Sole American Agents, SPON & CHAMBERLAIN, 120, Liberty St., NEW YORK.

Entered as second-class matter, April 14, 1899, at the Post Office at New York, New York, under the Act of March 3, 1879 (Sec. 415, P.L. & R.).

Single Copies, 14 cts. Annual Subs., $5.50. Post Free.

The MODEL ENGINEER & PRACTICAL ELECTRICIAN

4d

A Journal of Small Power Engineering

Founded 1898
66 Farringdon St London E.C.4

Vol. 62. No. 1501. THURSDAY, FEBRUARY 13, 1930. Post

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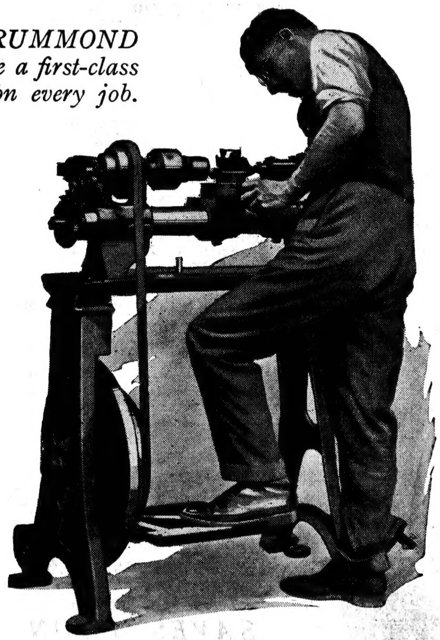

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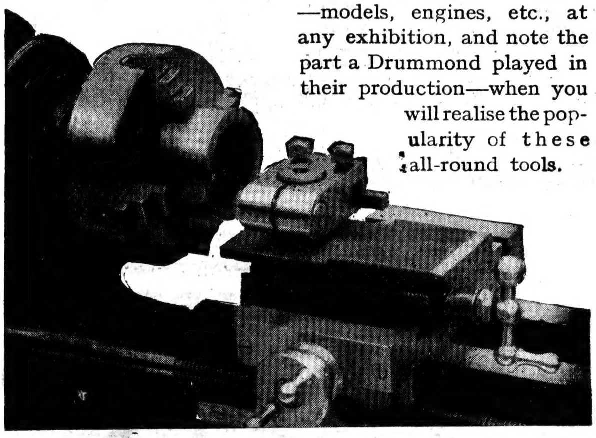

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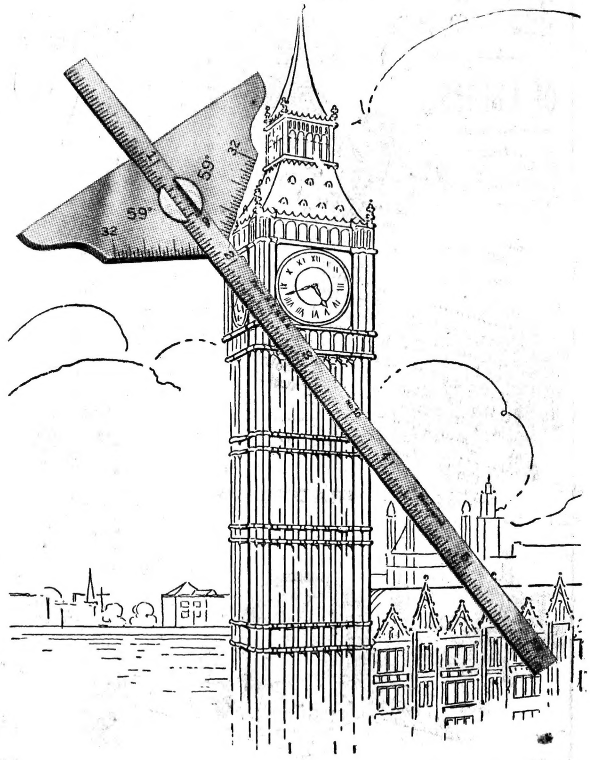

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MODEL ENGINEER
Edited by
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Tech. Research and Workshop Dept.: ALFRED W. MARSHALL, M.I Mech.E. A.M I.E.E.

Editorial and Publishing Offices: 66 FARRINGDON STREET, LONDON E.C.4
Single copies, 4d., post free 5d.
Annual Subscription, 21s. 8d., post free.

VOL. 62. No. 1501. FEBRUARY 13, 1930. PUBLISHED EVERY THURSDAY. 4d.

SMOKE RINGS

WE publish in this week's issue the opening instalment of the description of THE MODEL ENGINEER wireless receiving set. I have christened this "THE MODEL ENGINEER 1,500" set, as it marks the passing of our 1,500th issue, and symbolises the progress of wireless science since we published our first wireless article on the making of a coherer thirty-two years ago. For many years THE MODEL ENGINEER was the only journal publishing articles on the construction of experimental wireless apparatus, and some of our enthusiastic readers of those days profited by the information and inspiration given in our articles to enter the wireless industry in its early stages and achieve important personal and material success. It is therefore quite appropriate that we should still maintain touch with that side of scientific work and give present-day readers useful and up-to-date information and advice. I asked Mr. Barton Chapple to approach this design from the point of view of the model engineer as a competent mechanic with a desire to possess a really first-class receiving set within his power to make either for himself or for his friends. I said we wanted a design which would give first-class reception from all home and Continental stations which might reasonably be desired, and at the same time would be fully adapted to meet the new broadcasting conditions. Mr. Chapple, who is in the very front rank of wireless technicians, has taken a great personal interest in the success of this design, and, having built it and submitted it to exhaustive tests, has the fullest confidence in offering it to our readers. There are, of course, hundreds of sets of all kinds described in books and in the wireless Press, and the ordinary constructor might well have an attack of mental indigestion if he tried to assess the merits of them all, and select a really good all-round set to make. We are saving him that trouble, and I am quite convinced that everyone who follows Mr. Barton Chapple's instructions and builds "THE MODEL ENGINEER 1,500" set, will have every reason to be satisfied with his choice. A correspondent wrote me the other day in regard to this set, and said he hoped we would not content ourselves with giving instructions for the assembly of purchased components, but would describe fully the making of the components themselves. This is ruled out from the start by the fact that many of the components necessary are the subject of patents, but there is also the disadvantage of the fact that while some of the components could no doubt be effectively made by the skilled model engineer, most of them would either be quite beyond his abilities, such as the valves, for example, or could not be made satisfactorily except after prolonged trial and experiment. In purchasing finished components from specialist manufacturers, the constructor not only gets them more cheaply and more quickly than he could make them himself, but gets the advantage of the expert knowledge and research which has been put into the component before it has reached its marketable stage. There is a certain amount of constructive work to be done in fitting up the set, which every model engineer will enjoy, and, if he so chooses, there are certain of the simple details be can make for himself instead of buying. I shall be glad to hear how my readers get on with the building of this set. If any difficulties arise either during construction, or in operation after it is finished, Mr. Barton Chapple will be pleased to explain them away. I am sure that those who build it will get a great deal of pleasure out of it, and I am equally sure that many wireless friends, when they see and hear the finished set, will want to know how it was done, and will want to build one like it.

* * *

A SHEFFIELD reader, "G. M. F.," writes me, taking strong exception to the phrase "Sheffield junk merchants" which has sometimes appeared in our "Shops, Shed and Road" columns, in reference to the supplies of some model locomotive parts which some years ago were made in that city. My correspondent says, "We in Sheffield are jealous of our reputation, which is second to none, and the fact that a wrong impression may be created in the minds of others renders it necessary to take notice of the remarks which have occasioned this letter." I do not suppose for a moment that any wrong impression has been created by the phrase referred to, but I willingly publish my correspondent's protest. The name of Sheffield is synonymous the world over with all that is best in steel, in edge tools, and in silver plate, and if unfortunately at one time some disappointing model locomotive products emanated from that great centre of industry, I do not think the reputation of the city generally has suffered in the least degree. One often hears the expression "Brummagem" applied to imitation or spurious wares which are supposed to be produced within the confines of Birmingham. But Birmingham goes on uncaring, resting assured that the quality of the work produced by the many high-class firms in the metal and hardware trades in that famous Midland district will be the real criterion of her place in the industrial world. And so with Sheffield; all the world knows a Sheffield blade, and accepts "Sheffield made" as a hall-mark of undisputed quality.

* * *

MR. J. H. McDOWELL, of Kinver, near Stourbridge, sends me an interesting letter agreeing with my comments on the address recently broadcast by Sir Alfred Yarrow, and referring to his own student days at the Finsbury Technical College, where he first heard Sir Alfred speak. Mr. McDowell goes on to mention Professor John Perry. He says: "I can remember John Perry as he stood in Room 21 and told us that engineers were men who did things which other people said were impossible. If we were a bit worrying, he would say, 'Some of you will be cab-drivers, and some will be at the top of their profession.' A cab-driver seemed to be the depth of degradation for an engineer, and now it is a skilled job. *Tempus fugit.*" Although I was at Finsbury some years earlier than Mr. McDowell, I also sat at the feet of John Perry and drew instruction and inspiration from his delightful lectures. I do not know anybody who did more to simplify the teaching of the basic principles of mechanics than Professor Perry. He designed all kinds of very simple laboratory equipment with cords and pulleys and weights, which demonstrated to us the parallelogram of forces and other problems in mechanics in a most entertaining way. Laboratory work was almost a play-time; grown-up students playing with mechanical toys, all the time learning something and proving something in a way which was never forgotten. I remember, too, hearing the pronouncement about cab-drivers on more than one occasion. It was Perry's most withering rebuke to students who were inattentive or dilatory in their work. I wonder how often it came true; I do know, however, that some of his students, many of them, in fact, have risen to very responsible posts indeed in the engineering world. What a pity Finsbury Technical College has gone under. It has set its stamp of quality on many a leader in engineering, electrical and chemical science.

* * *

THE results of our 1929 Speed Boat Competition are somewhat disappointing, but this is probably due to the uncertainty which for some time overshadowed the revised conditions of the contest, and also to the lateness with which those conditions were published. For this we must accept the blame, although we, like some of the other interested parties, perhaps felt the need of a period of interregnum during which stock of the position could be taken. Only one silver medal has been earned, and this has been gained by Messrs. A. & J. Skingley, of the Victoria Model Steamboat Club, for the performance of their boat *Cissie IV*, Class B, Section 11. This boat has a displacement of $11\frac{3}{4}$ lbs., is engined with a single-cylinder two-stroke petrol motor $1\frac{1}{2}$-in. by $1\frac{1}{2}$-in. bore and stroke, and attained a certified speed of 21.75 miles per hour on the circular course. Although well below record, this is really quite a good achievement under the new conditions. A Certificate of Performance is awarded to Mr. Edward A. Walker, of the South London Experimental and Power Boat Club, for 9.3 miles per hour on the circular course, with his boat *Nipalong*, displacement 11 lbs. 9 ozs. This craft has a single-cylinder four-stroke motor, $1\frac{1}{8}$-in. by $1\frac{1}{8}$-in. bore and stroke. We hope to publish illustrated particulars of these boats in an early issue.

Percival Marshall

Setting Jewelled Pivot Holes in Clocks and other Instruments.*

By R. N. U. Pickering, F.B.H.I.

OWING to their hardness and the high polish of which they are capable, jewels are used for the bearings of light machinery such as clocks, watches and for electric instruments, compasses, chemical balances, etc.

Being brittle and liable to crack or chip, they are not suitable for heavy machinery. When properly made and fitted they greatly reduce friction and provide a material which resists wear more than metal bearings.

They have been used in watches since 1700, and were introduced by Nicholas Facio, of Geneva, at that date, but his invention was not at first favourably received either in Paris or London, and the Clockmakers' Company declined to grant him a patent; nevertheless, he was made a member of the Royal Society in consequence, and jewelling was speedily adopted in England and other countries, but, being expensive, was confined chiefly to the escapements of watches. Now in many cases it is overdone, especially in the cheap Swiss watches which are jewelled up to the centre hole with badly made garnet jewels for show, whereas brass holes would be more satisfactory. The stones found to be suitable for jewelling are the diamond, ruby, sapphire, chrysolite, agate and garnet. An arbitrary scale of hardness has been devised in which the diamond is taken as 10, the sapphire 9, ruby 9, chrysolite 7, garnet 6-7, agate 7.

A test of hardness is one stone scratching another, the harder scratching the softer.

A file will have no effect upon a stone which is suitable for a jewel hole.

The diamond, which is pure crystallised carbon, is the hardest substance known (with the exception of the metal tantalum, which is said to be equally hard) is used as endstones to cover jewel holes in watches and chronometers. When powdered, it is used for polishing other stones and splinters of it are used for drilling or turning them and also for cutting glass, truing carborundum wheels, etc. Its sp. gr. is 3.5.

*With some supplementary illustrations and notes on them by Geo. Gentry.

Ruby (red) and sapphire (blue) are both varieties of corundum or oxide of aluminium Al_2O_3, which when pure is colourless, but it usually contains about 1 per cent. of ferric oxide or of chromic oxide, the latter probably giving the red colour to the ruby. The blue colour of the sapphire is probably due to the presence of titanic oxide.

The word corundum is applied to opaque stones, used for abrasive purposes. Emery is corundum mixed with magnetite and other stones of lower hardness.

Carborundum, now extensively used in workshops, is a silicide of carbon C.SI., artificially prepared.

There are three varieties of ruby: oriental, sperial, and balar; the first is the hardest and best, and capable of a higher polish; the other two varieties are softer and oil in contact with them is said to rapidly deteriorate.

The sp. gr. is about 3.7.

Oriental sapphires have about the same hardness and density as the ruby but are more brittle; they may be white or milky as well as blue.

Chrysolite has a green colour and is an alluminate of beryllium $Be_2Al_2O_3$ containing some ferrous oxide, the density varying from 3 to 3.7.

Agate, which is composed mainly of silica, derives its name from the river Achates in Sicily, where it was found at the time of Theophratus.

It has a peculiar banded structure, the bands being usually irregularly shaped following the configuration of the cavity in which it was formed.

Onyx is an agate in which the bands are well defined and often black and write. Its sp. gr.

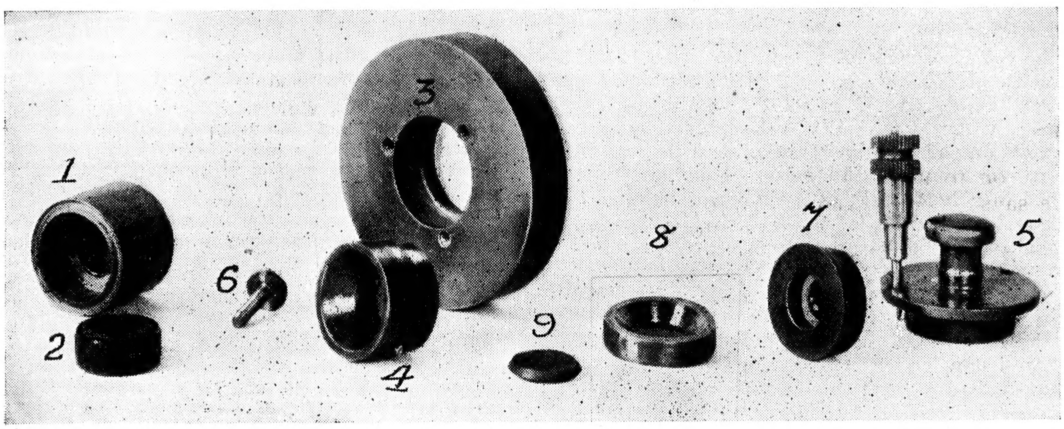


Fig. 3.—Parts of Jewel-hole Settings taken from Models made by Mr. Pickering.

is about 2.62. The hardness is 7, about the same as quartz. It is porous. It is used as a knife-edge for chemical balances and for jewelling ordinary clock pallets and holes, but is scarcely good enough for observatory regulators. The garnet, so-called from the Latin Granatus, seed-like, from the appearance of the spherical crystals embedded in a matrix in which it is found, is composed of lime and magnesia, combined with oxide of iron and manganese and alumina and chromic oxides. Its sp. gr. varies from 3.55 to 4.20. Its hardness is $7\frac{1}{4}$. It is used for jewelling common watches, but soon shows wear.

