Building the "P.M." FOLDING SPEEDBOAT

NEWNES

PRACTICAL MECHANICS

JUNE 37

6D.

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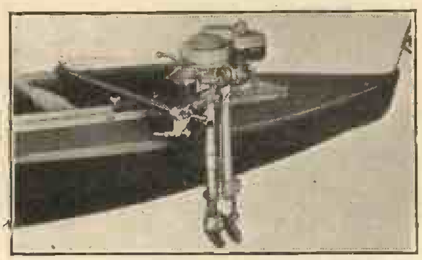

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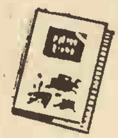

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PRACTICAL MECHANICS

VOL. IV. JUNE, 1937 No. 45.

Fair Comment

By The Editor

Trade Secrets

MOST people have heard the story of the foreman sewage cleaner who asked his labourer if he would mind fixing the candle on a piece of board, and then reviled himself for doing so, with the remark that "he hadn't meant to teach the assistant that, until the third year of his apprenticeship." In most trades and professions there are the narrow-minded people who regard their skill as something to be kept as a trade secret, and they regard with suspicion anyone who asks them a question as to how a certain job is done. These smug people forget that if every one had adopted that attitude they would not have been able to learn the particular trade or profession themselves. There is no such thing as a trade secret, for since no one man can do every part of the job himself he is bound to teach others to assist him. If the file maker, and the chisel maker, and the lathe maker, and the drill maker refused to teach the secrets of their craft to apprentices, when they died off there would be no one to carry on the industry. Every craft is inter-dependent upon another. The author cannot write without the aid of the paper maker and the pen-nib maker. The carpenter cannot work until the steel maker has done his job, and the steel maker cannot work without the foundrymen, whilst the latter would be unable to cast and to mould without the dredging machine which provides them with the sand. Industry is built only by the co-operation of many allied industries. It is the commercial conception of the House that Jack Built.

These narrow-minded people who are annoyed when a so-called trade secret is disclosed are the first to seek information from their colleagues or from the Editors of technical papers when they are confronted with a problem which they do not understand. Every technical book and every technical periodical discloses trade secrets, and it is well that this is so. It is the function of teachers, editors, authors, and journalists to disseminate the world's heritage of knowledge, and the "trade secret" individual is usually he who has obtained the secrets from others.

This preamble arises from a letter I have received from a certain stage artiste whose claim to entertain is that he is a so-called escapologist and illusionist. He is most annoyed that I should publish the secrets of his craft, and that I should give away in this journal the methods of the conjurer. This is what he writes: "I have been a regular reader of your journal for a number of years now. I have to-day cancelled my order with my newsagent and shall never buy another copy. I realise this will not put you out of business, but will serve to show my feelings. The published descriptive matter of another man's profession which is his bread and butter is a disgrace to your own. To write the descriptive article for publication is breach of faith, and will bring the contempt of every conjurer in the country to bear on your contributor, whom I am grieved to see has become one of the many exposers of the art of magic."

I am glad to know that one so narrow-minded has ceased to purchase this journal, which is better without such a type of reader. But, of course, he is not a reader. He is annoyed to think that this journal should dare to publish such information, but I shall continue to do so. Suppose every fitter in the country objected to me publishing articles on fitting; assume that every turner refused to take the paper because I publish articles on turning, or wireless engineers cancelled their orders because we dealt with the construction of wireless sets. Journalism would become impossible.

I have no doubt that my splenetic correspondent thoroughly enjoys reading articles which are not concerned with his profession but which enable him to absorb the trade secrets of other professions. Quite possibly this so-called conjurer does not confine his attention to conjuring (such performances only take place in the evening), but probably engages in some other occupation in the daytime. Unless others had disclosed their so-called secrets he would be without the apparatus which is essential to the performance of almost every conjuring trick. I do not know of many tricks which rely upon skill alone, and when you know how they are done they are childishly simple. Trick packs of cards, boxes with sliding compartments, trick tables, servantes, and other devices are necessary. So-called slight of hand is usually so much bunkum, like the patter which most conjurers effect to describe their magic passes. The secret of the successful conjurer is showmanship. Most people now know that Houdini was largely a fake, but a good showman. In fact, the story is told of this famous lock picker who claimed to be able to get out of any strong room, straight-jacket or cell, that he once lost the key of his lodgings and was unable to gain entry. A violinist is entitled to write articles on the violin, and I shall continue to publish the secrets of anything and everything which comes within the ambit of PRACTICAL MECHANICS.

A man who seeks to monopolize a tit-bit of information which he has obviously learned from others must be mental if he thinks that he can succeed in doing so. Fortunately this journal is read by intelligent people and can afford to do without those with such astonishing viewpoints. No man can succeed without the co-operation of others. We are taught the basis of most things at school, and this conjurer with the trade secret complex would not have been a conjurer if school-teachers had maintained secrecy.

Building the "P.M." Folding Speedboat

THE overall length is approximately 9½ ft. with a beam of 3½ ft., and a depth of 15 in. Folded, the dimensions are 9 ft. × 15 in., thus it can be easily carried on the roof of car or stored stowed along a wall. The transom, frame, and seats are, of course, packed on top of the folded hull.

The Concluding Article on the Construction of our Speedboat. The First Article Appeared Last Month

Launching

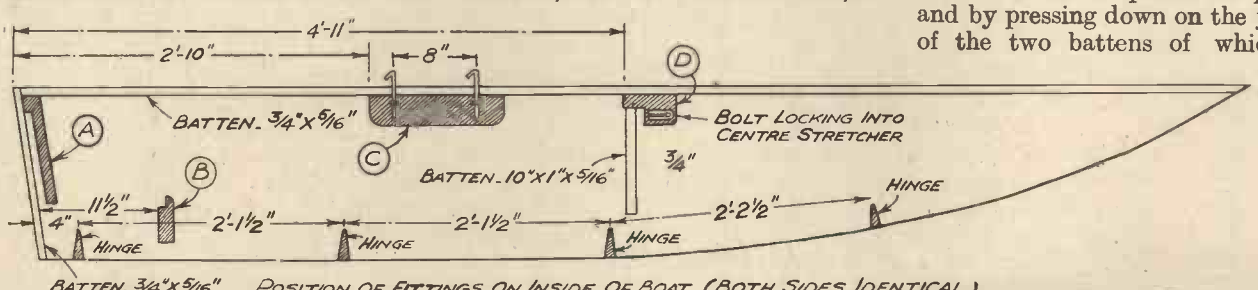
From the folded position to complete erection ready for launching, a period of about four to five minutes at the most is required.

To erect, the folded boat is stood on edge and the sides pulled outwards when the device will resemble the letter W, pressure is then brought to bear on the central bottom seam which corresponds with the apex of the central part of the W. This forces the sides out at the bottom and flattens the bottom of the boat out so that the cross section now resembles a flat bottomed U.

The next stage is to get in the rigid transom, and to facilitate this, an expanding device is used. This is composed of two pieces of wood about ¾ in. × 1 in. crossed and riveted together in the manner of a pair of scissors; and the ends of the longer arms are notched so that they can fit over the inner strengthening battens of the tops of the sides.

An Expanding Device

This device is placed in position, and by pressing down on the junction of the two battens of which it is



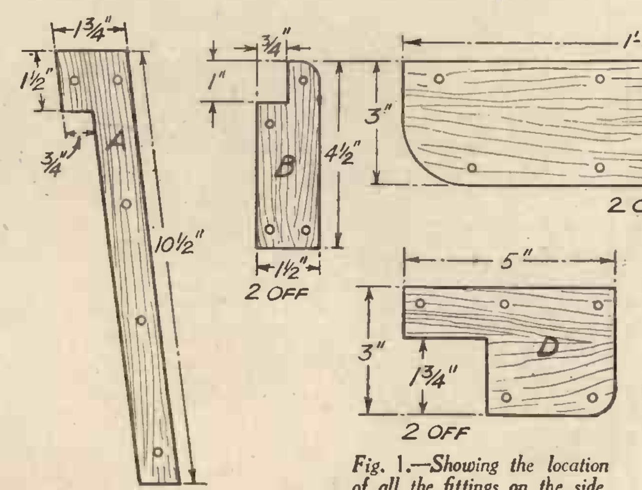


Fig. 1.—Showing the location of all the fittings on the side.

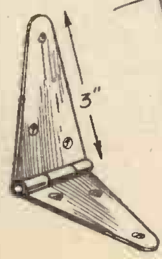
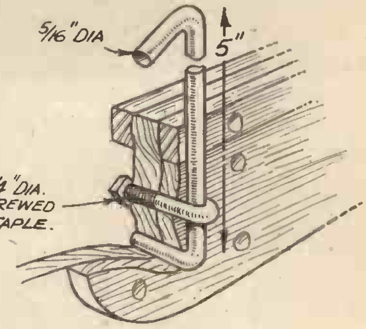


Fig. 2.—Details of the hinges.

