marine Failures and Breakdowns."—F. T. STEWART, Hon. Secretary, 14, Adelaide Road, Kensington, Liverpool.

Norwich.—The last meeting of the Norwich Branch to be held before the summer recess, will take place on Friday, June 6th. There will be a discussion on a projected workshop scheme, and a short paper will be read by Mr. J. C. Walker on "The Advantages of Model Engineering." A full attendance is expected.—G. N. C. MANN, Hon. Secretary and Treasurer, 2, Redwell Street, Norwich.

Nottingham.—The third meeting of the Nottingham Branch was held on May 2nd at the Gordon Café, Derby Road. The chair was taken by Mr. G. Wilson at 8.15 p.m. The members present numbered twenty, and five new members were admitted. The business of the evening was the report on the progress of the workshop. The Workshop Committee reported that the work on the lathe was very well advanced, and its completion was expected very shortly. After the business was concluded, a long discussion on dynamos resulted from the exhibition of a dynamo by W. Monks. It was really a very high-class and ingenious arrangement, and all electrical members were highly pleased. The meeting was brought to a close at 10.30 with a vote of thanks to the Chairman. The next meeting will take place on Friday, June 6th, 1902.—R. P. READER, Hon. Secretary and Treasurer, 4, Wellington Square, Park Side, Nottingham.

Tyneside.—A preliminary meeting of this branch was held in Newcastle-on-Tyne at Pillar's Café, 10, Pink Lane, on Saturday, May 3rd, for the purpose of electing officers. Mr. R. Bamford took the chair, and the following officers were then elected: Mr. F. Addleshaw, Secretary; Mr. T. Boyd, Treasurer; and a Committee was also formed. It was generally agreed that this branch should be called the "Tyneside." It was arranged that the first monthly meeting should be held on Saturday, June 6th, at 7 o'clock, in the same rooms, when a compound launch engine will be tested with a boiler kindly lent by Mr. J. Hill; also a small dynamo by Mr. E. Campbell. The meeting closed, at 8.15, with a vote of thanks to the Chairman. The yearly subscription was fixed at 5s. 6d. All communications to be made to the Hon. Secretary, F. ADDLESHAW, 2, Gladstone Street, Shieldfield, Newcastle on-Tyne.

To Readers in Maidstone and District.

AN effort is being made to start a branch of the Society of Model Engineers in this town. Will intending members please write to (enclosing stamped addressed envelope), or call upon, Mr. F. SILLS, 25, Hardy Street, Maidstone?

AT a general meeting of the Aeronautical Institute and Club, held at St. Bride's Foundation Institute on Friday, 2nd inst., Mr. Auguste E. Gaudron read the second part of his paper on "The History of Navigable Ballooning," which was entirely devoted to the experiments of M. Santos Dumont with his various balloons. The lecturer paid a warm tribute to the tenacity with which M. Dumont had held to the task he had set himself, and to the generous manner in which he had devoted a large amount of his private fortune to the object he had in view. Mr. Gaudron, who is a professional aeronaut of many years' experience, was of opinion that if M. D umont had taken for his initial basis of construction the advanced stage of improvement in design attained by Messrs. Renard and Kerbs fifteen years previously, he could have done with No. 1 what he accomplished with his No. 6 balloon. The lecturer also thought that more certain results would have been obtained had the propeller been placed in front instead of at the back of the balloon.—O. C. FIELD, 20, Adelaide Road, Brockley, S.E.

* * *

THE latest inventor of perpetual motion hails from Chicago, says the *Engineer*. His idea, briefly stated, is that there is a natural draught in every tall chimney, independent of any furnace or other source of heat at its base, and this the inventor utilises to drive a windmill. He proposes to build a steel stack 1,050 ft. high, and estimates the power obtainable from it at 50 h.-p.

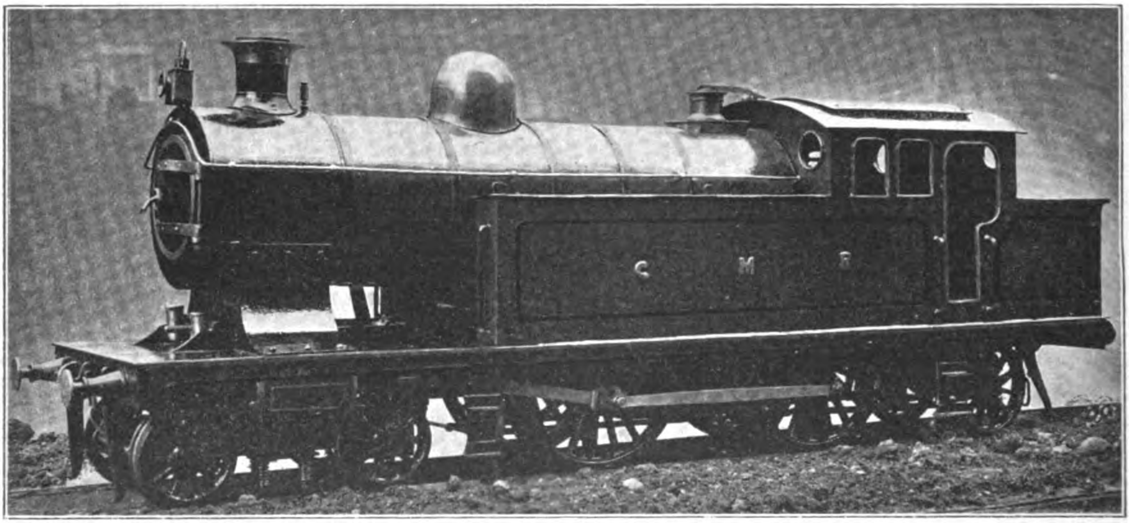
A New Design of Model Tank Locomotive.

¾-IN. SCALE AND STANDARD GAUGE.

(Continued from page 224.)

THE controlling gear of the radial wheel is similar to that of the bogie, and was shown in detail in the last issue. The springs are, by their position, only of sufficient strength to bring the trucks to the normal position and offer very little resistance to a lateral movement of the wheels when the engine strikes a curve.

The bearing spring of the radial wheels in the finished engine are four in number, two to each axle-box. The springs are arranged one on either side, hanging from a crossbar on the top of the box. On the drawing a slight improvement is shown; a pivoted lever is used, and between its fulcrum and the bearing lug on the axle box the spring pin is slung. This passes downward through a lug which projects on the outside of the frame, and to which it is riveted, forming a bearing for the spiral spring. The required tension is effected by two nuts as in the other axle-boxes.

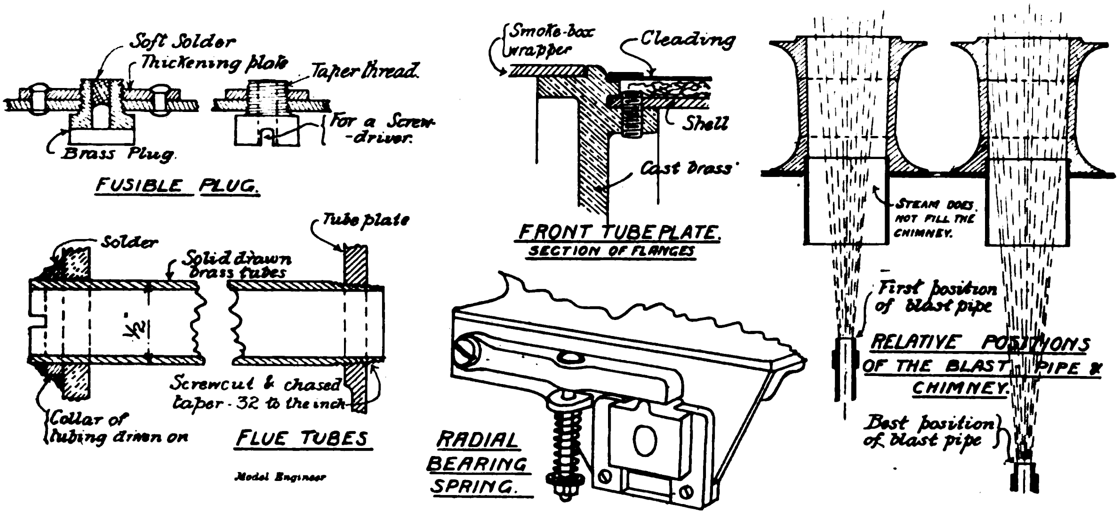


A ¾ IN. SCALE MODEL LOCOMOTIVE.

The boiler, the principal feature of the design, and to which everything else was sacrificed if it came in the way, may now be briefly described. The largest diameter, and the greatest distance of the centre line above the rail level, consistent with appearance, was adopted. This worked out respectively to 3¾ ins. diameter and 6¾ ins. above the rail. The diameter outside the cleading is a bare 4 ins.

The shell is of copper 1-16th in. in thickness, and the barrel is out of the same sheet with the wrapper of the firebox. The longitudinal seams are chain-riveted with 5-64ths rivets at about ⅜ in. to 5-16ths pitch. The throatplate and backplate are of similar copper sheet and riveted in the same manner, all joints being tinned before fixing, so that on the blow-lamp being applied after the riveting, the whole of the joints were made steam-tight. The wrapper of the inside firebox is 1-16th in. thick, and also the flanged backplate. The tube plate—as the flue tubes are screwed into it—is made from a good piece of ⅛ in. brass plate. This takes a fine thread like that of 32 to the inch, very much better than copper, and to cut down the weight, below the tubes and on the flanges, it is reduced in thickness to about 5 64ths in. The joints of inside firebox, after riveting, were silver soldered, a process requiring great care, and one which was given out to an expert to do. At the same time, the bare ⅝-in. copper water tubes were silver soldered in. These are eight in number, inclined about 3-16ths in. all in the same direction. Through some of them stays pass from side to side connecting the outside wrapper and preventing it from bulging; the tubes, of course, acting as stays for the inside plates. Ordinary brass bolts and nuts are used for the remainder of the stays. The water tubes are purposely arranged irregularly, the idea being to provide something in the nature of a baffle arch in front of the flue tubes, preventing the hot gases from immediately going up the tubes and making it just as easy for the flame to pass through the spaces between the rearmost detail which required repair after the engine was completed. The arrangement, adopted upon a guarantee of perfect working, was a cast ring with a 1-16th in. copper tubeplate attached by screws, the joint being made with red lead. Some of the screws being defective and one of their heads being drilled off when fixing the dummy lubricator behind the chimney, caused failure in one trial and leakage in another. This leakage was found out by the fusible plug; the boiler was drained of the water very quickly, and as the water from the leak issued into the smokebox, it was evaporated and carried away without being noticed, and the fact that something was wrong did not emphasize itself until the water repeatedly went so low as to let the crown be high and dry. The use of a cast front would have obviated all this trouble.

This brings us to the evaporative power of the boiler. The heating surface appears to be ample, judging from the designer's own formula, which, for usual sizes of model locomotives with the ordinary boiler, is $300\,S^2$ = total square inches of heating surface when S = the scale



DETAILS OF ¾-IN. SCALE MODEL LOCOMOTIVE.

water tubes and along by the crown of the firebox. No firehole door is provided, although a small air inlet of say two ½ in. or ⅝-in. tubes back nutted on the outside may be fitted. These would then take the place of any stays, and, if fitted with doors, would provide an air inlet without making the interior of the cab hot. For those who wish to cut down the work upon the engine, this refinement may, without any detrimental effect, be dispensed with, as it is in the present case.

The roof stays are two in number—5-32nds in. thick—and are designed to take the weight on the crown at the working pressure; the additional strength required, for safety, to prevent the crown coming down being provided by the shape of the crown, which is shown on the detail drawing (Page 246), and the vertical support lent by the flanged ends. The nuts of the stays, it will be noticed, are midway between the water tubes; similarly the fusible plug. This is most important, as it has been necessary to remove it two or three times, which can easily be done with a screw-driver when the engine has been upturned.

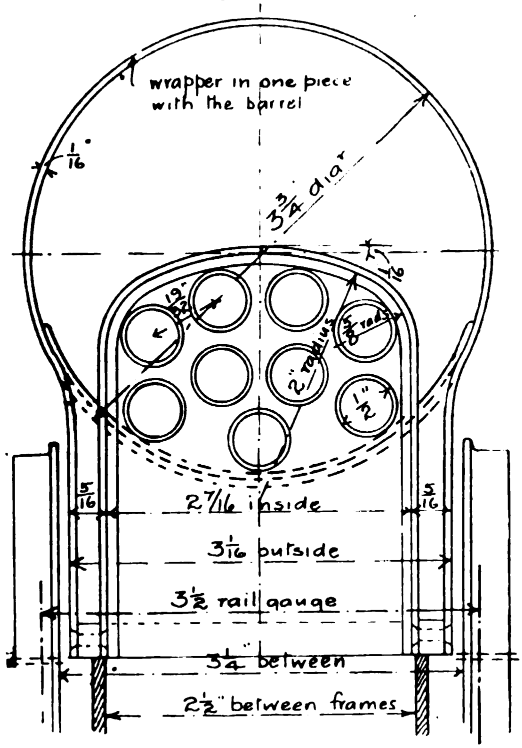
The smokebox tube-plate should be a brass casting. In the contract drawings, this construction was indicated, and through not being adhered to in this point, the tubeplate gave a little trouble—this was practically the only of the model; thus, for the model in question, the heating surface should be

$$300 \times (\tfrac{3}{4})^2 = \frac{300 \times 3 \times 3}{4 \times 4} = \frac{2700}{16} = \text{nearly } 170 \text{ sq. ins.}$$

It is, in the present design, without reckoning the superheater, some 13 sq. ins. above what it might be, and it is found to be, with one No. 4 Primus silent burner, more than enough for the dimensions of the cylinder, which may be, if the maker requires the engine to be run up and down, say a 100 ft. track, with the constant starting, increased to 13-16ths in. with safety. The present engine is an ideal one for a long run, and should cover about ½ mile to ¾ mile without stopping.

The boiler has been found to evaporate about 2 to 2¼ cub. ins. per minute upon a brake test. This means that the engine can be continuously run with the regulator full open, the wheels being braked down by the hand brake to about 300 revolutions per minute with a boiler pressure of 50 lbs. to 55 lbs. This has been done and the performance will continue as long as the fuel lasts. The immense value of the Primus burner may be noted in connection with the tests of this engine. Whether it is worked at 500 or 100 revolutions, the production of steam is a directly varying quantity. This is automatic, just in the same way as a real locomotive, by the action of the blast. The large locomotive, when standing still, the fire not being urged to any extent, does not evaporate much water, and the boiler does not blow off, which, if it made steam at the rate it does when running, would be its state in a very few seconds.

The boiler, in spite of heating surface, was not made to steam until some final adjustments had been made. The burner did not give out its fullest heat until the proper height of blast pipe was found experimentally. Any fuel requires oxygen to completely burn it, and as a locomotive boiler requires forced draught almost more than any other type to perform the work required of it, the source of the draught must be attended to. In the real locomotive the proportions and relative positions of the blast pipe and the chimney are important factors, and so with models, more especially those using oil burners,



Cross Section through Firebox.

care must be taken in a similar direction. The burner may be watched, and it will be seen (the steam blower being shut off during the experiment) that the burner will smoke when the engine is stopped, signifying that solid unconsumed carbon is being given off; if the engine is run at slow speed the smoking will stop, but the evaporation of water *will not be so great as when the engine is worked at a much higher speed.* The reason of this is that the blast brings only a sufficient amount of air into the firebox to transform the carbon into CO, carbon-monoxide, a colourless gas, giving out 14 units of heat. If the engine is made to run faster the more oxygen brought in allows the products of combustion to approach or attain to CO_2, which gives out in the chemical change 22 units of heat. These extra 8 units of heat, of course, produce correspondingly larger amounts of steam to meet the greater demands of the engine. At the meeting of the London Society of Model Engineers, in December last, the engine ran continuously up and down the track in spite of the bad leakage and the total derangement of the blower for an hour, the lowest pressure shown by the gauge being 37 lbs.

The original and final arrangements of blast pipe are shown on the sketch on Page 245. The necessity for the alteration was found by putting a short piece of 1-in. brass tube in the top of chimney, making an extension stack—the effect upon the steam production was electrical.

The boiler is provided with a steam blower, the tube passing from the cock in the cab through the boiler. The regulator is of the type illustrated in our issue for April 15th, but has a steam-tight box containing a spiral spring instead of the flat spring shown in the above-mentioned drawing. A 1-in. diam. Schaffer and Budenburg steam gauge is used.

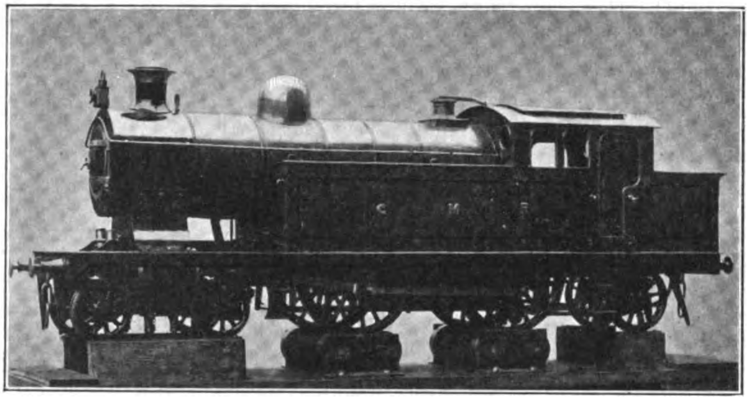
The smokebox deserves some attention. It has been designed to facilitate getting at the boiler readily. It is a piece of tube which slips on to the flange of front tube-plate.

The smokebox front plate is a turned casting, which is a tight fit into the smokebox. The smokebox may be removed by undoing the two unions on each end of the superheater, taking out the dummy lubricator, removing the two side plates of the saddle (which are attached only to the smokebox and footplating), unscrewing the steam pipe from the steam chest, and lifting the exhaust pipe from the holes in the cylinders. If any leak is suspected, the whole of the front plate of the smokebox, with the door, may be removed for the inspection of the tube ends, etc., whilst the engine is in steam. The smokebox is lagged inside with asbestos millboard, and tinplate, with the result that the engine may be handled during working at any place except the smokebox door without burning the fingers. The boiler is lagged with flannel soaked in alum, with tin-plate cleading. The superheater has been found to be a distinct advantage; it dries the steam splendidly. If the steam is raised to the working pressure, the engine will start right away on opening the regulator.

The design of cab, which for a real locomotive has not been employed yet for a tank engine by any English railway company, was specially adopted to enable the boiler fittings to be well lighted. To drive the engine, the ventilator of the cab roof is made to remove, so that the reversing lever, regulator, and the various handles may be easily manipulated. This has proved to be very convenient, and when running at night a small paraffin lamp is carried in the cab to show a light upon the steam and water gauges. This latter fitting, by the way, is made in a simple manner, and its reliability is ensured by making all its passages not less than ⅛ in. diameter. One cock is used—a blow-off cock at the bottom. The cab and tanks, with the footplate up to the slide bars, is constructed separately, and lifted over the boiler into position and secured by screws to the angle edging of the footplating, which extends in one piece from buffer plank to buffer plank. The raised footplate in the cab is a separate fitting. The side tanks were designed to carry water, but as the engine proved sufficiently heavy, these we constructed as sham tanks. Half of the back tank or coal-bunker is the only water supply. In this is fitted a hand pump, and also, in the bottom, a short piece of tube with a valve for emptying the tank. This discharge valve is an ordinary cork, with a brass wire attached to it for enabling it to be lifted easily. The left-hand side of the bunker holds a cylindrical oil tank, 2⅝ ins. diameter, fitted with a screw-down oil valve, release valve, air inlet valve fitted for a bicycle pump, and filling screw.

The brakes are a combination hand and automatic, worked by a spring tension, which may be released by a small wheel engaging an inclined plane at the level of the rails. The brakes are set by pressing down the brake handle in the cab. The brake is very useful in testing the engine upon the friction rollers shown in the photograph with the locomotive in place. The frame is fitted with two rollers running in plain bearings for each driving wheel, the carrying wheels being simply supported at the right level upon blocks.

The engine is painted a bright green and Venetian red, some difficulty being experienced in getting the right colour, but this was overcome by re grinding the enamel with pigment until a good shade of each colour was obtained. The engine was built to contract, the lowest tender, that of M. S. Don, of Goudhurst, being accepted,



THE MODEL RUNNING ON THE FRICTION ROLLERS.

and by this means the building of the engine was satisfactorily accomplished without undue trouble and expense. Criticism of the design and construction is solicited, and if any readers require further details described, information will be tendered in as complete a manner as the space at our disposal will allow.

Model Yacht Clubs.

South Shields Model Yacht Club.

THE racing programme of the South Shields Model Yacht Club for 1902, shows a long succession of important fixtures, which should prove highly interesting to sportsmen in the district. Races have been arranged for almost every Saturday from March 15th to September 27th, and the Coronation Day, Thursday, June 26th, is made a special occasion, when, as a note informs us, members are requested to dress ships in honour of the day. Enquiries should be directed to the Hon. Secretary, Mr. R. A. TERVIEL, 28, Wouldhave Street, South Shields.

To Model Yacht Club Secretaries.

A new Model Yacht Club, which, promises to be a big success, is in process of formation at Hastings. The Secretary wishes to obtain copies of the rules in force in other clubs so as to be able to frame the local rules in general accordance therewith. Will secretaries of clubs seeing this request kindly forward such information to Mr. JOHN R. GARDEN, 5, Lower Road West, St. Leonards? London club rules are particularly invited.

Models Made Without a Lathe.

I.—An Electro Motor and How to Make It.

By G. L. GRIFFITHS.

(Concluded from page 220.)

THE winding of the field-magnet has been left till now, as a bobbin large enough to carry 1¼ lbs. would not go through the iron ring comfortably. Get a smaller reel, and wind the wire on to that. Now hold the part with the long screws in the left hand. Place a piece of thin silk ribbon 6 ins. long along the outer flat edge. Start on the extreme left of the part cut away, and leaving 6 ins. or so as a spare end, wind very evenly towards the right. On reaching the extreme right, turn the spare portion of ribbon over on to the wire, and continue winding in the same direction, but to the left now, and so on. A short piece of ribbon at either end of each layer will keep the last turns of each layer from slipping. At *least* 500 turns should be got on each side without encroaching on the armature space. When about 500 turns have been put on, turn the magnet half round with the same side uppermost, holding the part with the short screws on the left hand, repeat operation there, being sure to wind just as evenly and tightly, also to put the same number of turns on as before.

Having wound the 1000 turns, varnish well with several coats of shellac varnish. If the wire has been kept clean, no colouring matter will be needed in the varnish. A clear varnish over green-covered wire gives a good effect.

FIG. 10.—FIELD-MAGNET FOR MODEL ELECTRO MOTOR.

Fixing the Magnet.—This can be done in several ways. Two are given, the second of which I used myself, as I think it is the firmer. Two pieces of brass, ½ in. by 3-32nds in. and 2 ins. long, are bent like this ⊃ one hole, 3-16ths in., is drilled in the short end, and two in the long end. With four round-headed screws these two feet can be screwed to a wooden base; through the other two holes the long screws are put, and then clamped up tight with an extra nut.

For the other way get a piece of oak, 10 ins. by 5 ins., ¾ in. thick. Across its width in the centre mark out a space 1½ ins. by ¾ in., and cut this out to the depth of ¼ in. in the centre, but graduating off to nothing at the ends, that is, the bottom of the cut will have the radius of a 3 5-16ths-in. circle.

It will be seen that the magnet can rest in this slot; but places must be cut to allow the nuts to sink in flush, and holes drilled through the base to let the screws go through. Make the places for the nuts a tight fit. Now take out the long screws from the magnet, put the nuts in their places in the base, then the magnet on top of them.

By putting the screws through the magnet, nuts, and base, and fastening on the underneath side with extra nuts, an immovable job will be made. Of course, the magnet must be at right angles to its base. File up the lower pole as smoothly and accurately as possible.

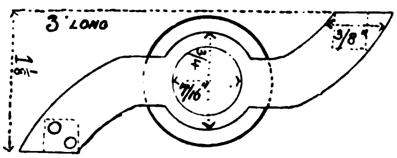


Fig. 11.—Brush Rocker.

Bearings.—These claim our attention now. If the last job has been done accurately, the following lengths of brass will be needed; two pieces of brass tube ⅞ in. long, with an inside diameter the same as the diameter of the shaft. If this cannot be had, do as I did, and gradually file the insides down until they will revolve round the shaft easily, but without the slightest shake or end play. Four pieces 2 ins. long, one piece ½ in. long, and another piece ⅞ in. long, all of them ⅛ in. thick ¾ in. wide will also be required. Drill two holes in each of the last two for screwing down to the base exactly in the centre of each piece. File all edges up square. If you have a drill large enough, drill a hole to a fairly tight fit for the brass tube at 19 32nds in. from one end of each of the four pieces. If not, make the hole as large as you can with a drill and file until large enough. Having no drill of the requisite size, this was my method.

The form of the bearings is so plainly shown in Figs. 1 and 9 that a lengthy description is unnecessary here. Take the piece ⅞ in. long, and across the face—not edge—mark two lines ⅛ in. from each end. Drill two small holes in each space ¼ in. from the side. In these holes drive home four small steel pins (a tight fit) ¼ in. long. On the under edge of two of the long pieces drill similar holes the same distance from the edges. Now tin the parts of these three pieces that are to be connected together (Fig. 9) by means of soldering iron, resin, and solder; then fix the side pieces on the steel pins. Now tin the ends of one of the pieces of brass tube, fit in the holes at the top flush with the outside edges, and stand the whole on a hot stove plate for a minute, and a good strong bearing should be the result. Treat the other bearing in the same way, with the exception that this being narrower, the brass tube will protrude for ⅜ in. on one side. This is to carry the brush rocker.

Brush Rocker.—Cut a piece of brass ⅛ in. thick the shape and size of Fig. 11, and drill two holes each end as shown. Also cut two pieces of hard wood 1½ ins. long ¼ in. square. Cut these away for a distance of 1 in. on one side to the depth of ⅛ in. At ⅛ in. from each end of these slots drill a small hole; their use will be shown later. The top part of a terminal off a Leclanché carbon or a piece of brass tube is now wanted. Cut a 7-16ths in. hole in this, and solder it to the other piece of brass, so that the two holes are true to each other. Now fasten on the two pieces of wood by four round-headed screws. Two strips of *thin* sheet brass, 2 ins. long, ⅜ in. wide, will make the brushes. One thirty-second of an inch is quite thick enough. Two pieces of brass, ¼ in. wide, 1 in. long, 1-16th in. thick, with a small hole drilled ⅛ in. from each end, and four small brass bolts and nuts, will fasten these brushes in, as shown in Fig. 1.

Of course, if stocks and dies are possessed, a screw, as shown, could be fitted, otherwise the tight fitting of the brush rocker on the bearing will have to be relied on to

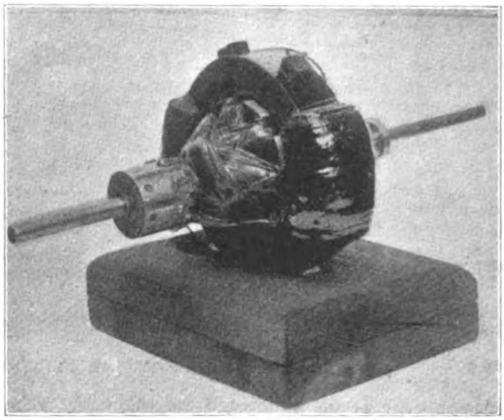


Fig. 12.—Armature and Field-Magnet.

keep it in position when the most favourable position of the brushes has been determined.

If everything has been followed out well, Fig. 1 will explain itself *re* the fitting of the whole model to its base, the only things to bear in mind being the levelness of the bearings, the easy running of the armature with only a very little end play between the bearings. The poles of the armature and the poles of the fields must on no account touch at any spot.

Now put two terminals at one end of the base (commutator end), and join up as follows:—Ends 1 and 1A of the fields are joined together; end 2A is joined to one of the terminals. Drill a hole in the base, and on the underneath side cut a channel from the hole to the terminal, pass the wire through the hole, lay it in the channel, and join to terminal. Fill in the channel with marine glue. Join end 2 to one of the brushes. The other brush is connected to the remaining terminal.

If the maker chooses, he can improve the appearance of his model, as I did, by polishing all the brass parts, excepting the commutator, and covering with Silico Enamel, and enamelling the iron part with Club Black Enamel, excepting the poles of the fields and armature. Oil cups, are shown in the drawing, but are by no means indispensable. The kind I am using are, I believe, called the "Helmet Oil Cup," and are sold at cycle accessory shops. They add to the appearance and keep the bearings nicely oiled; but, of course, more tools are needed in order to fit them.