Attempts have been made for many years to produce precious stones in the laboratory, and in 1877 Fremy and Teil produced some ruby flakes, which were exhibited in the Natural History Museum.

In 1805 red stones having the characters of genuine rubies came from Geneva, and were found to be reconstructed stones, *i.e.*, fragments of real stones melted by the oxy-hydrogen blowpipe and coloured by the addition of potassium bichromate.

In 1904 Verneuil invented the inverted blowpipe and was able to produce synthetic corundum from alumina and obtain the colour of the ruby by the addition of chromic oxide and that of the sapphire by the addition of titanium oxide and magnetic oxide of iron.

They are now made in large quantities and have the same density, hardness and optical characters as the natural stones, and, being much cheaper, are excellent for holes.

Synthetic stones can be distinguished by circular or curved striation and by the presence of minute spherical bubbles in their substance, whereas in the natural stone the striations are straight and any bubbles are elongated in the direction of the striation. The main bulk of holes are made in Switzerland, though some of the factories, like the Waltham in America, make their own.

The Swiss cement the stones on a block and grind them flat by presenting them to a disc charged with diamond powder, driven at a great speed; when sufficiently reduced, they are reversed on the block and the other side ground till of the required thickness. They are then placed in a holder six at a time and held in a slide-rest and drilled from a lathe by a steel wire charged with diamond powder. The objection to this method is that the holes may not be central nor vertical. The sides and oil sinks are turned with a splinter of diamond and the holes opened and polished by means of diamond powder carried on a copper wire.

It requires a good deal of practice to make satisfactory jewel holes, and it is far better to obtain them ready made.

If, however, it is desired to make some holes and an unlimited amount of time and patience is available, there is no reason why they should not be produced in an ordinary workshop.

A copper lap about 2 ins. diameter and ¼ in. thick must be rigged up in a lathe which can be run at a high speed, and charged with coarse diamond powder and paraffin, and the stone ground flat on both sides by holding it against the surface of the lap and moving it about.

Carborundum powder can be used to cut agate and soft stones in place of the diamond powder.

The stones is then cemented to a small brass faceplate with shellac by heating over a spirit lamp and while still hot run true in the lathe by holding a piece of pegwood against it by means of the hand-rest, a centre is then turned with a diamond graver, and the stone drilled with a diamond drill. Diamond gravers and

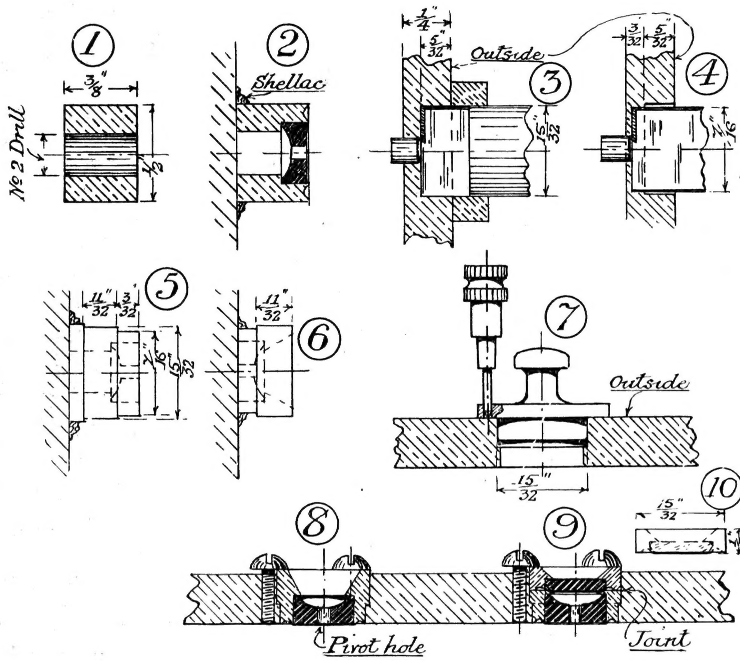


Fig. 2.—Details, mostly in Section, showing the procedure in mounting Jewel-holes and Finished Settings in Sections.

drills are made by drilling a hole in the end of a brass wire and embedding the fragment of diamond in a bed of shellac by heating and allowing it to cool. The hole when made through the stone is enlarged to size with a brass broach charged with diamond powder and polished with finer grades of diamond powder. The oil sink is turned with the diamond graver and polished with a copper wire and powder and the periphery turned true. The stone may then be detached by warming the brass faceplate cleaned from the shellac in spirits of wine, and its surface polished by rubbing it on a ground-glass plate with very fine diamond powder.

Stones can be slit by means of a thin steel circular disc about ½ in. diameter run in the lathe and charged with diamond powder. Where possible, as with small mechanism, jewels should be set with the plate cemented to a chuck and the hole run true in the lathe. A hole is then turned out to a depth corresponding to the thickness of the stone so that it rests in a sink slightly below the surface of the plate, and a circular groove is then turned round it and the metal burnished over it by means of a small conical burnisher. Holes so set are said to be rubbed in as opposed to screwed in; in the latter the hole is set in a brass setting and fitted into a hole in the plate and held by the heads of two or three screws screwed into the plate and pressing on to the rim of the setting to hold it in place as is seen in many watches.

In jewelling a regulator clock, one of two methods may be adopted, either screwed-in countersunk jewel settings as above, or the holes may be set in collets having a flange. The pivot holes in the plates are opened out for these to fit and the flange is drilled and corresponding holes drilled and tapped in the plate for screws to hold them in position. This is a more simple procedure and is quite satisfactory, but the countersunk holes make a more workmanlike job, especially if the screws are also countersunk.

Supposing it is desired to jewel a regulator clock having plates ¼ in. thick; the following method may be adopted or it can be modified to suit existing conditions.

If the clock is already made and the train run in, the jewel holes must be obtained to fit the existing pivots, if not, the holes may be obtained in manufactured ruby or sapphire seven millimetres in diameter by two millimetres thick, with holes for the smaller pivots No. 50 drill wire gauge or No. 35 for the larger pivots, which carry the second, minute and hour hands. If the pivots have not been made they should be turned and polished to fit the jewel holes and the train run in the brass plates, the pivot holes are then opened out to the size of the settings.

To set the holes a length of good brass rod, or, better still, gunmetal rod, is drilled through its centre with No. 2 drill (twist-drill gauge); it is then cut up into the number of pieces required, each being ⅜ in. long. Each piece is fixed to a small brass faceplate—which fits the lathe perfectly true—by heating it and the faceplate in a Bunsen burner or a spirit lamp with a layer of shellac, it is then run true on the lathe by holding a piece of pegwood on the handrest and gently pressing it against the edge of the hole in the brass until the shellac sets. The hole is then enlarged with a small inside tool till the jewel hole fits the cavity and lies a little below the face of the brass. It must be an easy fit and the jewel must not be forced in or it may be cracked. By moistening the sides of the jewel with some shellac dissolved in spirit and replacing it will keep it in its place. A groove is now turned out round the hole to leave a thin wall of brass standing up round it; by applying an agate or steel burnisher this is burnished over the jewel, and, if carefully done, it will be firmly fixed in its setting. If the amount turned over is excessive, it can be removed and cleaned up with a small hand graver. When all the required holes are set the plates must be prepared to receive them.

For the sizes given two counterbores will be required, one 15/32nd in. diameter and the other 7/16th in. The centre pins of each must be of the same size.

The pivot holes in the plate must now be enlarged to the same size as the pin of the counterbore; the plate must be clamped in the drilling machine and a suitable-sized drill for this purpose passed through all the holes.

The larger counter bore, 15/32nd in., is fitted in the drilling machine and must run perfectly true. If the drilling machine has a stop enabling the depth of cut to be limited, it must be set so that the counter bore will cut a hole 5/32nd in. deep;

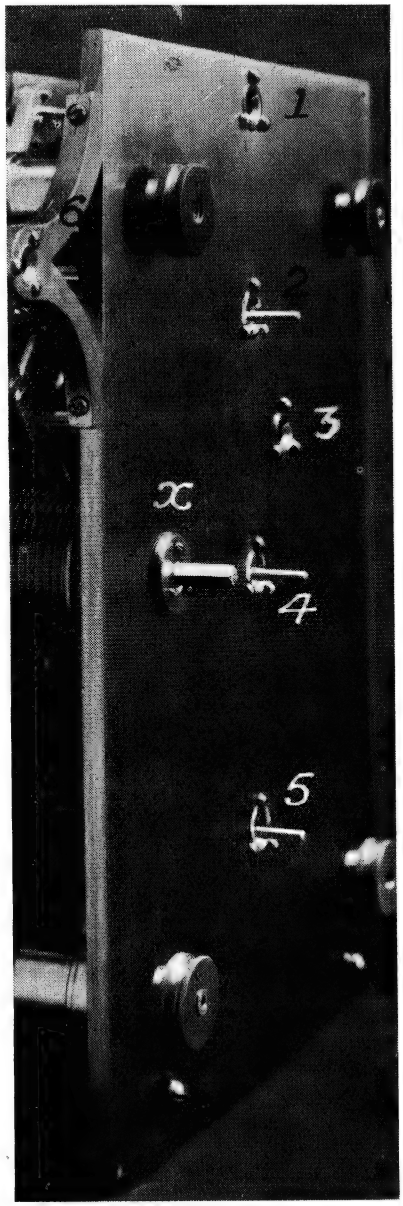


Fig. 1.—View of the Outside of the Front Movement Plate of a Regulator, showing the Disposition of the Jewelled Pivot Holes.

if this is not available a collar must be fitted to the counter bore to attain the same result.

All the holes can now be counter bored to the required depth. It is important to note that it is the under surface of the back plate and the front surface of the front plate which have to face the counter bore in drilling, as the jewel settings are put in from the outside of each plate.

The smaller counter bore is now fitted in the drilling machine, its pin placed in the hole at the bottom of the sink now formed, and the remaining piece cut right out.

By this means there is formed a ledge 5/32nd in. from the outer surface of the plate and 3/32nd in. from the inside of the plate, the back hole being 15/32nd in. in diameter and the inside hole 7/16th in. in diameter.

The bushes in which the jewels have been set have now to be turned to be an exact fit into these spaces. It is best to do this in pairs, starting with the 'scape arbor first, fitting first the back and then the front jewel; by so doing the end shake of each arbor can be properly adjusted.

The bush is again cemented on the faceplate, and while the shellac is hot, run true by holding a pegwood point in the hole; this must run perfectly true before the brass setting is turned or the whole will not be concentric, more especially as in heavy jewels the hole is not in the exact centre of the stone, *i.e.*, the hole is not concentric with the periphery, but the setting must be made so. The setting is now turned down till it fits the small hole in the plate as far as the ledge, *i.e.*, 3/32nd in., and the large end is then turned down till it fits the large hole in the plate. It is then removed from the faceplate and reversed, the end in which the jewel is set being cemented to the plate, run true, and the face turned down sufficiently for it to stand above the plate 1/32nd in., so that the heads of the screws which are to hold it in place may press against it. The hole in the brass may be turned out cone-shaped to within 1/16th in. of the edge, leaving a rim against which the screw heads press.

The setting can be polished with tripole and pith or scratch brush and gilt.

When all have been correctly fitted so that the end shakes of the arbor are correct, the plates must be tapped for the screws.

There are three screws to each setting and they should be made from silver steel, hardened, tempered and polished, and blued. The threads should be small and the heads large to clamp the edge of the setting. Ten B.A. thread with a rounded head 3/16th in. diameter will be suitable.

The plate should be drilled with a No. 55 drill at three equidistant points 1 mm. from the edge of the hole. If drilled too close when tapped the metal will be forced in and the setting will not fit.

It is advisable to make a templet for centre punching the holes by turning up a plug to fit the hole, having a flange in which these equidistant holes are drilled at the correct distance; a centre punch can then be passed through the hole and the plate marked correctly for drilling. This also ensures the screws being arranged symmetrically in line.

Great care is necessary in tapping a plate $\frac{1}{4}$ in. thick 10 B.A. or the tap will break; it is advisable to use a drill rather larger than the standard size and slightly broach out the opposite end of the hole to that at which the tap is entered.

If it is preferred the three screws which hold the setting can also be countersunk in the plate by making a small countersink, the pin of which fits the 10 B.A. hole. In this case the setting is made level with the plate and does not stand above it and a portion of the rim of the setting is cut away for half the diameter of the screw which is made to fit the countersink and turned down level with the plate.

Care must be taken that the setting does not twist round, and it should be fixed when the countersink for the first screw is made and the screw put in before the others are made.

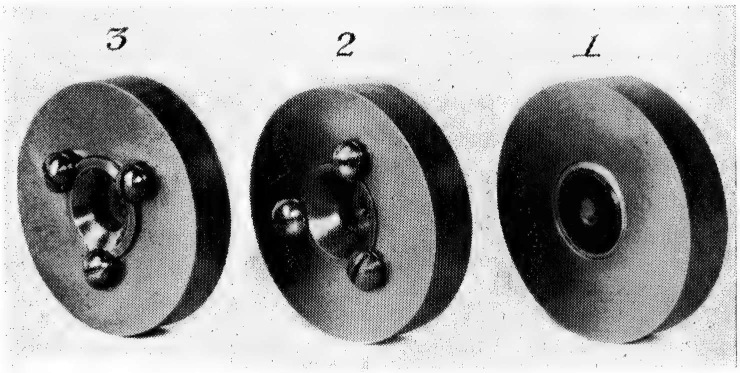


Fig. 4.—Models showing Complete Jewel-hole Settings viewed inside and outside, with and without Endstones.

If endstones are required they are mounted in brass rims turned out in the lathe like the jewel holes and secured to the setting by three small screws or sunk in the setting and held by the same screws which hold the setting. To jewel pallets the anchor is made either in brass or soft steel fitted to the 'scape wheel, then the pads are slotted either by a milling cutter or file and the jewels made to shape, polished and secured in the graver by shellac.

Notes on the Illustrations.

Fig. 1 shows the outside of the front plate of a regulator (*i.e.*, the equivalent of the motion plate of an ordinary long-case clock, but having no motion work), indicating the setting of jewel holes, which are numbered as follows: 1 the pallet arbor, 2 the 'scape arbor, 3 third wheel, 4, centre wheel, and 5 hour wheel, 2, 4 and 5 being lengthened pivots to take the seconds, minute and hour hand collets. No. 6, on a projecting bracket, takes the arbor of a jockey roller, which carries the weight line to the side of the case and which is jewelled. The pivot bush, marked *x*, is a metal hole for the winding arbor, which is not jewelled, being both too large, and subject to a heavily weighted live load. All the jewelling shown is duplicated on the other plate.

Fig. 2, a series of ten scale sketches,

numbered, follow the author's description approximately in order. No. 1 shows, in section, the sizes of the prepared material for the jewelled bush. Turned from ½-in. round brass rod, holed concentrically with No. 2 drill or 7/32nd in. This can be chuck-turned and parted off, but must run true well within a 1/64th in. of error, because it has to clean up to 15/32nd in. on the outside. No. 2 shows the shellac chuck setting, set true to the bore, which is opened out to just take the jewel hole (shown in section dark hatched). An annular groove is indicated on the front, which leaves a circular fin enclosing the jewel, which is bevelled slightly on the corner. This fin is burnished or spun over the bevelled edge of jewel, and thus locks it in.

No. 3 shows the method of opening out the plate on its outside. A 15/32nd-in. counter bore is fitted with an adjustable depth ring, and has a guide point fitting the opened-out pivot hole. This is carried to a depth of 5/32nd in. into the plate, the ring being set to that depth. No. 4 shows the 7/16th-in. counterbore, having the same size guide pin, which is carried on right through the plate, leaving a shoulder in the hole at a distance of 3/32nd in. from the inside of plate.