A SUITABLE TYPE OF HINGE. (8 REQUIRED.)



DETAIL OF ROWLOCK.

Fig. 3.—The rowlocks, which are constructed from 5/16 in. round iron rod, should be bent to the shape shown.

composed, leverage is obtained to force the sides outwards when the wooden transom can be slipped home.

The central frame is inserted in a similar manner with the use of the expander, and when in position the bolts are shot, thus securing it rigidly in place. The seats merely rest in place and are in no way secured.

As regards finish, varnish is best, one good coat of half varnish and half linseed oil as a primer, and two light coats of neat varnish is sufficient.

All canvas joints are treated with marine glue as specified in the materials list. Tar or paint may be used but are messy and unsightly.

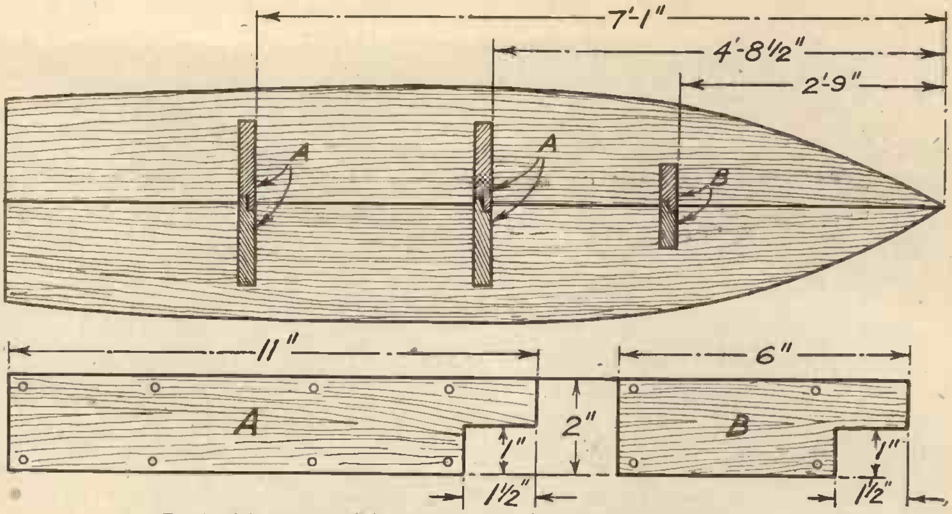


Fig. 4.—The positions of the locating tongues for holding the boat rigid.

Materials

With regard to materials there is little necessity to give a wide range of choice, plywood is suggested, although masonite or similar materials could be equally well employed. For the hardwood battens either American rock elm or oak could be used. If cheapness is a consideration, ordinary English elm may be employed but this twists badly in storage pending use.

The following list are suggested materials and given in the sizes which they should be bought. All wood is planed and should be ordered finished sizes.

MATERIALS

For the sides and bottom :
4 pieces ⅜-in. pine plywood, each 10 ft. long and 14½ in. wide.
For the Transom :
1 piece ply, 3 ft. × 14 in.
For the Frame :
1 piece ⅜ ply, 3 ft. 2 in. × 14 in.
For Seats :
1 piece ¾ ply, 5 ft. × 12 in.
1 piece ⅜ ply, 5 ft. × 12 in.
For Battens :
10 pieces American rock elm or oak, ¾ in. × ¼ in. each 10 ft. long.
For Miscellaneous Strengthening Pieces:
1 piece of mahogany ¼ in. thick, 7 in. wide, 5 ft. long.
Canvas (extra stout) :
1 strip 12 in. wide, 10 ft. long.
1 piece 18 in. × 3 ft. 6 in.
1 piece 2 ft. × 8 in.
Hinges, etc. :
4 2-in. butts for seats.
6 long type gate hinges, 4 in. overall.
2 small door bolts about 2½ in.
Screws :
Order as required, mostly ½ in. No. 6.
Marine Glue for Joints :
Jefferies "F" quality marine glue. 1 quart tin price 5*s*., plus carriage, obtainable from Alfred Jefferies & Co., Marsh Gate, Stratford, London, E.15.

The first stage of the work in constructing the boat will be to cut out the two sides and the bottom pieces.

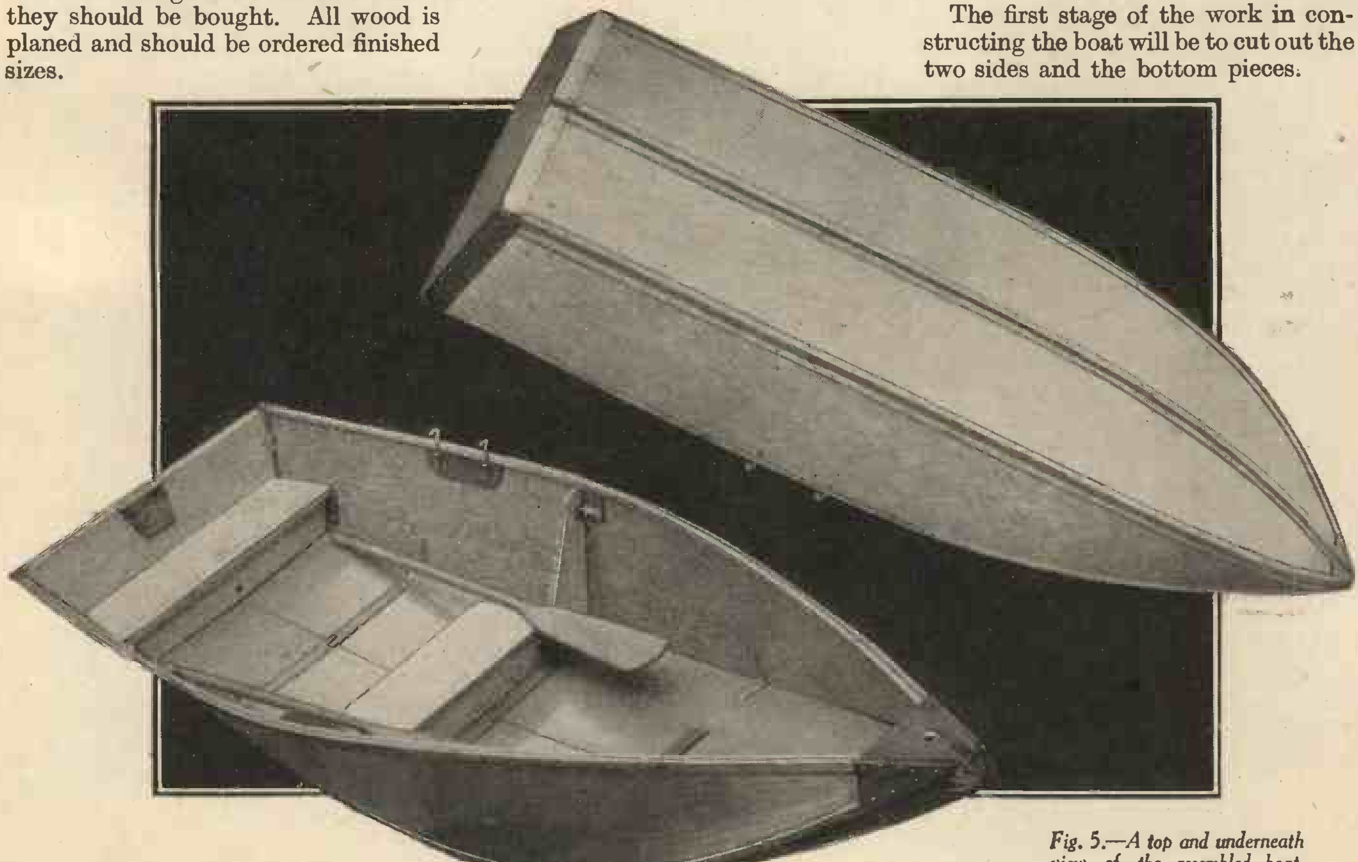
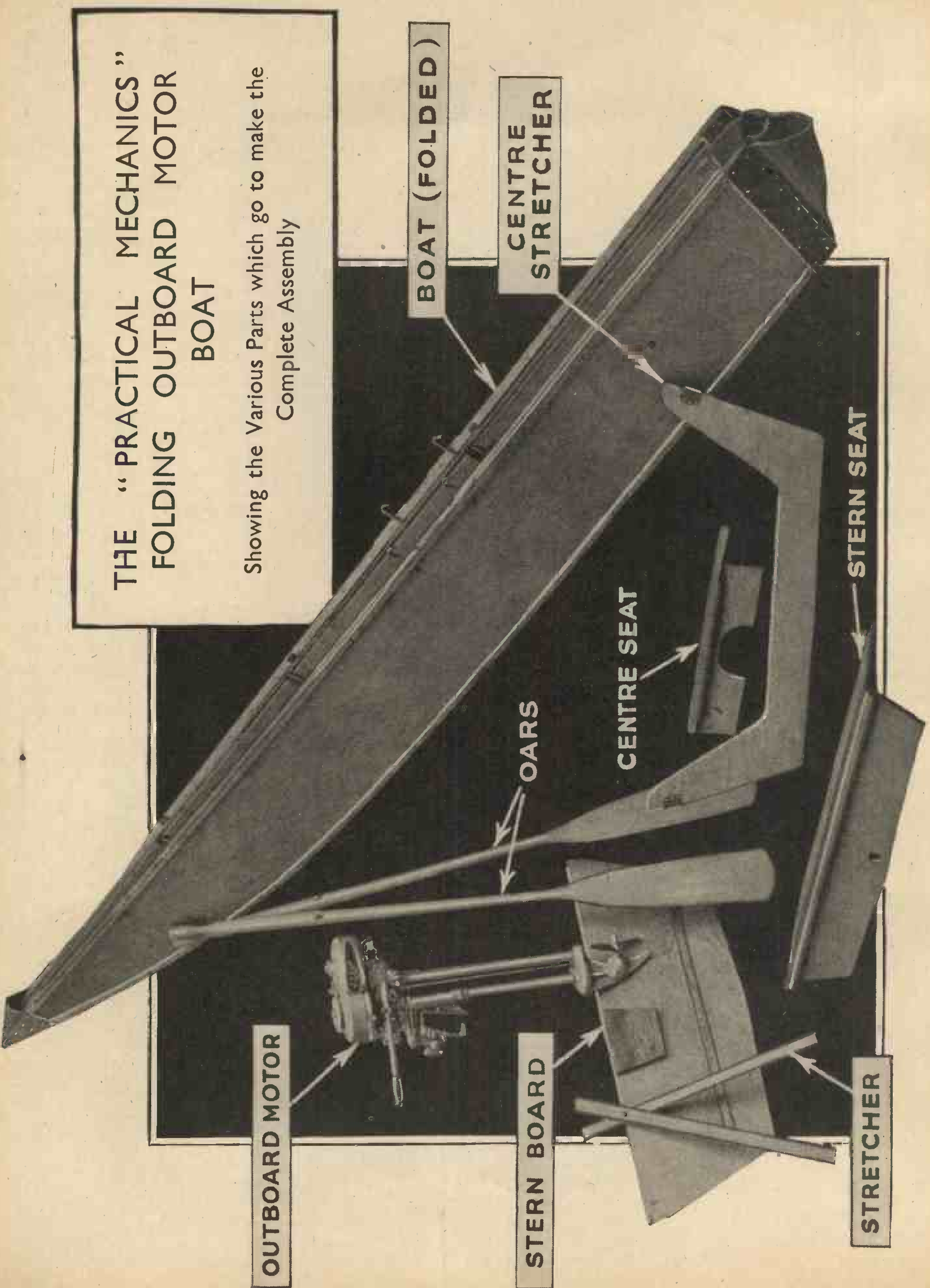