The Motor Bicycle: Its Design, Construction and Use.

By T. H. Hawley.

I.—Introduction. Some Practical Experiences relating to Design and Construction of the Motor Bicycle.

In an early chapter of my former series of articles on motor cycle construction generally, I expressed a view adverse to the motor bicycle.

That was written over a year ago, and in the interval I have been converted to the belief that there is a great deal of pleasure, experience and practicability surrounding the motor bicycle of to-day, and vast possibilities for the future.

My conversion has not been spontaneous, but has been a gradual process based on actual personal experience of the most practical kind, and during the process I was at all times inclined to be sceptical rather than enthusiastic, so that ultimate convictions may take higher rank.

What I mean by this is that I started with the firm conviction that I should prove the motor bicycle to be a practical failure, and I have given it every chance to prove itself such. However, I have been compelled to alter my views, and before proceeding to the actual design and construction, I may present to my readers some exact facts in my own experience which should be a valuable guide to those who propose to enter into the construction of the entire machine, or any part of it, and more particularly to such as may be experimentally inclined, and with a desire to depart from the beaten path of present day design.

The production of these articles has been purposely delayed, in order that the later stages of my experimental work might be incorporated; and I think the series will be correspondingly appreciated in value, for certain points of vital interest which were somewhat obscure to myself and others only a few months back, are now well estimated, and in my complete analysis of the good and bad points in motor bicycle design I shall now be able to speak in definite manner, and also advance arguments of conclusive character in each direction.

My original misgivings were chiefly in regard to side slip and difficulty of transmission. The former I now estimate as being of no moment on anything like ordinary surfaces—say, not more dangerous than the ordinary bicycle, though when a side slip does occur, the consequences are vastly more serious to rider and machine.

The transmission of power from the engine to the driving wheel is a problem which is far from being satisfactorily solved up to the present moment. Belt drive and chain drive have each got their advantages and disadvantages; each is far from being efficient or reliable; and it is probable that the machine of the future which will gain most favour will disclose a combination of the two, or, at any rate, a division of the positive drive and the belt.

In a chain drive, or any other positive transmission, a great strain is put on the chain or gearing at the instant when the engine "catches on" or commences to drive, and this sudden strain is equally bad for the engine itself, to say nothing of the effects on the tyre of the driving wheel, so much so that chains repeatedly break, engine crank pins and other parts snap off or are distorted, and the driving wheel tyre is rapidly worn out, these conditions being aggravated if the machine is ridden in traffic with frequent shutting-off and re-starting of engine. On the other hand, when the engine does start, and providing the chain does not break, then on a long, clear run the chain or any other positive drive shows up to great advantage as compared with the belt.

My experience, so far as the bicycle is concerned, has, however, been chiefly with the belt drive; and I would describe its chief advantage as being extremely kind and obliging to the engine and the tyres; but as a transmission agent under varying circumstances it is far from the ideal.

Starting with the new belt, there is the initial stretch to take up, the belt requiring adjusting every few miles during the first hundred or so; then, by the time the belt is worked into shape, it probably happens that oil commences to leak through from the crank chamber of the engine and gets to the belt. Then the real trouble begins; for to get the machine along at all it is necessary to unduly tighten the belt, which, in turn, places an undue strain on the engine crankshaft, this again resulting in increased leakage of oil, and so on. And if by any chance some inferior or unsuitable oil be introduced to the crank chamber, then these troubles will be magnified to such an extent that the machine will not take the slightest hill and will give very little speed on the level.

But supposing a perfectly shaped belt at proper tension, a driving pulley on the shaft with good gripping surface, proper engine oil in exact quantity, and no leakage from engine to belt, then nothing could be better, either in speed, power, or smoothness of running; but the difficulty is, that having established such conditions, they cannot be maintained for any length of time.

The first few explosions cause the engine to race away, and the load is taken up gradually without strain on either engine, belt, or tyre, but with considerable wear of engine, pulley, and belt, and this initial slip at starting is, apart from the latter conditions, a very decided point in favour of belt drive, as it admits of starting up hill without the jerky action associated with all forms of positive drive. However, this subject will be dealt with in detail later on; and for the present I will revert to some actual experiences and particulars of the machine on which they were gained.

First of all, I wished to get to the bottom of the entire question of the practicability of the motor bicycle; and in the second place, I wanted to ascertain how far the constructional detail of such a machine came within the scope of the ordinary mechanic or amateur, or rather, I should say, the tools at his disposal.

These questions I approached in the most practical manner, by building a machine from tested materials of known value, and with the aid of the fewest and simplest tools possible. The construction of the motor itself was not attempted, because of lack of time and absence of facilities for doing the work, so it was decided to employ what I then believed, and still consider to be, the best bicycle motor on the market—"The Minerva," though by this I do not wish to infer that the "Minerva" is perfect or incapable of being improved upon; but after careful consideration of the various types, I arrived at the conclusion that it presented more advantageous points than any of its competitors, and I have had no reason to depart from this opinion.

One very great advantage enjoyed by the "Minerva" alone is the facility with which it may be attached to any ordinary bicycle frame, the whole combination of motor, tank, carburettor, silencer, &c., being clipped on to the usual standard pattern diamond frame, with no other tools than a screwdriver and spanner. This, however, must not be taken literally so far as the ordinary bicycle goes, for it would be a suicidal policy to hitch a motor to any machine without first reinforcing it in certain vital parts; indeed, to be safe and get good all-round results, it is quite necessary to build a special frame and fit special tyres. But one or two chapters will be devoted to the subject of converting an ordinary machine into a motor bicycle.

It will thus be seen, that in view of these articles, I practically commenced my motor bicycle experiments with possession of the (in my judgment) best motor on the English market, thus getting an advanced basis for argument and suggestions for improvement.

Before relating results, it may be well to give specific details of the machine and its entire equipment, thus enabling those constructors who wish to work out original ideas differing from the drawings, I shall present to form some opinion of the value of the various fine problems involved.

The frame itself was built from B.S.A. (Birmingham Small Arms Company) fittings, of special type designed for the motor bicycle. This design does not materially differ from the ordinary B.S.A roadster machine, except that the back forks and stays have a wider spread to clear a larger tyre and the belt pulley. The front fork crown is also wider for the same reason, and the wheel base (centre to centre of wheels), is some 3 ins. longer than usual. The fork crown and the steering socket, as well as the front forks, are also very much stouter and stronger than the ordinary, and, of course, the tubing employed throughout the frame is much heavier in gauge, though of usual diameter.

The full specification of the machine is as follows:—B.S.A. frame, 23-in. seatpost, 47½-in. wheel base, 28-in, equal wheels, curve of front fork 2½ ins. forward of centre line of steering socket, steering socket 9-ins. overall, bottom bracket centre 13½ ins. from ground line, gearing 80 ins., cranks 7 ins., large gear wheel 52 teeth of ½-in. pitch., back forks built up on forged steel bridge piece, and both back forks and stays cranked outward to clear tyre and belt pulley. Frame tubes of Shelby cold drawn weldless steel; bottom tube to which engine is clipped 1¼ ins. by 16 B.W.G.; seat post 1⅛ in. by 20 B.W.G., butted for 4 ins. at lower end to 16 B.W.G.; top tube 1⅛ ins. by 22 B.W.G., butted for 3 ins. at each end to 18 B.W.G.; back fork sides, D section, 18 B.W.G.; back stays, D section, 20 B.W.G.

Front forks, crown, and steering-post were supplied ready brazed up by B.S.A. Company, and are approximately as follows:—Forks, oval section, 16 B.W.G. at top tapered to 18 gauge at ends; crown of specially strong double plate type with deep shield from lower plate giving increased brazing surface on fork side; steering column of extra stout butted tube, 16-B.W.G. in telescoping portion and tapering gradually to 14 gauge where brazed into fork crown.

Tyres—2-in. Clipper Reflex special motor bicycle tyres, in Westwood rims.

Spokes—14-B.W.G. double-butted high-tension, by D. F. Taylor & Co., Birmingham, being 12-gauge at the rim, and 13-gauge at the hub.

Bowden rim brakes to both back and front wheel, and Bowden exhaust valve lifter. Engine drive by twisted raw-hide belt ⅜ in. diameter, working over 3½-in. corrugated pulley on engine to 21-in. V-grooved pulley bolted to spokes of driving wheel.

Engine equipment consisting of usual "Minerva" carburettor and tank, induction-coil and accumulator, both enclosed in tank case, semi-automatic lubricating device operated from saddle whilst travelling; capacity of tank and carburettor, about 1 gallon of petrol; capacity of tank for lubricating oil, about 1 pint; capacity of accumulator 20 ampère-hours, charging rate 2 ampères; voltage when fully charged, about 4·5; voltage when fully discharged, 3·8; average distance capacity of accumulator, 800 miles; of lubricating oil, 500 miles; of petrol, 100 miles.

The motor is of the ordinary four-cycle or Otto type, 62 mm. bore by 70 mm. stroke, the ratio of compression being 7½ atmospheres, giving 1½ actual brake horse-power.

In the way of improvements on the earlier type of Minerva motor the following may be noted.

The actual b.h.p. of the new engine is double that of the 1901 pattern, arrived at by increasing the bore and also the ratio of compression from 3 in the old pattern to 4½ in the new.

Both exhaust and inlet valves are larger in diameter, and the exhaust has a prolonged lift; the guides to each valve stem are also longer, and in the case of the exhaust a steel bush takes the place of phosphor bronze, and is automatically lubricated on the throw about principle by the crank motion.

The common type of compression tap is replaced by a spring valve, which cannot stick or become deranged; the contact-breaker has the position of trembler blade in reverse of ordinary De Dion practice, a raised Λ projection on the cam lifting the trembler into contact with the screw in place, a recessed cam causing a break in circuit as in the usual De Dion method, this effecting much economy of current by reason of the short time during which the primary circuit is closed, and also placing the platinum contact points in a better position for evading oil.

The cylinder radiating flanges are deeper, and more numerous than usual, the spaces between flanges being 9 32nds of an inch, and the flanges themselves very thin. Improvements in the metal and in the method of casting and machining the cylinders have permitted the cutting down of thickness in cylinder wall to a fraction over ⅛ in., these latter points ensuring the engine from overheating, even when running under the worst conditions, providing lubrication is attended to.

The flywheels are 6½ ins., or 165 mm. diameter, and the weighted rims 24 mm. deep by 24 mm. broad (the weight I have not ascertained). The engine is clipped by four bolts to the bottom tube of the bicycle, immediately in front of the bottom bracket, and having its cylinder bore practically in line with the bottom tube, thus presenting the hottest part (the combustion head) to the cold inrushing air caused by the motion of the machine.

Other points in design I shall make clear when we come to deal with various systems in sectional drawings. For the present, the above description of engine and machine will suffice for reflection and comparative purposes, so I will now detail my experiences on the above machine.

In fitting the motor and accessories to the frame, I found that although, as already stated, the whole might be done with the help of no other tools than screwdriver and spanners, in actual practice various little adjustments were necessary to bring everything into position. Thus, the pipe work connecting carburettor and engine, and that connecting the lubricating device with crank chamber, required a certain amount of bending or shaping to bring the coupling faces in line; the rods operating the compression release, and the advance sparking, although telescoping to allow for adjustment in length, required rather nicely setting out to get a good working fit, and, at the same time, clear carburettor on the one hand and contact-breaker and crank on the other side; these, however, were small matters and easily adjusted. But later on I had a lesson on the great importance of small matters, by reason of the leakage of the two-way cock communicating with lubricating oil tank and engine crank chamber, added to a leaky drain tap at bottom of engine.

It is, of course, important that these small engines should be periodically supplied with an exact quantity of exactly the right quality of oil. If the quantity be insufficient, or not applied within the required time or distance travelled, then the engine will work badly, with a scouring grating noise, and if allowed to continue very long in this condition the cylinder wall and piston rings will suffer, or the piston may bind and cause fracture of the crank-pin or some other part. On the other hand, if the supply of oil is too plentiful, then the surplus will quickly find its way through the crankshaft bearings to the belt on one side and the contact-breaker on the other, resulting in almost total loss of power in belt drive, with frequent mis-fires through dirty contact surfaces; another result generally accompanying this state of affairs being that some of the surplus oil gets through to the upper side of the piston and even the valves, where it becomes charred and causes leakage at one or both valves. Similar results or a combination of the whole of these troubles will follow the employment of unsuitable oil. Indeed, this question of proper lubrication of the engine has in this case a greater bearing on the total efficiency than almost all other points combined; hence, it should be thoroughly well understood and very carefully attended to.

Well, what occurred through the leaking cock was this. The oil in the reserve tank was under air pressure, thus maintaining the injector body full of oil. The cock being leaky, this force, added to gravity and the suction action of the piston, combined to cause a slight but steady flow of oil to the engine, all unperceived and unknown, so that the usual flooding occurred and no end of trouble was occasioned through the belt becoming saturated with oil, the trouble coming on over and over again because the cause was not suspected for some little time.

Eventually it was discovered and the oil pipe disconnected, the measured dose of cil afterwards being filled in at the plug hole by pouring in the ordinary way.

The next phenomenon was just the reverse. The oil ceased to come through on to the belt and contact-breaker; but, instead of the machine running thirty miles or more on one dose, the engine would begin to grind and work dry in ten or fifteen miles, although the oil was known to be the best procurable for the purpose (United Motor Industries, Ltd., "D" brand).

I then discovered that whenever I stopped, a thin black stream trickled from the tap for emptying dirty oil from crank chamber, the cause being that the set-screw in the stem of the tap not being threaded fully up to its head, although screwed up as tightly as could be, had no bearing on the washer, and so did not hold the tapering centre tight up in the conical hole; the cock on the lubricating tank merely wanted carefully grinding in. Yet, between discovering the cause and making the remedy, together with the time occupied in cleansing the belt over and over again, I was put to no end of inconvenience on a long tour, having on two occasions to stay all night at towns which I had planned to leave far behind.

I merely mention this as I think it a most valuable object lesson to all who are contemplating motoring or motor construction, as showing the extreme care in detail workmanship which must be exercised if good results are to be obtained.

During the first two weeks I had the machine running I took moderately short trips, rarely exceeding thirty miles, during which time sundry little adjustments and alterations were found necessary; meanwhile the engine, the belt, and the bicycle itself were getting into running order. For example, the levers working the "mixture" and the "advance" were too slack a fit on their sockets, the vibration causing an alteration in these important adjustments, vibration too being answerable for a leakage of petrol through from the reserve tank to the carburettor, so that the latter was constantly flooded, in which condition the engine worked very badly, and would cease operations altogether on bumpy road.

How all these little matters were rectified will be dealt with in proper order. Meanwhile, to resume experiences.

I had determined, once I knew my machine to be somewhere like right, to put it through an exceptionally severe test for proving its reliability as a touring machine for daily use over long distances, without making special arrangements or carrying elaborate repair outfits.

To this end, I ran the machine some 150 miles during the two or three days preceding Easter week; and then with no further preparation or attention to the machine than fitting a newly-charged accumulator, a new sparking plug, and of course, a full supply of petrol and lubricating oil, I started out to do a tour of 700 to 800 miles.

All I carried in way of tools were a small adjustable spanner, a screwdriver, some copper wire, and a voltmeter.

No renewals whatever were taken, and I had therefore no spare sparking plug, contact screw, or trembler, neither did I carry an inflator, though I had a Midget repair outfit in my pocket by accident rather than design. It might reasonably be argued that these conditions scarcely gave the machine a chance to make a good performance; but then I did not wish to mince matters, and knew that whatever difficulties I encountered would be better impressed on my memory, and the experience correspondingly valuable, added to which was the factor that I should be absolutely dependent on chance supply of renewals at the particular point or town where I required them, this factor being an important one in demonstrating the practicability of the motor bicycle for touring work.

The general scheme of the tour was a return trip from the South West Coast to the North East Coast, with sundry detours from the main route, the terminal points being Southsea, near Portsmouth, on the one hand, and Scarborough in Yorkshire on the other, though the actual start was made in Buckinghamshire, first going South, then returning by almost the same route, and so missing London, getting to the Great North Road at St. Neots.

The principal places passed through *en route* were: Horndean, Petersfield, Farnham, Windsor, Slough, Amersham, Leighton Buzzard, Bedford, St. Neots, Huntingdon, Norman's Cross, Stamford, Grantham, Newark, Retford, Doncaster, Selby, York, Malton, Scarborough—and the reverse.

I mention the route because it is a particularly trying one in the way of hills, especially in crossing over the by-roads of Buckinghamshire—in fact, all the way from Slough to beyond Leighton Buzzard.

The first thing to go was the sparking plug within the first forty or fifty miles, although it was one of the higher priced ones, a temporary repair being made and causing but little delay until another was found at a small cycle shop for 1s. 6d., a price so low that small faith was placed in it, but it happened to turn out well and lasted some five hundred miles.

The next thing to go wrong was the oil getting on to belt, as already described. Approaching Grantham, a spill occurred through looking behind for a motor car which I had just passed; this snapped off the right-hand crank, two miles out of Grantham, and my selection of B.S.A. fittings for my machine found justification in the fact that Mr. Gollin, cycle maker in the London Road, was able to fit me an exact replica in twenty minutes, whereas, if my machine had been a Coventry-made one, a three days' stop at the very least would have been necessary—being holiday time and the works closed.

Beyond a slight recurrence of the belt trouble and the usual trimming up of the contact-breaker surfaces, etc., nothing of importance occurred until, near York, the firing became very irregular, and finally the engine stopped.

Plug, contact-breaker, wires and connections were all tested in vain; then the accumulator was tried, but no movement of the voltmeter needle followed. Now the accumulator had been working well some 20 miles back, and even if run down too low to produce the firing spark, it should still have shown well over 3 volts, so the logical conclusion was that there must be a short circuit or a break of circuit between the two cells; and so it proved, for the lead strip connecting the two cells had fractured from vibration, yet the fault was hardly visible through the black compound. A few strands of flexible wire, of course, soon remedied this, when the voltmeter showed 4·2 volts.

The oil on belt and dust combined had, by the time the northern terminus was reached, worn the engine-pulley completely smooth, with consequent poor gripping power on the belt, so it was deemed advisable to wire to London for a new pulley to meet me at Doncaster on the return trip, and it was just before leaving York behind that the faithful plug gave out, though I had, in the meantime, taken the precaution to have another in reserve.

Of the return journey I need not speak at length, as nothing beyond plug mishaps and a mild recurrence of belt trouble—this time through unsuitable oil—occurred to make special note of, suffice to say that the journey was successfully accomplished, the total distance run being just on 800 miles in nine days, no riding being done after lamp-lighting time, except on one occasion, when the belt detained me two hours past dark.

To sum up the whole ride, the greatest drawback in design proved to be the uncertainty of the belt transmission due to (*a*) small size of engine pulley; (*b*) unequal diameter, and consequent unequal grip of belt due to variation of thickness of raw-hide; (*c*) frequent adjustment of belt, due to wear, stretching, &c.; (*d*) belt slip through oil, due in turn to (*e*) imperfect detail workmanship in lubricating device and leakage at engine crankshaft bearings.

On the other hand, in every other respect, both engine and machine behaved admirably. The valves were never touched, nor was any part of the engine renewed or dismembered, with the exception of the pulley, yet the compression was quite good at the finish, and indeed, after a light grinding in of the valves, the compression appeared better than before the long trip.

The same belt ran right through, breaking away once at the hook, and being worn much smaller by the end of the trip, but in excellent running order. The general wear and tear showed up most at the pulley, the belt, the contact-breaker platinums (through insufficient surface in the condenser of the induction coil), and the crankshaft bearings.

The tyres (Clipper Reflex), made a marvellous performance, as they were never re-inflated, let alone punctured throughout the tour.

The accumulators (Peto & Radford's, of Hatton Garden, new armoured type), showed full 4 volts at the finish. The petrol consumption would be between 7 and 8 gals., 7 gals. being taken in on the road in addition to what was started with, the fresh supplies being usually in quart doses, because of the flooding mentioned, and the fact that the engine works better when the carburettor is only about a quarter full. Four sparking plugs in all were involved, two giving out through cracked porcelains, and another through breakage of the centre conducting wire at the point where it leaves the porcelain.

None of the bicycle bearings were touched, and nothing but a just perceptible shake in the driving wheel was found at the finish.

The hill-climbing powers of the machine were severely tested, and varied considerably according to the condition of the belt and pulley, but everything on the North Road, *i.e.*, north of St. Neots, was ridden both going and returning, though, of course, pedal assistance was required up such hills as Gunnerby at Grantham. The speed on the level could at times be got up to 30 miles, but when conditions were good 20 to 25 miles could be maintained for some time, not the slightest trouble arising from overheating.

Not a single instance of side-slip occurred, the accident referred to being due to swerving the machine over and catching a stone.

The machine was completed about March 1st, and has made several fairly long trips since the one detailed above, as well as running some few hundreds of miles before it, and up to present date (May 1st) it has in all covered about 2,200 miles.

The only renewals other than those referred to above have been a new trembler blade to contact-breaker, and a new platinum tipped contact screw.

It will be seen that the petrol consumption works out roughly at a gallon per hundred miles, and the average price at 1s. 2d. per gallon, 1s. being charged in several places in the London district, rising to 1s. 4d. to 1s. 6d., as the distance from London increases. Thus, I think, that on the whole the economy in running will be admitted, because, although my roadside disbursements for one thing and another in connection with the machine amounted to some 30s., all except the petrol and one irreparable sparking plug remain in hand, and cannot be charged to the running account.

I have endeavoured to place readers in possession of actual facts, and as far as possible give them the benefit of my experience in brief, so that they may use the same in estimating the value of the various suggestions I intend to make in subsequent articles, in which I hope to fully describe and illustrate the motor and machine on which this experience has been gained, and also offer alternate designs for such as care to strike out on original lines.

Following the plan adopted in the previous series of articles, I shall, in the first instance, follow closely on standard lines in order to simplify the construction in cases where it is desired to do part of the work only and purchase other parts ready finished to correspond to the rest of the entire design.

I am fully aware, and have shown by what I have written above, that there are faults in design in the best of present day bicycle motors and motor bicycles, some of which might be quickly remedied *on paper*, but to the amateur constructor, or, indeed, to anyone wishing to carry through a single machine without involving undue time and money, it is necessary to forego what may be excellent points in design in the motor in order to facilitate the construction of the entire machine.

As a case in point, it has been shown what a source of trouble oil on the driving belt is, though if the engine bearings were made double the length greater durability would be ensured and the oil would not get through, but although this improvement is easily made on paper, it would involve re designing the bicycle bottom-bracket, so that the cranks should clear the engine—that is, if the Minerva position of engine is to be maintained.

Still, I hope to show how considerable improvements may be made without setting up insurmountable difficulties.

(To be continued.)

Low temperature electric furnaces are already in successful use for laboratory purposes, and for the little muffles employed in mechanical dentistry. Another proposed use for these furnaces is in the working of metalliferous ores in places where fuel is extremely rare but water power abundant.

How to Make Permanent and Electro Magnets.

By T. G. JAMIESON.

(*Concluded from page 227.*)

Electro-magnets.—If, instead of using a steel bar, we introduce a bar of soft iron between the coils (Fig. 1), the result will be an electro-magnet. The great difference between permanent and electro-magnets is, that while the steel retains nearly all the magnetism imparted to it, the soft iron ceases to be a magnet immediately the current is cut off. The lifting power of an electro magnet depends not only on its "magnetic strength," but also upon its form, the shape of its poles, and on the form of the soft iron armature which it attracts. The formula for computing the strength of an electro magnet is so complicated that it would not be within the scope of this magazine to deal with it here. We will therefore pass on to the other details.

As in the case of permanent magnets, the horseshoe form is found to be most powerful. This is due to the fact that a greater number of lines of force pass through the armature. The amount of wire to be put on the cores

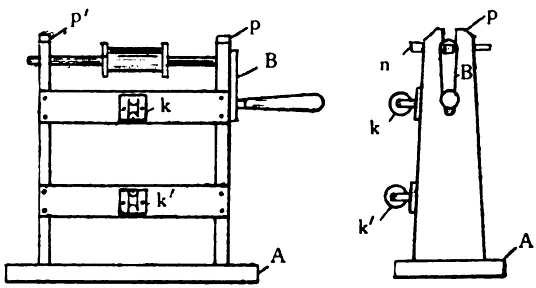


FIG. 6.

largely depends upon their size and shape. As the magnetising power of the current decreases in proportion to the square of the distance from the core, it follows that very little power is gained by adding on layers of coils beyond a certain limit. As a rule, the number of layers placed on the cores do not exceed that which will increase the section of the completed magnet to three times that of the iron core; as, for example, assuming that we are constructing a magnet having a core ½ in. diameter, the diameter of the wound core, including coils, should not exceed 1½ ins. The next consideration is the gauge or size of wire wherewith to wind the cores. The strength of the current at our disposal will partially decide this point, for it has been ascertained that the same amount of magnetism will be gained by sending a current of 1 ampère 100 times round an iron core as would have been gained by sending a current of 100 ampères once round the same core. These facts are concisely stated as follows :—The magnetism of an electro-magnet is proportional to the current, and to the number of turns of wire in the coils; or, in other words, is proportional to the "ampère-turns." If, therefore, the current at our disposal is one of high E.M.F. (electromotive force) and low current, we must wind our cores with many coils of fine wire, but if the E.M.F. is low and the current large, then we must wind with fewer turns of a thicker wire.

The coils should not be wound directly upon the limbs of the magnet, but for convenience in winding are wound upon two separate bobbins, the bobbins being then slipped over the iron cores. These bobbins may be wound by hand, but it will greatly facilitate the winding to make use of the winder shown in Fig. 6. In this, the baseboard A is of walnut, 16 ins. by 7 ins. by 1 in., and is mortised to take the uprights p and p'. The uprights are 15 ins. high, 4½ ins. wide at the bottom, 3 ins. wide at the top, and 1 in. thick. A slot is cut in the top of each upright, about ¼ in. wide and 2 ins. deep. This should be done by boring a 1 in. diameter hole about 1½ ins. from top, and then cutting away the wood between hole and top of upright, thus leaving a round at the bottom. A wooden key n (Fig. 6) is used to keep the axle at the bottom of slots. To the front edges of each upright is screwed a sash pulley or similar fitting, k, k^1, preferably of brass. Each pulley is mounted on a cross piece, as shown in the Fig. The axle is provided with wooden crank (B), and is best

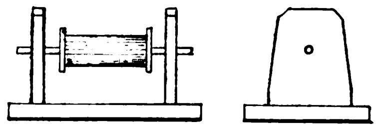


FIG. 7.

made from beech. Two or three axles should be provided to take bobbins of different bore, and each should have its ends turned down to ¼ in. diameter where it rests in slots (see Fig. 6). A square is left on one end to take crank. The wire is usually supplied wound upon reels, and these may be mounted on an axle so as to revolve, and supported as shown at Fig. 7. The wire is led from this reel, and passed under the bottom pulley on the front of winder; then carried up and over the upper pulley, and attached to the axle of winder. The wire should be given about four turns round axle close to head of bobbin, and then lifted over the bobbin head, and wound regularly until the correct number of layers has been laid on. The use of the pulleys on front of winder is to give the necessary tension to the wire and, at the same time, remove irregularities. A smooth, round-edged wedge of beech may be used, in conjunction with a mallet, to help

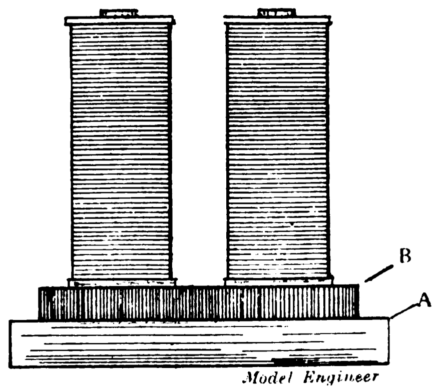


FIG. 8.

lay the coils evenly. Both winding machine and bobbin holder will require to be clamped or screwed down to table. When the bobbins have been wound they should have their starting and finishing ends twisted together, and the whole then steeped in melted paraffin-wax to improve the insulation. The winding of a bobbin must always be in the same direction, and if the handle is turned over and under, this direction must be continued throughout the entire winding of the bobbin. When one layer has been completed, the second layer is laid on over the first, and the operations repeated until winding is completed. As the coils are not carried round the yoke or bend of an electro magnet, it is obvious that the wire will require to be made to cross from one limb to the other in the form of an ∞.