No. 5 is the same shellac setting as in No. 2, but has probably to be remade, in order to set the hole in jewel, which may not be quite true to its outside, running dead true in lathe. The outside of bush is now turned to conform to the shouldered hole in plate, and must be a nice push-in fit, with the flat face of jewel hole about flush with the inside of plate. No. 6 shows the bush reversed on the shellac chuck, set fairly true, and faced off to stand 1/32nd in. outside the face of plate. The No. 2 or 7/32nd-in. bore is turned out conical, leaving sufficient of the faced edge to take a screw head overhang. This operation could as well be done firmly held in a true s.c. chuck, but care would be necessary to avoid marking or deforming the outside of bush.

No. 7 shows the operation of marking off the plate for the screw holes. The boss of the little brass template must fit the 15/32nd-in. bore of the plate, and be of less depth than 5/32nd in., so not to rest on the shoulder in hole. The stem of punch is about 3/64th in. diameter, and should fit the template hole without appreciable side shake.

No. 8 is a section of a complete jewel hole set to its bush, and secured to the plate by the three screws, which are No. 10 B.A. The screw heads overlapping the edge secure the bush hard up to the shoulder in the plate hole. No. 9 shows a similar section but with the jewel hole bush turned shorter, and fitted on the outside with an endstone. The latter is about the same size as the jewel hole, but is not holed, and is only about a bare 1/16th in. thick. It is fitted to a supplementary bush in the form of a frame 15/32nd in. diameter in the same manner as the other, and goes in the plate hole on to the other bush, and is secured by the screws in the same manner. No. 10 is an elevation of the endstone bush as it appears when taken out.

Fig. 3 is a numbered group of the various fittings taken from a series of models supplied by Mr. Pickering. These will be on view in our shop window at 66, Farringdon Street. They are also available for examination by interested readers who care to call. In this, No. 1 shows the initial bush turned out ready for the insertion of the jewel hole and grooved for the closing-in operation; No. 2 is an agate jewel hole having a dished oil sink at the top. The ruby holes are shallower, made flat at the back and have an oil countersink. No. 3 is a model, in circular form, of a section of a clock plate showing the shouldered bush hole and the tapped screw holes. No. 4 is the complete turned bush fitted with a ruby jewel hole. No. 5 is the template and punch for marking off; and No. 6 one of the screws showing the extra large head. Nos. 7, 8, and 9 have to do with endstone fitting, No. 7 being the shortened bush containing the ruby jewel hole, like No. 4, but turned much shallower; No. 8 the endstone mounted in its bush; and No. 9 an endstone only.

Fig. 4 is a group of some of Mr. Pickering's models, showing at No. 1 the appearance of a set jewel hole viewed on the inside of plate, and No. 2 the same as viewed on the outside. No. 3 is the same as No. 2, but has an endstone fitted which, curiously enough, although a deep ruby colour, shows the jewel hole through as though it were clear glass. In this connection it appears that ruby, being a crystal, admits of the passage of actinic light in spite of its colour, and therefore it *might* not be safe to glaze a dark-room lamp with ruby instead of ruby-coloured glass. But this is a side issue, and only referred to in order to assure the reader that an endstone is really there.

It would be interesting to know from Mr. Pickering how endstones are fitted in relation to end shake of the arbors, and whether it is advisable to so adjust them that the pivot end comes against them before the pivot shoulder touches the inside of jewel. Also, under what conditions endstones are fitted in this manner.

Royal Air Force Aircraft Apprentices.

600 Vacancies for Educated Boys.

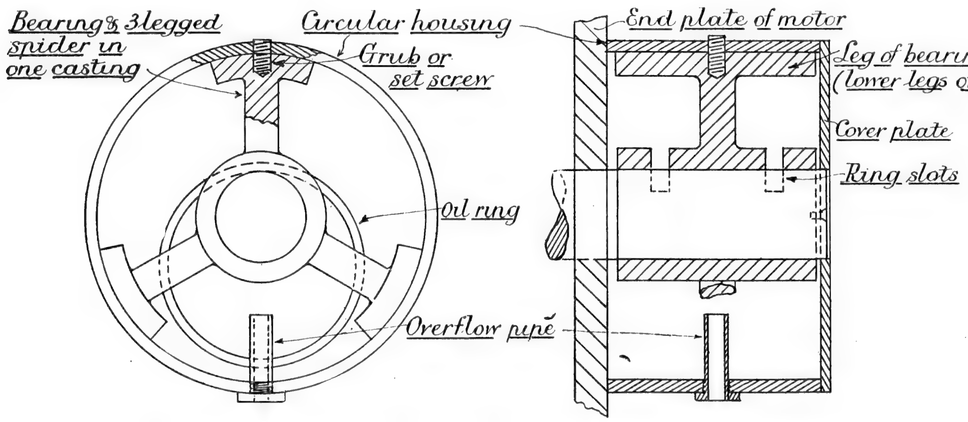
The Air Ministry announces that 600 aircraft apprentices, between the ages of 15 and 17, are required by the Royal Air Force for entry into the Schools of Technical Training at Halton, Bucks, and at Cranwell, near Sleaford, Lincs. They will be enlisted as the result of an open competition and of a limited competition, which will be held in the near future by the Civil Service Commissioners and the Air Ministry respectively. Successful candidates will be required to complete a period of twelve years' regular Air Force service from the age of 18, in addition to the training period. At the age of 30 they may return to civil life or may be permitted to re-engage to complete time for pension. Full information regarding the dates of the respective examinations, the methods of entry, and the aircraft apprentice scheme generally, can be obtained upon application to the Royal Air Force (Aircraft Apprentices Department), Gwydyr House, Whitehall, London, S.W.1. The sons of officers, warrant officers and senior N.C.O.'s of the three services will receive special consideration.

A Simple Ring Oiler Bearing for 1-h.p. Motor.

By William Duncan.

The article on a built-up A. C. motor by Mr. A. H. Avery has prompted me to write about this bearing. In the motor referred to ball bearings are specified, and, of course, they will be quite satisfactory, but prone to roaring, which may be disagreeable in a job which might otherwise be practically silent. Ring oiler bearings are silent and require very little attention; their disadvantage in this case is purely a constructional one. They generally need cast housings with complicated cored cavities; they are also difficult to machine. There was an article on these bearings in THE MODEL ENGINEER some years ago, but I do not think this particular type was described, in fact, I do not remember coming across it except in the case of an old electric motor of ½ h.p. to which I once did some repairs. I was rather taken with the idea at the time, and made a mental note of it, as located the spider, and an overflow pipe at the bottom prevented too much oil being put in. There were two circular openings, closed by brass plugs on short chains, near the top of the housing, one each side of the upper leg of the spider. These served for inspection, and for the introduction of oil.

If I were making a bearing on these lines for a motor such as Mr. Avery's, the housing would be of steel tube. This would need to be bored parallel, and the ends faced square. The end-plate of the motor would need a short spigot turning a good fit for this. The outer cover-plate would hold the housing in position by means of long bolts or studs which would be screwed into the motor end-plate. These could pass outside the housing tube, or if appearances were considered they might be contrived to pass inside the housing, though care would be needed



Part Sectional End and Side Elevation of Ring Oiler Bearing for A.C. Motor.

it struck me that it would be very simple to make, requiring only lathe operations on simple castings, or it might even be built-up, thus dispensing with the latter.

The diagrams explain how the bearing was constructed on the motor which I repaired. The circular housing and the end-plate of the motor were in one casting, this was machined with a spigot to register in the field magnet casting, and the bearing housing was bored parallel. This, with the exception of a few screw holes, represented all the machining of the end-plates. The bearing itself and the three-legged spider were cast in one, in gunmetal. The appearance was not unlike a tripolar armature. The bearing had been bored, then driven on a mandrel and the spider turned to make it a fairly tight fit in the housing. The ring slots were cut, two to each bearing as shown. The rings themselves were prevented from jumping out of the slots by pieces of wire, shaped like staples, soldered across the top of the slots.

When in position, a grub-screw at the top to see that they did not foul the oil rings. A paper washer and gold size would be needed at each end of the housing tube to secure an oil-tight joint.

The actual bearing could be a casting, as on the original, though I should prefer to build it up from steel pieces, brazing them together, and then use a separate phosphor-bronze bush pressed into the centre piece, suitably pinned to prevent it turning and putting the slots out of register. The clearance holes to accommodate the shaft in the end-plate and cover would be bell-mouthed inwards, and suitable oil throwers pressed on to the shaft itself to prevent creeping.

Concrete Railway Goods Wagons.

The first concrete railway goods wagon has just been completed at the Temple Mills works of the L.N.E.R. The sides, floor, and roof of the wagon are composed of concrete reinforced with steel rods, the whole body being mounted upon a standard steel underframe.

The PRACTICAL ELECTRICIAN
LIGHTING·POWER·MAINTENANCE·REPAIRS

Modern Electrical Installation Work.

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

Lead-Covered Wiring.

IN this system the vulcanised rubber conductors are provided with a sheathing of special lead alloy. This system is more suitable for surface wiring than otherwise, although a good deal of it is used for sunk work. The sheathing is intended to be the mechanical protection to the V.I.R. conductor—but wherever run under the surface some additional protection such as steel tube should be provided.

The conductors used may be single core, which is of circular section, twin, or three-core, the two last being flat or oval. Generally, for interior wiring work, the conductors are of non-Association class, although the Association grades are obtainable from any of the C.M.A. manufacturers.

Jointing and Bonding.

As "looping-in" from point to point would not be practicable in this system as it is in conduit wiring, it is necessary to join the conductors by means of china connectors, these being housed either in junction boxes which are specially made for this purpose, or, alternatively, in the recess at the back of the wood block on which is fixed the ceiling rose, switch or plug. In this latter case tinned brass bonding rings are used which are recessed in the back of the block, their purpose being to bond together the metal sheathing of each conductor entering or leaving, this sheathing being ultimately "earthed," as in the case of steel conduit. For meeting the case of a number of lead-covered conductors entering or leaving an ordinary wood-framed distribution board, a "bonding strip" is used, which consists of two narrow metal plates fixed together at intervals, the conductors being held by their sheathings in the spaces between the fixing screws.

Fixing the Conductors.

The lead-covered conductors may be fixed on the surface of the wall or ceiling or may be run along the joists between ceiling and floor. Frequently they are run under plaster work, and, *if* such a course *must* be followed, they should be protected from mechanical injury by being run in either welded or brazed steel tube. As an alternative to this some cable makers supply a protective steel covering which is placed over the conductors and fixed at the sides by means of screws.

When ready to fix the conductors, the first step is to mark out the run with a chalk or pencil and then along this fix at intervals of about 12 ins. the special tinned brass clips which are provided for this purpose by Henley's and the other leading cable makers who run lead-covered wiring systems.

Bending the Conductors.

Bends should never be made too quickly nor too sharp. Preferably, a bend should be as "easy" a one as the circumstances will permit, and when finished should show no sign of the lead sheathing "crushing in" on the inside of the curve. It is best made by holding the conductor with both hands and working it round with the ball of the thumb.

To Remove the Sheathing.

It should be nicked with a penknife completely round the circumference, when it will be found that a slight bending to and fro will cause it to break and thus it can be drawn off from the tape of the conductor and without any injury to the latter.

The Bonding Wire System.

With a view to simplifying the bonding together of the lead sheathing of the various lengths of conductor, most of the cable manufacturers now supply an alternative pattern of lead-covered conductor in single, twin or triple, having a tinned copper bonding wire laid immediately under the lead sheathing and therefore in contact with it throughout its entire length. This enables one to dispense with the various bonding clamps which would otherwise be required. To preserve the continuity of the bonding wire a tee or other junction box is provided with a brass pillar in the centre carrying a nut and washer, so that the bonding wires from two or more conductors can there be joined together, the conductor wires being still joined as usual by china connectors.

While possessing obvious advantages, special care must be taken in this system to be sure that no accidental nicking or cutting of the bonding wire occurs—which would, of course, be fatal to its success.

Amongst the best-known lead-covered wiring systems may be mentioned:—

Henley's (W. T. Henley's Telegraph Works Co., Ltd).
"Kaleeco" (Callenders).
Helsby (British Insulated Cables, Ltd.).
J. & P. (Johnson & Phillips, Ltd.).
"Magnet" (The General Electric Co., Ltd.).

Generally, it may be stated that all these systems differ from one another only in the patterns and details of the accessories used.

To ensure the success of any lead-covered wiring system, it is essential to observe at least all the following points:—

1. *Don't* fix conductors by means of nails or wire staples, use the proper clips.

2. *Don't* run conductors along the floor, in the angle formed by the wall and the floor, unless they are protected by being drawn into pipe.

3. *Don't* think you can do a lead-covered wiring job and do without the various accessories such as junction boxes, bonding rings, etc.—they are all essential to a proper job.

4. *Don't* drag lead-covered conductors over rough brickwork or any rough surface.

5. *Don't* use from a coil, always keep the conductor on a drum—makers supply these without extra charge.

6. *Don't* forget when wiring a building in carcase condition that the plasterer will come along with his trowel—an excellent instrument for injuring soft lead sheathings—protect the conductors with temporary wrappings of canvas or paper.

7. *Don't* forget that inefficient bonding or earthing causes many failures.

The Earthing of Metal Work.

One of the most important points to which the installation man must give his attention is the earthing of the exposed metal work of his job. This, of course, specially applies to every job carried out either in metal conduit or in any metal-cased wire system. The reason for this is that unless earthing is properly attended to grave risk of shock to the person becomes possible, to say nothing of increased fire risk.

So important is the matter that it is made a special feature in:—

The Regulations of the Institution of Electrical Engineers;
The Regulations of the Home Office governing the use of electricity in factories;
The Regulations of the various County Councils covering the use of electricity for lighting and for power work in theatres and cinemas, etc.

Unfortunately, installation men whose training and experience are not as good as one could wish, are liable to make, and *do* make, blunders in connection with earthing from which very serious results may follow. As an example, one has frequently seen a piece of 1/.044 or even a piece of 1/.036 bell wire put in to form the main earth conductor for a large cinema. Sometimes such a wire is twisted loosely round the *overflow pipe of a lavatory flushing tank*, this being assumed to be quite all right as a main earth. Each of such points as these is quite sufficient to render the "supposed" earthing perfectly useless.

Before any earthing is attempted, *make sure* that all conduit work or metal-cased wiring is metallically continuous throughout, remembering always that it is a very simple matter for discontinuity to occur, even in a screwed pipe system, particularly, of course, if you are using wood cased distribution boards, or switches mounted on wood blocks. At such places see that you bond across from the conduit or the metal-cased wire on the one side to the conduit or metal-cased wire on the other.

How to Earth.

First see that you have electrical continuity throughout the conduit work, or, if the job be done in metal-cased wire, then through the sheathing of this. Care must be taken not to forget any iron-clad distribution boards, switches or fuses or any other metal-clad accessories or parts. Some engineers insist on the earthing of the actual electric light fittings where these are of metal and also tumbler switch covers, and in the writer's opinion such a course is a most desirable one. Continuity having been assured and proved by a simple bell and battery test, next settle on your main earthing conductor. The Regulations of the Institution of Electrical Engineers provide that this shall have a minimum size of 7/.0045 sq. in., which is equivalent to a 7/.029, but otherwise the section must be not less than half of that of the largest conductor contained in the conduit. The earth wire must be of high conductivity tinned copper. In any case, it should be of ample size, over rather than under the size given by the I.E.E. regulations.

Where to Earth.

Preferably as near as you can to where the supply enters the building, and no matter what be the source of supply. Should the job be of considerable size it may be desirable to earth at more than one point, in which case bond the two or more earthing conductors together, by means of a copper conductor of equal section.

Let the Main Earthing Conductor be Visible.

Don't, for instance, bury it under plaster work or floor boards or yet put it up in the roof.

Although visible and readily get-at-able, don't let it be exposed to interference, therefore where within reach it should be protected against mechanical damage by being put into tube or a wood casing.