Fig. 5.—A top and underneath view of the assembled boat.



THE "PRACTICAL MECHANICS" FOLDING OUTBOARD MOTOR BOAT

Showing the Various Parts which go to make the Complete Assembly

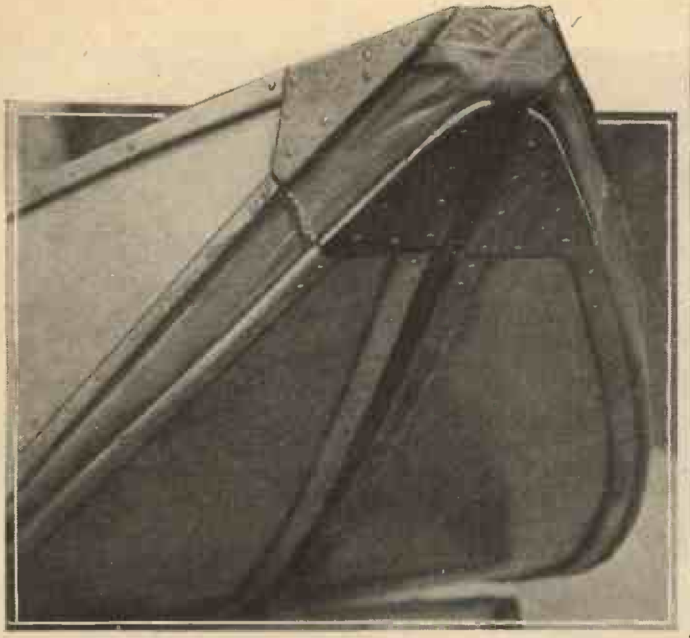


Fig. 6.—The canvas nose-piece is clearly shown in this illustration.

Fig. 7.—The sides of the boat are forced apart with the stretcher while the stern board and centre stretcher are placed in position.

These, of course, are cut from the large piece of $\frac{5}{16}$-in. plywood shown in the materials list.

Referring to the first two illustrations of the preliminary article in the previous issue the upper one shows one of the side pieces whilst the lower shows one half of the bottom. The parts should be marked out and shaped in accordance with these diagrams, and it will, of course, be seen that it is only necessary to mark out one of each in this way, for the finished parts can then be used as templates for the others.

Great care must be take to see that the two sides and the two bottom halves are exactly the same shape and in every way identical, and to make certain of this, it is as well to clamp them together for the final finishing off. The work on sides and bottom completed, the back board or transom may be taken in hand and cut out according to the diagram from $\frac{3}{4}$-in. plywood. Cut the notches at the top corners very carefully, as shown in detail A, lining them with thin brass strips as shown. The notch, it will be seen, is $\frac{5}{16}$ in. deep and 1½ in. long. It will be as well to finish the job outright, so the engine mounting block and seat batten may as well be fitted now.

The Seat Batten

The seat batten should really be of ⌐ section, so that the groove in the rear edge of the seat can drop over it, thus preventing the seat from drifting forward. The centre stretcher or frame can now be taken in hand and made according to the diagram from $\frac{3}{4}$-in. plywood.

The top edges are slotted in a similar manner to those of the stern board, but in this case, two small holes are bored to receive the bolts which are

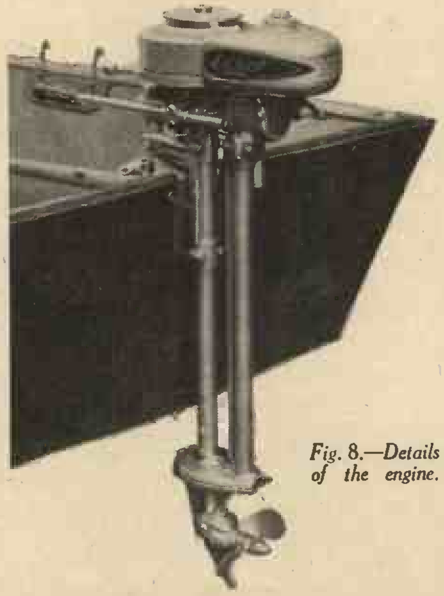


Fig. 8.—Details of the engine.

used to retain the frame in position, and both holes and slots are protected from wear or enlargement by sheathing with thin brass as shown.

Constant reference to the diagram on page 432 of last month's issue, which shows the completely assembled boat, will considerably facilitate the work at all stages. Having got the main items made, the edges of all parts, including the sides and bottoms, should be given three coats of varnish, each coat being allowed to soak well in; this, of course, is to protect the wood from the action of water, for the edges are the most vulnerable part of plywood.

Assembly

We are now ready to start part of the assembly work, and taking the two bottom halves, place them together on the floor in such a manner that the complete bottom is formed. Temporarily secure them thus by lightly tacking a few odd battens across at intervals of eighteen inches. and then turn the whole device over

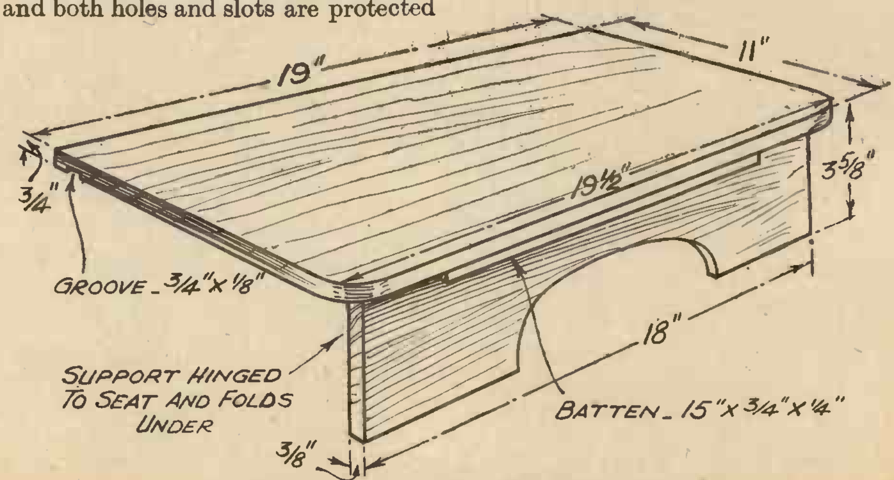


Fig. 9.—The centre seat which drops snugly into position.