If viewed from the poles, the winding will appear to be reversed on one of the bobbins, therefore the second bobbin will require either to be wound in the opposite direction, or placed on the limb of the magnet with its reverse end uppermost. In making the connections between the coils of each limb, the starting end of the second bobbin is attached to the finishing end of the first. That this is equivalent to winding a single bar continuously in the same direction, will be very easily proved by observing both ends of the bar and noting the direction of the winding. If the cores holding the bobbins could be bent back into a straight line with the yoke, the winding would be seen to be in the same direction; therefore, by applying

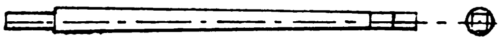


Fig. 9.

ampère's rule, we may ascertain which of the pole-pieces will exhibit north polarity. A piece of iron bar, about 5 ins. long and ½ in. diameter, bent into the form of a horseshoe, and surrounded with about 100 ft. of No. 19 cotton-covered copper wire, when excited by a two cell bichromate battery, should be capable of lifting upwards of 10 lbs. An electro-magnet, suitable for laboratory purposes, is shown in Fig. 8. It consists of a baseboard A, 12 ins. by 9 ins., to which is screwed the electro-magnet by means of its yoke B. The cores of the magnet are each 10 ins. long and 1 in. diameter; they should be made from very soft, round iron rod, and screwed into the yoke for a distance of 1 in. The yoke is 10 ins. by 6 ins. by 1 in., and is bored and tapped to receive the cores at about 2¼ ins. from each end.

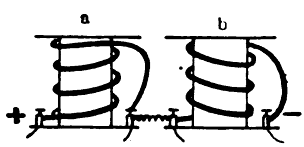


Fig. 10.

The coils are wound upon brass bobbins, made from 8¼ ins. of brass telescope tubing, which is fitted at its ends with boxwood discs, 3¼ ins. diameter, and ⅜ in. thick. Holes are bored in the discs to receive the brass tube, the ends of which should be flush with the outside faces of discs. Each bobbin is wound with about 150 yards No. 19 copper wire, double cotton covered. The bottom disc of each bobbin is provided with two small binding screws, to which are carried the ends of coils. Supposing the binding screws to be numbered 1, 2, 3, and 4 respectively, as in Fig. 10, the starting end of coil *a* is connected to binding screw No. 1, finishing end of coil *a* to screw No. 2, starting end of coil *b* to screw No. 3, and finishing end of coil *b* to screw No. 4. Binding screws N s. 2 and 3 are now connected by means of a short length of insulated wire, which is wound round a pencil, so as to form a helix. The wire coming from the positive element of the battery is connected to binder No. 1, and the negative wire to No. 4. A two- or three-cell battery will be capable of magnetising this magnet.

For the Book-shelf.

A.B.C. of Electrical Experiments. By W. J. Clarke. New York: Excelsior Publishing House. Price $1.00 (4s. 6d.) post free.

As may be gathered from the title, this is a book of electrical experiments. It would be interesting to any young amateur, and deals with a varied selection of matters—such as batteries, magnets, coils, bells, telephones and telegraphs, wireless telegraphy, motors and dynamos, and static electricity. The illustrations are numerous and clear, though they might have been neater with advantage. The author explains that he has himself felt the need of instructions to make *simple* apparatus, and, having overcome the difficulties, is now able to write his experiences for the benefit of others.

Slot and Surface Windings for Armatures.

OUR contemporary, the *American Electrician*, some time since, published some useful facts with regard to relative advantages of the different methods of winding armatures. Below is a *resumé* of the conclusions derived from the data given. The writer begins by stating that American manufacturers have practically entirely abandoned the surface-wound dynamo. The former type is at present only constructed for special purposes, such as plating and electrolytic work. In Europe, and especially in England, the surface-wound machine is still in the lead, manufacturers there always contending that the slot-wound dynamo is much more given to sparking than is the surface-wound machine. In the experience of the writer, dynamos in the United States spark less now than they did years ago, when they had surface and hand-wound armatures. This is not saying that the slotted core improves the conditions governing sparking, but that the conditions have been thoroughly analysed in recent years and that machines are now built along lines which reduce the sparking tendencies to a minimum. The points of superiority generally credited to the slot-wound dynamo are, first, that on account of the short air-gap there is a considerable saving of magnetising force; and, second, that as the conductors are buried in the iron, they are not so easily damaged as when lying on the surface of the core. The writer then proceeds to show that for small machines of given weight and angular velocity, at least 50 per cent. more output can be obtained if the armature is slot-wound than if it is surface-wound.

A number of years ago, a manufacturer who was then still building surface-wound dynamos noticed that his machines were considerably heavier than slot-wound machines of equal output and speed, built by his competitors. A 7½-kw. dynamo, for instance, running 1,200 r.p.m., weighed 1,400 pounds, while machines of this size, with iron-clad armatures, only weighed 1000-1100 pounds. The natural conclusion is, therefore, that the iron-clad armature dynamo is lighter and more compact, and can be built at a lower cost than the surface-wound armature dynamo of equal output and speed. The latter consideration, which concerns manufacturers and purchasers alike, certainly is responsible for the general adoption of slot-wound to the exclusion of surface-wound armatures in America.

Whilst it is not always the case, in the present instance it certainly is true that the model maker should follow the larger practice as closely as possible. We reiterate the statement that in small dynamos, plain drum armatures should never be used under any circumstances whatever.

A Small Power Vertical Steam Engine.

By JAMES R. BEITH.

THE accompanying photographs and description refer to a small model vertical engine I finished recently. I first designed it, made full-size working drawings, and then patterns for the various parts requiring to be cast; these patterns include a full set for the cylinder, with core boxes for the steam ports and exhaust port, also a core box for the valve casing, so that guide strips could be cast on inside of valve casing next to valve face to act as guides for the slide valve.

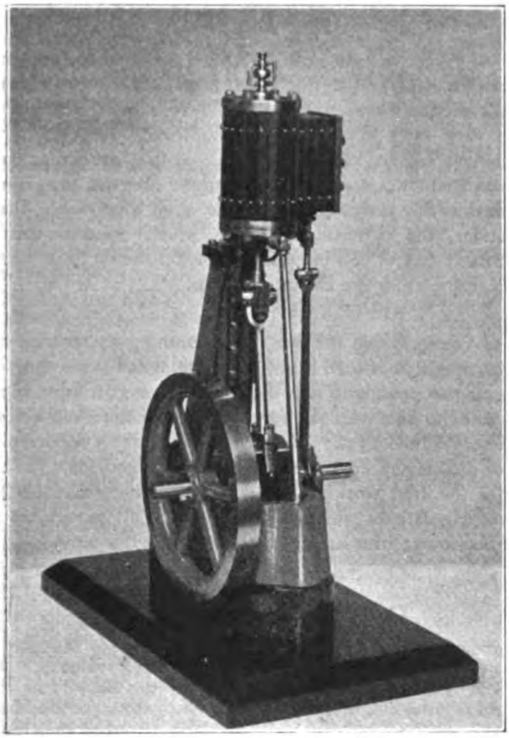
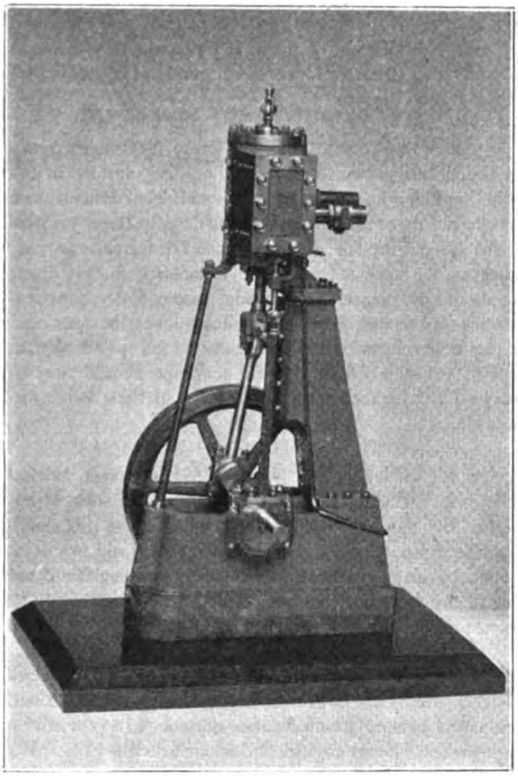
The turning, etc., and fitting was next done, all the screws, bolts and nuts being home made of mild steel, so that I can safely say that the model, from beginning to end, with the exception of the castings and forgings, was entirely made by myself. The material used all through in the construction is as near as possible what would pertain in a large engine.

The cylinder, which is 1⅝-ins. bore by 2¾-ins. stroke, is made of hard cast-iron, the valve casing and cover being made of softer iron. The piston is gunmetal, and is fitted with two phosphor-bronze piston rings about ⅛ in. broad by 3-64ths in. thick. The studs for valve casing are screwed into valve face and pass right through the sides of casing, the cover being slipped on top and then all screwed down. I find this method of fitting the valve casing convenient for adjusting the slide valve, as I have lock nuts on the valve spindle. The crosshead is made of mild steel and has split brasses, and cap for adjusting. The connecting-rod and bearings' brasses are split and fitted with distance pieces and steady-pins to allow for adjusting after wear. Eccentric strap is also fitted with brass distance pieces between the two halves. All parts are carefully fitted and "bedded-down" with red lead and the "scraper," and all flat-wearing surfaces are got up as true as possible to a surface plate which I had specially made for small work.

The valve spindle works through a gunmetal-bushed guide bracket, which, with the addition of the inside strips for slide valve, make a very steady working job. Crankshaft is built, being made of mild steel, and fitted with balance weights to crank webs; in addition to this the flywheel is balanced on inside of rim, so that there is very little vibration when working.

The keyways in crankshaft were cut by fixing the shaft between lathe centres with a distance piece between webs, to prevent springing; a square-faced tool, slightly less in breadth than key-way, was placed sideways in tool holder, and packed up to the requisite height; the lathe saddle was then "racked" along the bed by hand, and tool fed in a little for each cut. I may state that a very neat key-way can be cut in this manner, if care be taken not to give too much feed to the tool. This method is, of course, only applicable where a screw-cutting lathe can be obtained. The cylinder body is covered over with plaster-of-Paris, on which are bedded the small mahogany strips, the screws passing through each strip into the plaster, which acts as a non-conductor of heat.

Further details can be got fairly well from the photographs, which were taken by Jamieson, Polcc Studio, Shawlands, and whom I can recommend to any Glasgow modellers, as taking every care to ensure good work.

MR. BEITH'S MODEL VERTICAL STEAM ENGINE.

The Editor's Page.

MR. T. H. HAWLEY's new series of articles on motor bicycles commences in the present issue, and, judging by the number of enquiries we have had on this subject, we believe it will meet with a very general welcome. The building of a successful motor bicycle is so much more within the scope and the ability of the average home mechanic, that the subject will doubtless appeal to a far larger section of our readers than Mr. Hawley's previous series on motor tricycles and quads. Mr. Hawley's extended experience of cycle work coupled with the fact that he has himself recently built a machine exactly on the lines to be described in his articles, will ensure his matter being thoroughly practical and up-to-date, and we have no doubt that readers who are at all interested in motor cycling will find his contributions of the utmost service.

* * *

We have had several requests lately for some articles on the making and using of small milling cutters in the lathe, and also on the cutting of small gear wheels, and it occurred to us that prize competitions in these subjects might be productive of some useful information. As, however, we have several prize competitions still open, we should be pleased to consider some really practical articles on these subjects, as ordinary contributions, and to pay at our usual rates for those which we decide to accept. A stamped addressed envelope should accompany all articles for return in the case of their being unsuitable.

* * *

"A. K. V." (Lincoln) writes: "I have seen several articles in THE MODEL ENGINEER *re* the smallest steam engine, but have not yet seen any which equal this which I quote from a paper four or five years old:—'It is owned by an inventor of mechanical curios on the other side of the Atlantic. It is so small that it can easily be carried in an ordinary vest pocket, with room to spare, and the weight is less than half-an-ounce. It is a perfect engine, and when the few drops of water its tiny silver boiler will hold are converted into steam, the engine will run at the rate of 3000 revs. per minute. In type it is a high-pressure beam engine, and is constructed principally of gold and silver. There are over 150 pieces in its make up, some so small as to be almost invisible without the aid of a magnifying-glass. The diameter of the cylinder is 1-16th in., diameter of flywheel ⅝ in. The boiler is made of silver in five distinct plates or sheets. There are no rivets in the boiler or in any part of the engine. The separate parts are all held together by screws. These screws are perfect in form and detail, and hold the separate parts of the machine together as though they were rivetted; and yet each is so small that it has to be picked up by the aid of a magnifying-glass and a sharp-pointed pair of pincers. The inventor constructed the engine at the age of 16, and it is said that the late Mr. Barnum offered him £200 for it, which he refused.'"

* * *

"H. G. B." (Pontypridd) writes: "Referring to the letter of 'A. N. (Bury)' in Editor's Page, I have constructed a model coal mine on the very principles which he ('A. N.') advocates, the most minute details being shown. It measures 6 ft. long, 4 ft. high, 1½ ft. wide, with trams (curves), screens, coal waggons, shaft, *wire ropes* for winding, and guides. The wheels of the trams were moulded by myself, and are only lead, because I had no furnace for harder metal, and was probably of too proud a spirit to ask others to make them. The wheels are flanged, and have spokes. The only things which I did not make were the sheet brass and wire ropes. The model is worked by steam, and reverses automatically, tips the coal into the screens, and shows how the screen is lowered to allow the coal to slide into the waggons. The waggons are exact representatives of 10-ton waggons, with breaks and break-block, etc."

* * *

"F. B. K." (Bowral, N.S.W.), writes:—"Can any reader of THE MODEL ENGINEER inform the writer as to the present whereabouts of a beautifully finished model of a very early locomotive—an improved 'Rocket,' with domed firebox, cylinders inclined as the 'Rocket's,' but actuated by sprocket valve motion. It was displayed during the early 'sixties' in the shop window of Alexander, the optician, in High Street, opposite Castle Street, Exeter. So interesting a model should be in South Kensington or the Exeter Museum."

* * *

We regret that the work of examining the entries for Competition No. 18 is not quite completed at the time of going to press with this issue, and we are therefore compelled to hold over the announcement of the result till our issue of June 15th. We would also take this opportunity of drawing special attention to our Competition, No. 22, for the best working models of a flying-machine, the closing date for which is June 30th. Full particulars of this Competition are given elsewhere in this issue.

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. 21.—A prize of the value of £2 2s. is offered for the best description and drawings of a small electro-motor, to work from continuous current supply mains at 60, 100, 110, 200, or 220 volts. The output of the machine should be about 1-10th h.-p. actual, suitable for working light machinery, a fan, or sewing machine, without heating. The particulars should include a description of the method of making patterns for all parts required to be cast, the best way to machine the parts, the construction and winding of the armature, and suitable windings for each of the voltages mentioned above. The article should also include details of the starting and controlling mechanism, and it is desirable that all details, at all events, be drawn full size. The usual general conditions apply to this Competition. The closing date for receiving entries is June 15th.

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.

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.

Answers to Correspondents.

"OLD READER" (Liscard).—The award in our prize competition for description of an amateur's electric light plant was announced in our issue for October 1st, 1900, and the successful article appeared in the issue for October 15th, 1900. Both these issues can be obtained through any agent for THE MODEL ENGINEER, or direct from our publishers.

"J. R." (Brechin).—Our publishers do not send back numbers until they receive a remittance. Obtain issue of November 1st, 1901, for description of an electrically driven model steamer.

"F. J. P." (Fallowfield).—Thanks for your letter. We shall be pleased to have particulars of the motor.

Practical Letters from Our Readers.

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

Simple Model Locomotive Design.

TO THE EDITOR OF *The Model Engineer*.

DEAR SIR,—In reply to Mr. James Stirling's criticism, there is nothing against the method proposed by him; and if the amateur has no taps or dies for screwing the axle and wheel, then it is the only one which would ensure a good and substantial finish. I have, however, just finished my own wheels and have screwed them on to the axles. The diameter of the screwed portion in my case was 5-32nds in. instead of 3-16ths in., owing to my only having a tap and plate for the former size.

I used a 3 in. Cushman chuck to turn the wheels, the operation being as follows: A rough cut is taken on the flange edge only, with the tread in the jaws, then with the flange gripped by the chuck the tread and front face of tyre is roughly turned up. The wheel is again reversed, the tread being held by the chuck securely and truly, whilst the back of the wheel is rough-turned, bored, and tapped. The axles should be centred, shouldered, and screwed between the centres, when the wheel can be screwed on. The second wheel should be prepared similarly to the other and then screwed on; the axle-boxes, which should have been previously prepared and fitted to the frames, being placed on the axle between the wheels. The coupling rod bosses can be then set at right angles, and if they will not come right at first a little metal must be filed off the boss of one wheel until they nearly do so. A good wrench, taking the two wheels, one in each hand, will then accomplish the desired result. The wheels can now be turned up on their axles in the usual way, the method of driving being by the self-centreing or the ordinary driver-chuck and dogs. The exact centres of the coupling-rod pins may be marked out afterwards; and the wheels need not be taken off the axles if the frames are arranged with a slot so that the complete running parts may be slipped up into place in the frames.

I do not claim any special advantage in this way of machining the wheels; as I stated in my concluding paragraph, it is almost impossible for a designer to prescribe exactly any or all the details of construction, and the difficulties which may arise. The manner in which many jobs may be accomplished will vary with the maker and the tools at his disposal. If I had had a slide-rest in finishing my wheels, I might have done them in an entirely different way.

With reference to Mr. Lea's suggestion. This ingenious way of forming bends in pipes is not applicable in the case in point. The pipe must be allowed a lateral movement to the extent of the amount it enters the steam block, so that it may be put into position or removed when occasion may require.

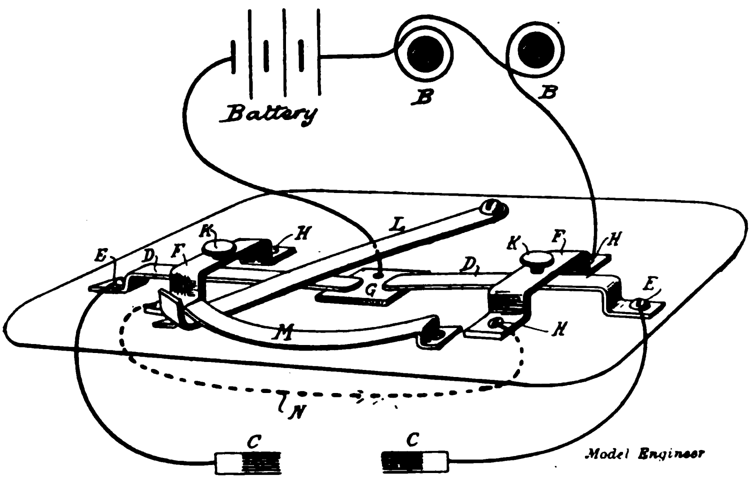
I may add that a boiler, made to the published design, has just been completed, and has been found to give excellent results.—Yours truly, H. G.
London, W.C.

A Simple Reverser for an Electro-Motor.

TO THE EDITOR OF *The Model Engineer*.

DEAR SIR,—In your issue of April 1st I find described a simple reverser for an electro-motor. As I think it is rather troublesome to have to remove the wires and place them in a different position in order to reverse the current, I send a sketch of another idea, in which it is only necessary to move a lever to the right or left as required. In the sketch C, C, are the brushes and B, B, the two field-magnet cores of the motor. The brushes are connected to two pieces of springy sheet brass, about 4 ins. long and ½ in. broad, and bent to the shape shewn at D, D. The ends of D, D, marked E, E, have a hole drilled through them so that they can be screwed to the base-board with their other ends distant about ½ in. Underneath their ends is screwed a square piece of brass G (about 1 in. square), so that if either of the springs D, D be pressed down, they will make electrical contact with G.

Two strips of brass must now be bent to the shape shewn at F, F, and two holes drilled through the places marked H, H; also another hole must be drilled through the top part K, to admit of an adjusting screw tipped with platinum. The holes H, H are for screwing the bridges to the baseboard. The bridges must now be screwed over the springs about 1½ ins. from the ends E, E, and the screw adjusted so that it keeps the springs



Reverser for Small Electro Motor.

about 1-8th in. from G. The two bridges must be connected by a piece of copper wire, N, running in a groove under the baseboard. If now the bridges are connected to one pole of a battery and G to the other pole, and, say, the left-hand spring pressed, till it touches G, the current will flow in one direction; but if the right-hand spring is pressed, the current will flow in the opposite direction round the armature.

A lever, L, has now only to be arranged that will keep the springs down, and this had better be about 5 ins. long. This lever, when moving, will slide along the springs, but these, being bent, will be pressed on to G. So that the lever will keep in position, a curved brass strip, M, had better be screwed to the baseboard above the lever for it to work on; also two pieces of stout brass wire had better be driven into the ends of M to keep the lever from going too far.—Yours truly,

Tunbridge Wells. Stanley Okell.

Rating of Model Engines.

To the Editor of *The Model Engineer*.

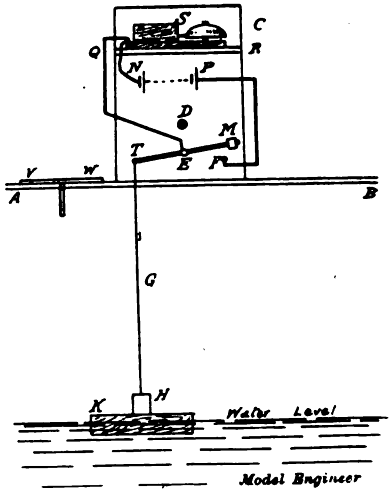
Dear Sir,—Will you allow me to make a suggestion to your readers with regard to the power-rating of model engines? Why cannot we have a standard power unit for models, say 1000 ft.-lbs. per minute? In my opinion this would be far preferable to the present way of rating an engine, *i.e.*, bore, stroke, steam pressure, and speed, or by fractions of a horse-power. The Society of Model Engineers has a standard gauge for model locomotives and a track for testing them under steam, so why not have a power-testing apparatus for stationary model engines, motors, &c.? I sincerely hope that fellow-readers may think the above subject worthy of discussion in these columns.—Yours truly, G. Lee.

Edmonton.

A Simple Electric Tell-tale for Bath or Cistern.

To the Editor of *The Model Engineer*.

Dear Sir,—Sometimes, when one wishes to fill a bath or tank to a certain height, it is annoying to have to wait and watch it. To obviate this, a simple apparatus might be arranged as follows: It consists of a case, C, which may stand on one edge of bath, A B. On the outside of this case is pivoted a bar of wood, T M, at E, and



Water-Level "Tell-Tale" for Bath or Cistern.

from T hangs a string or fine wire G, to a float of cork, K. The squares M and H are small pieces of lead to maintain a balance. F and E are terminals. D is a screw with rubber round it to act as a buffer against T M's coming over. N and P are the poles of a battery in the case connected to an electric bell, S lying on the division, Q R. One wire from S is connected to E, which is in connection with M by a strip of copper laid along E M. The other wire from S is joined to N, and P and F are likewise connected up. The line G is adjusted so that when water is up to required level M swings down till it is in contact with F, thus completing the circuit and ringing the bell until the float is lifted out of the water and hung in the rack, V W. The size of case must be decided by the space at disposal.—Yours truly,

Birkenhead. C. M.

A Simple Steam Crane.

To the Editor of *The Model Engineer*.

Dear Sir,—My little boy had a shilling model vertical engine given to him, and, naturally, wanted something for it to "work." So I had to put my "thinking machine" to work, and, after due consideration, constructed the following:

I made two wheels, 1 in. and 2 ins. diameter with V-shaped grooves in them, and fixed both on the same spindle. Then I got a lever clock movement (timepiece, not alarum), took it to pieces, and fitted to the end of the spindle which had carried the seconds hand a grooved pulley, 7-16ths in. diameter and 3-16ths in. thick. I then put the clock together again, but only put in the mainspring wheel, centre wheel, third wheel, and the seconds pinion, on the outside end of which I drove the small grooved pulley. Instead of the key on the main spindle I screwed a piece of wood (taken from one of those toy bladders which children blow up and then allow to empty themselves with a squeak) for a winding drum. Then I tied the movement down to a piece of wood, with iron binding wire twisted round two of the pillars and then put through holes in the wood. For belts I used fine twine, and tied the ends together with a reef knot. One went from a ½-in. pulley on the engine flywheel to the small wheel of the speed pulley, and the other from the larger wheel of the speed pulley to the pulley on the clock movement. A piece of wood was fixed up as a crane jib with a cotton reel at the top held by a screw; then a piece of fine twine was tied to the winding drum, passed over the reel and down through a small pulley to which the weight to be lifted was tied, and then taken up and hooked on the screw.

We then got up steam, the engine went at a fine rate, and lifted 12 ozs. of lead 5 ft. high in half-an-hour.

—Yours truly, J. A. B.

Ibro.

Model Yachting Correspondence.

Model Yacht Sails.

To the Editor of *The Model Engineer*.

Dear Sir,—Many of the illustrated boats in your most interesting journal may have very good hulls; they are partially in the water, and cannot, therefore, be seen. But the sails, in some cases, seem to me to be very indifferently cut and bent, the luffs of the mainsails being, I think, too large, and the heads consequently too short. The mainsails and jibs are also, I think, often out of proportion, the former being too small in proportion to the latter. These details do so spoil the look of a boat, and also very probably seriously affect her sailing capabilities.—Yours faithfully, C. J. C.

Bourne End.

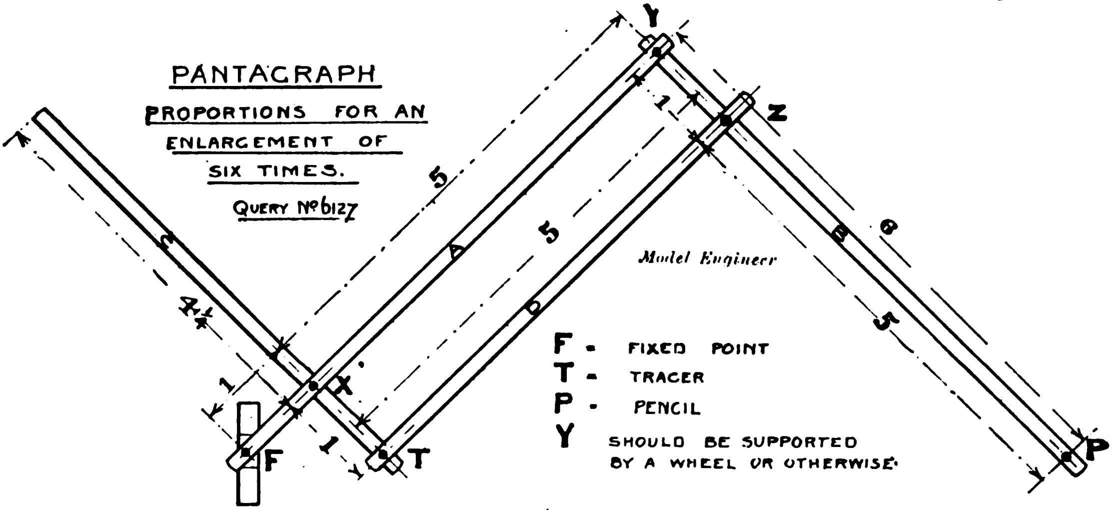
Queries and Replies.

[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.

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 :—

[6127] **Pantagraph.** W. D. (Torquay) writes: Would you kindly tell me how to place the pantagraph in the drawings enclosed, so that I can enlarge six times, that is, to make the pencil travel six inches to the tracer's one inch. Each rod is 18 ins. long.