Don't leave the earthing conductor loose or only partially fixed. Pay as much attention to proper fixing of this as you would to the fixing of any other part of your work.

Earth to be Used.

Usually, the earthing conductor is connected to the "live" water main which supplies the premises, this forming an excellent earth, low in resistance, and permanent in character. Some supply authorities request that the installation man should earth on to the armouring of their incoming service cable. This, of course, *can* be done, but the writer would prefer the former method. It must be remembered that the I.E.E. Regulations (No. 101) note that "the armouring of cables cannot in all cases be relied upon for the purpose of earthing." In certain places other and equally good "earths" may be found, as, for example, a lake, river, or dock. In such cases an earth plate will require to be provided in order that the necessary area of contact may be obtained.

(*To be continued.*)

Electrical Questions and Answers.

(Mainly Selected from Recent City and Guilds Examination Papers.)

25. Q.—Why are quick make-and-break tumbler switches sometimes used in preference to those which are quick-break only?

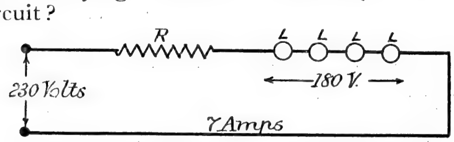
A.—The necessity for tumbler switches which are of quick-make action as well as being quick break has arisen from the introduction of the gas-filled type of metal filament lamp. The resistance of any metal filament lamp is obviously greater when it is cold than when hot, but the presence of the cold gas which surrounds the filament naturally tends to prevent that filament from heating up as rapidly as in the case of a vacuum lamp. It is therefore necessary that at the instant of switching on there should be a full and good contact to withstand the momentary extra surge of current which then occurs, otherwise burning or heating of the contacts of the switch must inevitably occur, resulting in its early destruction.

26. Q.—Why are you told to use resin only as a flux when soldering joints in electrical conductors? Name three other fluxes with which you are familiar and mention a use for each.

A.—Resin is chosen as a flux in soldering joints for the reason that it is non-corrosive and does not cause injury either to the conductor or to its insulation. (It is worthy of note that in the City Guilds practical examinations only resin or at least a mixture formed of resin dissolved in methylated spirit has been permitted.)

Other fluxes used are: (*a*) Resin dissolved in methylated spirit as mentioned or resin with Neat's foot oil, these being permissible for electrical or other work. (*b*) "Killed spirits," that is, hydrochloric acid in which some zinc has been dissolved, is used as a flux for soldering copper, tin, iron, zinc, etc. (*c*) Tallow is used as a flux in lead joints where plumbers' solder is being used, as, for example, in wiping a joint between the lead sheathing of a cable and a brass gland, or in wiping a lead sleeve over a joint in a lead-covered cable.

27. Q.—A circuit consists of four 45-volt lamps in series, taking 7 amperes, and it is fed at 230 volts. What will be the value in ohms of the steadying resistance necessary for this circuit?



Running 45-volt Lamps on 230-volt Circuit.

A.—The total pressure required by the lamps will be: $45 \times 4 = 180$ volts, so that $(230 - 180) = 50$ volts must be absorbed by the resistance, R. From Ohm's Law we have:

$$\text{ohms} = \frac{\text{volts (drop)}}{\text{amperes}} = \frac{50}{7} = 7.14 \text{ ohms.}$$

A Combined Lampholder and Plug.

The "Xtra-Point" lampholder and plug illustrated below has recently been placed on the market by Messrs. W. E. Beardsall & Co., Ltd., 5, Victoria Bridge, Manchester, who are the sole selling agents for this exceptionally useful electric fitting. The sample before us is

The "Xtra-Point Lampholder.

designed to carry 5 amperes. In most domestic electric installations a limited number of wall plugs are provided, from which an extra and temporary supply of current can be taken for such things as vacuum cleaners, irons, bowl fires, bedwarmers, toasters and other table apparatus. But if, in addition to these fixed points, every lighting point can also take a plug for running either apparatus or extra lamp, the convenience, let alone the absence of expense, are matters worth considering. The illustration shows the idea, and it only remains to say that this double-purpose lampholder is well made, the cord-lock—the arrangement for attaching the flexible to the holder—being particularly strong and neat. The holder has other noteworthy features, as the user will soon find out for himself, but which need not be enumerated here. Contractors, retailers, and individual users will, however, be supplied with any further particulars on applying to Messrs. Beardsall, at the address above.

Lantern Lectures for Scientific Societies.

We are informed by the Business Company, 100, Victoria Street, London, S.W.1, that they have arranged to hire out a powerful sharp-focusing series of lanterns suitable for the largest lecture-halls or the smallest. A qualified operator is supplied to show lecturer's slides. They also have available several technical series of lantern slides which may be hired with lecturer, at moderate rates, with or without lantern. The subject matter includes the Kearney High-Speed Tube Railway, Evolution of Road and Rail Transport, London Omnibuses and Trams and Light Railways, the latter including views on the Kent and East Sussex, Nidd Valley, Sand Hutton (18-in. gauge), Ravenglass and Eskdale, and other railways. New items are frequently added.

The "Model Engineer" "1500" Three-Valve Receiving Set.

By H. J. Barton Chapple,
Wh.Sch., B.Sc. (Hons.), A.C.G.I., D.I.C., A.M.I.E.E.

IN designing this special three-valve receiver for THE MODEL ENGINEER, I have been guided in my efforts by certain outstanding points. First of all, I learn that this marks the re-entry of this journal into the set constructional field after an interval of many years. Then, again, such a large section of the readers are quite skilled mechanics and delight in taking a pride in their handiwork. With these two points uppermost in my mind I felt that it was not only necessary to present to the readers a set which for performance and appearance would give every satisfaction, but one which would justify completely the decision of your Editor to adopt this course.

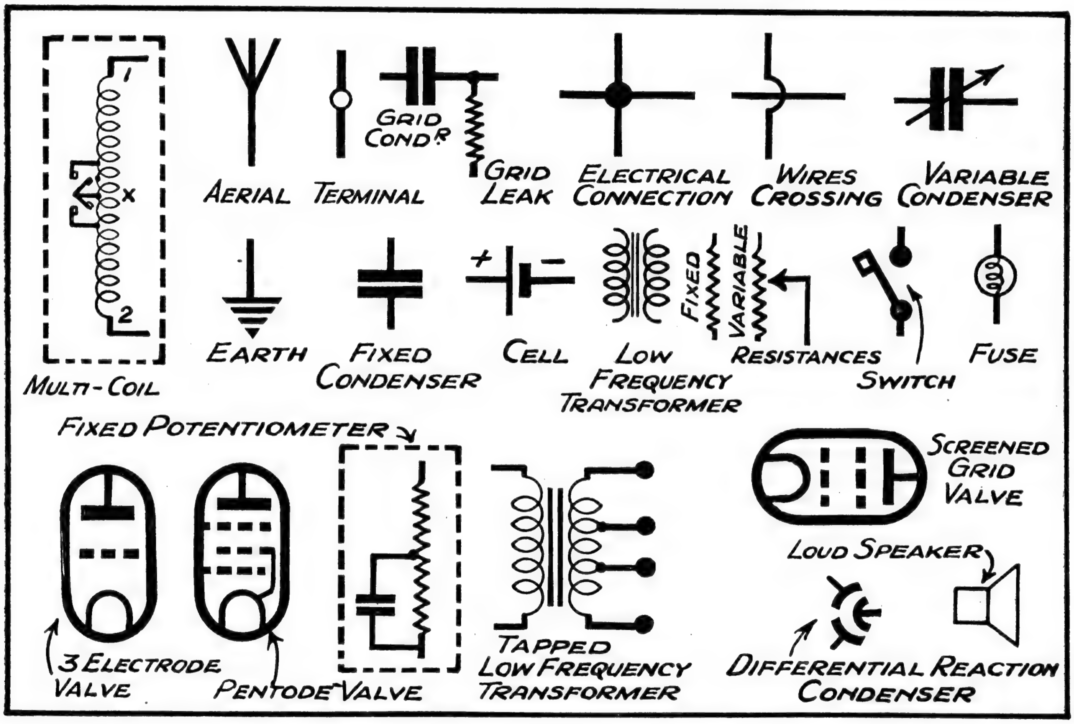


Fig. 1.—Showing Symbols used to indicate Various Components in the "1500" Set.

Important Features.

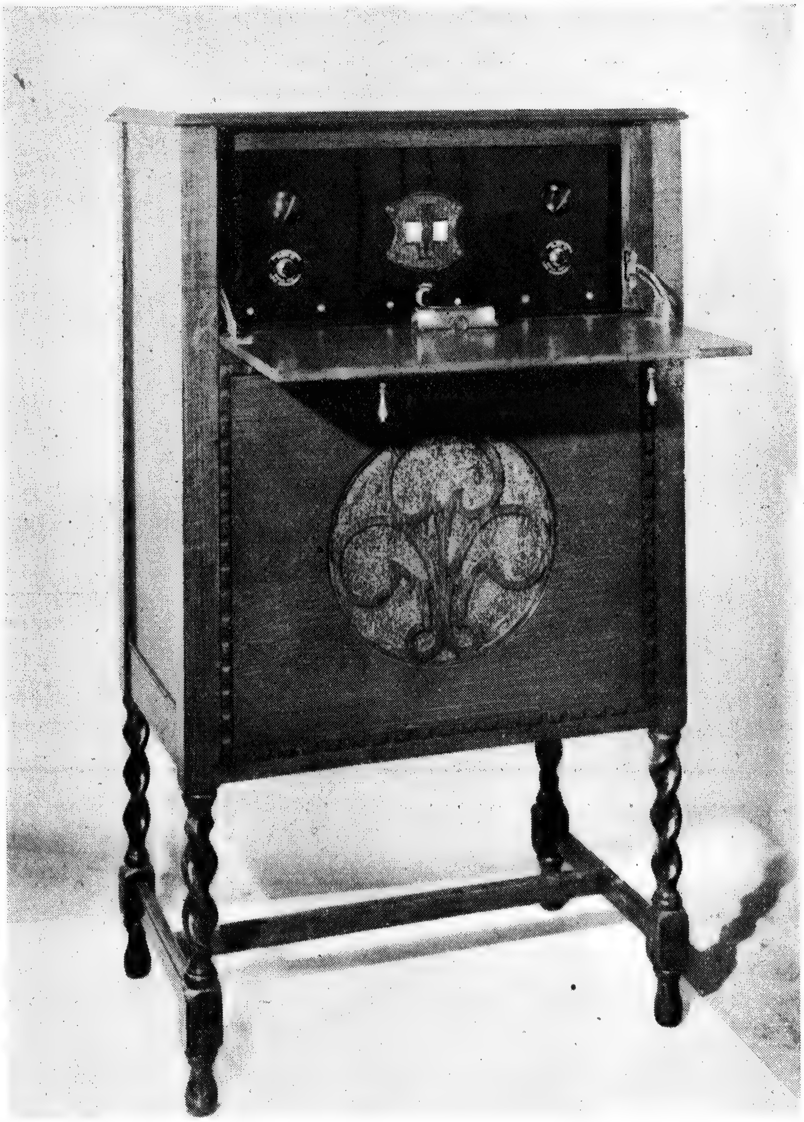
The keynotes for the set were therefore summed up into three salient features, namely, (*a*) an ability to secure the all-important alternative programmes; (*b*) musical reproduction of a first-class order; and (*c*) an ability to reach out to the Continent and satisfy one's curiosity as to what types of transmission are occurring in countries beyond our shores.

Once the full details of this MODEL ENGINEER set have been given to readers, I am sure that they will agree that the points mentioned have been fulfilled with a margin to spare. Three valves were chosen, for that represents a combination capable of giving many alternatives to the local broadcasting programme which can be listened to in comfort on the loud-speaker. To satisfy the bulk of the demands of the potential constructors, such important details as ease of control, simple range changing from high to low wavelengths, the provision of volume and reaction adjustments, high-class reproduction, adequate selectivity for the modern conditions of high-powered stations, good sensitivity and pleasing appearance are all embraced in this receiver.

The Components Required.

All the components have been chosen with care so that they will work together with the greatest efficiency, hence it would be invidious to single out any one item and say the success of the set depends entirely upon the performance of this component. It will be advisable, however, to follow all the working instructions and constructional details with care, for a great deal of time and thought has been spent in laying out the set and reducing the wiring to the shortest possible paths.

The complete list of all the components used in the actual receiver photographed and described will be found in tabular form, so that



"The 'Model Engineer' 1500" 3-Valve Receiving Set.

(Specially designed by Mr. H. J. Barton Chapple, Wh.Sc., B.Sc., to commemorate the **1,500th** *issue of "THE MODEL ENGINEER").*

The construction of this absolutely up-to-date set is now being described in our pages. The opening instalment appears this week (pp. 156-159) and the remaining articles will appear in our issues of February 20th and 27th. Blue prints will be available : see next week's issue for particulars.

EVERY READER SHOULD MAKE THIS SET.

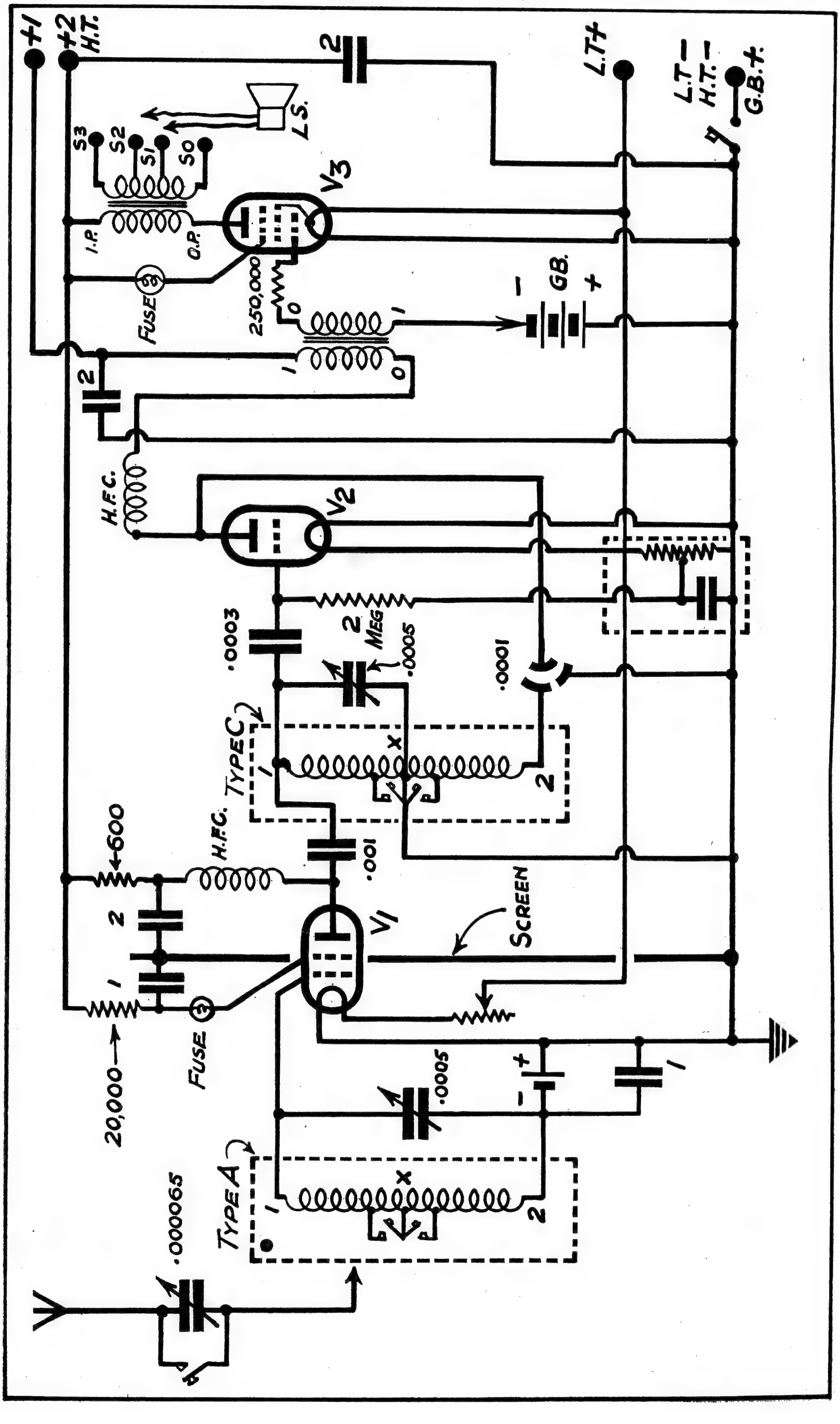


FIG. 2.—THE CIRCUIT FOR THE "MODEL ENGINEER" "1500" THREE-VALVE RECEIVING SET.

you can start at once to acquire them in readiness for the full working instructions which will follow next week. If desired, the reader can include items of other make in his own receiver, but he is warned only to choose components from makers of repute, and also make sure that sufficient room has been allowed in the set to accommodate any different-sized components.