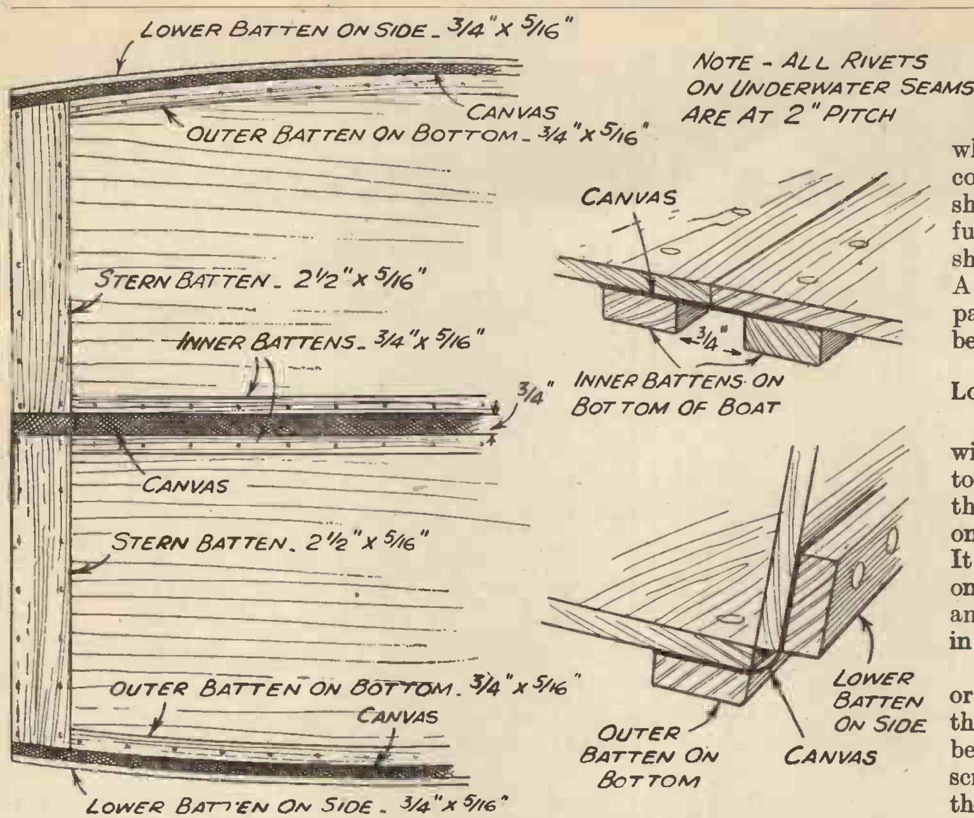


Fig. 10.—The underside of the boat showing the waterproof seams.

so that the battens are underneath. We can now carry on with the hinged canvas joint, and to do this, cut a strip of canvas 2½ in. wide and a few inches longer than the length of the bottom pieces.

This must be glued with marine glue (ordinary glue is useless) right along the seam so that an equal amount of canvas is on each half.

Two battens of ¾ in. by ¼ in. hard wood are now secured along the edges of the canvas to within 2 in. of the stern end, with either rivets or screws spaced 2 in. apart, but whichever method is adopted these fastenings must be driven dead tight so that the edges are watertight.

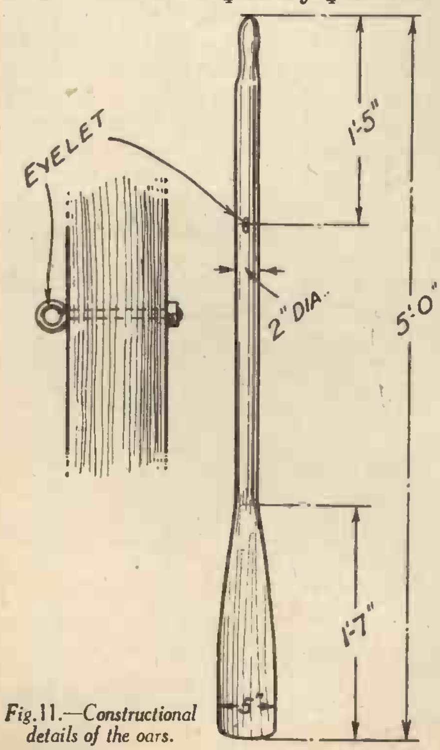


Fig. 11.—Constructional details of the oars.

The Hinged Seam

The temporary battens may now be removed, and if the work on the seam has been properly done, the two halves will fold down with the curved edges exactly registering. The sketch on page 432 (see last month's issue) clearly illustrates the principle on which this hinged seam is made.

The sides are ringed to the bottom in a similar manner, but a little surplus canvas is left between the battens to allow them to hinge inwards; the battens finish 2 in. from the stern. Before making this seam, however, the shape of the boat can be formed and the parts held in position by fitting the metal hinges on the inner sides as shown in the assembled diagram, page 432.

When all the seams are made the front or bow of the boat where the four parts unite must be covered with a canvas cap as shown in detail A, and the sides further protected by covering with shaped pieces of ¼ in. mahogany. A brass eyelet is let into the top part to enable a painter or rope to be secured.

Locating Tongues

The next job to take in hand will be to make and fit the locating tongues to keep the boat rigid, and these are shown in the illustration on page 432, and in detail in Fig. 4. It will be noticed that two large ones and one small one are used and are fitted in the positions shown in Fig. 4.

We may now fit the gunwales or inner and outer battens round the tops of the sides. These may be either through riveted or screwed separately according to the choice and skill of the reader. This is shown in the sketch on page 432.

We must now make a suitable groove or channel on each side of the boat at the stern to receive the stern board or transom, and this is accomplished by running two strips of batten ¾ in. (full) apart, from the top rail to the bottom of the sides; this will form a closed groove, into which the sternboard is sprung, the notch therein fitting over the toprail. When these are completed the sternboard may be placed in position, and similar grooves made for the frame or stretcher, and the holding bolts fitted. This frame is fitted by springing open the boat and dropping it in position, after which the sides spring in and grip it, further assisted by shooting home the bolts. The boat should now assume its proper shape, and we must make the sternboard watertight by fitting the canvas capping or false transom. This is done by making a canvas back, the edges of which are turned over the

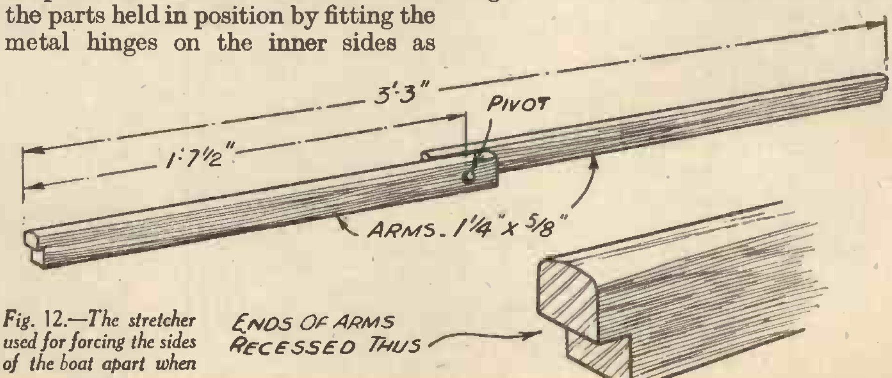


Fig. 12.—The stretcher used for forcing the sides of the boat apart when erecting.

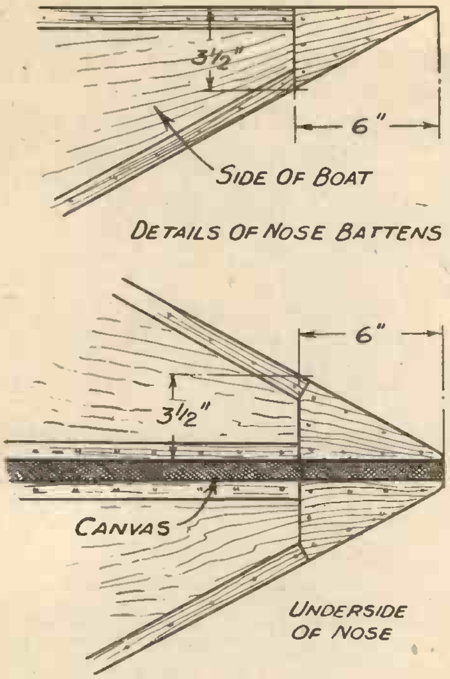


Fig. 13.—The nose battens.

bottom and sides for 2 in., and glued, thus, with marine glue. Battens 2 in. wide are now screwed over them, which explains why our fore and aft seam battens finished 2 in. short of the stern.