The pantagraph is an instrument consisting of a system of levers which are arranged and proportioned so that two of the joints (T and P) may move together in any direction, but in predetermined ratios. The pantagraph shown in your sketch (not reproduced) is capable of being arranged so that it may enlarge to six times. The distances between the various points of junction (or pivots) should be made as indicated in the accompanying illustration. The unit given thereon may, if your rods are slightly over 18 ins. long, *i.e.*, 18 ins. long between centres PY and FY, be 3 ins., and therefore the distances given should be multiplied by 3, the result being in inches. To alter for any other enlargement with the same apparatus a table is given below:—

Points.	Twice.	3 times.	4 times.	5 times.
P to Y	18	18	18	18
P to Z	9	12	13·5	14·4
Z to Y	9	16	4·5	3·6
F to X	9	6	4·5	3·6
T to X	9	6	4·5	3·6
T to Z	9	12	13·5	14·4
X to Y	9	12	13·5	14·4
F to Y	18	18	18	18

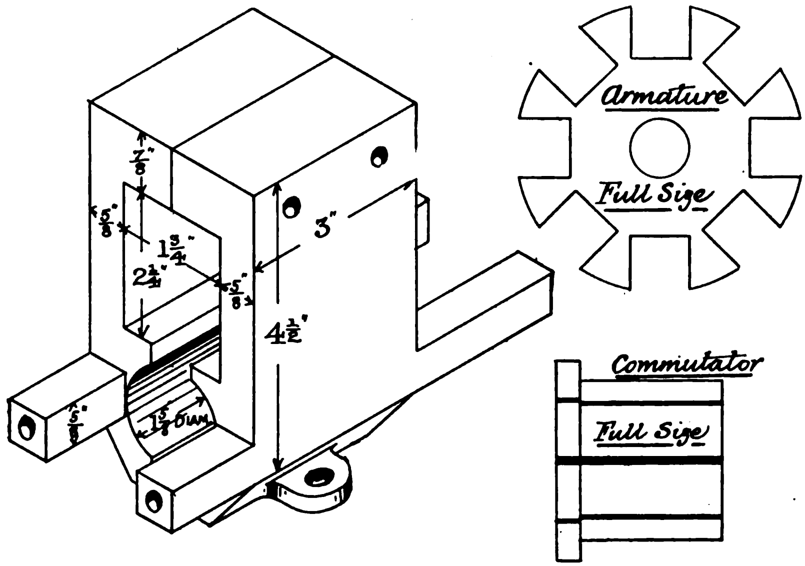
The above figures are in inches, and for any other lengths of rods A and B, when N = the number of times the drawing is to be enlarged, these two rods should be divided into N parts and then, as shown on the drawing herewith, PZ, XY and TZ = (N-1) parts, and FX, TX and YZ = 1 part.

[6151] **Induction Coil.** J. E. A. (Cardiff) writes: I shall be much obliged if you will give me your advice on a 2-in. spark coil which I am making for *x*-ray work. The core is ¾ in. diam., made up of No. 22 soft iron wire. Primary winding consists of four layers of No. 16 D.C.C. wire. Amount of secondary wire is 2½ lbs. (No. 36 S.C.C., S.W.G.), continuous length (not sections), and find that I can scarcely obtain a 1-32nd in. spark when using two bichromate cells. I used no condenser. The shock, however, was powerful enough for half-a-dozen persons. The contacts are properly tipped with platinum. I have reversed the current, and adjusted contact screw, but with no better result. Only one thing I omitted to do, and that was to soak the bobbin of secondary wire in paraffin wax before laying it on. (1) Would the fact that the secondary was in one continuous length, and not in sections, make any difference in the length of spark? (2) Do you think that by having an extra large condenser, and using about ten cells, that I should get a 2-in. spark from the finished coil? (3) What is meant by "self-induction" of primary? Do you think that this has anything to do with my getting such a poor result? (4) What are the *x*-rays? Is it those which proceed from the "anode," or is it the rays produced when the anode and cathode meet?

In the first place, a 2-in. spark coil is of little or no use for *x*-ray work. At least a 4-in spark is necessary. You should have put only 2 layers of the No. 16 wire on the primary, and the fact that you have 4 layers is very much against satisfactory working of the coil. Still more important is the continuous winding, which is the very worst method of winding the secondary of a spark coil, and this is aggravated by the fact of not having paraffined the wire. It is useless to apply a very heavy current in the hope of getting a longer spark, since the only effect would be to break down the insulation still more thoroughly, and there is nothing for it but to re-construct the coil in accordance with scientific principles if you wish to get good results from it. If you have not already done so, you should study a book on the subject—Norrie's "Induction Coils" for example, which can be obtained from our Book Department, price 2s. 2d., post free, and no one should attempt to make a sparking coil of any size without some definite practical instruction such as can be obtained from a book of this sort. Self-induction is simply the effect of induction on adjacent turns of wire in the primary, each turn of which acts on those near it in precisely the same way as the whole primary acts on the secondary coil. As already hinted, it is very largely this which determines the small spark you obtain, and the result is even more marked as you have no condenser in the circuit. As to the nature of *x*-rays, so debatable a point cannot be made the subject of a reply in the Query Department. There are several books dealing with the matter, and doubtless you can find some information from books in your local libraries.

[6107] **Undertype Dynamo (40-watts).** W. K. (Erith) writes: I should be greatly obliged if you would enlighten me on the following questions. I am making a dynamo as in sketch. I have wound the fields with 2 lbs. 2 ozs. of 22 D.C. wire, and have got thirteen layers of fifty turns on each field. I want to know how to wind the armature to suit the windings of the field-magnets, and what voltage and ampères I could get from it? I also wish to know the correct winding for an 8-part commutator?

Wind the armature with 5 ozs. No. 23 wire. The method of doing this is shown clearly in our new handbook—"Small Dynamos and Motors" (price 7d., post free), and is too long to repeat here. The speed of the machine should be 3 100 revolutions per minute, and you may expect an output of 2 ampères at 20 volts. We note there is an excessive thickness of metal at the pole *tips*. This is somewhat disadvantageous, as it leads to leakage of lines of force. Your drawing is reproduced one-third size, the armature stampings and commutator being full size.



40-WATT UNDERTYPE DYNAMO (in Isometric Projection). HALF SIZE.

Query No. 6107.

[6240] **Current Required to Heat Platinum Wires.** J. G. W. (Dublin) writes: (1) With regard to my Query No. 5954 in the April 15th issue about heating the wire, I am acquainted with the usual "Ohm's law" given in the text-books, and the reason I was puzzled was because of the low intensity of the battery I was using. It was a single bichromate cell (of large plate area), three carbons and two zincs, 7 ins. by 2 ins., carbons are cut-plates with coppered tops, and can give quite 50 amps. on the short circuit, and heated the 1-in. of 22 gauge platinum wire to redness, which I can quite understand. But I do not yet understand how it will heat 20 ins. of No. 40 gauge, which must have hundreds of times more resistance, with the same intensity of battery power. As far as I can see it is opposed to "Ohm's law," but I am quite willing to take your word for it now you know the full particulars of the battery. (2) Will a single Daniell cell 1·07 volts have sufficient intensity to charge a single cell of Edison's storage battery, ·75 volt with copper oxide and zinc plates in solution of caustic soda.

By Ohm's law, $C = \frac{E}{R}$. In your case E is fixed (2 volts as nearly as possible) and R consists of the internal resistance of battery, the resistance of the platinum wire, and that of the circuit wires. The resistance of 1 in. of No. 22 platinum wire may be taken as ·002 ohm, and *if* the current is 50 amps., it follows that the remaining resistances must total up to ·038 ohm. A current of 50 amps. is, however, more than twice as much as No. 22 platinum wire could carry, and it is very doubtful whether such a current could be obtained from the cell. As a matter of fact, the potential does not remain at 2 volts with so small a resistance in circuit. It drops very low, and the real current (as indicated by the fact that the wire is only at red heat) is probably not much more than 12 amps. Now as to the No. 40 wire. Platinum wire of this gauge will fuse with less than 2 amps.; one ampère would make it a bright red. The resistance of 20 ins. of No. 40 platinum wire is just under 2 ohms; the internal resistance of battery and circuit would just bring it to 2 ohms altogether. The voltage = 2; therefore, Current = $\frac{2 \text{ volts}}{2 \text{ ohms}}$ = 1 ampère, which, as you will note, is the amount just stated to be sufficient to heat the wire to redness. In this case, the comparatively high resistance of the circuit keeps up the value of the voltage figure nearly to its full amount. We trust this explains the difficulty. (2) Yes.

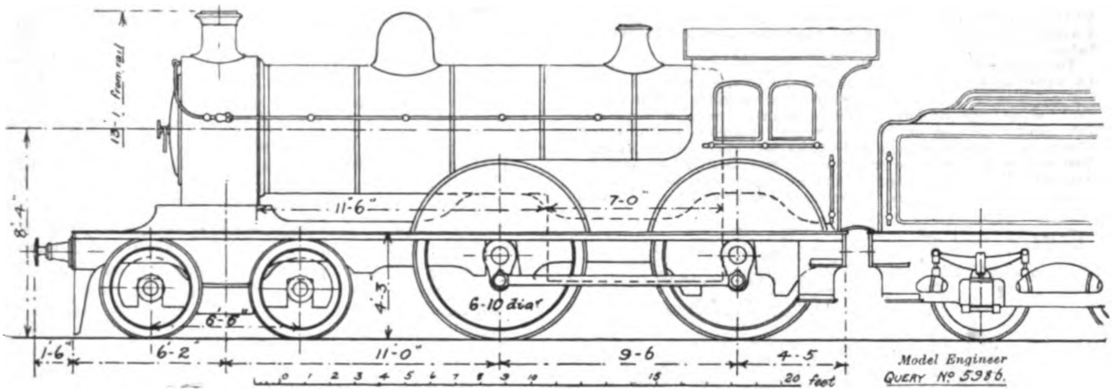
[5741] **Model Paddle Steamer.** G. H. C. (Bristol) writes: (1) What size cylinders (double-action oscillating) would drive a 3 ft. 6 ins. model paddle steamer at a moderate speed? (2) As to boilers to supply steam to above. There is a space forward of engines, 9 × 4½ × 4½ ins., which is available for boiler and fuel container, the fore saloon being unflooded. Aft the engines, there is a space of 1 ft. × 4⅝ × 3¾ ins. in under the floor of the saloon. Could you give a design of suitable boiler?

The chief difficulty in the design of a model paddle boat is the arrangement of the boiler and engines. The paddle shaft being generally in the centre of the craft, the boiler, whichever side it is put, must be balanced by a corresponding excess of weight on the other side. You might arrange the boiler behind the shaft, and the oil tanks in the fore part of the vessel. Another trouble which is experienced in this type of model steamboat is the engines. We cannot point to very many efficient model paddle boats. There are two principal reasons to account for the comparative failure of this type of model, as follows. (1) The boats are very often over engined, and the type of engine, a double cylinder oscillating, which is generally used, is not, as commonly constructed, mechanically efficient. (2) Even if the engines were good in design and not of too large dimensions, paddle wheels run at much too low a speed to obtain the greatest amount of work from the steam. Say the engines run at 60 to 80 revs. per minute, they are most likely using just as much, if not more, steam than when running at a very much greater number of revolutions per minute, owing to the large increase of cylinder condensation consequent upon the very slow piston speed. The following arrangement is recommended as worthy of practical experiment:—Engines: A single double-acting cylinder, oscillating (spring contact) or slide-valve, ⅝ in. × 1¼ ins., working on to an auxiliary shaft under the paddle shaft. The cylinder may be placed horizontally or diagonally, just as is found convenient. The auxiliary shaft to be connected by a small spur wheel to a larger one on the main shaft, the gearing down being about 3 to 1. By this arrangement the engine will be as powerful as one on the main shaft with two larger cylinders, and will run a reasonable speed, preventing a great deal of cylinder condensation which will, we think, with the disuse of the second cylinder, more than compensate for the friction of the gearing. The boiler may be similar to that in the *M.E.* for April 1st last year (page 145), or one on the lines of that shewn in issue of March 15th last (page 143), and November 1st (page 215), 1901. The size of the latter type of boiler might be 2¾ ins. diameter by 7 ins. long, when three down tubes could be arranged with about six water tubes, 3-16ths in. outside diameter.

The firing may be a spirit vapourizer, the most suitable burner for which seems to be W. W. H.'s, which is shown on page 89 of February 15th issue.

[5986] **N.E.R. Express Locomotive.** H. P. J. (York) writes: I wish to build a ½-in. scale model of the latest type of 4-coupled express engine on the N.E.R., 2015 Class, and would be very much obliged if you could give me an outline elevation, showing shape of frames, diameter of wheels, and cab.

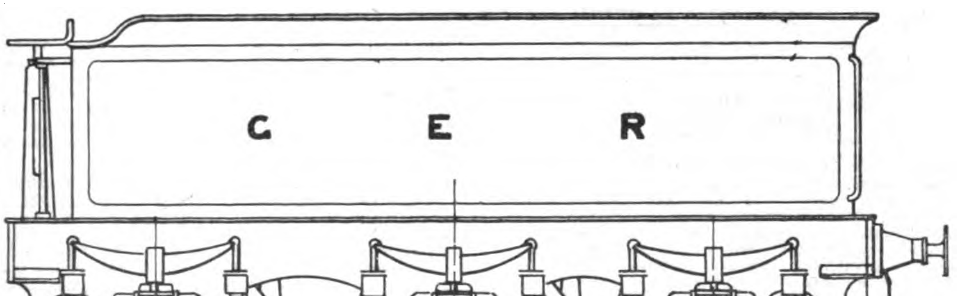
We herewith give an outline sketch of the latest N.E.R. four-coupled express locomotives. The diameter of the bogie wheels is 4 ft.; other particulars may be obtained from the drawing.



North Eastern Railway, Four-coupled Express Locomotive.

[6229] **Electro-motor for Model Boat.** S. M. H. (Croydon, Australia) writes: I have a model boat, 30 ins. long, 5½ ins. deep, 5 ins. beam, containing a 12-volt accumulator. Kindly inform me as to the best size of motor. Please also give method of winding armature and field-magnets, size of propeller, and probable speed of boat.

Since you have a comparatively high voltage, the motor should take only a small current, if the cells are not to be too rapidly exhausted. We should advise an ordinary undertype motor, fitted with tripolar or (if the greatest *power* is to be obtained) an H armature, 1¼ ins. diameter by 1⅛ ins. long. The field-magnets would be best in wrought iron. On the armature may be wound two or three ounces of No. 28 wire, and on the field-magnets, 4 ozs. No. 24, connected in series. The proportions of the motor, the methods of winding, etc., can all be found in our handbook No. 10, "Small Dynamos and Motors," particulars of which you will find in the advertising columns. The propeller might be 2 ins. diameter, fine-pitched, so that the motor can run at nearly top speed. We cannot estimate speed of boat accurately—it might be about three miles per hour.



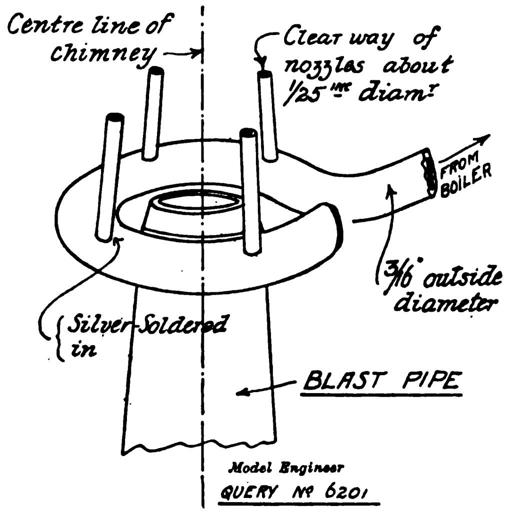
Query No. 5345. Standard Great Eastern Railway Tender.

[5345] **G.E.R. Locomotive Tenders.** L. J. H. (Bury St. Edmunds) writes: Would you kindly send at your earliest convenience sketch and principal dimensions of tender for 420-type G.E.R. mixed traffic locomotive? The model I am constructing is ½-in. scale.

Herewith we give an outline drawing of a standard G.E.R. tender. The scale to which it is reproduced is ¼ in. to the foot—half the size of your model.

[6201] **Locomotive Boiler Manipulation.** T. M. (Lincoln) writes: I have made a portable boiler and engine. Would you kindly assist me in my difficulty? Will you kindly tell me the reason my boiler will not burn coal? When I light a fire it goes out, with door shut or open. I have tried it all ways. I have had a 2¼-in. chimney 6 ft. long; also I have had it in the wash-house chimney, and I cannot get it to draw. A fire has been placed in the smokebox end as well, with just the same results. The boiler is made of ⅛ in. iron. The tubes are ⅝ in., steel, ten in number. The boiler is riveted all over with 3-16ths in. rivets. The grate is 4½ ins. long by 6¾ ins. wide, and the barrel 7 ins. diam. 12 ins. long. I have tried all different heights of ash-pans, and would you kindly tell me what pressure the boiler will stand? Would you tell me what power the engine (1¾ ins. bore by 3½ ins.) would develop? I have made several models, but I have never been in a fix like this before.

The proportions of the boiler are not good. The grate should have been at least ⅝ or 2-3rds the length of the barrel. In your boiler it is as ⅜ to 1. It is, however, of ample width. With regard to the working of the boiler. With a natural draught a larger and much longer chimney would be necessary; but more especially with yours. A loco boiler will not work at its best with natural draught. The evaporation will be surprisingly increased by an induced draught. The 2¼-in. chimney may be retained, the height advisable is from 9 ins. to 12 ins. A steam blower should be introduced



in the smokebox at its base; this may be of the form shown on the accompanying sketch, and should be about level with the top row of tubes. The small tubes should not be of greater internal diameter than that indicated, and their axes should converge very slightly. The exact diameter of the blast nozzle may be determined by practical experiment. To raise steam, use an extension stack and footblower as shown in our issue of October 1st last (p. 166). As the boiler is provided with such a comparatively small grate, a sharp current of air through the firebox will be required to keep up a good head of steam. If, however, you find it difficult to manipulate it in the way we have named, it might be worth while lengthening the grate, but if you arrange the means of inducing a draught, we do not anticipate this expedient having to be adopted. The grate should be fitted with 5-32nds-in. bars, the spaces between being about ¼-in. wide. Use half-burnt cinders from the domestic fire, with the coal, and, if readily obtainable, some charcoal will be found beneficial, especially at starting. As the firebox crown does not appear to be stayed, the working pressure should be moderately low, say, about 30 lbs. At 30 lbs. and 250 revs. about 1-6th b.h.-p. would be developed by the engine. Kindly adhere strictly to our rules in future. If you had enclosed your address or a stamped addressed envelope, we might have been able to give you an answer earlier. It is impossible to get replies in the paper "in the next issue" after the receipt of the query.

[6332] **Simplex Dynamo, 10-watt.** J. H. S. (Eccles) writes: Will you kindly give me full dimensions of a very small dynamo, giving current enough to light only one 3-c.-p. lamp at a low voltage? I prefer the field-magnets to be cast in malleable iron all in one piece, the armature to be made of stampings of Siemens' type. Please also state gauge and quantity of wire to be wound on both fields and armature.

A 3 c.-p. lamp of high efficiency type would require a 10-watt dynamo to light it efficiently. Referring to our new handbook—"Small Dynamos and Motors," the first example given therein would appear to meet your requirements exactly. This is a Simplex dynamo with field magnet cast in one piece, and having an armature 1½ ins. diameter by 1½ ins. long. As you intend to use a Siemens' H armature, the length might be reduced to 1 in., keeping the diameter 1½ in., and the field-magnet should be reduced in length accordingly. The wire for the armature in this case would be 1¾ ozs. No. 20, and that for field-magnets, 5 ozs. No. 18. This is for connection in series.

A Book for the Amateur Mechanic.

THE amateur mechanic is short of important tools, if he has no books. A few he knows to be essential, but these generally deal with special branches of work, particularly in the case of a worker who has special proclivities. A volume of a more general nature, dealing with a big range of mechanical matters, should be eminently useful in such a case, provided it is thoroughly practical, and its contents dealt with not too briefly. This is the case with Messrs. E. & F. N. Spon's "Mechanic's Own Book"—now in its sixth edition—and which comprises some 700 pages, dealing with mechanical drawing, casting and founding, forging and finishing, soldering, sheet metal working, carpentry, carving, painting, staining, mechanical movements, turning, lighting, and numbers of allied matters. The book may be obtained through our publishers, Messrs. Dawbarn & Ward, Ltd., 6, Farringdon Avenue, London, E.C., the price being 6s. cloth or 7s. 6d. morocco covered, post free.

Amateurs' 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.*]

Messrs. Hughes, Fawcett & Co.'s Prize Competition.

We are asked to announce that the competition recently held by Messrs. Hughes, Fawcett & Co., Hebden Bridge, resulted as follows:—Mr. M. Simmons, c/o A. W. May, Esq., Walsoken, Wisbech (first): Mr. A. Hinde, 106, Richardson Street, Carlisle (second). The misspelt word was "required"; it is printed "reqnired" in the firm's catalogue—N instead of U. The subject matter of the page is Lathe Headstocks, and the word is the third from the left hand end of the sixteenth line from the top. The firm received some 450 letters, out of which thirty-one competitors named the winning word.

***1½-in. Scale Model Locomotive Castings.**

The Model Manufacturing Co., of 52, Addison Road North, Notting Hill, W. who have already produced castings of several well-designed models, have sent us a part of the set they are supplying for making a 1½-in. scale model of a S.E. & C. Ry. four-coupled express locomotive, No. 735, Mr. H. Wainwright's latest design. We have the drawings supplied with the castings before us, and may say that they have been neatly and carefully executed, and, as is always the case, will, during the construction of the model, be found to help the builder considerably. Some trifling discrepancies between the original and the model are to be found, but they do not materially affect the excellences of the reproduction. As to the castings, both iron and gunmetal, they are really excellent in every way, very clean, sound, and of good shape, and we can strongly recommend them to the model engineer who wishes to make a locomotive which will pull himself along. The list sent us with the sample castings states that the complete set supp'ied consists of fifteen steel parts, fifty-five iron, and fifty-seven gunmetal castings, and we are of opinion they are very good value for the outlay.

***A New Arc Lamp.**

An arc lamp which substitutes a "brilliant pale golden light" for the well-known intense white light of the ordinary arc lamp should meet with great favour. This is the property of the "Flame" Arc Lamp, now being supplied for either continuous or alternating current by the Union Electric Co., Ltd., 151, Queen Victoria Street, London, E.C. The lamps are made in various powers, and all accessories, carbons, resistances, etc., are sold by the same firm. Particulars can be had on application, THE MODEL ENGINEER being quoted.

Electric Goods for Motorists.

Induction coils, ignition batteries, and electrical accessories of interest to the motor-car owner are sold by Messrs. W. J. Bishop and Co., 88, George Street, Croydon. The former include coils for bicycles and small and large cars, whilst the ignition batteries are of strong, sound make, in various sizes. Small pocket accumulators, as shown in Fig. 2, are also listed. A speciality is the electric inspecting lamp, shown in Fig. 1. It is for use on motor-cars, and is run from the ignition battery. An illustrated price list will be sent to any reader mentioning this journal and enclosing a stamp for postage.

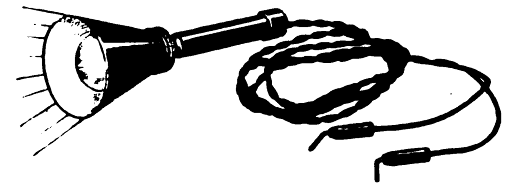
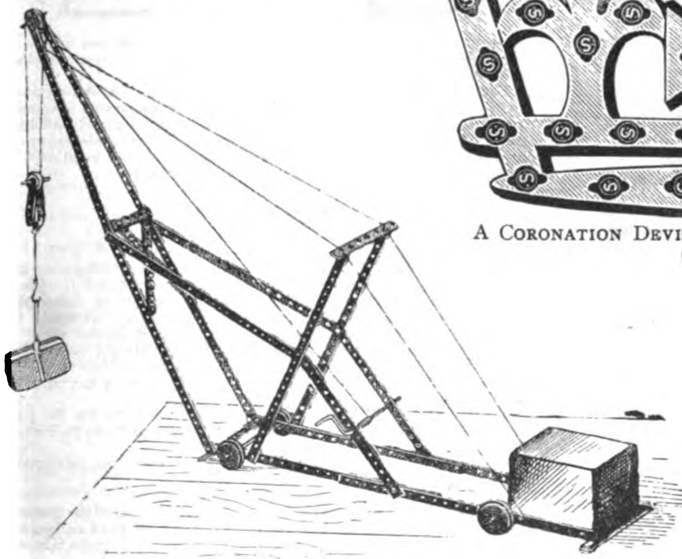


Fig. 1.—Electric Inspection Lamp.

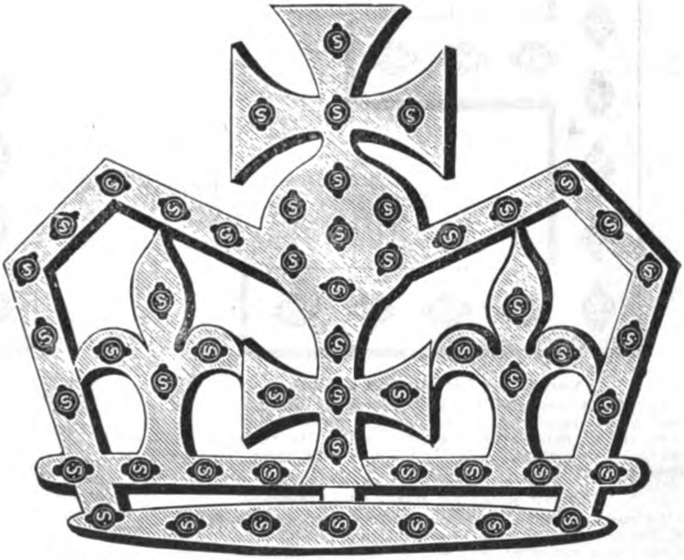
Fig. 2.—Pocket Accumulator.



One of the Models Built from Messrs. Elliot & Hornby's Mechanical Set.

*A Mechanical Toy for Embryo Engineers.

Parents and elder brothers are very often at a loss to know what to purchase in the way of toys for the younger members of the family who evince a natural liking for things mechanical. To meet this need, Messrs. Elliot & Hornby, of 18, James Street, Liverpool, have introduced to our notice an adaptable and practically unbreakable toy, with which the child is able to make up models of engineering structures and machines. The object of the invention is to train the young in mechanical construction, and accompanying this latest version of the box of bricks is a pamphlet, entitled—"Mechanics Made Easy," giving illustrations of the various models which can be made up by the set of apparatus, including model bascule and swing bridges, lines of railway, travelling and overhead cranes, etc. The set, packed in a neat tin box, consists of lengths of tinned iron, with smooth edges and regular perforations, 12½ ins., 5½ ins., and 2½ ins. long—a dozen of each, about eighteen angle pieces, specially grooved rods for use as shafts and axles, a box of bolts and nuts, which, by the way, are of good quality, and are not likely to speedily wear out; pulley and flanged wheels, with key-ways; cord, books, and ingeniously conceived keys, which are capable of making the pulleys and wheels either fast or loose upon the shafts. Models of wheelbarrows, rope tramways, swing and bascule bridges, are possible - in fact, the scope of the toy is unlimited, and, to prove its capabilities, we built up, in about a quarter-of-an-hour, a representation of the Rottingdean submerged railway. No turning, cutting, or drilling is required, and, above all, no dirt or mess is occasioned by its use. Professor Hele Shaw, of Liverpool, in a letter to the inventor, says: "Thank you very much for the photographs of your clever toy. . . . I shall certainly buy a set for my little boy. . . . With a little ingenuity and exercise of the imagination it should be as good as a fairy story, and what can one say more!"



A Coronation Device by Messrs. Ward & Goldstone.
(*See next page.*)

Small Steam Engines.

We published, some months ago, particulars of a well-designed steam engine placed on the market by Mr. B. R. Wicks, Bridgeport, Conn., U.S.A. We have now examined photographs of some other of his productions, including a horizontal steam engine of 1¼ h.-p., one of from ¼ to ⅛ h.-p., and a little vertical engine of substantial construction rated at 1-16th to ⅛ h.-p. Readers should obtain further particulars of these engines, remembering to place a 2½d. stamp on their letters. Mr. Wicks also informs us that he is engaged on designs for as many as ten steam, gasoline, and oil engines shortly to be placed on the market, and judging by his other designs these should prove substantial and good looking engines.

Change of Business Ownership.

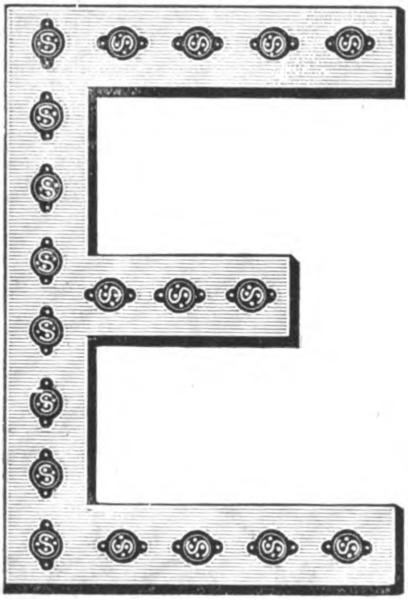
We are informed by Messrs. Page & Co., Kimberley Gardens, Green Lanes, London, N., that they have acquired the business of Mr. W. H. Carter, of Braemar Road, South Tottenham, and will execute all orders for accumulators, etc.