Theoretical Representation.

Let us make a careful examination of the theoretical circuit of Fig. 2, and learn all the important details, for in this way the reader will become acquainted with certain aspects of the set which he is liable to overlook if he embarked on its construction immediately. As a guide for those who are not thoroughly familiar with the usual theoretical symbols for the different wireless components, a list is included so that you can visualise each item and trace out the circuit easier. This is an advantage, for wherever you see any particular symbol illustrated, the necessary part for the receiver can be found.

Tracing the Circuit.

The tuned circuits are made up from two multi-coils tuned by a pair of drum-drive control condensers. These coils maintain a permanent centre tap on both long and short windings, a special incorporated switch effecting the wavelength range change. In addition, the windings are so positioned that magnetic field interaction is eliminated between the separate portions of the same coil. The lead-in from the aerial is joined to a small variable condenser so that various degrees of selectivity can be obtained according to conditions of environment and proximity to stations.

Since occasions arise, however, when this condenser may be conveniently cut out of circuit, say for example, when using a short indoor aerial, or where selectivity is not of supreme importance, a baseboard short-circuiting switch is joined in parallel with the condenser as shown diagrammatically. Provision is made for connecting this condenser either to terminals 1 or X of the multi-coil, and the reason for this will be made plain when the operating instructions are dealt with.

Screened Grid H.F. Stage.

There is a screened-grid valve in the high-frequency stage, and every precaution has been taken to ensure its efficient operation. Notice the inclusion of a small $1\frac{1}{2}$-volt bias cell in the grid circuit of this valve, arranged to apply a negative bias. This is important, for without it tuning is apt to be broad, and it will be more difficult to tune out a powerful interfering station owing to the grid current which flows. Furthermore, the plate current is reduced by having it in circuit. For a volume control a rheostat has been joined in the positive filament lead of the valve. This is also a safeguard against valves that exhibit a tendency to oscillate, for the resistance can be adjusted to prevent this.

In addition, should there be any difficulty met with in selectivity problems, when once the desired station has been tuned in at full volume, reduce the strength by adjusting the filament resistance and then increase the reaction. This will restore the volume to its previous magnitude but any objectionable background due to neighbouring transmissions will vanish or be reduced considerably.

Passing to the Detector Valve.

The signals that have been amplified in the high-frequency valve are forced to take the path through the .001 mfd. coupling condenser to the tuned circuit in the grid of the detector valve owing to the presence of the high-frequency choke (H.F.C.). The choke used in this position must be specially designed for use in the plate circuit of the screened-grid valve, and have characteristics differing from those of the high-frequency choke in the plate circuit of the detector valve.

Reaction control is provided by a .0001 mfd. differential reaction condenser working in conjunction with the detector valve high-frequency choke and the reaction winding of the type C multi-coil. It is found generally that this gives a somewhat smoother working for this reaction adjustment. To still further overcome sudden or "floppy" reaction which evidences itself by having to move the reaction knob several degrees backward before reaction ceases, with consequent loss in volume, a fixed potentiometer has been included. This is a refinement which is well worth while and brings about an easier control.

The Low-frequency Coupling.

After the signals have been rectified by the detector valve V_2, they are passed on to the valve V_3 by means of a low-frequency transformer coupling. A fixed resistance of 250,000 ohms is connected between the secondary terminal of the low-frequency transformer and the grid of the last valve, which, in this particular set, is a pentode valve. This assists in preventing any high-frequency energy passing through the low-frequency amplifying stage and causing distortion and other unwanted effects. In conjunction with the pentode valve I have used a special output transformer so that the full advantage obtainable from a power valve of this class may be secured. It can be used with any make of pentode valve and any type of loud-speaker since there are four step-down ratios provided.

There are certain other points about the set which call for explanation, but these will be held over until next week, when, in addition, the constructional work will be dealt with.

(To be continued.)

The Components Required.

One oak cabinet with baseboard 10 ins. deep (see article) (W. & T. Locke, Ltd.).

One Ebonart panel 18 ins. by 7 ins. by $\frac{1}{4}$ in. (Redfern's Rubber Works, Ltd.).

One dual drum vernier dial complete with two .0005 condensers (Garnett, Whiteley and Co., Ltd.).

Two multi-coils, type A and type C (A. F. Bulgin & Co.).

One .0001 differential reaction condenser (Burne-Jones & Co., Ltd.).

One binocular high-frequency choke (L. McMichael & Co., Ltd.).

One standard high-frequency choke (Burne-Jones & Co., Ltd.).

Two anti-phonic valve-holders and one universal valve-holder (Whiteley Boneham & Co., Ltd.).

One .000065 baseboard mounting balancing condenser (A. F. Bulgin & Co.).

One 20,000 ohm wirewound resistance with holder (Radio Instruments, Ltd.).

Three 2 mfd. condensers, type BB (Dubilier Condenser Co. (1925), Ltd.).

Two 1 mfd. condenser, type BB (Dubilier Condenser Co. (1925), Ltd.).

One .001 mfd. mica condenser, type 620 (Dubilier Condenser Co. (1925), Ltd.).

One .0003 mfd. mica condenser, type 610 (Dubilier Condenser Co. (1925), Ltd.).

One fixed potentiometer (London Electric Wire Co., Ltd.).

One panel-mounting push-pull switch (A. F. Bulgin & Co.).

One baseboard push-pull switch (A. F. Bulgin and Co.).

One panel-mounting 30-ohm rheostat (Igranic Electric Co., Ltd.)

One 2 megohm Dumetohm resistance (Dubilier Condenser Co. (1925), Ltd.).

One 250,000-ohm Dumetohm resistance with holder (Dubilier Condenser Co. (1925), Ltd.).

Two single fuseholders complete with low-consumption bulbs (A. F. Bulgin and Co.).

One low-frequency transformer, type J, 3 to 1 ratio (Igranic Electric Co., Ltd.).

One "Pentamu" output transformer (Radio Instruments, Ltd.).

One 600-ohm decoupling resistance (A. F. Bulgin & Co.).

Nine insulated terminals, type B, marked H.T.+1, H.T.+2, L.T.+, L.T.–, L.S.+, L.S.–, G.B.–, Aerial, Earth (Belling & Lee, Ltd.).

Two safety connectors for S.G. valve anodes (Belling & Lee, Ltd).

Two spade terminals marked L.T.– and L.T.+ (Belling & Lee, Ltd.).

Five Wander Plugs, horizontal entry, marked H.T.+1, H.T.+2, H.T.–, G.B.–, G.B.+ (Belling & Lee, Ltd.).

One seven-way multiple battery cord (A. F. Bulgin & Co.).

One single-cell G.B. battery clip No. 6 (A. F. Bulgin & Co.).

Two treble capacity 60-volt H.T. batteries and one 18-volt G.B. battery (Ripaults, Ltd.).

One sixty-ampere-hour accumulator, type B.W.6 (Edison Swan Electric Co., Ltd.).

Four packets yellow Glazite (London Electric wire Co.).

Two 6-in. extension handles with 3/16th-in. sleeves (A. F. Bulgin & Co.).

One Automatic station log (A. F. Bulgin and Co.).

One aluminium screen (see article) (Burne-Jones, Ltd.).

One loud-speaker (see article) (Whiteley Boneham & Co., Ltd.).

Three valves: screened grid, detector and pentode (see article)

Sundries: screws, soldering tags, red and black flex, rubber-covered flex, 1½-volt cell (type U.W.1), Ebonart terminal strip, 9½ ins. by ¾ in. by ¼ in., crocodile clip.

Exhibition of Scientific Instruments.

The Physical Society and the Optical Society: New Section for Apprentices and Learners.

THE Twentieth Annual Exhibition of Scientific Instruments and Apparatus by the Physical Society and the Optical Society was held at the Imperial College of Science and Technology, South Kensington, London, during January 7, 8 and 9. Admission on the first two days was, as usual, by ticket only, but on the third day tickets were not required. These exhibitions are of remarkably interesting character, lectures are also given, and there is a section devoted to Research and Experiment. No charge is made either for tickets or admission, the affair being a private show. The next exhibition will, presumably, be early in January of 1931, readers interested should note this, and apply for a ticket towards the end of the coming December.

Apprentices' and Learners' Competition.

A special feature of the exhibition which has just been held was a section for apprentices and learners. It included examples of craftsmanship and designs, drawings and tracings of scientific instruments. Classification was by age, entries being accepted in two grades: A under 18 years of age, B over 18 but under 21 years of age on January 1, 1930. Four prizes were allotted for craftsmanship: grade A first £3, second £1 10s.; grade B first £5, second £2 10s. Prizes for drawings: grade A first £3, second £1 10s.; grade B first £5, second £2 10s. The exhibits sent in by the competitors both in articles of craftsmanship and in drawings were of a high standard; they were an excellent show. We understand that this section is to be continued; we commend it to the notice of apprentices and learners engaged in scientific instrument-making and optical work. Particulars can be obtained by writing to the Secretary of the Physical Society and the Optical Society, 1, Lowther Gardens, Exhibition Road, London, S.W.7. "A simple example which will reveal the degree of skill of the competitor will be preferred to complex apparatus. It is not intended to accept exhibits composed merely of assembled components which are not the work of the individual competitor. No entry fees will be charged to individual competitors." Here is an opportunity for apprentices and learners to obtain a prize and have their work displayed before a discriminating and very special class of visitors in an exhibition of high and specialised character.

The Exhibition in General.

With regard to the exhibition in general, it comprised an extensive show of trade firms, including some of the very latest and advanced instruments and apparatus, with demonstrations in many instances. Also, a section demonstrating research and experiment of absorbing interest not only from a purely scientific stand-point but in application to industry and commercial manufacturing. Experiments revealing marvellous advance in scientific research and interesting lecture and educational apparatus from various technical institutions.

Photographing the Unseen.

By the use of ultra violet light it is possible, with the aid of a microscope, to search for objects which are so small that they cannot be seen even with the highest practicable magnifying powers of lenses. The short wave-length of ultra violet light, however, enables photographs to be taken, through quartz lenses, of these extra minute objects. Adjustment for focus of the lenses is so delicate that, we are informed, only two microscopes have been made capable of effecting this, and they cost £600 each. Dr. L. C. Martin and Mr. B. K. Johnson have, however, solved the problem by the simple method of applying an adjustable weight to the stage of a microscope of usual construction. The adjustment is effected by actual deflection of the stage as the weight is altered in amount. Their arrangement was exhibited, the effect of the movement of the stage being demonstrated by the optical colour bands known as Newton's rings. The weight consists of a glass vessel containing mercury, the quantity of which can be varied by raising or lowering an independent reservoir which connects to the weight vessel by means of a flexible tube. We are indebted to Mr. B. K. Johnson for a very interesting demonstration.

Engineering Appliances.

Amongst these were spring-testing machines for tension and compression. Krupp's patent Mikrostat gauges measuring 1/25,000th of an inch and applicable to work of large diameter, and a Durometer for measuring the hardness of indiarubber and other pliable materials. These were exhibited by Coats Machine Tool Co., Ltd., 14, Palmer Street, London, S.W.

Models.

There was considerable evidence of the utility of models for demonstration purposes; the research laboratories of the Gramophone Co., Ltd. (H.M.V.), and the Marconiphone Co., Ltd., exhibited by models a method of reproducing physically the conditions in record grooves of any desired type. The groove model was constructed of brass laminæ so that it could be accurately set to show reproduced sound waves of any character; there were also various models showing points of needles and the effect of wear resulting from traversing the groove in a record. The models of both grooves and needles were to a size 400 times larger than the actual thing, the shapes were obtained by optical magnification. A converse of this was the model of a transmission tower testing plant shown by the research laboratories of the General Electric Co., Ltd. It was to a scale of 1/16th in. to 1 ft., and represented an outdoor method of applying actual horizontal and vertical stresses to lattice towers used for supporting overhead electrical power transmission lines. Some of these towers are 100 ft. in height. The model showed a tower under test with all the gear in position, the stress towers used to balance the applied loads, and the instrument cabin. Photographs showing towers which had collapsed under test were also shown.

Lectures.

Several lectures of a scientific nature were given; that by Mr. S. G. Brown, F.R.S., on "Gyro Compasses for Gun-Fire Control," was of absorbing interest, though highly technical. It revealed the various intricate conditions which obtain and have to be met in the use of gyro compasses for navigational purposes and which are probably unsuspected by ordinary observers.

Lighting of Machinery.

The difficulty of adequately and efficiently lighting machines used in fine work will be appreciated by mechanics and operators engaged in precision practice. The research laboratories of the General Electric Co. exhibited an electric spot welding machine in which the illuminating lamp was built in as an integral part of the machine. It was a 6-volt 12-watt headlamp run off an additional winding on the welding transformer and directed its rays by a parabolic reflector close to the place where the welding electrode was applied to the work. The system is termed "Built-in Lighting Equipment," and the idea is that it might be applicable to various kinds of machines. The lighting unit is removable when required. The idea is worth consideration and application where brilliant illumination of a cutting tool or operation is required.

Electricity at Your Service.

Power Station Efficiencies.

In his Presidential address to the British Association meeting at Johannesburg, Professor F. C. Lea pointed out that the average overall thermo-dynamic efficiency of British electric power stations was 15 per cent., the best having an efficiency of 21.3 per cent., but a power unit recently supplied to Chicago by a British firm gave on test an efficiency of 34 per cent.

Electricity in Agriculture.

Eighteen per cent. of the power used in agriculture in the State of California (U.S.A.) is furnished by work animals, and, of the remainder, electro-motors furnish 42 per cent. at an average cost of 9 cents (4½d.) per h.p.-hour. It is reported that the farmers who employ electricity agree that it materially reduces the working costs of a farm.

Models Employed in the Shannon Power Scheme.

Before deciding upon the design of the great Shannon Power Works, which are now coming into operation, a series of experiments with models was carried out at the hydraulic laboratory of the Technical High School, Berlin, under the auspices of Professor Dr. Ing. Ludin. The experiments resulted in the selection of an arrangement of four deep sluices each nearly 33 ft. wide and of two shallow sluices, each about 60 ft. wide. The power house at Ardnecrusha is a reinforced concrete building with six corresponding openings to admit the water, but at present three only are being utilised, for three Francis turbines, with vertical shafts direct-coupled to generators running at 150 r.p.m. These generators will develop about 90,000 horse-power.

SHOPS SHED & ROAD

A Column of "Live Steam."

By "L.B.S.C."

The Third "Baby" Arrives.