The top edge of this canvas transom should be in some way strengthened either by stitching another piece about $1\frac{1}{2}$ in. wide along it, or making the back $1\frac{1}{2}$ in. oversize and turning the edge over.

The Seats

The seats may now be taken in hand, and which require but little explanation, as they are clearly illustrated in the assembled diagram, page 432. Details of the stern seat are given in the lower figure, page 431. The leg is, of course, hinged to the seat so that it folds inwards so that when the boat is folded up it can be packed flat.

The groove in the rear edge fits over the batten on the transom, whilst a similar groove is cut in the front seat to fit over the frame or stretcher (Fig. 9).

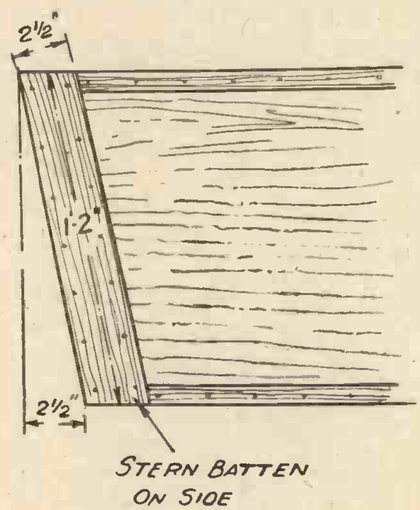


Fig. 14.—The stern batten.

The seats themselves are formed of $\frac{3}{4}$-in. plywood, whilst the legs are of $\frac{5}{16}$-in. ply. The rowlocks, which may now be made and fitted, are constructed from $\frac{5}{16}$-in. round iron rod, and bent as shown in Fig. 3. One end it will be seen is bent at right angles and passed through a hole bored in the side of the boat. The rowlock is held in position by a $\frac{1}{4}$-in. screwed staple.

The oars will require a screw eye fitted in them so that this eye can be passed over the hooked end of the rowlock and down the stem.

The Rowlocks

Two rowlocks are fitted on each side so that alternative rowing positions can be given to suit the person rowing.

These rowlocks, also the frame bolts, etc., are, of course, mounted on protecting or strengthening plates of $\frac{1}{4}$-in. mahogany as shown in details *C* and *D*, Fig. 1. The location of all the fittings on the sides is also shown in Fig. 1. If the boat is to be used on salt-water, care must be taken that iron hinges, bolts, etc., are not secured with brass or copper rivets or screws, otherwise corrosion will set in by action between the two metals with salt spray.

The finish of the boat may be enamel or varnish. The latter is recommended, as enamel is prone to chip with constant folding of the boat.

Give three good coats of varnish with boat in the assembled position.

Handling the Boat

In using a boat of this description it must be borne in mind that, whilst strong for ordinary purposes, liberties cannot be taken with a folding craft. If used when bathing, it is inadvisable to clamber over the sides, and heavy persons should not lean against them.

Trim the boat well when under way—our illustration on page 430 is a very good example of correct trim with three adults aboard. Avoid too large an engine. A 1-H.P. engine, such as the "Elto Pal," is adequate, and no extra speed will be obtained which will be in proportion to increased horse-power.

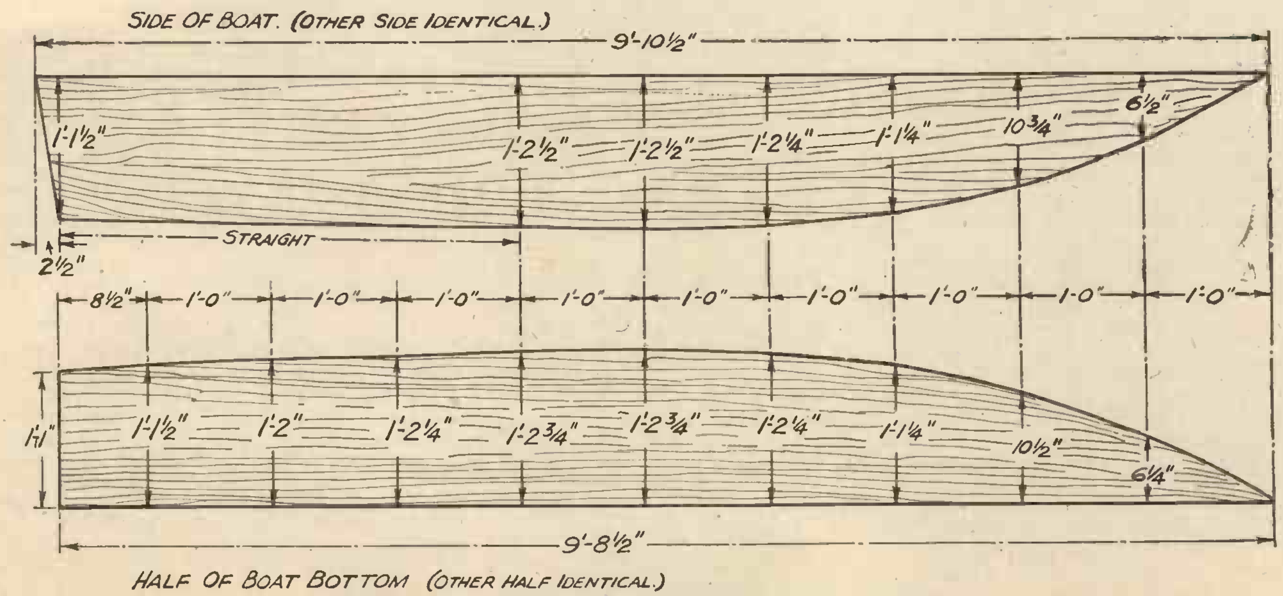


Fig. 15.—Measurements for constructing the sides and bottom of the boat.

MODELLING, MOULD-MAKING AND CASTING

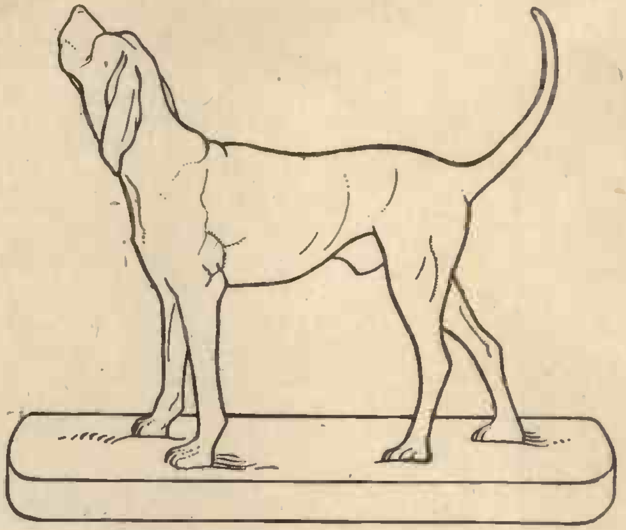


Fig. 3.—A drawing from a plaster cast of a dog.

An Interesting and Practical Hobby

THE processes of modelling, mould-making and casting are of a more mechanical nature than is generally supposed.

Statues and busts of celebrated people, so often seen in public buildings, are the result of much methodical construction. The camera is a most valuable aid to a sculptor. The model is first photographed from every angle, at the same distance, so that there is a concrete idea of how the finished cast will appear to the spectator. The sculptor works from these photographs when the sitter cannot give too much time to posing.

The general mass of clay which is to represent the subject, is built up on stout wooden board which has a central support of twisted lead piping (*see* Fig. 1). The board is damped before use. Fingers and thumbs are the most effectual tools for clay modelling and boxwood and wire tools are only necessary for small details (Fig. 2).

When the clay is built up, piece by piece, to the right size, the proportions of the whole head, and afterwards, of the separate features in relation to each other, are checked with wooden calipers. Calipers resemble a gigantic pair of compasses, excepting that their points are blunted and curved inwards so that the features of the model can be conveniently measured. When the proportions are correct, essential details are put in and the final modelling is done. A hogshair brush is sometimes used to smooth the undercut portions of the clay. An unfinished piece of modelling is kept covered by damp cloths which must not be allowed to dry.

The natural or grey clay generally used is bought by the hundredweight and stored in galvanised bins with lids. It is kept damp by adding water, as unless kept in a proper state of moisture, it will always dry, crack and crumble.