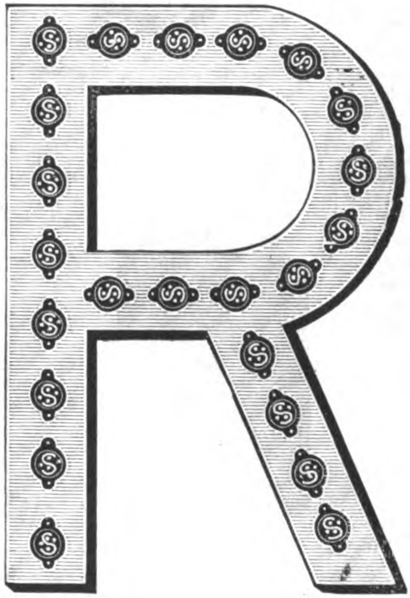
Illumination Bayonet Holders.

Some special "bayonet" type electric lamp holders are being supplied by Mr. Archibald J. Wright, 318, Upper Street, Islington, London, N. These and lamps, illuminated signs, and accessories are amongst the goods offered by the firm especially for Coronation illuminations, and wherever electricity can be employed they should be in request.

Coronation Devices.

Three electrically illuminated devices for Coronation festivities are shown on this and the previous pages. These sets are supplied, ready wired, and complete, with lampholders fixed, so as to prevent any trouble. Messrs. Ward & Goldstone, 45, Dutton Street, Strangeways, Manchester, who are offering these decorations, have already supplied a large number to the satisfaction of their customers.





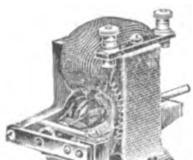
Messrs. Ward and Goldstone's Electric Letters for Coronation Illuminations.

Coronation Electric Pin Badges.

Another "Coronation" idea is an electric pin badge, lit from a small pocket accumulator. The device is carried out in various forms, and all particulars can be obtained from Messrs. Armstrong and Co., Twickenham. The Model Engineer should be mentioned when writing.

*A Cheap Motor for Boats and Tramcars.

We have received and tested a small electro-motor sold by Mr. T. W. Thompson, 73, Trafalgar Road, Greenwich, London, S.E. This motor has a laminated cogged-drum armature of excellent construction, wound in eight sections, and is self-starting. The field-magnets are of soft cast-iron of good section, and the particular motor sent is wound for from 2 to 4 volts. At the latter pressure, our test of the little machine showed that it was fully up to the power to be expected, and that it ran freely and without the slightest heating. Similar motors can be supplied for any voltage from 2 to 25, and we think them excellent value, the price being 10s. 6d. A set of castings and armature laminations (priced at 3s. 6d.) has also been submitted, and we are satisfied with their appearance. The magnet is particularly clean, and should need no machining beyond the drilling of holes for bearings, etc. Our illustration shows the finished motor, and further particulars can be obtained from Mr. Thompson on sending 2d. in stamps for his illustrated list. Mention should be made of The Model Engineer when corresponding.



A Cheap Self starting Motor.

Catalogues Received.

Hamilton Model Works, Hamilton, Canada.—This catalogue is a smart production. It details the "Triton" gasoline motor in various sizes and powers, finished complete, or supplied in the rough. Particulars are also given of launches and cars fitted with similar machines, parts and accessories being described. The list is fully illustrated, and will be sent post free to Model Engineer readers.

Ardwick Engineering Company, Bennett Street, Ardwick, Manchester.—A catalogue of steam, gas, and other engines is issued by this firm. These are in various sizes, from those we may call models up to powerful machines. Some useful notes on the care of steam yachts, and information as to the power required to drive launches of different dimensions, are included.

Fred V. A. Lloyd, 15, Lord Street, Liverpool.—A well-stocked and fully-illustrated catalogue of photographic apparatus is issued by Mr. Lloyd. It runs to more than a hundred closely-printed pages, with a good index, and its contents cover the whole range of photographic and lantern requisites. Readers should mention the name of this journal when sending for this catalogue.

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.

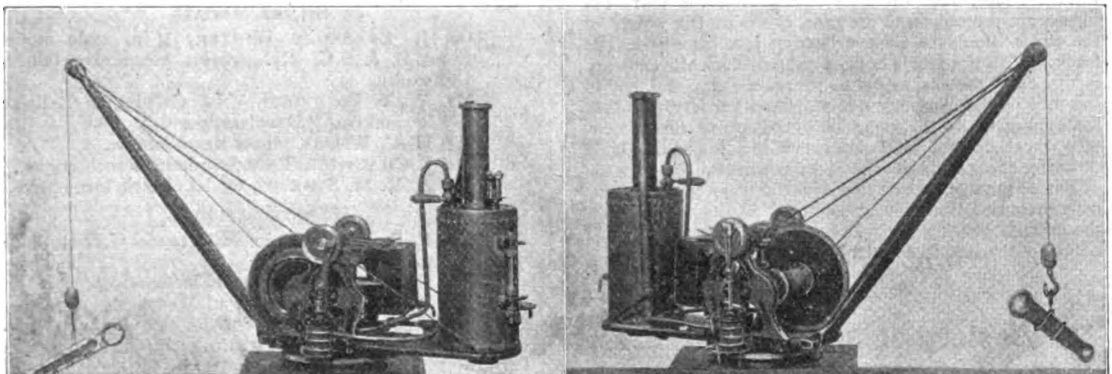
VOL. VI. No. 75. JUNE 15, 1902. PUBLISHED TWICE MONTHLY.

A Model Travelling Steam Crane.

By O. P.

MODEL cranes, whether worked by hand or power, and whether the latter be steam, electric, or otherwise, are extremely interesting and may be made very instructive as well. A model of this type can have such varied movements, as, for example, not only the raising or lowering of a load, but also swivelling, from the crankshaft to a vertical shaft, and thence by bevels to the axles. The slewing is similarly worked from a back shaft, which can be thrown in or out of gear with the main shaft. The speeding of the different motions is copied from a 3-ton crane which I saw working.

The cylinders are ½-in. bore and ¾-in. stroke, and the boiler is 5⅛ ins. high by 3 ins. diameter; the latter has a conical firebox with three cross tubes, and steams well. The burner is a ring of asbestos wick fed with methylated spirit by a drip from a tank attached to the frame. The boiler is fed with water by a hand-pump, and requires filling every twenty minutes when at work.



VIEW OF LEFT-HAND SIDE. VIEW OF RIGHT-HAND SIDE.
A MODEL TRAVELLING STEAM CRANE.

travelling, and changes of gears to suit the load. Of course, a considerable knowledge is necessary to enable one to build a machine to combine so many functions, but not much more skill is required than to construct a good model locomotive; and where a model railway track is out of the question, the crane is an excellent alternative.

The illustrations show two views of a model travelling steam crane, which has all the motions of an actual machine, except the raising and lowering of jib, and lowering load by steam, as there was no room for reversing gear to engines—this is controlled by band brake.

The travelling is worked by reversing mitre wheels

Some idea of the size of the machine can be gathered from the pocket-spanner attached to the hook; but I may mention that the width between frames is 2⅞ ins, the height from rails to top of crank-discs is 6½ ins., the jib is 14 ins. long, and the whole length from hook to end of boiler is 18 ins.

The material is mostly brass, with 3-16ths in. silver-steel rod for shafts and axles. With the exception of the castings of frame and jib, all is home-made, taps, cylinders, and toothed wheels being cut from the solid.

Last, but not least, it works well and will lift 6 lbs. and travel and slew with that load in both directions.

Electric Brakes for Tramcars.

AN interesting point in connection with the modern electrically-propelled tramcar is the question of efficient braking mechanism. Hand-applied mechanical brakes have given way to the more powerful pneumatic brakes. These require a considerable store of compressed air and have other objectionable features. The fact that an electro-motor, when driven by power, becomes a dynamo-generator has been turned to account in many cases, by shutting off the electric supply and cutting-in resistances in the armature circuit, the load thus imposed on the motor acting as a brake. This method is still far from perfect, but a modification has been introduced by the British Westinghouse Electric and Manufacturing Company in which the current generated by the motor or motors is made to traverse the coils of a large powerful electro magnet, the poles of which hang immediately over the tramway rail. The magnet is hung on spiral springs, and its poles are fitted with soft iron shoes. When it is desired to utilise the brake, the driver's switch is passed back over the contact points of the controller until it passes the "off" position. The motors then begin to act as generators, driven by the impetus of the car, and the current thus obtained passes through resistances, and according to the number of these in circuit is the rapidity of the stop determined. The action is the gripping of the rail by the soft iron pole shoes of the magnet which is of enormous braking power. A stop can be made down ordinary inclines from 12 or even 15 miles an hour in the length of the car, or it can be as gentle as can be desired.

Thrust or slipper brakes, acting on the rails, have, of course, been used heretofore, compressed air being the means. They have the disadvantage that the more the blocks are pressed on to the rails, the more the weight of the car is lifted, the wheels bearing less heavily on the track. With the new magnetic slipper block the contrary is the case, the car being, as it were, clamped down to the rails by the magnetic action. Another feature is that the application of the magnetic brake acts on supplementary wheel brakes, which are specially adjusted to give a powerful effect without skidding the wheels.

The advantages of the new brake appear to be the excellent control that can be exercised in its application, the great power, simplicity, certainty, and the economical nature of the supply utilised to produce the effect.

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 MEETING.

Saturday, June 21st.—Visit to Mr. H. A. Bennett's Residence and Model Railway. Trains to Ashford from Waterloo at 2.10 p.m., calling at Richmond at 2 35 p.m. Those members who intend taking part in this visit are requested to notify the Secretary by first post on Friday, 20th inst.

MODEL-MAKING COMPETITION.

The Second Model-Making Competition of the Society was held at the Holborn Town Hall, on Thursday, May 22nd, 1902. The number of entries, especially from the Provincial Branches, was not as great as it should have been considering the amount of work done by the members of the Society, who, including Provincial Branches, now number nearly six hundred. The quality of the exhibits, as a whole, was very good—in one or two cases the work being really excellent. The following gentlemen kindly acted as Judges: Mr. J. W. Restler, M.I.C.E. (Engineer to the Southwark and Vauxhall Water Company); Mr. W. J. Last, A.M.I.C.E. (South Kensington Museum); and Mr. Stephen H. Terry, M.I.C.E. Those competitors who were professionally engaged in the engineering or any kindred business, and those who had had instruction in the use of tools, were handicapped beforehand by a special committee composed of non-competing members, thus putting all competitors on a level footing as nearly as possible.

About seventy-five members and visitors were present at the evening meeting, Mr. Percival Marshall taking the chair at 7.45 p.m. The purely formal business of the evening being disposed of, a hearty vote of thanks to the Judges for their kind services, proposed by Mr. Marshall and seconded by Mr. D. C. Glen, was carried with acclamation. The Chairman then announced the result of the competition, after a few remarks upon the methods adopted in judging the exhibits. The system employed in awarding the prizes was one by which no model which was very good of its kind could be deprived of an award. A certain standard of excellence was fixed, and exhibits which reached or exceeded that standard were awarded a medal. The model which scored highest in each class, subject to its adjudged superior excellence, became entitled to a silver medal in place of a bronze medal, and in cases where two models—as happened in the locomotive class—were both of very high merit, two silver medals were awarded.

The following is a list of the successful competitors:—

SILVER MEDALS.

- Dr. J. BRADBURY WINTER, ¾ in. scale model L B. & S.C. Ry. express locomotive (clockwork).
- Mr. W. T. BASHFORD, ¾ in. Caledonian Railway locomotive, "Dunalastair 2nd."
- Mr. H. C. WILLIS, model steam launch.
- Mr. J. CHADWICK TAYLOR, model launch engine.
- Mr. A. R. M. SIMKINS, model electric locomotive.

BRONZE MEDALS.

- Mr. F. P. KIRTON, 1 in. scale model G.N.R. locomotive.
- Mr. F. SMITHIES, two model locomotives.
- Mr. W. J. TAYLOR, 440-watt Manchester dynamo.
- Mr. H. HILDERSLEY, 5-in. sparking induction coil.
- Mr. A. JAKINS, model steam yacht.
- Mr. H. S. BOORMAN, 4 in. screw-cutting lathe.

BRONZE MEDAL FOR BEST EXHIBIT FROM A PROVINCIAL MEMBER.

- Mr. C. GRIPPER (Stroud Branch), model torpedo boat.

CERTIFICATES (Highly Commended).

- Mr. W. H. Dearden, model shells.
- Mr. W. H. Dearden, callipers and gauges.
- Mr. H. Cattle, model vertical boiler.

CERTIFICATES (Commended).

- Mr. H. G. Riddle, model overtype dynamo.
- Mr. J. Chadwick Taylor, model Manchester dynamo.

In Class 5 (for the best exhibit by a member under twenty-one years of age) the models did not reach the standard of excellence, and no medal was awarded; similarly, in Class 8 (miscellaneous models) the highest award was a certificate of merit.—HENRY GREENLY, Hon. Sec., 4, Bond Street, Holford Square, W.C.

Bolton.—The monthly meeting of the Bolton Branch took place for the first time at its adopted room at the Oxford Café, Bolton, on Tuesday, May 20th.

In the absence of Capt. Salter, the chair was taken by Mr. C. A. Hays. In his opening remarks, the Chairman dealt with the aims and object of the Society, and it was ultimately decided that the London Society's rules, with very slight amendment, should be adopted.

A very general discussion then followed, members freely taking part.

There were no models on exhibition, but no doubt this was due to the fact of the Whitsuntide holidays interfering.

Sixteen members were present, and the evening was brought to a close by a unanimous vote of thanks to Mr. Hays for taking the chair. The Bolton Branch meets the third Tuesday in each month.—ERNEST MALLETT, Hon. Sec., 83, Manchester Road, Bolton.

Leeds.—On Tuesday evening, May 13th, the members of the Leeds Branch of the Society of Model Engineers paid a visit to the Yorkshire College (Leeds), when Professor Goodman (Professor of Engineering to the College) gave them a lecture on Steel, illustrated by diagrams thrown on to a sheet, also the testing of steel, and giving the members some very practical information on the manipulation of steel for structural purposes, and the principles of structure relative to the load to be carried. After the lecture, the Professor led the way to the Engineering Room, and there explained the working of a large testing machine which tests up to 100 tons, and to which the Professor had attached an automatic indicator which gives a diagram of the test being made. A piece of steel, 1 in. diameter by 10 ins. long, was put into the machine and a test made before the members, who afterwards made a general inspection of the machine tools, steam engines, gas engines, oil engines, water motors, and a steam turbine, throughout which the Professor gave the members some practical information, and the members of the Leeds Branch will not forget his kind, affable, and pleasing manner and the ever-ready disposition to explain any method or answer any question put to him.—W. H. BROUGHTON, Hon. Secretary, 262, Carlton Terrace, York Road, Leeds.

A Boat on Wheels.

By JOHN L. VON BLON.

THE queerest ship that ever sailed is a yacht on wheels, a graceful land-going clipper, that glides over the pathless stretches of sun-blistered plain, and carries her plucky navigators to and from their gold mine in the desert. Solitary gold hunters who have seen her white sails silhouetted against the bleak brown background in their aimless wanderings, have brought to the outer world strange and ludicrous tales of a phantom ship that sped by them like a bird on the wing. The spectacle of a trim-built craft, such as ordinarily belongs to the sea, skimming over that barren expanse, where not a drop of water falls, might well alarm less superstitious persons.

This vessel was built by Charles S. and Carl H. Hoyt, brothers, of Cleveland, O., eight months ago, and has been constantly in use since, running thousands of miles. Her owners have a gold mine in the buttes near the station of Rosamond, on the western border of the desert, and owing to lack of a suitable site they established their camp nine miles away. Between this place and the mine is a remarkable dry lake. Its surface is as hard as concrete, and swept as smooth as a tennis court by the sands for ever driven over it by the fierce winds rushing down through the Tehachepi Pass. While trudging wearily over this level tract, before a gale that almost blew them off their feet, one of the Hoyts suggested that if they had a waggon with sails they might make the trip easier and quicker. This idea was followed out, and with surprising success.

With only saw, and axe, and hammer and knives for tools, the young men began the work of construction. The material available consisted of the odds and ends to be found around a mining camp. The first requisite was a support for the machine, and for this the axle of an ordinary worn-out buggy was used, two iron wheels, 30 ins. in diameter, which had done service on a farming implement, being attached. Other parts were improvised with similar skill and ingenuity, and after a month of diligent application the workmen turned out a staunch "boat," 14 ft. long, 8 ft. across and tapering to the rear, with a mast 15 ft. high, mainsail 10 ft. on the boom and 10 ft. on the mast, jib and jibboom to match on ordinary "fore-and-aft," or "cutter" lines. A steering contrivance like those on hook-and-ladder trucks was devised, and *Desert Queen* stood ready for her trial trip. The initial run was doomed to end in disaster. While tearing along before a strong wind at a terrific rate the machine got beyond control, and a sudden gust brought her to grief with a crash. Bruised men, broken timbers and wrecked sails littered the ground. Neither of the Hoyts will ever forget the experience, for they will always bear the marks of the casualty as a reminder. Nothing daunted, they set to work re-building, and after many days repaired the damage and made necessary improvements, and now she carries her owners and their tools and supplies to and from the mine daily, and often on Sundays and holidays they take out excursion parties of half-a-dozen people, usually admiring visitors who have gone many miles to see the sight. Hundreds have been attracted to Rosamond from all directions for a look at *Desert Queen*.

Speed is the astonishing quality of the craft, and is almost beyond belief. On the open desert she has been speeded up considerably, and once is said to have made a straight run of forty miles in eighty minutes. She answers her helm perfectly, and sails about as "close" to the wind as the ordinary water craft of her size.

A fast ride on *Desert Queen*, amid surroundings more desolate than the lonely sea itself, is a thrilling and exciting experience. You go dodging between the dots of greasewood and cacti as you leave the camp for the solitude when the wind rises. Here and there grotesque yucca trees stand like sentinels, with gaunt arms outstretched to reach you; horned toads scurry away over the hot sands, and lizards dart, looking like blue streaks, for the shelter, but not always quickly enough, for the *Queen's* wheels have crushed many before they could move; jackrabbits go skittering through the brush, and little ash-coloured desert chipmunks scatter the sand about in their frenzied haste to get into their retreats; now and then a coyote, long and grey and lean—the picture of starved want—rises upon his scraggy hind legs and sniffs; occasionally you will run over a deadly "sidewinder" (rattlesnake) and hear the whirring of the rattles, or pass the bleaching bones of some poor creature that suffered the horrors of starvation and probably sucked the blood from its own parched tongue before the end came.—*Scientific American*.

IT has been found by tests on electric vehicles, says the *American Electrician*, that an energy consumption of 0·6 watt per pound weight of vehicle and load is required to give a speed of 12 miles per hour on hard, level road.

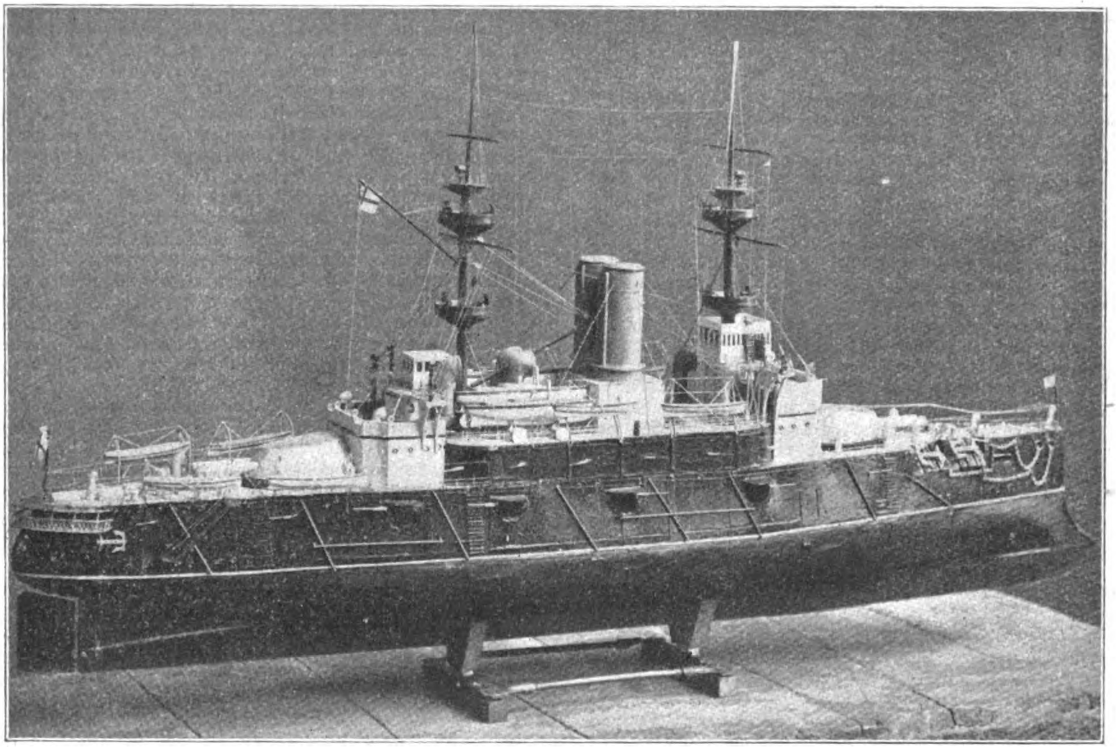
Models Made Without a Lathe.

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

By Eric E. Temple.

THIS article is a description of a model battleship made by myself before I left school, and is intended to encourage all the junior model engineers who have a taste for marine work, but have no lathe to carry into practice their bright ambitions, this boat being made entirely without one. I think, also, that many a "senior" might with advantage study the proportions, as well as the arrangements, of the fittings on this model, so that instead of taking the trouble to turn out huge and bulky guns, &c., totally out of proportion to the modern guns at the same time, it necessitates some of the fittings being made rather small.

The hull is built up of narrow strips of wood, ⅜ in. wide and ⅛ in. thick, nailed to bulkheads placed about every 3 ins. apart. These latter are cut out of oak ¼ in. thick with a fretsaw. So many good articles appear in this paper on the building up of hulls, that I will only briefly describe this part of the subject. The method followed is the same as that of building model yachts, excepting that the shapes of the bulkheads are, of course, different. Fig. 3 will give the idea for the shapes of the bulkheads required. The ram is cut out of a separate piece of wood and is glued on, as shown in Fig. 1. The most awkward part of the hull to make is, perhaps, the stern, owing to its peculiar shape. This I managed by not continuing the wood planks beyond bulkhead No. 13, thus leaving, as it were, a flat stern, on which I built up a stern of modelling clay to the required shape. A hole



A Model First-class Battleship.

and fittings, he might give at least a little idea of what a warship really looks like.

The model I have built and intend to describe here is that of a British first-class battleship—H.M.S. *Majestic*, of 14,900 tons displacement, 390 ft. long, 75 ft. broad, and drawing 27½ ft. of water. I have not attempted to put in engines of any kind, as it is only meant as a show model. This could, of course, easily be done, provided there is no danger of the decks becoming heated at all. The photograph gives a good idea of the actual appearance of the boat.

Fig. 1 shows the elevation, and Fig. 2 the plan. The total length of the boat is 3 ft. 6 ins., being a convenient length to enable it to be moved about when making; but, is cut out in the clay on each side, as shown at A, Fig. 4, through which the stern anchor cables are allowed to pass. The deck, which is ⅛ in. thick, is cut out of pine, and the holes for the two masts are drilled ⅜ in. diameter. Pieces are cut out of the hull to the shape shown at Fig. 5, for the recesses for the 12-pounder guns marked A on Fig. 1. Fig. 6 shows the place cut out for the starboard anchors, and Fig. 7 shows section of same, both of which will explain themselves, as also will Fig. 8 for the port anchor. The holes for the anchor's cables are cut out as shown (Fig. 9), and small pieces of brass tubing (rather flattened) are inserted (as shown by dotted lines) which go up as far as the fitting No. 12, Fig. 1, on the deck, and which are, of course, filed at each end to the

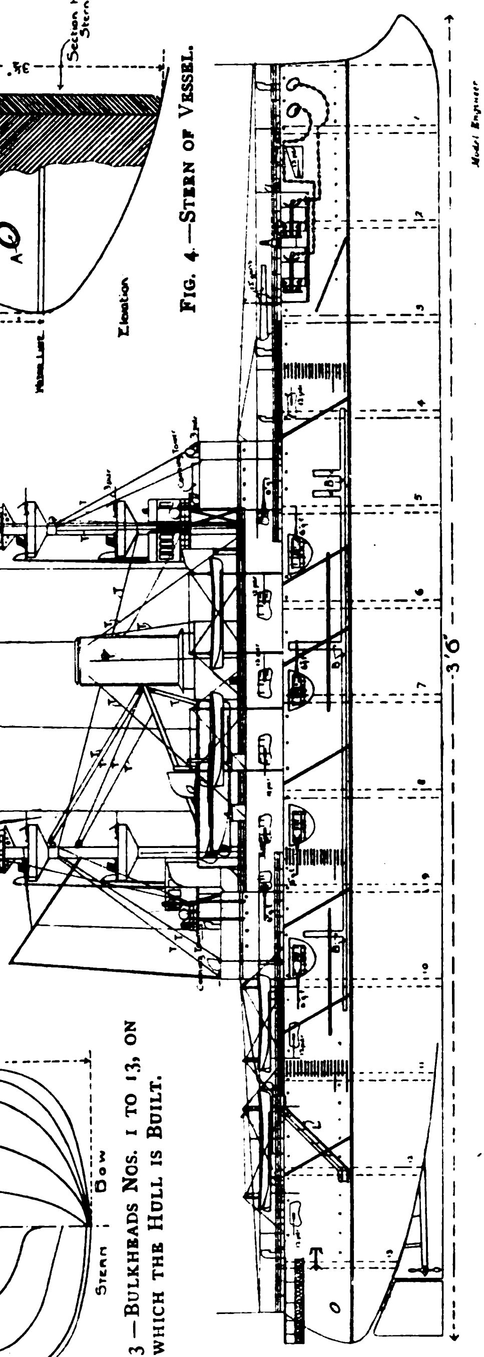


FIG. 1.

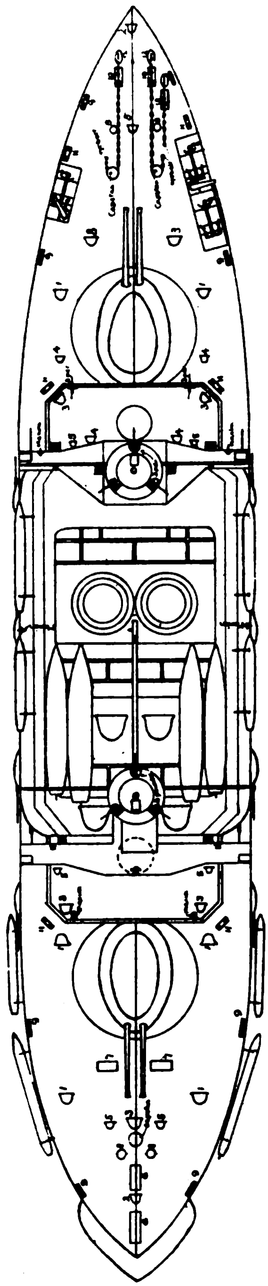


FIG. 2.

ELEVATION AND PLAN OF MODEL FIRST-CLASS BATTLESHIP.

Scale: **2 ins. = 1 ft.** (One-sixth Full Size).

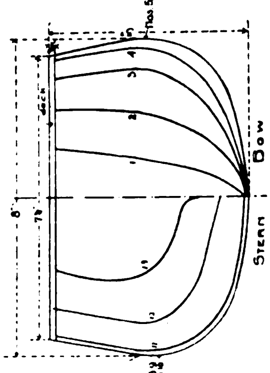


FIG. 3.—BULKHEADS NOS. 1 TO 13, ON WHICH THE HULL IS BUILT.