Well, brother loco men, I've shot a solemn resolution all to bits. No; *not* in a speakeasy, friend "Inquisitive." After the completion of gauge-o "Minnehaha," which was built a couple of years ago for Mr. Joe Lozier, notice of motion was given, and the motion itself duly proposed, seconded and carried unanimously, that there wouldn't be any more gauge-o locomotives turned out by this child. The violent crop of headaches and troubles with eye-strain which the building of that little locomotive brought to me, was enough to break the heart of an angel—and I'm sure a long way off that category—at the time of writing, anyway! The evolution of the successful $2\frac{1}{2}$-in. gauge Westinghouse pump was a bit of a teaser, too, but it was a quicker job and didn't "prolong the agony," in a manner of speaking, so we managed to survive making a few of them at odd intervals. I refused plenty of orders for duplicates of "Sir Morris" and "Minny," and told all and sundry that I wouldn't build another o-gauger even for Lord Bermondsey or the Duke of Barking Creek. But, alas! for good resolutions. Whether the shocking rough trip across the Atlantic (and will Mr. Neptune kindly inform the p.-way ganger in his division that the track between Southampton and New York *badly* needs relaying) had anything to do with it, or whether American air suits me better, I just can't guess; but I haven't had a trace of a headache since we landed, thank goodness for small mercies. That being so, when a worthy friend wanted a gauge-o locomotive ("just the last one, and no more," said he), I fell for it and started in to build her. At the time of writing, she is well on the way to taking the road on the new N.L.R.R.

Oil-fired this Time.

"Sir Morris" burned coal, "Minnehaha" was fed on poison-gas (or rather, the stuff which generated it), but the latest arrival will be fired by a little kerosene torch, or vaporising burner. She is a pretty good size for a "baby," and is a fairly correct copy of the New York Central "Hudson" type 4—6—4, similar to the engine in the American Express Company's window in the Haymarket, London. The leading truck is cut from $\frac{1}{8}$-in. steel plate and runs on wheels 13/16th in. diameter, solid pattern. Main frames are also cut from $\frac{1}{8}$-in. steel plate, and are shaped exactly as full-size American bar frames, but have brass axleboxes and spiral springs, and six-coupled driving wheels $1\frac{3}{4}$ ins. diameter. The trailing truck sides are bronze castings; the big engine has a booster, so the wheels are of unequal size, and "Josie" has one pair 13/16th in. and one pair $1\frac{1}{8}$ in. diameter, the latter being turned from a hunk of cold-rolled steel bar as no castings were available at the time. The cylinders are practically the same as "Sir Morris" and "Minny," but are bolted to a heavy smokebox saddle instead of direct to frame, and the whole assembly is mounted up on the frames similar to big

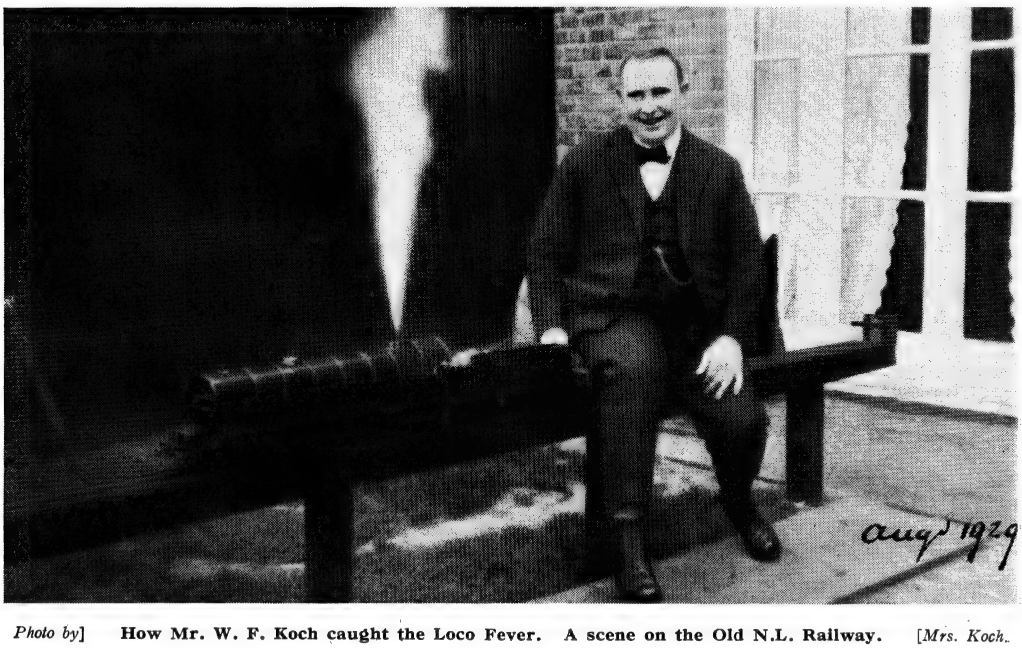


Photo by] **How Mr. W. F. Koch caught the Loco Fever. A scene on the Old N.L. Railway.** [*Mrs. Koch.*

American practice. "Sir Morris" had eccentrics, "Minny" had Baker gear, and "Josie" has Walschaerts for the sake of variety. Valve travel is nearly 3/16th in.; she cuts off at roughly 70 per cent. in full gear, and can, of course, be notched up like "big sister."

As the boiler is oil-fired, it was made on the water-tube system at the request of the future owner; however, as the grate space is no less than $3\frac{1}{2}$ ins. long and $2\frac{1}{2}$ ins. wide (as big as many $2\frac{1}{2}$-in. gauge engines) on account of it being over the four-wheel trailing truck, it would make an ideal type of engine to have a regular coal-fired locomotive-type boiler. The present boiler is 12 ins. long with a 2-in. diameter barrel. Feed is by a simple hand pump in the tender, as the boiler holds a good drop of water and only requires feeding at intervals. The burner is a variation of the axle-dodger type described in back notes and in my book, and the fittings and trimmings are practically the same as on "Minnehaha."

As soon as track tests are through, Mr. Calvert Holt has promised to take a photo of her for these notes, and if anybody would like to build a replica, will give the necessary sketches and a few hints and tips. She should be more powerful than "Sir Morris," as she carries 25 lbs. higher steam pressure and has a larger and heavier boiler. She should go around a 10-ft. circle if the leading end of the frame is filed to clear the front truck wheels, and the rear truck pivoted forward of the smaller pair of wheels so that the whole issue can swing bodily over like a Bissell truck. The drawbar is attached to the rear end of the trailing truck frame and coupled to the leading tender truck, so it doesn't matter a bean how much overhang there is, within reason, as the engine rear bumper-bar and tender sill are entirely free of each other and move quite independently.

She is a fairly simple job to build, the only ticklish places in the erecting being the steam and exhaust pipes, as connections have to be made inside the saddle. As this is only a shade over $\frac{5}{8}$ in. wide, there isn't much room to play about in, as you may guess; and if any brother loco man has a shot at building a copy of "Josie" and gets into difficulties at this point, I guess he'd better buy a box of candy or chocolates and try the effect of "bribery and corruption" on those members of his family who have the most delicate fingers. More about young "Josie" later, if all's well.

A Shock for the "Abortionists."

I saw an incident a little while ago, common enough in America, but which in Great Britain would give forty-odd fits to those poor misguided folk who dress up a bundle of wires in the shape of a steam locomotive and think the result magnificent; yet, if a steam loco-fan put a boiler and a pair of cylinders inside an electric locomotive's working costume, lynching would be too good for him, in their estimation. Well, just where the New York, New Haven and Hartford electric tracks join the New York Central, near Mount Vernon, there is a flyover junction, visible from the roadway. The former road uses overhead wires and A.C., and the latter third rail and D.C., the motors on the locomotives and trains being arranged for either system. As the old tin Lizzie hove in sight of the junction, I saw a New Haven train headed by one of the latest type electric locomotives just approaching the flyover. She eased up as she crossed the bridge and left the overhead wires, dropped her trolley (pantagraph type) and *started blowing off*; just like friend Irvin's engine would when he shuts off over the fly-over at Finsbury Park on one of the up morning rush-hour trains from High Barnet to Moorgate.

Poor old "abortionists"—wouldn't they just open their eyes wide and think that the order of things had been reversed!! But the explanation is very simple. The train was a "through" express which had been brought to the motive-power change-over point by a steam locomotive, to be hauled thence to New York by an electric. All the trains are steam-heated, and naturally the travelling public don't want to freeze for the sake of keeping the district around New York City free from locomotive smoke and ashes; so all the electric locomotives are fitted with an oil-fired boiler for the purpose of keeping the cars warm. The safety valve is on top of the cab, and does its duty in regulation style. But it sure looks peculiar to see some of the electric locomotives at the change-over, waiting to take their trains into the city, and occasionally popping off as if to show their steam sisters that they, too, can make a noise in the world when occasion arises. Also, it does much to dispel that "dead-as-ditchwater" atmosphere usually inseparable from electric stock. Another one of the "little things that matter!"

How to Fit the Averill Cylinders to the Chassis.

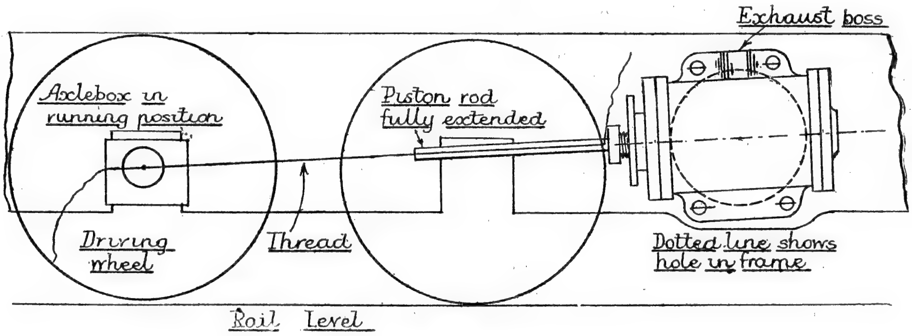
This is a simple enough job and doesn't require any of the apparatus usually employed on setting-up and lining-up operations. I use just a big toolmaker's cramp and a bit of string or cotton, that's all. The first operation is to set up the driving axleboxes to running position, and this can be done by screwing up the nuts holding the axlebox springs so as to get plenty of tension on them, and then jamming a piece of metal the requisite thickness between the bottom of the axlebox and the hornstay or pedestal tie. The pull of the spring will hold it tight enough to stay put. Tip: *aways* set the axleboxes to running position when fitting side or main rods, valve gear rods or connections, axle feed pumps or any other blobs and gadgets which derive motion from, or work with, the wheels of the locomotive when on the track. Beginners especially take heed, and you'll save bags of trouble and much heart-burning. When at Norbury I had a job sent me from a place eight thousand miles away; the builder had erected it with the axleboxes at the bottom of the slots, and when he put it on the track he said it "went all pooey," so therefore fooled around for six weeks or so trying to correct it. As the axleboxes in running position stood a good 3/16th in. off the hornstays, it didn't need a Sherlock Holmes to locate the cause of the "pooeyness," and a few hours' work put things in shipshape order. Just before we left England, I had a letter from our worthy brother and he said the engine was doing well.

Next take the two cylinders off the Averill steam-chest, and set the latter in the frames, with the spigots projecting through the big circular holes. Don't spring the frame to enter the spigots or you may give it a permanent set, which isn't desirable, but loose off one side from the buffer-beam. Now replace one cylinder, set it so that the piston-rod lines up by eye with the centre of the driving axle, and put the clamp on to hold it in position. Pull out the piston-rod as far as it will go; hold a piece of string or cotton back up against the cylinder cover, and stretch out tightly so that it lies directly above and parallel with the centre of the piston-rod. If the cotton also crosses the centre of the driving axle, the position of the cylinder is correct; if not, shift it till you get that result. Tighten up the toolmaker's clamp so that the cylinder will not accidentally shift, and then, with a No. 30 drill in a small handbrace, make four countersinks in the frame, using the holes in the cylinder bolting-face as jig. If by any chance you have managed to get the holes set so that the drill will not enter straight, use a bent scriber and carefully mark off the position of the holes with that, carefully centre-popping heavily after the cylinder is removed from frame. Repeat the process with the other cylinder; then take the steam-chest out of the frame, and drill the whole lot of holes with No. 30 drill; a block of wood jammed between frames will prevent any distortion. Clean off the burrs with a file, or a much larger drill used as a countersink will do the necessary. Replace the steam-chest, and line up the tapped holes in it with the drilled holes in the frame. The cylinders can then be placed in correct position, and the screws put in. The latter do not have to withstand the back thrust of the piston as with the usual type of cylinder. Their only job is to keep the assembly together and prevent it turning. Back thrust is taken up by the spigot of port face which enters the steam-chest, and the stress is transferred direct to frames by steam-chest spigots. The cylinders can be removed at any time without disturbing pipe connections, etc., by simply taking out the four screws and disconnecting the main driving rod by pulling out the crosshead or gudgeon-pin.

Guide-bars, Crossheads and Brackets or Yokes—

Suitable for these cylinders can be made according to the sizes given on the "Fayette" blue-prints; and if thus, will be suitable for our little shunting engine. Guide-bars can be cut from 3/16th-in. square silver-steel rod (drill rod) and filed up to shape, or may be just plain bars of 3/16th in. by ⅛ in., bevelled off at the ends to clear connecting or main rods. Although many full-sized railroads now use the Laird type of guides and crosshead, and others use a box crosshead with single bar, I plump unhesitatingly for the wide-spaced double bars and alligator crosshead in small work. They are easiest to make, stand up fine to stress and wear (and accidents!) and look "the real goods."

Crossheads when made single-sided with a large-headed pin, the head of which is sunk in a pin-drilled recess in the back of the block, are quite satisfactory for engines up to 3½-in. gauge. If, however, anybody wants a correct double crosshead with bearings back and front, the deep recess for the little end can (in the absence of a proper milling-machine) be cut with a slot-drill running at good speed in the three-jaw or drill chuck, the slot being formed in the end of a piece of steel bar of suitable cross-section, clamped to the tool block of the lathe and traversed across the cutter. The small piece of steel containing the slot is cut off afterwards and machined up to form the crosshead. Alternatively, the centre part can be made in the shape of a plain fork, formed by filing or milling; the top and bottom shoes are filed up from scraps of steel, tied on with a bit of iron binding wire, and finally brazed in position, using ordinary soft brass wire as a jointing medium instead of spelter. Leave the turning until after brazing is through; and then, if the job comes out O.K. and no apple-pie or almond-rock about it, set it up in our old friend the independent four-jaw chuck and turn the bosses for the piston-rods. I have already given bags of instructions how to fit crossheads so they *really do* support the piston-rod (in 95 per cent. of the commercial engines I have repaired the opposite was the case—crosshead "fitted where it touched," and not always then—makers please note) so need not repeat, save to emphasise that a correct-fitting sharp drill be used to push through the gland and stuffing-box when making the correct location of the hole in the piston-rod boss. Guide yokes can be filed from steel plate, to "Fayette" drawings, or any other shape desired; all you need is a file, hacksaw, and patience. Next, valve gears.



How to Line Up Averill Cylinders.

A New Italian Ship Model Testing Tank.

A magnificently equipped tank for the trial of models of ship hulls was completed in Rome in 1929 by the Italian Government. The tank is 900 ft. long, 41 ft. wide and 20 ft. deep, and the main carriage is designed for a maximum speed of nearly 40 ft. per second. The model shaping machine in the workshop attached to the tank will take a model 26 ft. in length.

Model Aeronautics.

Model Aeroplane Propellers.

By W. E. Evans (S.M.A.E.)

AIRSCREWS screw their way through the air like a wood-screw when turned moves through a piece of wood ; but, as air is not a solid, it gives considerably against the pressure of a propeller blade, which causes the propeller to have a marked percentage of slip. That is to say, if a propeller is designed theoretically to travel 100 ft. forward in 100 revolutions, the actual distance traversed may be only 75 or 80 ft. Allowance for slip must, therefore, be made in designing a model propeller for a given performance. This percentage of slip may be kept fairly low by skilful design combined with correct relation between thrust area and resistance of the machine. The success or failure of a flying model depends more upon the suitability of the propeller than many people imagine. A propeller should be correctly designed, well carved and properly balanced to give the best possible results. Bent wood propellers were almost universally in use many years ago, but are now generally discarded as being crude, and aero-dynamically inefficient. They are, therefore, omitted from this article.