Dry clay is beaten with a mallet and afterwards damped and rolled until it is plastic without being sticky. When kept in good condition it can be used for years and improves by being worked. Soft clay is re-conditioned by kneading powdered clay into it.

Plaster Casting

Casting in plaster requires skill and rapidity, especially when a large quantity of plaster is being handled. The plaster is added to a large bowl of water and well stirred in. As soon as it begins to get warm it will also start to thicken. The clay modelling is well covered with the gradually thickening plaster which sets quite hard when cold. At this stage, it is essential to work quickly and to make a really thick covering of plaster that is substantial enough to cast from. A large mould is generally made in two sections that are centrally divided.

When this is done, half the modelling is covered with plaster and the division well oiled so that the two halves will lift apart as required. A mould in two sections is more easily cleaned than a one-piece mould. When the plaster is cold and dry it can be taken from the clay without an effort. Plenty of running water and a large soft brush will clean away all traces of clay that remain. If a mould has been made with mechanical precision it can be fitted together again to give an exact reproduction internally of the original work in clay. Any number of casts can be made so long as the mould remains undamaged. When taking a cast, the inside of the mould is first thoroughly soaped and oiled. If this is adequately done the plaster that is used for the cast will not stick.

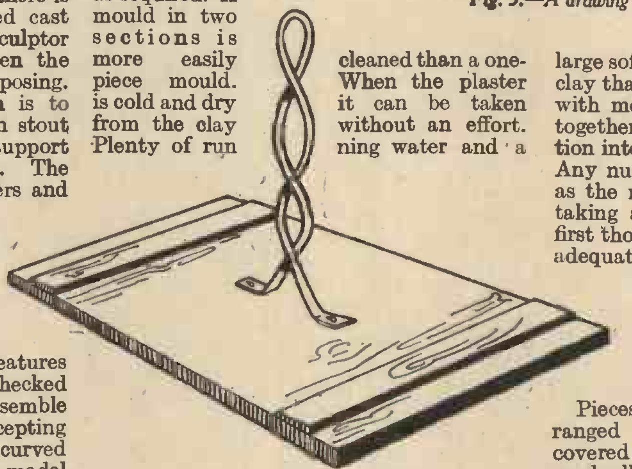


Fig. 1.—The modelling board with a oundation of lead piping.

The first layer of plaster that is applied to the inside of the mould must be thick; it should carefully cover all details, to avoid formation of air-bubbles.

Pieces of tow or butter muslin are arranged cross-wise on the wet plaster, and covered by another layer, the mould being gradually filled in with plaster and the tow or muslin added at the discretion of the caster.

When the plaster is dried and set, the mould can be easily removed. In some cases it is chipped away with a chisel and a mallet, the chisel being held at right-angles to the mould. Surplus plaster which has oozed up through the join can be removed with the fingers. Finishing touches are sometimes done on the plaster-cast itself. A polish made of beeswax and turpentine is finally applied with a silk or velvet duster.

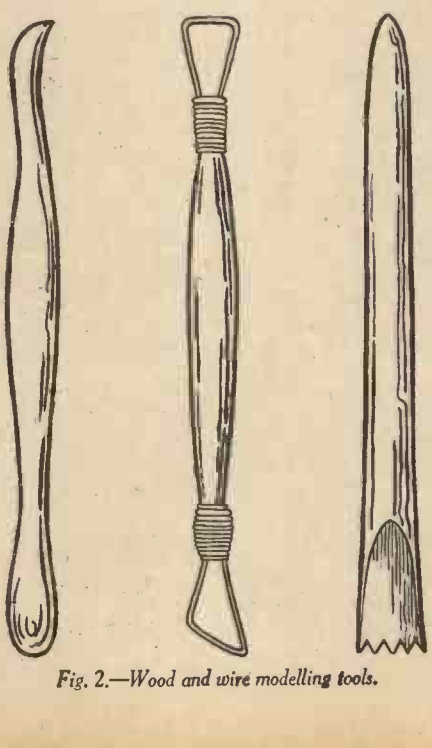


Fig. 2.—Wood and wire modelling tools.

From Plaster to Bronze

Plaster-casting is a stepping-stone to bronze-casting. A plaster cast is sent to the foundry where a gelatine mould is made of it. The mould is then sprayed with a thick layer of wax, and a core of fire-clay, large enough to touch the inner surface of the wax-layer, is made. This is held to the mould by pins, after which the mould itself is encased in fire-proof clay, and a hole made to take the molten bronze. The mould is heated enough to melt the wax and the bronze which is poured in fills up the cavity left by the wax. The inner and outer core are broken and removed as soon as the bronze is cool and ready for cleaning. Sculptors sometimes work on a bronze after it is returned from the foundry. The method of bronze-casting described above was invented by the Greeks, and is still used to-day.

The N. P. L. Watch Tests

How the National Physical Laboratory conducts Tests of Accurate Timepieces

The watch shown here is the Split-second Chronograph used by the staff of our Contemporary, "The Practical Motorist," in testing the speed and acceleration of motor cars. It is a Longines—makers of remarkably accurate watches, which have secured highest awards in "Kew tests."

VERY few people understand what is meant by an accurate watch. They read advertisements of watch manufacturers who describe their products as accurate time-keepers, correct time-keepers, good time-keepers, excellent time-keepers, precise time-keepers, fine time-keepers, and so on. Whilst these terms may be correct up to a point, they do not convey anything to the horologist, for one manufacturer may consider a rate of 30 seconds a day as "accurate," or "correct," or "precise," but unless we know what is considered the standard of good time-keeping these terms do not give any indication of the performance of the watch. Now that we have the time signal radiated from Greenwich at regular periods each day, the public has formed the habit of checking the rates of watches and clocks, and it finds that what was formerly thought to be a good time-piece is inaccurate. But providing that a watch has a constant rate—either gaining or losing, it is easy to estimate the time from the indication given by the hands, for the hands merely indicate the rate of a watch. The speed of movement of the hands is governed by the vibration of a hairspring attached to the balance of the watch, and its ability to keep time depends upon the accuracy of the balance, the quality of the pivot and the jewel, the hairspring, and the poising of the balance.

Not only must the watch have a constant rate, but it must have a constant rate in all positions. Obviously some impartial body must be set the task of testing the claims of manufacturers to label their watches as accurate time-keepers, and to set the standard by which watches may be judged. In this country that body is the National Physical Laboratory at Teddington, who issue Certificates under certain conditions of performance. It is very necessary that official time-keepers and others concerned with the accurate checking and recording of the passage of time, including the captains of ships, should possess watches known to be accurate. A record can be gained by a fifth of a second, and if the record was timed by a watch which could gain that amount in an hour, the record has been wrongly recorded.

Chronograph used at the N.P.L. in making daily comparisons between the watches undergoing test, and the standard clocks and rhythmic time signals.

The Metrology Department (rating division) undertakes the tests of watches submitted to them. There are two classes of test—A and B—which occupy 45 and 31 days respectively. The test is divided into 8 periods:

Period.	Approximate Temperature.	Position of Watch.
1	67° F.	In the "initial" vertical position. (See note below.)
2	67° F.	In a vertical position, turned clockwise through 90° from the "initial" position.
3	67° F.	In a vertical position, turned anticlockwise through 90° from the "initial" position.
4	42° F.	In a horizontal position, with dial up.
5	67° F.	In a horizontal position, with dial up.
6	92° F.	In a horizontal position, with dial up.
7	67° F.	In a horizontal position, with dial down.
8	67° F.	In the "initial" vertical position.

For the purpose of this test the "initial" vertical position is defined as follows: Pendant uppermost, in the case of pendant watches; 6 (VI) o'clock uppermost, in the case of wristlet watches; 12 (XII) o'clock uppermost, in the case of other watches not intended for pendant or wristlet use.

Periods 1, 2, 3, and 8 consist of 5 days each, but the remaining periods 4, 5, 6, and 7 each occupy 6 days, as owing to intervening changes in temperature, the rate obtained on the first day of each of these four periods is not used for the purpose of the test.

Class "A" certificates are issued for watches whose performance was such that: The numerical average of the daily departures from the mean daily rate, during any one of the eight periods of test, did not exceed 2 seconds; the mean daily rate in the "initial" vertical position (see note later on) differed from that in the "dial up" position at 67° F. by less than 5 seconds,

One of the watch testing-rooms at the National Physical Laboratory, Teddington.

and from that in any other position by less than 10 seconds; the mean change of daily rate with change of temperature was less than 0·3 second per 1° F.; the mean daily rate did not exceed 10 seconds in any position (*i.e.* in any one of periods 1, 2, 3, 5, 7, and 8).

The certificate is endorsed with the words "Especially Good" when a watch obtains a total of 80 marks or more out of a maximum of 100.