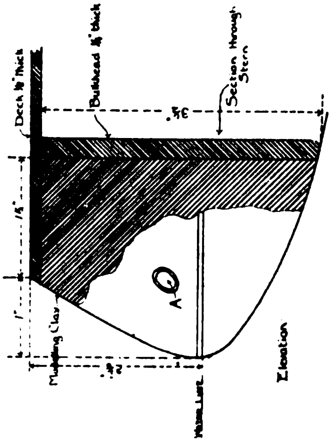


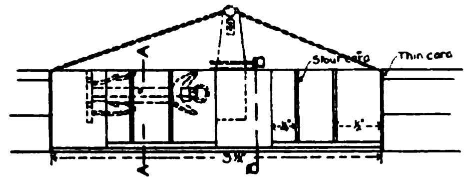
FIG. 4.—STERN OF VESSEL.

proper shape and painted red inside. The single one on the port side corresponds to the foremost one on the starboard. Fig. 10 explains itself, the rudder being made of wood, the casings for the propeller shafts cut out of a round stick ⅜ in. diameter—those often used for hanging up window blinds.

The sides of the citadel are made out of wood 3-16ths in. thick, in which the holes for the 12-pounders are bored diagonally. At the ends pieces of stout card are fixed and bent round in the position shown in Fig. 12, a

The first and fourth steps from the water-line are double the length of the others. To this same strip are fixed the projecting pieces marked B (Fig. 1) showing the armour belt, which are cut out of stout card, and are about ¼ in. wide. The whole strip is then painted black, care being taken of course to cut out all recesses for anchors, guns, etc., first. When this is dry, it is turned over, and on the side not to be seen are fixed pieces of gelatine right along the portholes, which have been made, so that it gives the effect of glass when viewed from the right side. In each

FIG. 6.



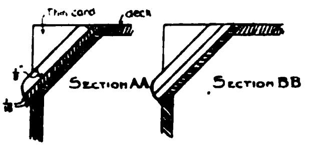


FIG. 7.

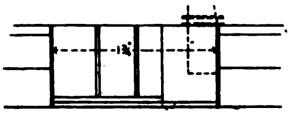


FIG. 8.

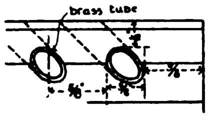


FIG. 9.

Model Engineer

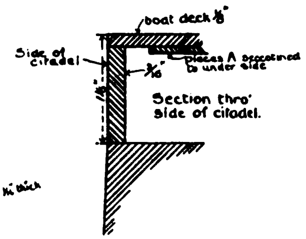


FIG. 11.

hole being made for the 6-in. quick-firing gun. The whole of this piece is glued on to the deck. Figs. 13, 14, and 15 show the construction of the fore and aft ends of the citadel, together with the conning tower decks and portholes, the latter being made in a similar way to those in the hull, which are explained further on.

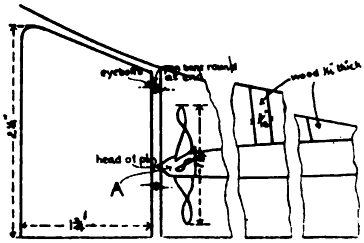


FIG. 10.

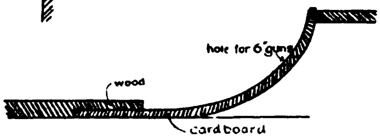


FIG. 12.

Fig. 16 shows the boat deck, with the fittings for the large ventilators and the funnels. The pieces marked A are made out of cardboard and fastened to the underside of the boat deck, as shown in Fig. 11. I have finished describing the main construction of the boat, and will now go into the more interesting part of the work—viz., the fittings.

hole is then inserted, with a little seccotine, a small ring, ⅛ in. diameter externally, this giving a very good effect as a porthole. The strip is then put into position on the side of the hull and fixed by driving in small pins. All below the water-line is painted red.

(To be continued.)

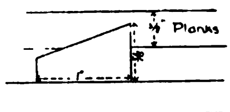


FIG. 5.

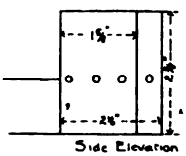
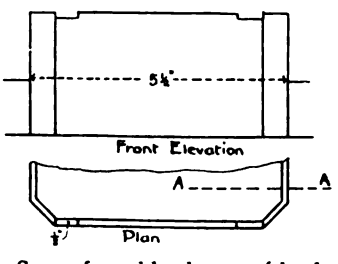


FIG. 13.



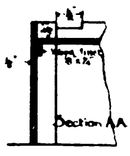


FIG. 14.

A long strip of cardboard is cut out to "armour," as it were, the whole space between the water-line and the top of the hull, from stem to stern. This is done on account of the number of portholes that have to be made, and would, therefore, weaken and probably split the planks were they to be drilled in them. On this strip of card are made a number of holes as shown in Fig. 1, ⅛ in. diameter, and the steps up the sides of the hull, which are cut out of a number of equal pieces of card (⅛-in. wide) of medium thickness, are "seccotined" to it, great care being taken to keep these all vertically under one another.

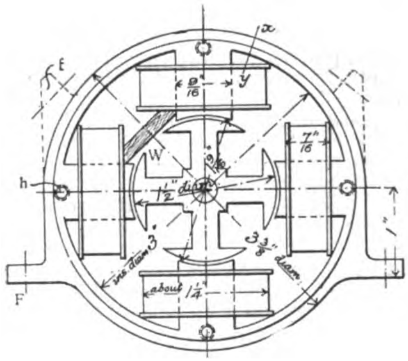
SCALE formed by the use of hard water in gas engine cylinder jackets can be effectually removed by filling the jacket with commercial muriatic acid, according to Mr. C. W. Andrews, at a recent meeting in Columbus of the Ohio Gas Light Association. It is allowed to stand in the jacket until the decomposition of the scale, with the attendant evolution of carbonic acid gas, is completed. One application has generally been found sufficient if the scale is light.

How to Build a Model Four-Pole Electro-Motor.

By F. E. P.

A SERIOUS difficulty in the employment of electro-motors for many model purposes is the high rate at which the armatures should revolve, especially if efficient working is a desideratum. Generally speaking, a motor having an armature 1½ ins. diameter

armature may be increased, but this involves usually serious electrical losses, and implies a much heavier machine for the same output. Multipolar motors have generally been thought out of the question for very smal outputs, but that this is not the case the present article wil prove. It is here shown that a serviceable four pole motor, of good appearance, comparatively simple construction, and efficient working, can be made by any reader having the experience necessary in the building of any other equally satisfactory machine. Such a motor will run at a thousand revolutions per minute at ful



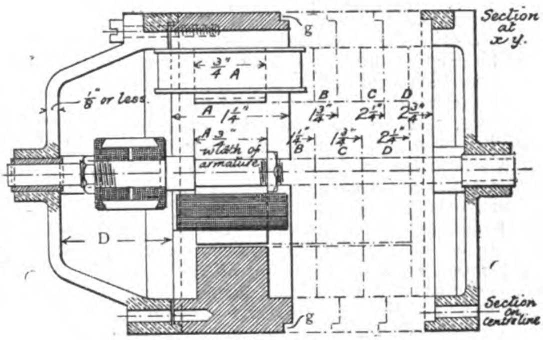


FIG. 1. Half Size. FIG. 2.

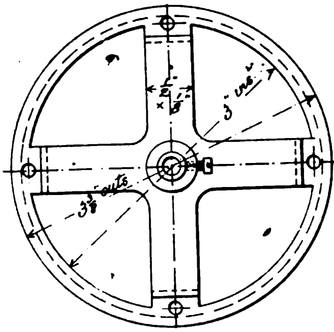


FIG. 3.

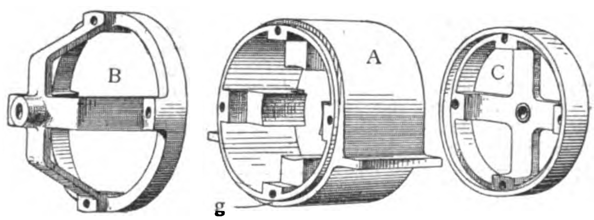


FIG. 4.

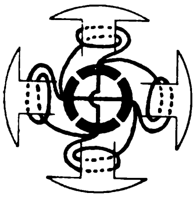


FIG. 5A.

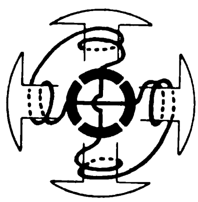


FIG. 5B.

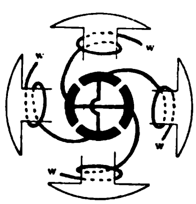


FIG. 5C.

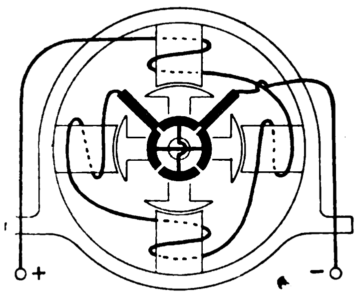


FIG. 6.

should run at nearly, if not quite, 3000 revolutions per minute to give the best results. As a matter of fact, the majority of these small machines are expected to work satisfactorily at much lower speeds, 1000 revolutions per minute being looked upon as high enough. This is a mistake, and with the knowledge we have nowadays in the matter of gearing, there should be no difficulty in so arranging matters that the small motor can work under proper conditions equally with its larger prototype; the worm and gear wheel offering perhaps, the best solution of the difficulty.

A proper "slow-speed" motor is not a simple thing to design in small sizes. Of course, the diameter of the

power, and will be quite as efficient as a bipolar motor at twice the speed.

Ordinarily, a drum or ring-type armature must be used with a four-pole field-magnet. The simplest expression of such an armature is that in which only four sections are employed, and this is very nearly equivalent to a quadripolar armature proper. An armature of this type, in fact, being easy to wind, is adopted in this instance, and although such a motor is not, strictly speaking, self-starting, it will rarely fail to start if the brushes are set in a suitable position. The winding of the magnet will be found quite easy, and the fitting of the motor a simple matter to anyone who has a lathe at his disposal.

To meet the requirements of readers, the motor has been designed so that four different sizes can be made, using the same diameters for armature and field-magnets, but elongating them for the larger sizes. The smallest machine is denominated "A," and this has an armature 1½ ins. diameter by ¾ in. long; the field-magnet casting is 3⅜ ins. diameter outside, and is 1¼ ins. long (in the direction of the axis). "B," the next size, has an armature 1¼ ins. long, and field-magnet 1¾ ins. long. "C" has the armature 1¾ ins., and "D," 2¼ ins. in length; the corresponding field-magnet dimensions being 2¼ ins. and 2¾ ins. respectively. The powers of the four motors thus suggested are, roughly, in proportion to their respective lengths of armature, so that taking A as 1, B would be 1⅜, C 2⅛, and D 3 times as powerful. As the dimensions increase the efficiency becomes greater, but not quite in the proportions of the power developed.

Before proceeding to describe the construction of the motor, a few words as to the capabilities of the different sizes will be useful. It is very nearly impossible to specify exactly what size electro-motor should be employed to drive, say, a launch—everything depends on "unknown quantities," as far as the designer is concerned: *x* is the form of the hull (which is often not even correct to its design), *y* the friction in bearings and waste of power in the propeller, *z* is the nature of the surface of the hull, and there are many other matters equally affecting the value of a given number of foot-pounds in driving the vessel through the water. As a matter of fact, the fitting of the best possible motor to any given model is a matter of personal experiment solely. It cannot be prophesied except in general terms and for the best possible workmanship. At the same time, *something* must be done to guide the beginner, and therefore the following table of suggestions, though limited in application by the foregoing statements, are put forward to assist him in concluding which of the machines will suit his case. It is safe to assume that if the locomotive, launch, etc., be fairly well built, the specified motor will drive it at a good rate.

Motor Type.	Watts absorbed at full power about	Will drive
A	24	A 9-16ths in. scale model "steam" or electric locomotive (2⅝ ins. gauge), or a launch hull, 4 ft. long, 9 ins. beam, 5 ins. draught. Maximum output of motor about 500 foot-pounds per minute.
B	40	A ⅝ in. scale locomotive (2⅞ ins. gauge), or launch, 4 ft. 6 ins. long, 10 ins. beam, and 6 ins. draught. Maximum output about 800 foot-pounds per minute.
C	50	A ¾ in. scale locomotive (3½ ins. gauge), or a launch, 5 ft. long, 11½ ins. beam, and 6 ins. draught. Output about 1000 foot-pounds per minute.
D	60	A 1 in. scale locomotive (4¾ ins. gauge), or a launch, 5 ft. 6 ins. long, 12 ins. beam, and 5 ins. draught. Output about 1,200 foot-pounds per minute.

With these data to guide him, the intelligent reader can no doubt estimate which motor to use, even for a very different purpose, or for a model of different proportions from those named.

The construction of the motor may now be described, particulars of the characteristic points of each part being given as it comes up for discussion.

Commencing with the field-magnet, it will be seen from Figs. 1 and 2 that this consists essentially of a ring 3-16ths in. thick, with four internally projecting poles, the latter being of square section and ⅜ in. less in width than the circular magnet yoke. The casting should be in soft iron, and may be annealed with advantage. Its form will readily be grasped by studying the perspective view, Fig. 4 A.

The position and form of the holding-down flanges may be left to the reader's decision, although as shown at *f*, Fig. 1, it would suit the majority of cases. For fixing in a boat, possibly the best arrangement would be to have instead two lugs as at *f*, drilled in the manner indicated.

Machining the casting will present little difficulty. First take off all roughness with an old file. Chuck the casting in any convenient way, bore out the armature tunnel, and turn down one edge, then turn the circular rebate *g*. Reverse the casting, turn the opposite end, and rebate same. Then drill holes in lugs or feet for holding-down screws.

The armature shaft can be turned from a piece of ⅜-in. diam. steel for the larger, or 5-16ths in. steel for the smaller sizes. It will need to be screwed for the arma-

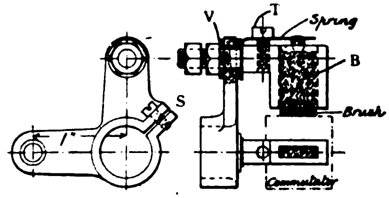


Fig. 7.—Brush Rocker.

ture nut and for the commutator, and should be left as large as possible in the journals. The armature is of quadripolar stampings about 1-40th in. thick, 30 being required for "A," 50 for "B," 70 for "C," and 90 for "D." They are clamped tight against a shoulder by the nut, all the poles being carefully aligned.

The commutator consists of a brass ring bevelled at the outer edges in the lathe and fitted over a bush of vulcanised fibre. This latter is undercut to take the tube, as shown in section in Fig. 2, and is cut right across by a thin saw. When ready, the commutator should be slit into four equal parts and assembled on the fibre bushes, which can then be tightened up by means of the nut. Thin pieces of card should be cut and glued in the saw kerfs.

The armature windings are shown in Fig. 5. As the machine is of the four-pole type, opposite commutator bars should be electrically connected to avoid the use of a 4-part rocker. The easiest way to do this is to run a short length of insulated wire round to the proper bars and solder to them or to the wires proceeding thereto. Four loose ends of wire are shown in Fig. 5C, being marked *w*, *w*, *w*, *w*. These ends should be at the end of armature away from commutator. They should be bared, cleaned, and all twisted together and soldered, insulation being again placed on the bare wire, which must not touch the armature itself. The winding Fig. 5C is about the easiest, and the other two shown have no electrical and no other mechanical advantages or disadvantages over the method shown by Fig. 5C.

The bearing caps should be cast in aluminium, or one of its light alloys, if weight is a consideration; otherwise, brass will be suitable, and in that case the thickness of the arms can be much reduced. These caps are simply rings of metal joined to a boss by means of four spokes or arms. They are different at the two ends of the machine, the perspective views, Fig. 4 B and C, showing them clearly. They should be chucked, the central hole bored out, and the rebate turned to fit that on the field-magnet nicely. Holes should be drilled at the thickened portions at outer ends of arms, and these may be marked off and drilled in the field-magnet casting. They are tapped in the latter for any convenient screws.

It may be remarked that one cap has been designed large enough to accommodate a drum armature if that is adopted. If not, the depth D (Fig. 2) may be considerably lessened, say by ¼ in., if the present quadripolar armature is adopted. The bearings should be short pieces of brass tube, sweated into the larger holes drilled in the bosses.

The field-magnet winding is indicated in Fig. 6. It is connected in series with the armature. The wire should be wound on neat strong bobbins of card, vulcanite, or fibre; and wedges of wood, fixed as shown at W, Fig. 1, and glued in place, will secure all.

The brush rocker, with its two holders at right angles, is shown in Fig. 7. All the metal castings for it may be aluminium. The rocker is sawn through the lug at S, and a screw fitted to fasten the rocker on the bearing boss. The holders are insulated from the arms by means of tubes and washers of vulcanite, or other material, V. A light spring may be fixed as shown, bearing a knob riveted at its outer end. The tension is regulated by a screw, T, by means of which any required pressure can be brought to bear on the brush, B.

The brushes are pieces of copper gauze, folded up to slide nicely in the holders, which are filed out as shown. Thus, the *end* of the brush bears square on the commutator face, an important matter if the motor is to be reversible. The shank of the brush holder is fitted with two nuts, and forms a terminal.

The following windings are recommended, the field-magnets being connected in series in each case.

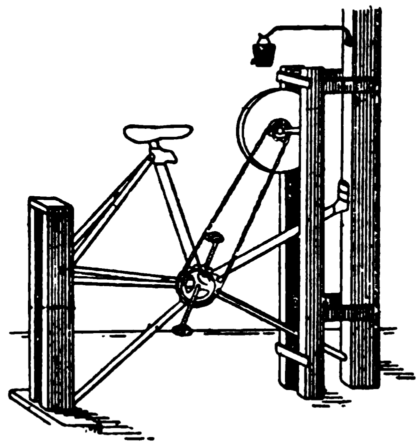
Supply Current Required.		Total Wire for Armature.	Total Wire for Field-Magnet.
A.			
2 a.	12 v.	1½ oz. No. 24.	4 oz. No. 21.
3 a.	8 v.	1½ oz. No. 22.	4 oz. No. 20.
6 a	4 v.	1½ oz. No. 20.	3½ oz. No. 18.
B.			
3½ a.	12 v.	2½ oz. No. 22.	6½ oz. No. 18.
5 a.	8 v.	2¼ oz. No. 21.	5 oz. No. 18.
10 a.	4 v.	1¾ oz. No. 20.	5½ oz. No. 16.
C.			
4 a.	12 v.	3 oz. No. 20.	9 oz. No. 18.
6 a.	8 v.	3 oz. No. 19.	8 oz. No. 17.
8 a.	6 v.	3 oz. No. 18.	8½ oz. No. 16.
D.			
3 a.	20 v.	3¼ oz. No. 23.	9 oz. No. 20.
4 a.	16 v.	4¼ oz. No. 20.	11 oz. No. 18.
5 a.	12 v.*	3½ oz. No. 20.	9 oz. No. 18.
7–8 a.	8 v.	3 oz. No. 19.	10½ oz. No. 16.

* This machine should run at a somewhat lower speed, absorbing a heavier current.

Machines of this type cannot be guaranteed to act well as dynamos, though they may do so. Fitted alongside a model vertical engine, to which it should be coupled direct, and supplied with a proper current, the motor would drive the engine and would look not unlike a modern electric lighting plant, the engine, to all appearances, doing the work. On the other hand, the engine, if of good construction, and capable of running at fully 1000 revolutions per minute, would drive the machine and produce a moderate current.

A Novel Grindstone Arrangement.

In the accompanying sketch is shown a novel grindstone. I had the frame of an old bicycle and utilized it in connection with the stone. In rigging it up, I first cut out the middle brace of the bicycle, and then with a 2 × 4 timber made the rear support. Next I stapled the front of the bicycle to a stout post and then made the frame for the grindstone. I braced the bicycle frame underneath as shown. By cutting the spokes out of the rear wheel I secured the small sprocket. Then I took a small piece of wood, fitted it snugly into the square hole



A Novel Grindstone Arrangement.

of the grindstone, bored a hole in the wood the size of the sprocket axle, and fitted the axle to the stone. My next step was to take a piece of iron, cut notches for the axle to rest in, and nail it to the frame, after finding the proper height for stone. As the stone was quite high, it was necessary to obtain two chains and put them together. This machine is now a handy ball bearing grindstone, which runs at lightning speed and which costs but little to make.—John Arrowood, in *American Blacksmith*.

If the combined efficiency of engine and dynamo is 83·78 per cent., says *Power*, it takes 1·6 indicated horsepower to produce a kilowatt.

* * *

At a recent meeting of the Physical Society, says the *Engineer*, Dr. R. A. Lehfeldt exhibited an electric heater. The apparatus consisted of a vacuum jacketed glass tube, containing water which was boiled by passing a current through a platinum spiral immersed in the liquid. Tap water is preferable to distilled water, because the small electrolytic action in the former causes the boiling to proceed quietly. Different temperatures can be obtained by using other liquids.

The Model Twin-Screw Steamer, "Duke of York."

By Percy H. Lee.

The following particulars refer to the s.s. *Duke of York*, a model twin-screw steamer built by myself during seven months of leisure time. This being my third steamer, one of which was built up, I have come to the conclusion that the best way to construct a boat is to cut out of the solid, although it is a little more expensive. This is the method I have adopted in this boat.

Having drawn a deck plan and plans of the different curves for the sides, the latter I mounted on cardboard, making templates of them. I then procured a good, sound block of cyprus, 5 ft. long by 8½ ins. wide by 10 ins. deep, and marking a centre line along it, on the top of which I placed my deck plan, which is 8 ins. wide, allowing ¼ in. on each side for the "tumble-home" of the sides, and with a pencil marked out the outline of the hull. After having cut away all the waste wood with a saw, and finishing off with a chisel, I began to use my templates, and with a gouge kept cutting away till the different templates bedded themselves to the block; then with a small iron plane took off the rough, and finally finished by giving the whole a good sand-papering.

The next job was the hollowing out, which proved to be very laborious. I got a brace, and with a 1-in. bit commenced to bore a number of holes; then took a chisel and began to get out some good chunks of wood. This took me a week to finish, for I have hollowed out to about ¼ in., with the exception of the bottom, which is about 1 in. thick so as to allow for some stout screws for bedding down engines.

The stern tubes were afterwards fitted in position. Measuring the distance from the centre line at the stern, I took a ratchet brace (this pattern being necessary, as shape of stern would only allow of half a turn) and bored the two holes. The tubes, having been spaced the correct distance apart and bolted to angle-plate, were then pushed through from the inside and let in with white lead, so making them water-tight, the angle-plate, Fig. 5, being secured to bottom of hull by three 1-in. screws. I then gave the inside three coats of light green paint, and the outside two coats of lead colour, as a preventative against splitting

Having finished the hull, I then commenced to put on the different decks, which are made out of ¼-in. white holly, and are divided in three parts—viz., fore deck, middle deck, and after deck. The fore deck. which is a fixture, has upon it the following fittings:—Hawse pipes,

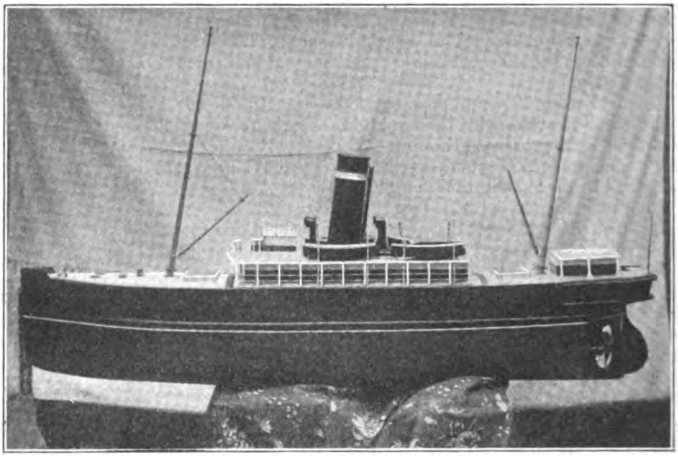


Fig. 1.—The Model Twin-Screw Steamer, "Duke of York."

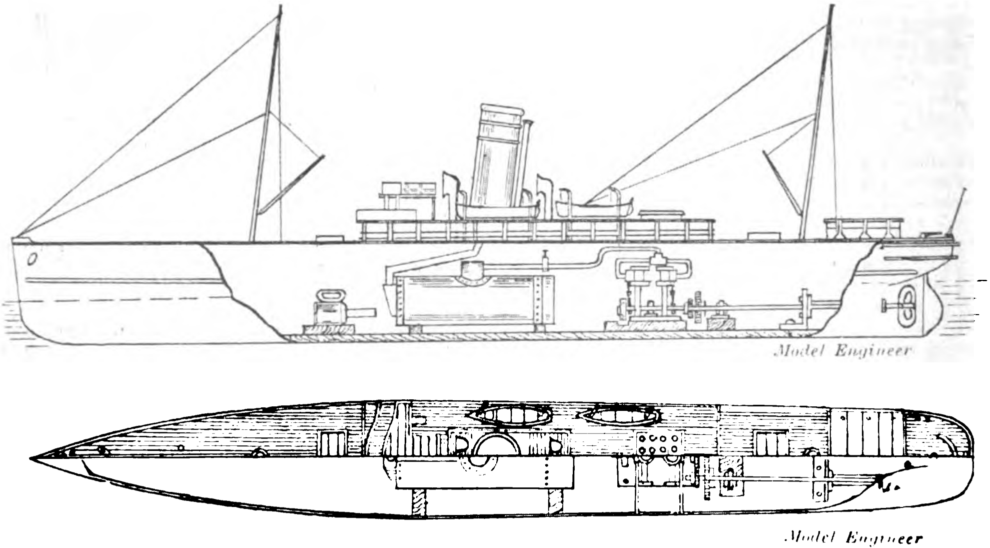


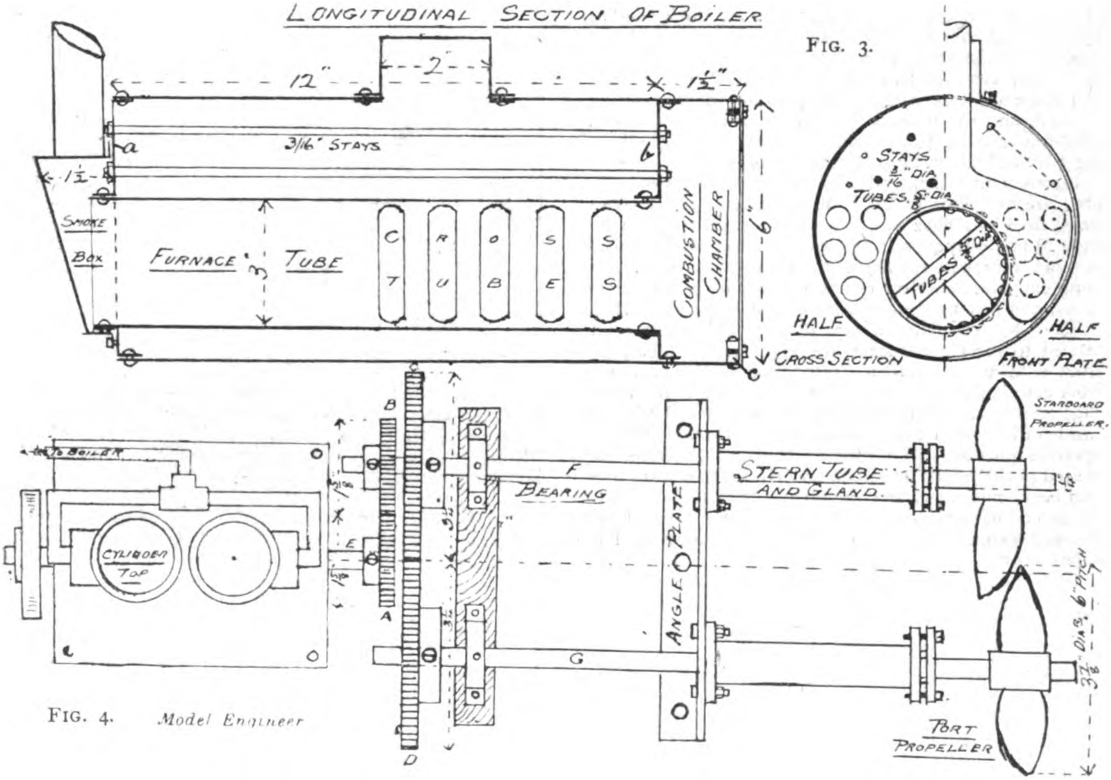
Fig. 2.—Longitudinal Section and Plans of Model Twin Screw Steamer.

capstan, mooring bits, fore-mast (with derrick), and aft the mast a large hatch giving access to the lamp.