Metal Propellers.

Metal propellers, I believe, will soon supersede the carved wood propellers for efficiency. As I have not yet had an opportunity of carrying out a series of tests with these, the subject of metal propellers must be left for a future occasion. But so far as my observation goes I am of opinion that because metal propeller blades can be much thinner than wood blades, the resistance is less, revolutions are greater and therefore the forward speed and static thrust is greater for the same power applied.

Designing a Propeller.

The propeller of a model aeroplane should be the final part of the complete machine to be designed and made because there are important factors to be considered, and they are—the wing-loading and the resistance of the model at various speeds. These cannot be accurately ascertained from drawings as the materials required cannot be accurately weighed, and, therefore, the wing-loading cannot be known, although this may be fairly well estimated by an experienced builder. Having finished the model excepting propeller, we can find the wing loading by weighing the model and adding the weight of a suitable propeller and measuring the area of the plane; then, by rule of proportion, we obtain the number of ozs. per square foot of lifting surface. Suppose a model weighs 12 ozs. and has a wing area of 2 sq. ft., the loading is 6 ozs. per sq. ft.

Flying speeds, that is cruising speeds where a model flies a horizontal course, vary as the square root of loading. Opposite is a useful table of cruising speeds in miles per hour and feet per minute for various loadings from 4 to 8 ozs.

Then there is hardly anything known at present about the resistance, or drag, of model aeroplanes, and herein lies an important field for experiment by aero-modellists, a suitable group of whom would be the Research Committee of the Society of Model Aeronautical Engineers. For the present we must be content with the bald statement that it is necessary for a propeller to give a static thrust of at least one-quarter the weight of the model, *i.e.*, a machine weighing 12 ozs. must have a propeller which will give a static thrust of 3 ozs. at the number of revolutions at which it should fly the model.

Static Thrust.

As a member of the Research Committee of the S.M.A.E., I have tested about fifty model aeroplane propellers, all of 10 ins. diameter, to get comparable results. The apparatus for carrying out these tests was exhibited on the stand of S.M.A.E. at THE MODEL ENGINEER Exhibition, 1929, so will not be described here, but a feature of the apparatus is complete absence of friction owing to the motor and revolution indicator, in fact, everything except the scale for reading the number of ozs. thrust being suspended by fine wires. Some important results were obtained. Firstly, it was established that when the number of revolutions were increased 50 per cent., the static thrust increased 70 per cent. or more. Similarly, when the revolutions were doubled, the static thrust was increased by 170 per cent. Therefore, although a propeller may not fly a model at the usual number of revolutions, it will do so if the revolutions are increased sufficiently. But, of course, duration will be sacrificed to attain this end. Secondly, the static thrust of 10-in. propellers of good design and medium pitch is approximately $1\frac{3}{4}$ ozs. at 1,000 revolutions per minute. Therefore, this size propeller cannot be expected to fly a model weighing 8 ozs. or more at that speed. At 1,500 revolutions the thrust rises to 3 ozs., but this is faster than the majority of propellers are driven. The maximum thrust at 2,500 revolutions is over 7 ozs. This is the result of the maximum output of motor, but graphs indicate that at a still greater number of revolutions the static thrust would still increase at the same rate as before up to an unknown point.

Loading.	Miles per hour.	Feet per min.
4 ozs.	12.0	1,056
$4\frac{1}{2}$,,	12.7	1,122
5 ,,	13.4	1,152
$5\frac{1}{2}$,,	14.1	1,212
6 ,,	14.7	1,296
$6\frac{1}{2}$,,	15.3	1,344
7 ,,	15.9	1,398
$7\frac{1}{2}$,,	16.4	1,446
8 ,,	17.0	1,494

Blade Width and Diameter.

Thirdly, the best results so far as static thrust is concerned are obtained if the blade width is kept to medium proportions, being neither narrow nor wide. The best width for a propeller of 10 ins. diameter was found to be

1 3/16th ins. Above and below this width the static thrust fell off. This was determined by gradually reducing a wide blade to a narrow blade.

Weight of Propeller.

The weight of a propeller should also be taken into consideration, which few except the ultra light-weight model builders do.

However, the inexperienced model flyer should not start off with a light-weight propeller because he will probably very soon break it, for reasons which need not be gone into here. But an impression prevails that a heavy propeller has a flywheel effect which helps to keep up its speed. This is a fallacy. Any model engineer knows that the heavier the flywheel the more power required to drive it at a constant speed. The same applies to propellers, and consequently a light propeller requires less power to drive it than does a heavy one. What really happens is when the power is shut off a heavy propeller will continue to run for a little longer time than a light one, which is no advantage.

The weight of the 12-in. propeller to be described later was exactly ½ oz., the minimum weight allowed by the rules of the static thrust competition. It was made of walnut wood, laminated.

Shapes of Blades.

Many designs of propellers have been tested on the "Thrustometer," as it has been aptly named by the Harrow Scientific Society, but none has given such good results as the old Chauviere pattern. This type has been superseded by more symmetrical designs in full-sized work owing to the unequal stresses imposed upon it at high speeds and constant danger of distortion and fracture. But this matters little in model work, as the blades are strong enough to resist all strains imposed on them in actual flying. A symmetrical design is frequently met with on commercial model aeroplanes, the chief reason being its immunity from breakage with rough landings in the hands of those who have never handled a model aeroplane before.

(To be concluded.)

Society of Model Aeronautical Engineers.

The Annual General Meeting was held at the Y.M.C.A., Tottenham Court Road, London, on Tuesday, January 28, when the following officers were elected for the year: President, Air Vice-Marshal Sir W. Sefton Brancker, K.C.B., A.F.C.; Vice-Presidents, Dr. A. P. Thurston, D.Sc., F.R.Ae.S., M.I.A.E., M.I.M.E., and R. M. Balston, Esq.; Chairman, A. F. Houlberg, Esq.; Vice-Chairmen, W. E. Evans, Esq., and R. Langley, Esq.; Hon. Secretary, S. G. Mullins, 72, Westminster Avenue, Thornton Heath; Hon. Treasurer, W. E. Evans, 20, Thurlby Road, Wembley; Competition Secretary, S. H. Crouch, 23, Mayfair Avenue, Ilford; Technical Secretary, R. N. Bullock, 76, Boyne Road, Lewisham; Councillors, Messrs. S. R. Badley, J. E. Pelly Fry, J. van Hattum, S. C. Hersom, B. K. Johnson, H. E. Onion, D. A. Pavely, W. J. Plater.

Meetings to be held on the following dates at the Y.M.C.A., Tottenham Court Road, W.C., were arranged: Tuesdays, February 18, March 4 and 18. All meetings commence at 7.30 p.m., and full particulars will be published shortly. The meetings are free to all members of the S.M.A.E., affiliated clubs, and anyone interested in model aviation wil be heartily welcomed.

Visits.—Following the very successful visits to the factories of the Desoutter Aircraft Co. and Messrs. Hawker recently, a further outing has been arranged for March 1, when Dr. A. P. Thurston will conduct a party over the aeronautical section of the Science Museum, South Kensington (South Kensington Station, District Railway). There will be no charge, but members of the S.M.A.E. or affiliated clubs who wish to join this party should notify the hon. secretary by post-card as soon as possible. The place of meeting will be the entrance to the Science Museum, and the time 3 p.m.

Hon. Secretary, S. G. Mullins, 72, Westminster Avenue, Thornton Heath, Surrey.

The Model Aircraft Club.
(T.M.A.C.)

The flying season of The Model Aircraft Club will begin on Saturday, March 1, at 2.30 p.m., on Wimbledon Common (near the Windmill), when a grand display of flying models will be held, including petrol, compressed air, rubber driven, heavy and light models. All members should make a special effort to be present.

Will all members of T.M.A.C., provincial or otherwise, make a note in their diaries that the first Saturday in the month is booked for competitions and displays under T.M.A.C. rules during 1930. Rules and full particulars of meetings will be published at an early date.

All communications should be addressed to the Hon. Secretary, A. E. Jones, 48, Narcissus Road, West Hampstead, N.W.6 ('Phone, Hampstead 8363).

The Model Aircraft Construction Society.

Our first meeting took place on January 9. The following resolutions were adopted:—

(*a*) The aims and objects in view comprise a scientific study of the problems of flight in the least expensive way.

(*b*) Officers elected: Gliding Instructor, Mr. F. Granger; Hon. Secretary, Mr. F. A. Lowe; Hon. Treasurer, Mr. H. Worrell; Committee, Captain Narbeth and Mr. P. Reynolds.

(*c*) Subscription would be nominal for working expenses only, any expenses incurred with full-size gliding will be footed separately, also prizes for model competitions.

(*d*) A generous offer of a complete biplane glider, "The Linnet," was readily accepted under the conditions presented by the donors, Messrs. Granger Bros.; the glider is a single-seater fuselage biplane, with wings mounted high.

(*e*) As it is desired only to increase membership with really enthusiastic presonnel, all newcomers must be voted into the Society; further, the Society will not seek recourse to any form of advertising, the only publications in future will be a monthly report of our activities to The Model Engineer and the S.M.A.E. journal.

(*f*) A private gliding and model flying ground has been secured; our first meeting in full force will take place on Easter Saturday.

(*g*) The question of affiliating to other Societies is being considered.

Hon. Secretary, Francis A. Lowe, 24, Bramcote Road, Beeston, Notts.

QUERIES and REPLIES

Querists must comply with the Conditions and Rules given with the Query Coupon in the Advertisement Page of each issue.

Selections from Queries recently replied to.

3534. Electrical and Scientific Instrument Makers.—W. W. (Cape Town, South Africa).

Q.—As a reader of THE MODEL ENGINEER since 1901, I shall be glad if you will let me have the addresses of the following firms: (1) The Universal Electric Supply Co. (at one time Manchester); (2) Messrs. W. Watson & Sons (scientific instrument-makers); (3) Cambridge Scientific Instrument Makers; (4) Messrs. Ambrecht, Nelson & Co. (suppliers of radio-active substances, at one time of 71, 73, Duke Street, Grosvenor Square, London, W.

A.—We append the required information:—(1) Now, Voltalite, Ltd., 4, Frederick Road, Pendleton, Manchester; (2) 313, High Holborn, London, W.C.1; (3) Cambridge Instrument Co., Ltd., 45, Grosvenor Place, London, S.W.1; (4) now, A. Nelson & Co., 73, Duke Street, London, W.

3489. Electric Heating Apparatus.—W. McL. (Nossend).

Q.—Could you tell me where I could obtain resistance wire for electric heaters, also price and quantity required for same working on 240 to 250 volts 25 cycles at about 2-3 amperes.

A.—A kind of wire much used for electric heaters is nickel chrome. It can be obtained from the London Electric Wire Co. and Smiths, Ltd., Anchor Works, Playhouse Yard, Golden Lane, London, E.C.; possibly the Economic Electric Co. could supply this or a similar kind. You will have to experiment. We suggest about 14 yards of this wire, No. 28 gauge, for a trial to take a current of about 2 amperes. The construction of electric heating appliances is a section of electrical work requiring experiment and experience.

3488. Fitting Engine and Boiler in Metal Hull.—R. W. (Gillingham).

Q.—What is the usual way of fixing engines and boilers to a metal hull boat? I have recently had a model tramp steamer given to me, and wish to finish it off in the most practical way. The boat is roughly 5 ft. in length and 1 ft. beam, and is built-up of sheet zinc.

A.—We suggest that you solder brass blocks or cross bearers to the inside of the hull and drill holes in these first which can be tapped to receive holding screws or left plain to receive bolts, according to the arrangement adopted. If the engine is not provided with holding-down lugs, these can be attached to the base. The boiler might be held by thin brass straps passing around it and provided with means of attachment to the holding-down pieces; it might rest in hardwood blocks. Thoroughly wash the joints between brass and zinc and paint over them to guard against electrolytic action. Sometimes the entire plant of engine and boiler is mounted upon a base of sheet metal and this arranged to attach to holding blocks or bearers by screws or bolts so that the whole plant can be lifted out. Experiment first with soldering blocks on to a piece of sheet zinc. Our book, "Machinery for Model Steamers," price 6d., post free, may interest you.

3486. Wire for Medical Coil.—G. B. (Norwich).

Q.—I am making a 4-volt medical coil. Will you tell me the S.W.G. for the primary winding, also necessary quantity of enclosed sample for the secondary winding?

A.—The wire you send is approximately No. 37 gauge double silk covered copper wire. The quantity will depend upon the dimensions of the coil. A description of a medical shocking coil is given in Chapter 3 of our book "Induction Coils for Amateurs," price 10d., post free. This coil takes about 16 ozs. of wire in the secondary winding. The primary winding consists of about 4 to 5 ozs. of No. 20 gauge D.C.C. copper wire. A condenser is not required and should not be used, it would cause the shock given to be too violent. Your No. 37 gauge wire will serve quite well for a secondary winding. There is no particular quantity, within limits of reasonable proportion, the greater the number of turns of wire in the secondary the more powerful will be the shock effect.

3535. Fayette.—L. E. V. (Tooting).

Q.—I cannot quite understand the dimensions given for the clearance radius for bogie wheels in the main frames. Please explain how the $1\frac{5}{8}$ ins. given on the drawing is arrived at.

A.—In reply to your query *re* clearance radius for bogie wheels in the main frame, and your statement that the $1\frac{5}{8}$ ins. figure given is wrong; we think that if you set out the dimensions correctly the distance question will come out to $1\frac{5}{8}$ ins. as near as possible, and the radius 1 1/16th ins. also must be adhered to, to give a safe working clearance. You have evidently come to a wrong conclusion by assuming that the centre of the radius is level with the bottom of the frame, but this is not so. This centre is actually 9/32nd in. *below* the bottom of the frame, the top of the 1 1/16th-in. radius being 1 7/32nd in. from the top of the frame. This is found from the position of the bolt holes for the cylinder, the centre line through which is also the centre line through the driving wheels, and which dimension it will be seen works out at 1 5/16th ins. from the top of the frame. Owing to the wheels being sprung this fixed wheel centre does not exist.

3536. Fayette.—L. H. W. (Birmingham).

Q.—I am building Fayette, and, knowing very little about it, cannot understand the following: Inside length of valve chests 1 5/16th ins. Overall length of valve buckle $\frac{7}{8}$ in. + two $\frac{1}{8}$-in. bosses = $1\frac{1}{5}$ ins., leaving maximum available space for travel of $\frac{1}{4}$ in., whereas the valve, being $\frac{7}{8}$ in., requires to travel at least $\frac{3}{8}$ in. to open ports at all at either end of stroke. Also, Baker gear only gives $\frac{1}{4}$ in travel, so ports do not open at all. Would it be satisfactory to reduce lap from $\frac{1}{8}$ in. to 1/32nd in., making valve 11/16th in.? It would the open ports with $\frac{1}{4}$-in. travel. If there are any other readers in this district (South Birmingham) who are building Fayette (or any other type), I should be very grateful if you could put me in touch with them.

A.—In reply to your query in connection with the valve travel of Fayette cylinder valves, we think that if you adhere to the drawings, the valve travel in *full gear* will come out just under $\frac{3}{8}$ in. We would not advise you to reduce the lap to 1/32nd in., as this would give a very late cut-off, and the engine would use an enormous amount of steam even when linked up. With regard to the question of inside length of the valve chest, this is correct, but the valve spindle guides should only screw in about half the thickness of the valve chest, that is, the screwed part of the guide should only be about $\frac{1}{8}$ in. long whereas the drawing shows them cross hatched the full thickness of the chest. This, of course, allows the bosses of the valve buckles to partly enter the tapped holes in the chest at each end of the stroke. We would advise you to look up the articles on Baker valve gear in THE MODEL ENGINEER dated July 5 and 19, also August 2 and 9, 1928.

PRACTICAL LETTERS from OUR READERS

Building Rotor for "The Model Engineer" A.C. 1 h.p. Motor.