Subsidiary Class "A" Test

A watch which has previously obtained a Class "A" certificate may be entered for a subsidiary retest normally occupying eight days. The watch is tested in the same positions and temperatures as those prescribed for Class "A," and the original certificate is endorsed with the date of the retest if the watch is found to be performing within Class "A" limits.

Class B

This test occupies five periods as follows:

Period.	Duration.	Approximate Temperature.	Position of Watch.
1	14 days	67° F.	Watch in a "vertical" position. (See note below.)
2	14 days	67° F.	Watch in a horizontal position.
3	1 day	42° F.	Watch in a horizontal position.
4	1 day	67° F.	Watch in a horizontal position.
5	1 day	92° F.	Watch in a horizontal position.

For the purpose of this test the "vertical" position is defined as follows: Pendant uppermost, in the case of pendant watches; 6 (VI) o'clock uppermost, in the case of wristlet watches; 12 (XII) o'clock uppermost, in the case of other watches not intended for pendant or wristlet use.

Class "B" certificates are issued for watches whose performance was such that: The numerical average of the daily departures from the mean daily rate during the same period of test did not exceed 2 seconds in either period 1 or period 2; the mean daily rate in period 1 differed from that in period 2 by less than 10 seconds; the mean daily rate did not exceed 15 seconds in either period 1 or period 2; the mean change of daily rate with change of temperature was less than 0·3 second per 1° F.

The certificate is endorsed with the words "Especially Good" when the mean variation of daily rate did not exceed 0·75 second for the average of periods 1 and 2 taken separately, when the difference described in (2) was less than 5 seconds, and when the mean change of daily rate with change of temperature was less than 0·2 second per 1° F.

Chronograph Watches

Each chronograph watch entered for Class "A" or Class "B" is first tested for the action of its chronograph mechanism. The ordinary Class "A" or Class "B" test, which is made with the chronograph mechanism disengaged, is not commenced unless the watch has been found satisfactory in regard to chronograph mechanism.

Time-of-day Chronograph Watches

The ordinary Class "A," Subsidiary "A" or Class "B" test, which is made with the chronograph mechanism disengaged, is not commenced unless the watch is found satisfactory as regards the chronograph action.

The following are the particulars and conditions of the tests made on the chronograph action.

If the watch fails to comply with these conditions, or is otherwise unsatisfactory, it will be rejected without any further test.

Tests are made over one or more periods of 24 hours each at about 67° *F. in the "dial up" position.* (*a*) With the chronograph disengaged; (*b*) with the chronograph in action; and (*c*) in the case of a split-seconds chronograph with the hands split.

The daily rate found under (*b*) must not differ by more than 5 seconds from that found under (*a*) or (*c*).

Short Tests.—(*a*) When the chronograph mechanism is in action and pressure is applied to the push-piece, the chronograph hand or hands must either stop dead at once, or else they must run on unaffected until stronger force is used. (*b*) There must be complete absence of "lagging" and moving in "spasmodic" jumps when pressure is applied to the push-piece. (*c*) The chronograph hand must start exactly from, and return to, the Zero mark. The inclusive errors of starting and stopping must not exceed + $\frac{1}{5}$ second. In the case of a split-seconds chronograph, the hands must run together in exact accordance unless split. (*d*) The indications of the minute-recorder must be exactly consistent with the position of the chronograph hand. In the case of "instantaneous" and "semi-instantaneous" minute-recorders, if the chronograph hand is stopped at 59$\frac{4}{5}$ seconds, the minute recorder should not indicate the completion of one minute. Conversely, if the chronograph hand is stopped at 60$\frac{1}{5}$ seconds, the recorder must not fail to indicate the completion of one minute.

Basis of Computation of the Marks Awarded

Each Class "A" certificate issued for a watch will contain a statement of the marks awarded on the results of the complete test.

Marks are assessed for:

(1) Consistence of daily rate. (Maximum = 40 marks.)

(2) Position adjustment. (Maximum = 40 marks.)

(3) Temperature compensation. (Maximum = 20 marks.)

The certificate is endorsed with the words "Especially Good" when a watch obtains a total of 80 marks or more out of a maximum of 100.

Consistency of Daily Rate

The numerical average of the departures of the individual daily rates from the mean daily rate for a given period of test, is defined as the "mean variation of daily rate" for that period.

The final value, "a" in seconds, obtained for the "mean variation of daily rate," is the numerical average of the eight individual values of the "mean variation of daily rate," obtained separately for the eight different periods of the test.

Marks awarded for consistency of daily rate

$$= 40\left(1 - \frac{a}{2}\right).$$

Position Adjustment

The marks awarded for position adjustment are computed entirely on the results of the six periods, Nos. 1, 2, 3, 5, 7, and 8, in which the test is made with the watch in different positions, at the normal temperature of 67° F.

The mean variation of rate with change of position, "*b*" in seconds, is taken as the numerical average of the departures of the six mean values of the daily rate in periods Nos. 1, 2, 3, 5, 7, and 8, from the algebraic mean of the six mean values.

Marks awarded for position adjustment

$$= 40\left(1 - \frac{b}{10}\right).$$

Temperature Compensation

The marks awarded for temperature compensation are computed on the results of periods Nos. 4, 5, and 6. These portions of the test are made in the "dial up" position and relate to temperatures measured in Fahrenheit degrees.

The temperature coefficient, "*c*" in

seconds per 1° F., that is, the mean change of daily rate for a change in temperature of 1° F., is defined by the following ratio:

$$c = \frac{\text{The sum of the numerical departures of the three average daily rates in periods 4, 5, and 6, from the algebraic mean of these three average daily rates.}}{\text{The sum of the numerical departures of the three mean temperatures in periods 4, 5, and 6, from the average temperature for these three periods.}}$$

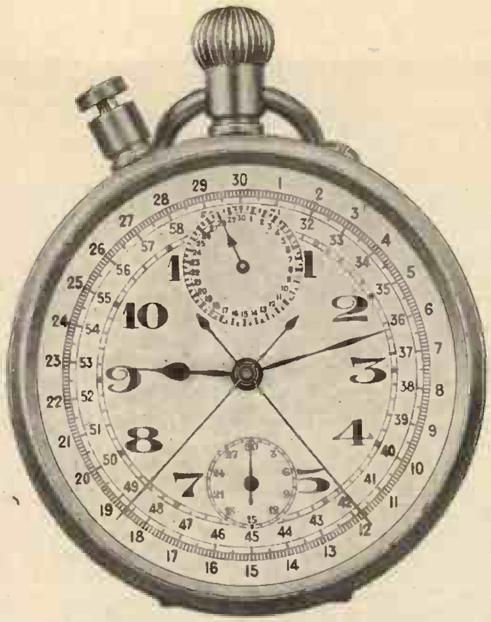
Marks awarded for temperature compensation

$$= 20\left(1 - \frac{10}{3}c\right).$$

The total marks awarded are therefore obtainable from the following formula:

$$\text{Total marks} = 40\left(1 - \frac{a}{2}\right) + 40\left(1 - \frac{b}{10}\right) + 20\left(1 - \frac{10c}{3}\right).$$

Where "a" is the final value of the "mean variation of daily rate" (average for all eight periods of test), "b" is the mean variation of rate with change of position (periods 1, 2, 3, 5, 7, and 8), "c" is the mean change of daily rate per 1° F.



A tenth-second watch by Guignard & Golay which has passed the "Kew" test.

	£	s.	d.
Watches, "time of flight" ($\frac{1}{10}$ and $\frac{1}{100}$ sec.)	0	15	0
Watches, "time of flight" ($\frac{1}{10}$ and $\frac{1}{100}$ sec.) full failure fee	0	10	0
Watches, "time of flight" ($\frac{1}{10}$ and $\frac{1}{100}$ sec.), partial failure fee	0	5	0
Marine Chronometer	5	0	0
Marine Chronometer. Rejected in periods 1 to 3	2	10	0
Marine Chronometer. Rejected in periods 4 to 5	4	0	0
New or Transferred Certificate, Watch or Chronometer	0	2	6
Full Rate Record (Class A)	0	5	0
" " " (Class B)	0	3	6
" Pressure Record (Class A)	0	12	6
" " " (Class B)	0	7	6

Fees for the testing of Clocks, Astronomical Regulators, and Miscellaneous Timing Apparatus will be quoted on application.

Insurance. In addition to the above fees, the sum of 1*d.* per 5*s.* of the test fee will be charged to cover the cost of insurance.

Tests of Foreign Watches

The Board of Customs and Excise have given their consent to the admission, free of duty and without Customs examination, of all foreign watches sent for test at the National Physical Laboratory, but not intended for sale in England, provided they are re-exported immediately after the conclusion of the test (Class A or B).