The middle deck is removable to allow for inspection of the machinery, and has a large cabin running the whole length of it, and above this is the hurricane deck, which is supported by angle irons, cut out of tin and drilled to receive the stanchion wire. This deck carries the bridge on which are mounted the two telegraphs, compass, wheel, etc.; situated under the bridge is the captain's cabin, and screw, this being essential on account of the wash from the two propellers.

All the decks are slightly arched, this being done by screwing curved cross-pieces of wood to the underside; they were then sand-papered and lined with a hard-pointed pencil to imitate planking.

The two masts were made out of two ¼-in. pieces of deal, and were planed down to the required thickness, and afterwards smoothed with a piece of glass; the two



BOILER AND ENGINES OF MODEL TWIN-SCREW STEAMER.

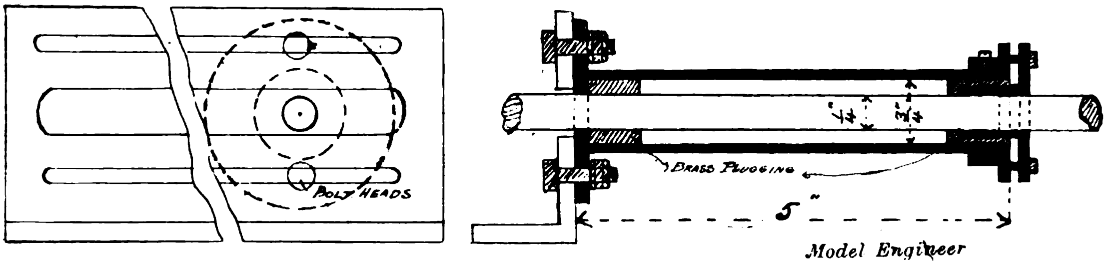


FIG. 5.—ANGLE PLATE AND (FIG. 6) STERN TUBE ARRANGEMENT.

aft this the funnel, four cowls, two gratings, engine hatch, and four sets of davits with boats—two on the starboard side, and two the port side.

The after deck is also a fixture, and has a small hatch for the purpose of lubricating the propeller shaft bearings; aft the hatch comes the mizen mast (with derrick), deck house, two sets mooring bits, and tiller, which can be set in any position and held securely by a small thumb-caps on top are two lead bullets, flattened and drilled to fit the top.

The boat being ready for painting, it was necessary to find the draught of water. The engines and boiler were fitted in position, and propellers geared together. She was then floated in the bath; but I found it necessary to put a little ballast in her; this I did in the way of lead, fixing it under the boiler, which soon brought her on an even keel. The water-line was then scratched on the bow and stern post, prior to receiving the final coats of paint, which below water were red, and above, black, with a white stripe over the two colours marking the water-line. I then gave the hull and decks two coats of coachmakers' varnish.

The boiler has a working pressure of 40 lbs., and is really a copy of the one designed by Mr. Pearce in his book on "Model Boiler-Making," but slightly altered to suit the requirements of my boat. The barrel is a piece of solid drawn copper tube, 3 32nds in. thick, and is 13½ ins. long over all, or 12 ins. water space, and 1½ ins. combustion chamber, the diameter 6 ins.; the front and back endplates are two brass castings. Patterns were first made and cast with two flanges on—one for riveting to shell, and the other for furnace tube; this is also a solid-drawn tube, 3 ins. diameter by 13 ins. long, allowing ½ in. at each end for riveting to boiler ends.

Inserted into back end of tube, and arranged diagonally, are five cross tubes, ⅝ in. diameter. (This boiler being fired by a benzoline lamp, it is necessary that very little or no obstruction in the way of cross tubes be placed in same, otherwise the flame is liable to flash back, and lamp explode; hence my reason for only fitting five cross tubes, and placing them at back end of furnace tube.)

The two endplates *a* and *b* (Fig. 3) having been tapped to receive the stays and eight return tubes, the front endplate *a* was then riveted in position; then the back endplate *b* was taken, tubes brazed in, and furnace tube riveted up, afterwards the whole slided down the inside of barrel till the tubes protruded through the respective holes allotted for them at end *a*. After having brazed in the return tubes and riveted up the furnace tube and back endplate *b*, four brass lugs were riveted on to inside end of combustion chamber *c*, a plate being fitted to same with a door for access to tubes by means of four small screws.

The smokebox was next fitted in position; this is also a brass casting 1¼ ins. wide at top and tapering down to ¾ in. at bottom, and is screwed into front endplate by four screws. The fittings were then mounted in position, and comprise steam gauge, water gauge, safety valve, filling plug, two bib cocks, and small injector which lifts the feed water from a tank situated in the bows.

The engine is a double cylindered reversible slide valve one having cylinders ¾-in. bore by 1-in. stroke, driving two three-bladed propellers, and was built from castings supplied by Martin & Co., and is placed in the centre of boat. This, of course, as all readers know, is not the case on ocean-going steamers; but my chief object in placing them so has not been for speed, but simply to do away with the list so noticeable in single screw models due to the reaction of the propeller. To do this I had to get four gunmetal cogwheels made—two ⅝ in. diameter, and two 3¼-in. diameter—they being secured to shafts by small setscrews (both engine and propeller shafts are ¼-in. steel). Fig. 4 shows the method I have adopted for driving the twin propellers.

Secured to engine shaft E is the small cog A. This works into cog B, turning round the starboard shaft F on which is secured large cog C, this working cog D and so driving the port shaft G, causing the propellers to revolve in opposite directions. To meet this the propellers are right and left hand, and were cast in phosphor bronze, 3⅞ ins. diameter by 6 ins. pitch.

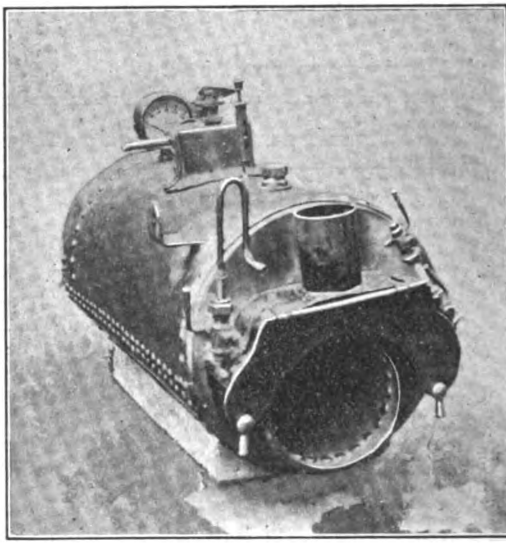


FIG. 7.—BOILER FOR MODEL TWIN-SCREW STEAMER.

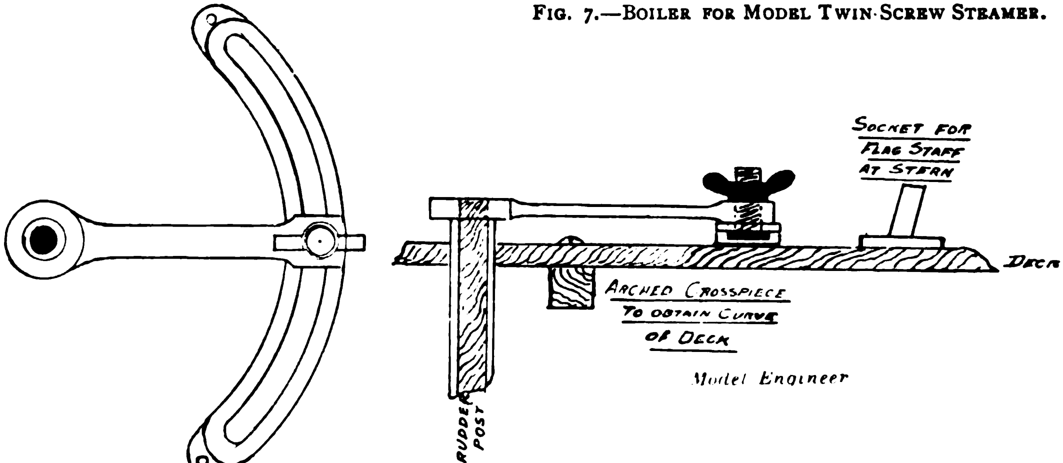


FIG. 8.—ADJUSTABLE TILLER OR STEERING GEAR.

The stern tubes (Fig. 6) were made out of ⅜ in. solid drawn copper tubes, both ends for a distance of ⅜ in. being plugged with pieces of brass; flanges were then brazed on one end for bolting to angle-plate (Fig. 5). The opposite flanges for receiving the glands are secured by a small setscrew, countersunk into tube to allow of removal for passing through holes drilled in the stern. Fig. 8 shows a plan and elevation of the steering gear, which is easily understood.

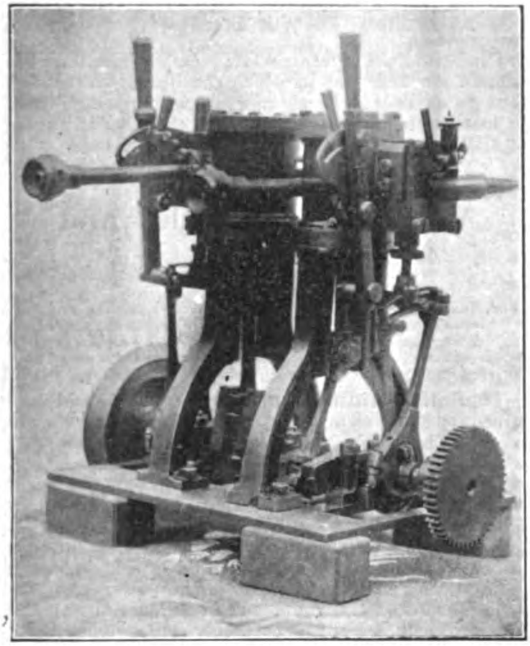


FIG. 9.—ENGINES FOR MODEL TWIN-SCREW STEAMER.

The lamp for firing the boiler is the "La Française" single nozzle, burning benzoline, and was purchased from Mr. Cusack, of Holywell Row, London; it can also be had with double nozzle.

I have here described and illustrated to the best of my ability details of my model twin-screw steamer, and have described how I built her.

HERR ENDRUWEIT, of Berlin, has patented an improved form of apparatus for producing thin films by electro-deposition, says the *Electrician*. An endless metal band is first coated with potassium sulphide, and, after washing, is passed through a nickel bath of the usual composition. The thin film of nickel obtained in this way is backed by copper (by passing through a similar bath containing a copper salt in solution), and by tough paper, before being stripped of its support. A strong sheet or roll of paper, faced with bright metallic nickel can be obtained in this manner, and the use of this material after relief-stamping and colouring, for wall-papers, and for advertisement showcards is said to offer many advantages. The electro-deposited "paper" is also reported to be useful for packing the stuffing boxes of high-pressure steam engines, and, if sold at reasonable rates, it is possible that there are many uses for which it may prove suitable.

A Handy Vice.

By DONALD LADD.

THE vice shown in Fig. 1, although made over twenty years ago, possesses some advantages deserving attention. Its main advantage is the quickness with which it can be adjusted to any size of work, and it is particularly suited to the work of the pattern-maker.

Its mode of operation will be seen by reference to the figure. The jaws A A are made of hard wood, 4 ins. by 4½ ins. The iron straps B B are pivoted at their upper ends to the jaws of the vice, and are pivoted together at their common centre C. Their free ends bear against iron plates L L, set into the sides of the jaws. The action of the straps is to keep the movable jaw at all times parallel with the fixed jaw or post. Both the movable jaw and the post are recessed sufficiently to receive the straps and thus allow the jaws to close together.

The vice screw D is of ash. A square thread at the front end is fitted with a handle nut, and is used for short adjustments and for clamping. The back end of the screw is cut with coarse square teeth, with three of which the stop E is engaged when the vice is being used. This stop E is held into mesh with the teeth by the spiral spring F. When the foot lever G is depressed the wire H draws down the block E, and the front jaw of the vice may be pulled out

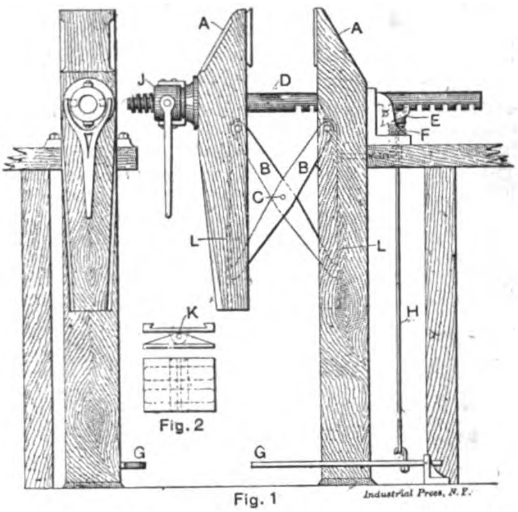


Fig. 1

A HANDY VICE.

or pushed in at will. This affords the quick adjustment. When the jaws are pulled out a little beyond the required width, the block E is released, and, rising, engages the teeth of the screw. The work is then clamped by a few turns of the handle of the nut J.

On the face of each jaw is an iron plate, the edges of which are bevelled to fit the dovetail on the back of the adjustable jaws. These jaws, shown in Fig. 2, have a grooved or dovetailed back corresponding to the plates on the jaws, and this back supports a jaw face, which is pivoted on the pin K, so as to allow it to adjust itself to any taper that may be on the work to be held.

One of the jaw plates is bevelled on its perpendicular sides, while the other is bevelled on its top and bottom edges, so that the face of one adjustable jaw pivots vertically, and the other horizontally. This allows the vice to accommodate itself to work of almost any shape that it may be desired to hold.—*Railway Machinery*.

Electric Furnaces.

FROM a paper read at the Manchester Engineering Section of the Institution of Electrical Engineers recently, by Mr. Bertram Blount, the following description of the typical electric furnaces is extracted, and will interest readers of this journal. The two furnaces shown are somewhat diagrammatic—not representing exactly the usual forms adopted, but the principles of construction are clearly indicated.

There are two types of electric furnace, the arc and the resistance furnace. Both are used in industry. The simplest effective form of arc furnace is that devised by Moissan, shown in the accompanying figure (Fig. 1). It

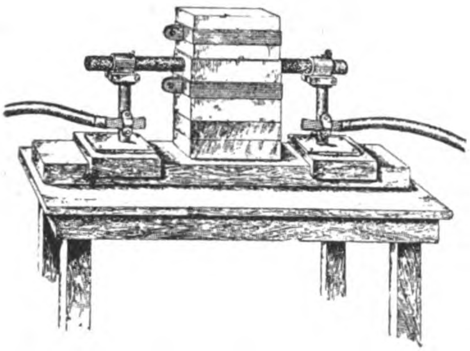


FIG. 1.—ELECTRIC ARC FURNACE.

consists of two blocks of chalk carefully dried and carved out so as to form a cavity in which a carbon crucible can be placed. Massive carbon electrodes pass to this cavity, and the arc formed between them plays over the hearth, heating the material to be treated in the manner of a common reverberatory furnace. The chief merits of the furnace are its extreme simplicity and the refractoriness and low conductivity of its materials. In the form shown, this furnace is necessarily discontinuous, but the complete inclusion and surrounding of its charge give much advan-

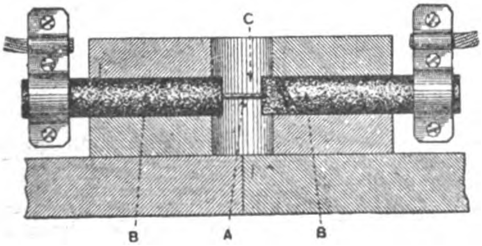


FIG. 2.—RESISTANCE FURNACE.

tage. Where contact of the charge with the electrodes is not harmful it may be possible to make this furnace continuous. There is no reason why a charging and tapping hole should not be provided, in which case the run might be sustained. The natural use of a furnace of this type is for the production at a high temperature of metals, alloys, carbides and similar fluid bodies which are too conductive to allow of easy heating in a resistance furnace. The application of the high heat of combination of aluminium to the reduction and fusion of refractory metal limits the utility of this class of furnace, and at the present moment it is used only in one industry with which the author is acquainted, and then in a modified form. This refers to the manufacture of CaC_2 (calcium carbide).

A typical resistance furnace is that devised by Borchers, and shown in the figure (Fig. 2). It consists of a slender carbon rod, A, supported between two stout carbon rods, B B. The small rod bridges the cavity C, which can be filled with the material to be treated. On passing a sufficient current the rod is raised to a high temperature, and the charge is heated from its very centre. This class of furnace is evidently generally adaptable, provided that the product of the action of the high temperature—*e.g.*, a metal—does not collect and form a good conducting connection between the large carbon rods. The type is presented by the furnace employed for the manufacture of carborundum.

These two types of furnace—viz., that in which there is a definite arc and that in which the heating is effected through a core of high resistance, or the charge itself—will be found to represent in one class or the other all the industrial electric furnaces at present in practical use.

Workshop Wrinkles and Recipes.

[*The Editor will be pleased to receive for this column practical wrinkles and recipes which readers may have found useful. In all cases it should be clearly stated if the information is original or not, and in the latter case the source should be mentioned. Original items will have the preference for insertion.*]

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 2 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.

How to Paint Aluminium.—The following is a good method for painting aluminium surfaces so that the paint after a certain time does not scale off: 1, Scrub and clean the aluminium surface well with a hard brush in a strong solution of soda; 2, Dry the wet aluminium in some hot place; 3, When thoroughly dry, put on varnish and bake aluminium in an oven for about half-an-hour to a temperature not exceeding 300° C.; 4, Remove aluminium from oven, whereupon it may covered with any colour of paint without fear of its scaling off.—FREDERICK R. SIMMS, in the *Autocar*.

To Write on Glass: moisten the surface with strong vinegar and write with an aluminium point. Infinitesimal particles of the soft metal are left adhering to the glass, and the writing is fairly permanent.—*Amateur Work* (Boston, U.S.A.).

The Editor's Page.

WE are now able to announce the result of our Competition No. 18, in which two prizes were offered for the best design and description of a small modern type direct-coupled steam engine and dynamo, capable of giving an electrical output of 500 watts. The fact that we have taken longer than usual to announce the results in this case is indirectly a compliment to the competitors, as it points to the very careful examination of all the designs which has been necessary to enable us to come to a fair and just decision. As the outcome of our deliberations, we have awarded the first prize of £5 5s. to the drawings and description sent in jointly by

Messrs. FRED. L. SPICER and FRANK P. SPICER,
Woodbank,
Prestwich,
Manchester;

and the second prize of £3 3s. to

Mr. A. FOULDS,
56, Whitley Hill,
Bradford, Yorks.

The following competitors have been selected for commendation, their names being placed in order of merit:—Mr. C. G. FRIEDEBERG (Wimbledon), Mr. FRANCIS J. KEAN (Forest Gate), and Mr. E. FITZGERALD (New Barnet).

* * *

We append a few general comments on the entries as a whole, which may be of interest:—The competitors have all taken considerable trouble to prepare their drawings and specifications, and each one has evidently made an effort to obtain a prize. In the majority of cases, however, the designer has endeavoured to adhere too closely to the details of large engines and dynamos. Instead of keeping in view the requirements of the competition—viz., a good small-power engine and dynamo for practical work, explained by clear drawings with simple straightforward description and calculations, these competitors appear to have taken the nearest available large engine and dynamo as a model, and reduced the design to a small scale, accompanying their drawing by incomplete descriptions and calculations. Fair knowledge of the engine, and fitting and turning, is shown, but the electrical parts of the designs are generally weak, some of the designers having merely collected information from various sources, and embodied it in their description without understanding its meaning. Others either omit necessary calculations, or assume that their readers are well-informed on the subject. The important item of the position of the engine eccentric is neglected in several cases, and insufficient information is given on what is perhaps the essential point in the working of a small, high-speed engine—the proper amount of cushioning in the cylinder. The power required has been fairly estimated, the engine proportions are good generally, and the finished models should look well; but the high speeds chosen would have been better met by more simple and substantial designs. The patterns will be difficult to make, and involve a great deal of work. Several designs show engine governors of modern types, though it is doubtful if they will be of any service in actual use. The first prize design is considerably in advance of the others in completeness of the drawings, and its authors also have made a good attempt to deal with some of the difficulties met with in model engines by original thought and suggestions. The winner of the second prize also sends a fair design, and shows evidence of having considered with some care the problem set before him. Generally speaking, we think the competitors have been too ambitious; less elaborate designs with plain, clear, working drawings easily understood, calculations in simple figures taken step by step, the whole to show that the author had intelligently studied his subject; this is what was required. It is useless for an author to state that his result is correct when he does not know if it is so, or to refer his reader to information which does not apply to the case. We shall publish the two prize designs in due course, and shall then deal in detail with any points which appear to us to be incorrect or incomplete.

* * *

Here is an interesting story of a model yachting misfortune, which points its own moral. It reaches us from an enthusiastic south-coast reader of THE MODEL ENGINEER, who writes: "It may interest you to know that I recently finished the model yacht described most fully in the August numbers, 1901. The model was greatly admired by all who saw it, but a misfortune befel it on Saturday. I launched the model, and intended shaping its course from a rowing-boat. I had done this before, but this time a stiff breeze set up, and I found that with all my best rowing I could not overhaul my yacht. It went right out to sea, and I was obliged, after a long stiff pull, to give up the chase and come back without it. I need not say I miss it, as it was a beauty, as far as my knowledge as a novice goes. I think it was very near, f not quite, perfection."

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. 21.—A prize of the value of £2 2s. is offered for the best description and drawings of a small electro-motor, to work from continuous current supply mains at 60, 100, 110, 200, or 220 volts. The output of the machine should be about 1-10th h.-p. actual, suitable for working light machinery, a fan, or sewing machine, without heating. The particulars should include a description of the method of making patterns for all parts required to be cast, the best way to machine the parts, the construction and winding of the armature, and suitable windings for each of the voltages mentioned above. The article should also include details of the starting and controlling mechanism, and it is desirable that all details, at all events, be drawn full size. The usual general conditions apply to this Competition. The closing date for receiving entries is June 15th.

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.

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.

Answers to Correspondents.

"Reform" (Kentish Town).—(1) If you will read our remarks again, you will see we asked for *intelligent* criticism. To describe a model as "tinkering rubbish" is not criticism at all; it is merely abuse. If you can produce better work yourself, let us have particulars of it. If not, you should refrain from sneering at the efforts of others, especially those who are honest enough to acknowledge the weak points in their work, as much can often be learnt from failures as from successes. (2) You do not seem to grasp the fact that it is not necessary to understand English to be able to read a working drawing. We have a number of appreciative foreign subscribers who have a very limited acquaintance with the English language. (3) It is quite natural for the firm you refer to to think their own goods the best. Our opinions are perfectly free and independent, and we are quite prepared to stand by what we say. If we praise an article, it is because we think it deserves it. To wilfully mislead our readers would do no good to them, to the makers of the article, or to ourselves.

"S. W." (Bolton).—The subject is not of sufficient general interest to warrant our devoting the necessary space to it. Reference to back numbers of electrical journals or to modern text-books would give you the desired information.

For the Book-shelf.

The Photographic Dealers' Annual. London: Marshall & Brookes, Harp Alley, Farringdon Street, E.C. Price 1s. Postage 4d. extra.

The Photographic Dealers' Annual must be regarded as an important and valuable reference book by the photographic trade, to whom alone it is issued, since it contains not only important contributions on matters pertaining to photographic work, and the trade addresses of manufacturers, wholesalers, and agents, but comprises also some well-arranged miscellaneous information, some part of which is sure to interest every possible reader. The volume must be regarded as a useful reference book in all ways, and the special articles, such as "Modern Photographic Lenses," "Magnalium for Photographic Purposes," and a "Photographic Dealer's Workshop," etc., etc., should prove especially useful to any dealer who takes any practical interest in his business.

The Locomotive Magazine, Vol. VIII, 1901. Locomotive Publishing Company, 102a, Charing Cross Road. Price 6s. Postage 4d.

We have received a volume of the art edition of the *Locomotive Magazine* for 1901, in which is included the supplementary issues of the journal that appear at certain times in the year, viz., the Xmas number for 1901, entitled "Locomotives of all Nations"; and No. 6 of the special series, "Cars of 1900." The latter gives splendid illustrations—photographs and scale drawings—of English and foreign carriages and other rolling-stock, and adds to the general interest of the book. It will be found to provide an endless source of interest in the quiet half-hours.

Practical Electric Railway Handbook. By Albert B. Herrick. New York: Street Railway Publishing Company, 120, Liberty Street. Price $3.00 (12s. 6d.). Postage 4d. extra.

This book is an American production, and is an excellent example of conciseness, completeness, and careful work. Four hundred pages of close reading and clear general and detailed drawings are devoted to the subject of street railway—or as we say, electric tramway—work in all its branches, and each section is most admirably treated. We may with advantage quote the various sections into which the book is divided: they comprise general statistics, testing, the track, the power station, the line, the car house, the repair shop, the equipment, the operation, storage batteries and boosters, and underground conduits. There are no wasted spaces and few omissions, but amongst the latter may be mentioned any detailed description of the ordinary trolley-arm. This is a point which might be worth the author's attention in any future edition. We do not know that English practice is very different from American in electric tramway matters, but can readily imagine that everyone employed in such work will find this handbook not only useful in his labours, but helpful to a very great degree in advancing his knowledge of a great and growing industry. We may add that the volume is in every way well-produced, the binding—a flexible leather flap cover—being admirably adapted to stand hard wear and to look well in spite of it.

Practical Letters from Our Readers.

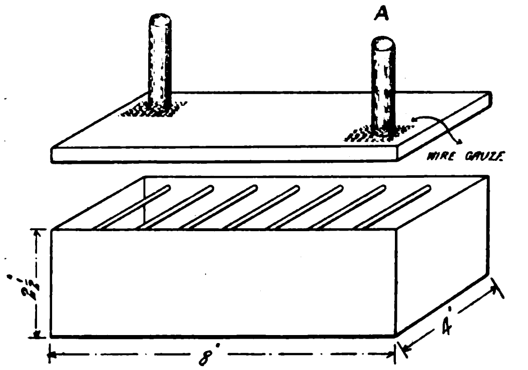
[The Editor invites readers to make use of this column for the full discussion of matters of practical and mutual interest. Letters may be signed with a nom-de-plume *if desired, but the full name and address of the sender* MUST *invariably be attached, though not necessarily intended for publication.]*

A Simple Carburettor for a Small Gas Engine.

TO THE EDITOR OF *The Model Engineer*.

DEAR SIR,—A simple carburettor for a small gas engine, such as was described in Vol. I of THE MODEL ENGINEER, may be very easily made from materials which can be had almost for the asking.

First, procure a tin box of about the dimensions shewn in the sketch below, and inside, about ¼ in. from the top edge, solder a number of stout wires. Now loop a quantity of ordinary lamp cotton over and under these wires, in such a manner that it touches the bottom of the box at every loop.



A SIMPLE CARBURETTOR.

Two ¼-in. holes should be made in diagonally opposite corners of the lid, and about 2 ins. of brass tube soldered into each. These tubes must be covered by a piece of fine wire gauze, soldered inside the lid. The lid should now be placed in position and soldered round quite air-tight.

The carburettor is now finished and may be about half filled with petrol, and the tube A connected to the inlet of the engine, the air-inlet of which should be partially plugged. It is, of course, not suited for long runs, but I have had it working successfully for about an hour at a time.

Needless to say, the engine on which this is used must either be fitted with electric ignition, or must have a blow-lamp in place of the usual Bunsen arrangement.—Yours truly,
F. G. ARKELL.
Battersea.

The Price of Matchboarding.

TO THE EDITOR OF *The Model Engineer*.

DEAR SIR,—As one who is in the timber trade, I beg to point out that the price for ¼-in. matchboarding is 7s. 6d. per square and not 3s. 6d., as stated in the article on "An Amateur's Compact Workshop" in THE MODEL ENGINEER, May 15th, 1902.

I have been a reader of your paper for nearly three years, and have always found it very interesting.—Truly yours,
H. McG.
Liverpool.

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:—

[6185] **Electric Tramcar.** E. A. B. (Leamington) writes: I am making tramcar, 1 ft. long, about 4 ins. wide by 5 ins. high; wheels, 1¾ ins. diam.; about 3¾ in. gauge; to be driven by an electric motor, constructed from directions received through the medium of your valuable paper. How far apart should axles of car be to travel round a circular railway, about 3 ft. diam., or should the rails form a larger circle? I should state that the rails are to carry current, and return *via* central rail, with collector underneath car. I want to reduce speed of motor 20 to 1. How many teeth should the cog wheels have?