DEAR SIR,—In your issue of January 30 I notice a suggestion from one of your readers for building up the rotor of the 1 h.p. A.C. motor for which I contributed some notes recently. This method of brazing the rotor bars to a copper ring, either internally or externally, is never likely to result in such a sound electrical job as the way described in the original article. It is admittedly easier, but all who are out to make a really good job of the motor should beware of making any modifications of this nature, even though they may be easier to carry out. The performance characteristics of a squirrel-cage induction motor are so inseparably bound up with the question of rotor resistance that one has to be extremely careful over the question of "joint resistance" between rotor bars and end rings. If the maker of the motor in question should not feel competent to braze up his rotor with the bars through the end rings, the best alternative is to mill a 3/16th-in. slot across the two ends of each rotor bar to a depth of $\frac{3}{4}$ in. and drive copper end rings into these slots, brazing up the lot solidly afterwards. To render the method described by your correspondent satisfactory it would be necessary to alter the shape of the rotor bars to the section of an inverted letter —, utilising the flat at the bottom for brazing to the rings. Mechanical strength in these jobs is quite a secondary matter in comparison with electrical conductivity and a high-resistance rotor will give an unsatisfactory speed characteristic when the machine is on load.—Yours, etc.,

A. H. AVERY.

Making Small Electric Motors Self-starting.

DEAR SIR,—Reference to the letter in THE MODEL ENGINEER issue dated January 23, page 96, by F. Helsmoortel, of Antwerp. I wonder if your correspondent has tried sloping the slots in his armatures?

Some time ago I had an order for a quantity of the "Edison" type of model boat motor for 4-6 volts, one of the stipulations being that they must be self-starting. I designed these motors with eight-section drum armatures running in field magnets as per rough sketch (not reproduced), the tunnels being properly bored out (I have a few of the castings still on hand). When mounting the stampings, I made the slots form a slight spiral, not straight, and parallel with the shaft. I found that about 1/16th of the circumference about correct, *i.e.*, the tooth at one end of the armature being in the position of its "next door" slot at the other end of the armature. Both discs and cylindrical commutators were tried, but results were about equal, and, owing to restricted space, disc commutators were finally decided upon. It is taken for granted that all likely spots for friction received attention by Mr. Helsmoortel?

I offer the above in case Mr. Helsmoortel has not tried this, and should he decide to do so, I should like to hear results.—Yours faithfully,

GEO. C. SMITH.

DEAR SIR,—Replying to the letter of Mr. F. Helsmoortel in your issue of January 23, it is probable that the trouble of his small motors failing to start is due to the armature slots being straight, *i.e.*, parallel to the centre line of the spindle, and would be overcome by staggering the slots in the manner shown in the accompanying sketch.

Many eight-pole stampings for models have very large slot openings compared with the tooth width and are apt to lock.

Should the above fail to effect a remedy, try one of the following (*a*) rock brushes slightly backwards,

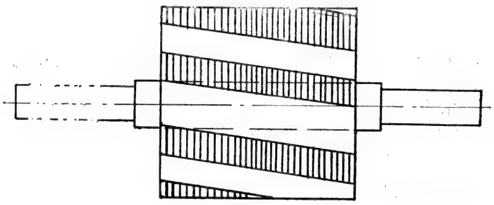


Diagram showing Arrangement of Armature Stamping.

(*b*) increase the air-gap between the armature and poles, or (*c*) put twice as many commutator segments as slots and wind two coils per slot.—Yours faithfully,

S. F. PHILPOTT, A.M.I.E.E.

DEAR SIR,—In reply to your Antwerp correspondent's letter on above in your issue of January 23 last: if nine divisions (or some multiple of three) instead of the eight were used, the motors ought to be self-starting.—Yours faithfully,

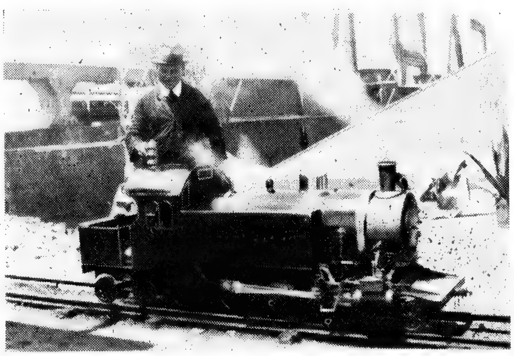
CECIL R. F. EUSTACE.

Magnalium: For Engine Pistons, etc.

DEAR SIR,—*Re* M. Suzor's letter some time ago concerning the metal of his piston of his famous racing petrol engine. I think magnalium is the same as the electron he refers to, and should suit his engine.

This is an alloy composed of magnesium and aluminium. It is lighter than aluminium, and is a stronger and tougher metal, its tensile strength ranging from 14 to 21 tons per sq. in., according to its composition. Good, sound, clean castings can be made from it, while it works well in rolling, filing or turning. Further, it can be soldered, forged and welded. The melting point ranges from 1,184° Fah. to 1,428° Fah., according to the alloy. It is a good conductor of heat, the specific heat being 0.2185° Fah. The alloy can be turned and faced at the same speed as brass. The tools should be keen edged to do good work, and will work beter if kept lubricated with turpentine, petrol or vaseline. The alloy takes a high polish, silvery-white, with rotten stone, tripoli, or rouge, and will retain its polish.—Yours respectfully,

EDWARD F. EVANS.



The 3-in. Scale Locomotive by Mr. G. G. Buick referred to on page 143 last week's issue. Cylinders $2\frac{1}{2}$ ins. by $4\frac{1}{2}$ ins.; boiler pressure 200 lbs.; dia. drivers 12 ins.; bogies 6 ins.; length 7 ft. 8 ins.

Petrol Motor Castings.

DEAR SIR,—Will you please let me have the name and address of a firm who supply castings for petrol motors up to 4 h.p.?—Yours faithfully,

J. H. SMITH.

[Can any reader supply this information?—Ed., MODEL ENGINEER.]

Clockmaking.

DEAR SIR,—I was much interested in Capt. Somerville's remarks *re* pendulum with Invar rod and cast-iron bob, for I am about to make a very similar one for a regulator. Would Capt. Somerville give some details as to its rate, length and size of suspension spring; also its material thickness. Type metal is often recommended for bobs in connection with Invar. Has it any advantages?—Yours, etc.,

"ANOTHER M.B.H.I."

Institutions and Societies.

The Society of Model and Experimental Engineers.

MEETINGS.—At Caxton Hall, Westminster, at 7 p.m. Thursday, February 20, lecture by B. E. Dunbar Kilburn, Esq., M.A. (member), on "Tides." Members are specially requested to note that this will be a Ladies' Evening. It is hoped that every member will do his best to bring a lady. Friday, March 7, Competition, Track and Model night.

DINNER.—The Annual Dinner of the Society will be held on Saturday, April 5, at Pritchards' Restaurant, Oxford Street. Tickets, price 7s. 6d. each, may be obtained of the Secretary or of any member of the Council.

WORKSHOP. — To-morrow evening, Friday, February 14, a "Gadgets" evening at the workshop. We have not had one of these evenings for some time. There ought to be quite a number of new things to be shown. Members who attend to-morrow evening will be sure of an interesting time, and if they will bring something to show and explain, they will be doing their bit. Ordinary tools, etc., are not wanted on this occasion, but we should like to see some of your special "brainwaves."

On Friday, March 21, Col. A. F. Marchment, D.S.O., M.C., T.D., one of our newer members, will give a demonstration on the method of producing the mottled finish which is sometimes seen on high-class tools and which is so much admired. At the recent meeting on January 28, Col. Marchment showed some beautifully made and finished tool-holders with some lovely mottling. On being asked to demonstrate the method of getting this finish, Col. Marchment immediately consented to do so. Will not some other members follow this excellent example? A demonstration on lacquering would be very welcome.

Information on any matters pertaining to the S.M.E.E. may be obtained from the Secretary, R. W. WRIGHT, 202, Lavender Hill, Enfield.

Institute of Patentees.

LECTURES.—At Caxton Hall, Westminster, London, S.W., on Thursday, February 20, at 8 p.m., "Scientist Looks at Spiritualism," by Prof. A. M. Low, D.Sc., A.C.G.I., M.I.A.E., F.C.S., F.Inst.P.I.; chairman, the Rt. Hon. The Lord Askwith, K.C.B.; admission free.

Bolton S.M.E.

The newly formed Society for Bolton and district has room for a few more members. Interested readers are invited to write or call.

Hon. Secretary, A. TAYLOR, 203, Hatfield Road, Bolton.

Leicester Society of Model Engineers.

NEXT MEETING.—Friday, February 14, at 8 p.m., in Swiss Café, Welford Road, open meeting.

Secretary, J. H. RILEY. "Earlsdon," Scraptoft Road, Leicester.

Transport Observation and Models Society.

The Committee is now engaged on the summer programme, which will include visits to garages, engine sheds and other places of transport interest.

The last two meetings of the winter session will be held at the Adelphi Hotel, John Street, Strand, on February 19 and March 19. At the former a paper will be read on the "Midland and Great Northern Joint Railway," and the latter a paper on the "London Omnibus."

Full particulars of the Society may be had from the Hon. Secretary, S. M. W. HANN, 7, Shirley Road, Croydon.

The Model Power Boat Association.

The Annual General Meeting will be held at Headquarters, "The King and Queen," Foley Street, off Great Portland Street, on Saturday, the 15th inst. Committee meeting at 6 o'clock, general meeting starts at 6.30. It is hoped that all members will attend, as the season's fixtures and other important business is on the agenda.

The West London Model Power Boat Club.

SAILING WATER, ROUND POND, KENSINGTON.

The Annual General Meeting was held on January 26. The officers elected for the ensuing year are: Chairman, Mr. Oakley; Vice-Chairman, Mr. Wilby; Committee, Messrs. P. Anderson, W. Butler, S. Haltorp; Hon. Secretary and Treasurer, W. Thornton Parry.

Mr. Butler, having scored the highest number of points for the year, was duly presented with the annual trophy cup. This cup now becomes the property of Mr. Butler, he having won this trophy on three occasions. Mr. Butler also won the cup presented by the club to members for the highest aggregate score for the year at the Model Power Boat Association Regattas.

Hon. Secretary, W. THORNTON PARRY, 2A, Ennismore Gardens Mews N., S.W.7.

Notices.

The Editor invites correspondence and original contributions on all small power engineering, motor 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 envelope addressed for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

All subscriptions and correspondence relating to sales of the paper and books to be addressed to Percival Marshall & Co., Ltd., 66, Farringdon Street, London, E.C.4. Annual Subscription, £1 1s. 8d., post free to all parts of the world.

All correspondence relating to Advertisements and deposits to be addressed to THE ADVERTISEMENT MANAGER, "The Model Engineer," 66, Farringdon Street, London, E.C.4.

Sole Agents for United States, Canada and Mexico: Spon and Chamberlain, 120, Liberty Street, New York, U.S.A., to whom all subscriptions from these countries should be addressed. Single copies, 14 cents; annual subscription, 5 dollars 50 cents, post free

Contents.

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

SALES AND WANTS

EVERYBODY'S MARKET for ENGINEERING ELECTRICAL & SCIENTIFIC GOODS

For particulars of Rates, Etc., see previous issues, owing to pressure of space this week.

General

Watch Repairers.—Tools, Material, Watches, Clocks, Gramophone Parts. List free. Repairs guaranteed. All parcels fully insured. Illustrated lists Tools and Materials, 6d.—BLAKISTON & Co., Ainsdale, Lancs.

B.A. Screws, Nuts, Washers, assorted gross 2s., list 2d.; small Whitworth Screws, assorted gross, brass 3s., steel 2s. 6d.; trade supplied.—J. H. BENNETT, Station Road, Willesden Junction.

Mechanics' Overalls at Pre-War Prices.—2s. 11d. strong blue or brown drill. Washing and wear guaranteed. Direct from factory at makers' prices. A p.c. brings patterns, inch tape and self-measurement chart.—CURREY & Co. (Dept. B.), 9, John Street, Thomas Street, Manchester.

Screws, Nuts, Washers. List free.—EDWARD EMPSALL, Trentham Place, Dewsbury Road, Leeds.

Bookbinding.—We supply Official Publishers Cover and bind your parts with strong cloth joints. Returned carriage paid for 4s. 6d.—WILLS, Bookbinder, 123-125, Church Street, Croydon.

Transfers in Oil Colours. Buy from actual makers. Wood Inlay, Floral, Dutch, Japanese, Birds, Trade Signs. Selection any kind, 1s. 6d. Includes catalogues.—Below.

Cycle Lining Transfers, self-fixing. All usual colours. Child could apply. 1s. set.—Below.

Doll's House Brickpapers, Wallpapers, etc. Samples 2d.—E. R. AXON-HARRISON, Jersey.

"Model Engineer," Vols. 1, 2, 3, in original bindings and perfectly good condition; a unique opportunity, as these volumes are now out of print; best offer secures. Apply quickly.—Box 1338, MODEL ENGINEER Offices.

Springs! Springs! Assorted, compression and expansion. Twelve varieties from ¼" to 2". 2s. for one gross, post paid. 100,000 already sold.—SCARRS, LTD., Kirkgate, Leeds.

Cheap Printing.—1,000 Billheads, 3s. 6d.; samples free.—CRETEWAY PRESS (22), Buxted, Sussex.

Special Brass Brazing Spelter, 9d. oz., post free.—DEANE, Mounts Road, Wednesbury.

Swift's 1" Objective, 15s.; Polarizer and Analyser, 25s.; Side Silver Reflector on Stand, 15s.; Sub-stage Abbe Condenser, 17s. 6d.; Large Eyepiece, 1".27, 3s. 6d.; all standard sizes.—HEATH, 28, Loughborough Road, London, S.W.9.

Why Pay 3s. 4d. per oz. for Silver Solder when material of identical characteristics can be obtained for 3s. 4d. per lb.? Try sample piece for 6d. It melts at the same temperature.—DUNN, 35, Faringdon Road, Plymouth.

Aeroplane Wheels, new, fitted with Dominion 26×2½ heavy tread tyres, and new tubes. Pair, complete with axles and bushes, 70s., carriage forward.—Below.

Sheet Aluminium, 24×11" approx., 1s. 3d.; Chamois Leathers, 16×16", 1s. 9d.; Spanners, assorted dozen, 3s. 6d.; Files, re-cuts, assorted dozen 4s.—Below.

Bolts, Nuts Washers, etc., 7-lb. bag, 4s.; Trench Periscopes, in case, 2s. 3d.; Hacksaw Frames, with blade, 1s. 6d.—Below.

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Middleton.—Send for photos (3d.) Sensitive Bench Drilling Machine (Lloyd), 68s.; Sensitive Pedestal ditto (Mossberg), 58s.; exceptionally fine Double-ended Grinding Machine (Lloyd), £3 15s.; Single-ended ditto, 39s.; perfect Leather Belting, 1¼", 1½", 1¾", 2", 2½", 3", 4", 3½d.—9d. ft.; new Grinding Wheels (Universal), 14"×1", 12"×¾" wide, 7s. 6d., 6s. 6d. each.

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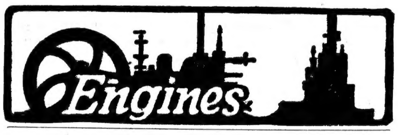

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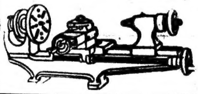

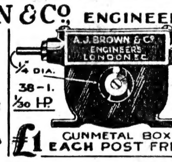

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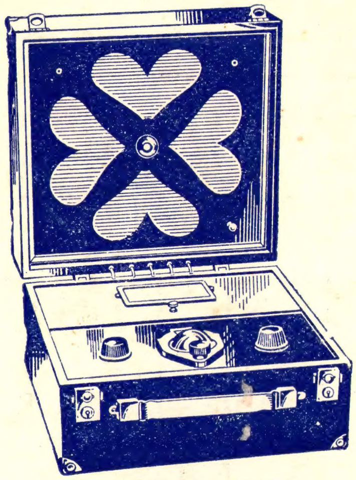

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