It is impossible to give an accurate answer to your question, as everything depends on the amount of side-play of journals, etc. You may proceed in either of several ways. The wheel-base may be fixed with axles parallel, and ability to pass the curves may be given by means of broad wheel flanges, and as large an amount of lateral play between rails and flanges as possible, and slackness of journals. In this case about 1-16th in. side-play in the journals, and at least the same amount between each flange and the rail when car is on the straight track, should be allowed if the axles are 6 ins. apart. Another plan, which may be adopted if the car is to run always one way, is to fix the axles on lines radiating from the centre of the track, and in this case the outer pair of wheels should be of larger diameter than the others. With a 3 ft. diameter track the outer wheels should bear to the others the diameter proportions of about 12 to 9·6, or, say 1⅛ ins. to 1½ ins., to ensure easiest running. If the latter course is adopted (and it is advised), the wheel-base may, of course, be made anything you like. A 3 ft. circle is a very small one indeed for a car a foot long, and most of the details of construction are matters for experiment. To reduce the speed of car wheels 20 to 1, the first and last wheels in the train of gearing should have teeth of proportionate numbers. Thus, if the motor-wheel had six teeth, the cog-wheel on axle should have 20 × 6 = 120. This would prove an awkward amount, and would best be got over by the employment of a single worm and wheel, the former having a single thread, and the latter 20 teeth. A suitable gear can be taken from a cheap cyclometer.

[6258] **Model Yacht.** E. McK. T. (Aston) writes: I enclose a rough sketch (not reproduced) of a 52-ft. racing cutter of which I wish to make a 30-in. model. (1) Am I correct in reducing sail plan and hull by means of altering the scale? (2) Will the model sail satisfactorily? It seems to me that the weight of keel and size of hull are cubically reduced and the area of the sail is only reduced by square. That is, taking the case of this model, which is reduced about 20 to 1, the hull is reduced in cubic feet 8000 times, and the sail area only reduced in square feet 400 times.

Apparently the outline of your design is that of a 52 L.R by Herreshoff, published in the Christmas Number of the *Yachtsman*. No dimensions were given of this vessel, and you have fallen into the very common error of assuming the boat to be 52 ft. over all. A 52 L.R. ranges from 46 ft. to 48 ft. on the L.W.L., and the rating is arrived at thus:—

$$\frac{\text{L.W.L.} + \text{B.} + \tfrac{3}{4}\text{G.} + 4\text{D.} + \cdot 5\sqrt{\text{S.A.}}}{2\cdot 1} = \text{Rating.}$$

G. is the "chain" girth at ·6 of L.W.L. from fore end. D. is the difference between the chain girth and skin girth at that section. You are perfectly correct in saying that the weight and size of hull are cubically reduced whilst the sail area is only reduced by square. In other words, solids vary as the cube of any one dimension, and areas as the square. We imagine the sail area, as originally given, would be probably about 3000 sq. ft., and the L.W.L. 48 ft.; the L.O.A. about 70 ft. to 72 ft. To reduce this to a 30-in. model, we get 30 ins. over all, 20 ins. water-line, with a sail area of 250 sq. ins. The present rule (as given above) tends to reduce beam and depth and to get as large a sail area as possible. The larger the boat, the more can these dimensions be exaggerated, and we are afraid that a model to scale would be very "crank." A 20-in. water-line model of the design given could not comfortably carry more than 400 sq. ins., and it would be advisable to drop the keel another inch to make the draught about 4½ ins. Suppose we assume the original boat is 70 ft. over all, then to reduce to 30-in. model all dimensions of hull must be divided by 28, making the new water-line 20·5 ins. The sail area, let us suppose, was 3000 sq. ft., which we wish to reduce to 400 sq. ins. We find then that all the dimensions of the sails, viz., the edges and spars, should be divided by about 33. We should suggest, therefore, 1-28th of full size for hull, and 1-33rd of full size for spars and sails. The question of sail area and hulls of models as compared with large yachts appears to follow the same argument as is generally accepted nowadays with regard to the size of cylinders of models compared with a real locomotive. A model hull is not so "powerful" for its size as the yacht's hull, and hence the sail area must not be as large in proportion.

[6266] **Mercury Vapour Lamps.** W. J. K. writes: Can you please tell me how I can make mercury vapour or gas, as I see it has been used to make an incandescent electric light? I should like to make one if you would kindly tell me how to set about it, also the conductivity of the gas as compared with water = 100.

We can give you no information beyond what has already appeared in the journal, where we stated that the lamps in question could not be easily made by an amateur. We are sorry also we can say nothing about the conductivity of the gas.

[6267] **Manchester Dynamo, 120 watts.** G. A. R. D. (Albury, N.S.W.) writes: It is a great boon to us out here to have such an excellent journal as yours to instruct us in our hobbies. One learns more through your paper than be could gain by reading books on the subject, etc., especially as different correspondents air their views against others, and so one gains. We in this part of the Commonwealth look forward to the coming of your journal very eagerly, I assure you. I am making a dynamo (Manchester type) as follows: Armature (drum type), 12 slots 5-16ths in. wide, ⅜ in. deep, consisting of laminated discs (36 to 1 in.), 2½ ins. diam., 3 ins. long, wound with 20 D.C.C. wire, about 12 ozs. in all. Field-magnets (wrought iron), ½ in. thick, 3 ins. wide, wound with No. 22 D.C.C. wire; shunt-connected; spindle, ⅜ in. diam. steel; speed, 2,400 revs. per minute. I have an engine, ¼ b.p. (cylinder 2⅛ in. 3½ in. stroke), for power to drive dynamo. Would 4 lbs. (2 lbs. on each field-magnet.) No. 22 D.C.C. wire be enough to give 20 volts, 4·5 amps., with 2,400 revs.? or should I drive at 2,800 revs. to get this output? What candle-power should it develop at (advised speed) this speed? What voltage for lamps? What wire should I use for wiring circuit to lamps? Can you suggest any improvement for efficiency?

Your dynamo should easily develop about 120 watts (6 amps. at 20 volts) at a speed of 2,400 revs. per minute. As to the wire for field-magnets, we should advise 3½ lbs. No. 21 (total), but possibly somewhat less than that will prove right. Without more knowledge of the machine we can only advise a little experimenting on your part. The 4 lb. No. 22 will, we think, offer too great a resistance, unless the machine is very well built, with armature running close; but, of course, it is a more economical winding. An output of 120 watts is equivalent to about 32 c.p., with ordinary lamps and these should be of same voltage as dynamo is rated, namely, 20. The leads to lamp circuit should be No. 14 solid, or a stranded wire of equal section—say, 7/20. Your dynamo is of very fair proportions, and we think it should prove satisfactory. A study of our new handbook, No. 10 ("Small Dynamos and Motors"), would give you the best idea of correct proportioning of small machines. We are very glad to have your letter. It is pleasant to hear that THE MODEL ENGINEER is of practical value to readers in far lands. Of course, we know that is the case, confirmatory letters from all parts of the world having testified to the fact, and we are always glad to hear from these distant enthusiasts.

[6284] **Model Launch Boiler.** T. J. R. E. (Stroud Green) writes: I have a steel boiler of the following dimensions: Length, 14 ins.; width, 5¼ ins.; height, 6¼ ins.; internal firebox (water all round), 13½ ins. by 4¼ ins. by 3¾ ins.; firebars, 7¼ ins. by 4 ins., no cross tubes, but well stayed. This boiler is fitted to model launch engines, and is to drive two oscillating cylinders, 1¼ ins. by 1 in. each. I have always had a great difficulty in getting and keeping sufficient steam with charcoal firing, although the exhaust steam goes up chimney, and I have blower as well. I give you rough sketch of boiler, and shall be glad of your valuable advice as to best possible manner for keeping up a regular and full supply of steam for fast work, driving a 6-ft. wood-built hull.

The boiler has only just over 100 sq. inches of effective heating surface, and should not have been coupled to an engine with *one* cylinder of greater dimensions than 1¼ ins. by 1 in. stroke. For the given engine the heating surface should have been nearly double the amount provided by the present boiler. You may temporarily try the effect of reducing the cylinder capacity by uncoupling one of the cylinders and blocking up the ports in the steam block. To accomplish the latter, take the piston, piston-rod, etc., down and put the cylinder in the position it would occupy when the crank is on the dead centre, and tightly screw up the pivot screw. The ports will be then closed from communication with the cylinder. Try the engine with the boat in the water, and note the effects. You can let us know of the result, and we will, if necessary, give you further advice upon the question of altering the boiler, but please send a scale or dimensioned drawing with a cross section.

[6291] **Compound Steam Engines.** H. M. (Bradford) writes: I should be very glad if you will answer me the following questions: A compound engine—H.P. 1⅝ in. bore, 3 ins. stroke; L.P. 3 ins. bore, 3 ins. stroke, working at 75 lbs. pressure and running at 100 revolutions per minute. What horse-power would it probably give, and how is such worked out, so that in future I should be able to work them out for myself?

Please refer to our issue of January 15th, the last reply to Query No. 5105, page 45, for the method of estimating the horse-power of your engine. The physical law which is required to be known, and which is not mentioned in the previous answer, is Boyles' Law of Expansion of Gases, viz., that the pressure of a given amount of gas varies inversely as the volume (the temperature remaining constant). For the purpose of roughly estimating the h.-p. of your engine, it may be taken that the temperature remains constant. In the first cylinder about the average pressure would be 65 lbs. and the steam on being exhausted into a cylinder of about three and a-half times its cubical capacity would drop in a corresponding degree to about two-sevenths of the pressure, = 18 lbs. We think that you would gain a little extra power by fitting a condenser and an air pump. The condenser should have about 200 to 300 sq. ins. of surface and the circulating pump should throw about 120 cubic inches of water per minute when the engine is running at 250 revs. per minute. We think that 100 revolutions per minute (the speed you give) is too low for efficient working. The use of the condenser would, perhaps, increase the average working-pressure on the low-pressure piston to about 25 to 26 lbs. Taking it at 25 lbs., the i.h.-p. of the L.P. cylinder (at 100 revs. per minute would be about $\frac{35}{132}$ i.h.-p., and that of the h.p. cylinder about $\frac{18}{132}$ i.h.-p. Total, $\frac{53}{132}$ = ·4 i.h.-p. The h.p. will, of course, vary directly as the speed and at 250 revs. per minute the engine would develop about 1 i.h.-p. with very little, if any, increase in the internal friction. The i.h.-p. of the low-pressure cylinder at 100 revs. per minute, and without the condenser, would be about $\frac{17}{132}$ which, with $\frac{18}{132}$ the i.h.-p. of high-pressure cylinder, makes a total of just under ¼ i.h.-p. We think that the L.P. cylinder is too large for a non-condensing engine, and that you will find that if it is lined up to, say about 2⅜ ins. bore, the engine will be more efficient. The initial pressure in the L.P. cylinder seems very low. We do not think it will make the ratio of capacity of the two cylinders greater than 1 to 2½ or 1 to 2¾ ins. If they are respectively 1⅝ ins. and 2⅜ ins. bore the capacities will be as 1 to 2 1-5th, and the initial pressure in the L.P. will be increased to about 29 lbs. You may, however, increase the average pressure in the L.P. cylinder by increasing the boiler pressure to, say 100 or 120 lbs. per square inch, if possible.

[6298] **Model Pullman Cars.** A. T. T. (Nottingham) writes: I am building a model Pullman car, similar to enclosed illustration, for a ¾-in. scale railway. Would you kindly inform me how the two 4-wheel bogies are attached to the car—are they only held by a centre pin?

Yes; for a small model double bogie railway vehicle of any description a centre pin only is needed. There is no transverse movement, such as provided in the leading truck of a locomotive, required. On the real Pullman cars a lateral motion is however given to the bogie, and this is allowed by a transverse beam called a "bolster," which is the only portion of the truck pivoted to the main body of the carriage and from which the truck itself is slung by bolts or links, and upon these it may swing sideways when necessary. By their position, the tendency of these links is to restrain the truck to its normal position. The transverse motion is designed to lessen the shock when the vehicle takes a curve at very high speed.

[6303] **Accumulators.** "COLONIAL" (Sydney) writes: (1) Kindly inform me how to make a Granule carbon cell. I have read your handbook on Batteries, but cannot find anything about them. (2) Would Linotype metal do for accumulator grids? I think it is made of an alloy of lead, tin, and antimony, though in what proportion I cannot say. If not, would ordinary type metal do? (3) Would a 5 c.-p. lamp light a bedroom 12 ft. by 8 ft., and what size accumulator (how many cells) would be wanted to run it for about 15 hours without recharging, and could I charge it with a granule carbon battery? If so, how many cells? and is the granule carbon cell better for constant lighting than the bichromate cell?

(1) A Granule carbon bichromate cell is shown on page 46 of "Electric Batteries." (2) We doubt whether the Linotype metal would give very good results. An alloy of lead and antimony is satisfactory for accumulator grids, but the addition of tin would probably cause trouble. (3) Yes; but not very brilliantly. A 5 c.-p. lamp of 20 volts might consume as little as ¾ ampère. An accumulator to run it satisfactorily for 15 hours would have to consist of 10 cells of about 15 ampère-hour capacity. Each plate should contain positive plate surface to the amount of about 1 sq. ft., so that if the cells had each five plates, three negative and two positive all 6 ins. square, they would provide ample capacity. It is possible to charge such an accumulator from a Granule battery, but this is

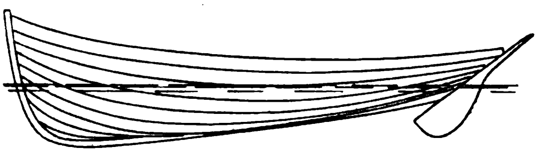
an extremely wasteful and expensive method, seeing that the primary cells themselves would light the lamp direct with much less loss. If this is your only method of charging the accumulators, we think you will be ill-advised in carrying out the scheme. We very much appreciate the kind remarks you make, and can assure you that everything will be done to keep THE MODEL ENGINEER up to the standard.

[6319] **Steam Launch Queries.** "PING-PONG" (Bolton) writes: I am constructing a steam launch 16 ft. long, and to speed at about 4 or 5 miles an hour. Could you give me any particulars as to what size of boiler I should need? What horse-power required to be developed, size of cylinder? Could you also inform me where I could procure a book which contains a design of a hull suitable for launch?

About ½ to ⅝ h.-p. would be ample. Any well-designed boiler having some 1,100 sq. ins. of heating surface may be used. A vertical boiler containing a large number of ⅝-in. flue tubes would do (see issue of February 1st, p. 69). You might make the shell of the boiler 12 ins. in diameter if this type is adopted. One cylinder, 2¼ in. by 2½ in., will be found sufficient for a light boat. Please refer to "How to Build a Motor Launch," published by the Rudder Publishing Company, 143, Strand, W.C.; price 5s.

[6367] **Northumbrian "Cobles."** J. E. L. (Westhoughton) writes: Can you give me particulars of proportions and construction of the style of boat known as "cobles," and used as fishing boats on the Northumbrian coast?

The useful class of fishing boats known on the north-east coast as cobles have several marked characteristics, as a reference to the



Query No. 6367. NORTHUMBRIAN "COBLE."

sketches herewith will indicate. In the first place, the depth of the boat forward is very great—about twice that at the stern. The lines are rather fine at the bows, but run to a full beam amidships, this being continued aft, where the boat is very flat, and lies almost on top of the water. The keel rakes upwards towards the stern, so that when the boat is run ashore stern first it lies easily its full length on the sand, with the stern reaching well over to dry landing. The rudder is peculiar, and its form and position are indicated in the sketch. Of course, it is unshipped before running ashore. Approximately correct proportions are given, the section shown being a little aft of amidships. A noticeable feature is the great width of the planking, as indicated in the latter sketch. These boats in experienced hands are safe and able to ride almost any sea, but they are unhandy, and experience is essential in their management. We believe they are usually furnished with dipping lugs.

[6328] **Blue Printing.** J. B. N. (Cardiff) writes: I should be glad if you could tell me the name of a firm that supply the rolls of transparent drawing paper and sensitive paper for blue printing.

Mr. A. G. Thornton, 68, St. Mary Street, Manchester, will supply you with all kinds of sensitive paper, and also the transparent drawing paper usually called tracing paper, you require. For photo-reproduction of drawings a tracing paper of a slightly blue shade should be used. A yellowish tinge is detrimental to good prints. Tracing linen is as good as anything for the purpose and is less liable to serious damage in handling.

[6331] **Small Voltmeter.** C. H. J. (Nailsea) writes: Would you be so good as to give me an answer to the following two queries on the simple voltmeter described in the April 1st MODEL ENGINEER? (1) About what quantity of wire is necessary for the voltmeter? (2) Should the several layers of wire be insulated one from the other? If so, how?

(1) 4 ozs. of No. 36 wire would be plenty for the purpose. (2) No. We should advise soaking the coil of wire in paraffin wax, and winding as evenly and closely as possible, but it is undesirable to get in any extra insulation. (Please note Rule 1 at the head of these columns.)

[6344A] **Electric Lamp for Bicycle.** H. J. B. (Liverpool) writes: Will you kindly inform me, through your Queries and Replies, how to make an electric bicycle lamp to be driven by the wheel of bicycle, size and shape of magnet, and armature? Also winding and what sort of lamp to use.

We have several times pointed out the disadvantages of a bicycle lamp worked from a dynamo on the machine. Without repeating the arguments on the subject, we may state that with the smallest effective light and the best of dynamos, the power required is equivalent to that necessary to drive the machine against a fairly strong head-wind. The weight of the dynamo is also a serious objection. Will you be good enough to note the conditions at the head of these columns laid down for querists? Particular attention is specifically called to No. 1, and this you ignore altogether! Under the circumstances, you cannot rightly expect an answer at all.

[6344B] **Current Obtainable from Leclanche Battery.** H. J. B. (Liverpool) writes: I should like to know what amperage twelve No. 2 Leclanché cells will give out.

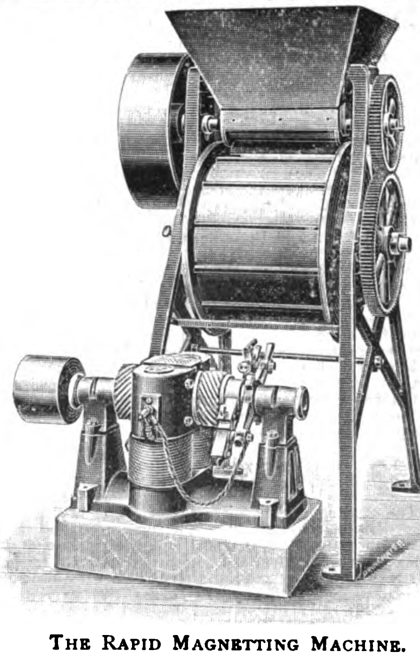
The current in ampères from any battery can be found if the internal resistance, external resistance, and voltage are all known. Unfortunately, not only is it impossible to say exactly what the internal resistance of your batteries will be, but also the voltage is a variable quantity, depending upon the resistance in circuit. Supposing the voltage remained at its highest possible value, which, in the case of a Leclanché battery is 1·5 per cell, and the internal resistance at ·5, the current obtainable on short circuit would be 3 ampères, whether one, two, or even twelve cells were in series. As a matter of fact, short circuiting the cells instantly lowers the voltage, and the passage of a comparatively heavy current, even for a moment, polarises the cells, thus raising the internal resistance and lowering the current at once. You should study the subject in a book like Cooper's "Primary Batteries," and quoting from this, we note that on a test of a Leclanché cell through a resistance of 10 ohms, a maximum current of ·3 ampère was obtained, and this was falling pretty quickly at the end of an hour's trial.

Amateurs' 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.*]

A Magnetic Separator.

Many years ago magnetism was requisitioned to serve the purpose of separating iron or steel filings, borings, etc., from amongst other metallic odds and ends. The method had its failings, amongst which were those due to the employment of permanent magnets. A new machine, in which these latter play no part, has been introduced by the Rapid Magnetting Machine Co., 125A, Cambridge Street, Birmingham. It is fitted with electro-magnets, worked from a dynamo, and is, therefore, far more powerful than the older type. The action is automatic, the machine requiring no attention, and it will treat any kind of material in which iron scraps, particles, or small iron or steel goods are mixed up with other metallic or non-metallic substances. Enquiries by interested readers should be accompanied by a stamped envelope, and THE MODEL ENGINEER should be mentioned.



THE RAPID MAGNETTING MACHINE.

Catalogues Received.

Ashmore, Benson, Pease & Co., Limited, 39, Victoria Street, London, S.W.—Portable storage batteries for electrical ignition of gas and oil engines, for working phonograph and other electro-motors, for lighting small hand-lamps, and indeed for all ordinary purposes to which these batteries are suited, are supplied by Messrs. Ashmore, Benson, Pease & Co. A neat list to hand gives prices and particulars of these A.B.P. accumulators, as they are styled, and indicates a number of important firms and public bodies to whom sets have been supplied. Readers should mention THE MODEL ENGINEER when writing for a copy of this list.

Thomas Dyson, Gay Lane, Otley, Yorks.—Bicycle motors, complete or in separate unfinished or partly finished parts, frames and components form one department of Mr. Dyson's business. These details are enumerated in a price list to hand, which gives full particulars as to prices. Another list is devoted to sparking plugs and coils, and those interested in these matters should write, mentioning THE MODEL ENGINEER, for copies of either or both the lists.

G. S. Hooker, Paragon Works, Retreat Place, Hackney, London, N.E.—A handy price list of the "Hooker" gas and oil engines just to hand shows that these engines are supplied in various sizes from ½ to 5 h.-p. The catalogue gives many particulars, from which we gather that all the engines are of high-class manufacture, and require no skilled attention in running. The oil engines work with ordinary petroleum. Oil launch engines and motor car engines, working with either petroleum, petroleum spirit, or benzoline are supplied. Readers should send a penny stamp and quote this journal when writing for the above list.

British Thomson-Houston Company, Limited, Rugby, England.—Pamphlet No. 121, issued by this well-known firm, is devoted to a description and prices of small direct-current electromotors of graduated sizes, from 1-10th to 2 h.-p. The pamphlet is beautifully printed and illustrated, the illustrations being half-tone reproductions showing various applications of the motors as well as the parts of the machines themselves. As to these latter, they are of the enclosed type, and are made with a magnetic circuit of laminated iron, which secures high efficiency and lightness. These motors are intended for hard work, and readers who think of installing electric power in their workshops, &c., will do well to study the features of these "Type CA" motors. Mention should be made of THE MODEL ENGINEER when writing for particulars.

Fraser & Chalmers, Ltd., 43, Threadneedle Street, London, E.C.—From this firm comes an exceptionally neat pamphlet descriptive of the Riedler electric and power driven pumps, for which the Company is the sole licensee in Great Britain and the Colonies. The pamphlet sets forth the special advantages of this type of pump, the particular feature of which is a mechanically controlled valve, whereby a high speed of working is rendered possible. The firm also manufactures a large variety of machinery for various industries, such as that for colliery, chemical and metallurgical processes, and a list of some of the places to which such machinery has been supplied forms a feature of the present catalogue.

Alf. Dougill & Co., Ltd., 34 and 36, Great George Street, Leeds.—Gas and other internal-combustion engines, from ¾ h.-p. upwards, are the principal items dealt with in a set of illustrated lists to hand from this firm. These engines, it is stated, can be worked by paraffin, benzoline, gasolene, or acetylene gas, and can be used for every variety of work. Copies of numerous testimonials show that the engines have given every satisfaction to purchasers. The firm has also some specialities for motor-power users, and their gas engine lubricating oil is a high-flash lubricant which will enable an engine to run satisfactorily at full power without trouble. THE MODEL ENGINEER should be mentioned by readers sending for the above list.

The General Electric Company (1900), Ltd., 69-71, Queen Victoria Street, London.—We have received from the General Electric Company (1900), Ltd., a copy of their new and voluminous catalogue, comprising the various sections which they have issued during the last twelvemonths or so, together with a great deal of interesting added matter. The General Electric Company is claimed to be the largest electrical firm in this country, for they employ 5000 hands. The opening pages give a lot of useful information for those who wish to buy, sell, or manufacture, including tables of weights and measures, with metrical equivalents, foreign money tables, data for house wiring, and comparison with gas for private plants, hints to purchasers, and a glossary of electrical terms. For those colonial customers who have not always time to write home for quotations, a series of estimates for complete plants are included, and, finally, there is the General Electric Company's special telegraphic code, by means of which any of the 100,000 listed articles in the catalogues can be cabled for in conjunction with the ordinary commercial codes; and many electrical and mechanical expressions are coded as well, so that orders can be sent for all requirements. The various sections aggregate close on 1000 pages, and (with few exceptions, as in lamps, where the varieties are too great) every article has a catalogue number, and every class of article is accompanied by a short and concise description and specification. All the articles illustrated are manufactured by the General Electric Company. It is practically impossible to review in detail a book of 1000 pages, but we may draw attention to some of the patented articles and specialities of this firm. There is an almost endless variety of switchboards, point switches, plugs, cut-outs, and ceiling roses, amongst which we would specially mention the "Link" switch, "Loop-in" ceiling rose, and the many articles on the "H.V." system, and with lined fuse-chambers. Water-tight switches, arc lamp switches, house switches, and cut-outs for high and low tension, and lamp holders are plentiful, and this section is completed with the well-known, London-made "Robertson" lamps. Section W deals mostly with the firm's "Omega" wires and cables, but we find flexible wire in great variety for every conceivable purpose, telephone and multiple, intercommunication and dry core cables, and the General Electric Company's system of "Union" conduits and fittings, to say nothing of insulators, wiring tools, jointing material, etc., etc. Section M includes the "Stanley" series of ammeters and voltmeters made at the Manchester works, and the well-known "Aron" meters made in London, the "Wilson" time switch, and the "Stanley" auto cut-outs, besides many other instruments and apparatus of the same kind. Section E which follows, commences with the General Electric Company's "Angold" arc lamps and gear for same, Lyons' liquid resistances, stage apparatus "Freezer" fans, and the high-class motor rheostats, controllers and automatic lift controllers sold by the General Electric Company. The rest of this section is mostly taken up by transformers, small motors, accumulators, and engineering accessories. A small, but important section, T, deals exclusively with traction material. Section P is the next and deals almost exclusively with dynamos and motors. Here we find the well-standardised "Byng-Hawkins" multipolar dynamos and motors, open and enclosed types, single and polyphase generators and motors, and various appliances connected with these. A yellow supplement completes this part, in which steam, gas and oil engines, boilers, and other prime motors not made by the General Electric Company are listed for the special benefit of buyers abroad. Section H is devoted to electric heating and cooking. The General Electric Company manufactures in this line include everything in the cooking way from kettles and saucepans to ovens and hot cupboards, and in the heating line from "Glow" radiators and ordinary radiators to irons, shaving pots, soldering tools, and a host of small industrial appliances. Section L comprises electric bells and kindred apparatus. It is a large section and describes bells of various classes, indicators, and signalling apparatus for all and every purpose. Pushes alone occupy many pages, and Leclanché, sack and carporous wet cells, E.C.C. and century dry cells, tell-tales, magnetos, gas lighting apparatus, telegraph instruments, accessories, speaking tubes, and finally lightning conductors (including the "air to earth" system) complete this section. The next section is known as K, and deals very exhaustively with the General Electric Company's specialities in the way of telephones. The "Geeko" bell push telephones are much in evidence, and many pages are taken up by accessories and various other telephones for special purposes, annunciators, switchboards, extension bells, and wires. Section O deals with medical electricity. Here we find a large variety of induction coils, and electrodes for application of current, as well as apparatus for epilation, cautery, examination, Röntgen rays, and skin affections. In addition, there are a host of batteries (primary and secondary), small motors for dental and ventilating purposes, watch and clock alarms, and a strong line of portable accumulators. This section ends with some useful automobile accessories. The last and largest section of the catalogue, namely, F and G (fixtures and glassware), deals with everything in this line from cord grips to electroliers, and from cardboard shades to cut-glass globes. This section, which includes some 1000 original designs, is beautifully got up on art paper, and is a fitting conclusion to the series which precedes it. The General Electric Company's catalogue has appeared about every two years for the last twenty years, and the present issue appears to beat the record as a trade reference book, and it should be invaluable to all dealing in electrical goods.

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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