Foreign firms sending watches for test at the Laboratory, and wishing to avail themselves of this arrangement, are required to observe the following regulations:

(1) The watches *must* be sent through the British Post Office to the National Physical Laboratory by parcel post, insured (Colis postaux assurés), or by insured-box post (Boîte avec valeur déclarée poste).

(2) At the time of posting, an entry must be made upon the "Declaration" (Déclaration en douane) that the watch or watches are sent to the National Physical Laboratory for testing purposes only, and are to be re-exported at the end of the test.

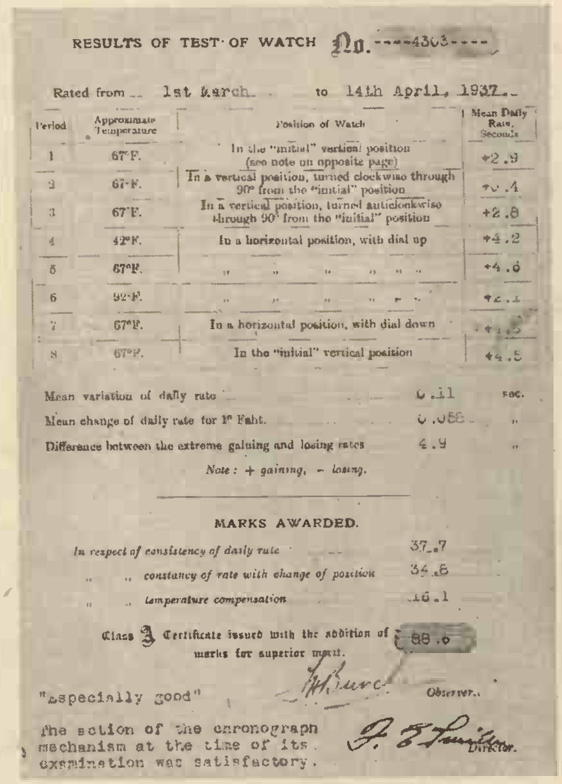
In the case of watches sent from Switzerland the sender should indicate clearly to the Swiss Postal Authorities, at the time of posting, that the parcel is *for transmission by post* and *must be delivered to Teddington through the British Post Office. It will not be accepted* if sent through a forwarding agent (agent expéditeur).

(3) Special labels are provided by the National Physical Laboratory for use on these parcels, and only parcels bearing these labels and forwarded in accordance with the conditions stated under (1) and (2) above will be recognised as coming under this special arrangement.

(4) The watches will be returned to the sender, after the trial, in a similar way, by parcel post, or by insured-box post.

Schedule of Fees

	£	s.	d.
Watches, Class A	3	0	0
Watches, Class A. Rejected during periods 1 to 5	1	10	0
Watches, Class A. Rejected subsequent to above periods	2	10	0
Watches, Class A. Subsidiary test	1	0	0
Watches, Class A. Subsidiary failure fee	0	10	0
Watches, Class A. Failure in respect of chronograph action	0	5	0
Watches, Class B	2	0	0
Watches, Class B. Rejected during periods 1 or 2	1	0	0
Watches, Class B. Failure in respect of chronograph action	0	5	0



RESULTS OF TEST OF WATCH No. ----4303----

Rated from 1st March to 14th April, 1937

Period	Approximate Temperature	Position of Watch	Mean Daily Rate, Seconds
1	67° F.	In the "initial" vertical position (see note on opposite page)	+2.9
2	67° F.	In a vertical position, turned clockwise through 90° from the "initial" position	+[illegible].4
3	67° F.	In a vertical position, turned anticlockwise through 90° from the "initial" position	+2.8
4	42° F.	In a horizontal position, with dial up	+4.2
5	67° F.	" " " " " "	+4.6
6	92° F.	" " " " " "	+[illegible]
7	67° F.	In a horizontal position, with dial down	+[illegible]
8	67° F.	In the "initial" vertical position	+4.5

Mean variation of daily rate 0.11 sec.
Mean change of daily rate for 1° Faht. 0.055 "
Difference between the extreme gaining and losing rates 4.9 "

Note: + gaining, − losing.

MARKS AWARDED.

In respect of consistency of daily rate 37.7
" " *constancy of rate with change of position* 34.8
" " *temperature compensation* 16.1

Class A Certificate issued with the addition of 88.6 marks for superior merit.

"Especially good" Observer.

The action of the chronograph mechanism at the time of its examination was satisfactory. Director.

Here is a reproduction of a page of the Kew "A" certificate, gained by the watch shown above.

World's Biggest Icebreaker

THE world's biggest icebreaker, the *Joseph Stalin*, with a displacement of 11,000 tons, was recently launched by the Orjonikidze Shipyards of Leningrad. The *Joseph Stalin* is 106 metres long, 23·2 metres wide and 20 metres high. Her three 3,350 h.p. steam engines, fed by nine boilers, will enable the icebreaker to develop a speed of 15½ knots in calm water. The hull of the vessel is specially reinforced.

ITEMS OF INTEREST

Steel ribs are placed 31 centimetres apart throughout the whole of her length, while those parts which will receive the full impact and pressure of the ice are reinforced by metal plates 45–50 milimetres thick.

A place for a large hydroplane and two small airplanes, as well as for a take-off catapult is provided in the stern of the vessel. The *Joseph Stalin* will carry four 3-ton and two 1½-ton electric cranes, four lifeboats, each capable of carrying thirty-eight persons, two cutters and several other craft, including a motor barge.

The *Joseph Stalin* is to make her maiden voyage to the Arctic this year.

Glass Wool

WE learn that chemists in America have been so successful with the production of glass wool that hopes have been raised that the material may lead to new textiles.

THIS MONTH IN THE SCIENCE AND

Asphalt Banks for the Mississippi

THROUGH the ages the Mississipi has wound a complicated course across its flood plain. For a century past the white man has been fighting to control it along a set course and prevent it from eating new channels out of its banks. The problems are accentuated from time to time by floods such as have been recently experienced. Many forms of bank protection and reinforcement of the high embankments along its course, called levees, have been tried. Now engineers have decided to try asphalting the banks above the water mark to give them a tar-mac protection reinforced by steel mesh just as though it were a main road surface. Below the river surface the shelving bank requires protection as well, otherwise the river would speedily undermine the above-water protection. To this end steel mesh mats coated with asphalt are being lowered down on to the bed of the river and fastened there. The mats are made up on a special barge which is a sort of floating road-making machine. The mats are laid down in two hundred foot wide strips stretching out 500 feet towards the middle of the river. One mat overlaps another to form a continuous protection. Time alone will show how far man can control the course of the world's third biggest river.

The world's largest electric shovel mounted on caterpillars, which weighs, in working order, 1,150 tons, and carries a dipper or bucket of 33 cubic yards capacity. This type of machine is used extensively in America for stripping the overburden of waste material off the coal deposits so that the coal may be mined in the open without the necessity of costly underground tunnelling.

Sugar from Wood

THE world is suffering from a surfeit of sugar. The sugar cane crops of East and West Indies together with the subsidised beet crops of Europe provide far more sugar than the world consumes. As if this were not enough, a process for converting wood into sugar has been perfected in Germany. A large factory at Mannheim is operating this process. Chemists have known for a long time that wood cellulose is very similar to sugar in chemical makeup. Both consist of carbon atoms united with the atoms of hydrogen and oxygen. But the cellulose molecule is more complicated than the sugar molecule. Bergius, the man who devised the process for turning coal into petrol, is responsible for converting the wood-to-sugar change from a laboratory possibility to a full scale commercial process.

Concentrated Hydrochloric Acid

EXTREMELY concentrated hydrochloric acid is the reagent he employs. Wood Pulp is digested with this, and in one process the resin in the wood is separated from its cellulose and the cellulose is changed into a mixture of sugars. The resins are run off, the acid is evaporated from the sugars, and a hard, dry, neutral cake of sugars is left which itself is a valuable foodstuff. But if the mixed sugars are fermented in a special way some of them are converted to alcohol and the residue is pure glucose. Glucose, as medical opinion has shown, is an extremely digestible type of sugar although it is not identical with cane sugar which consists of a body called sucrose. The important thing about this whole process is, however, the production of alcohol which can be used instead of petrol. Petrol may be called the sinews of modern civilisation—and of modern warfare. Germany is striving to cut down her imports of petrol and this process helps to this end. It should be noted that the initial treatment with very concentrated hydrochloric acid would not be possible if modern chemical engineers had not devised acid resistant, glass-lined steel digester vessels.

Rocket Aeroplane

THE R.A.F. is said to be experimenting with a fighter which uses the rocket principle of propulsion in addition to the normal propeller. The heat of the exhaust gases and the air stream which cools the engine provide this part-rocket propulsion. Normally this heat energy is entirely wasted. The cooling air after it has passed the engine travels round a radiator heated by the exhaust gases. This heats the air up, increases its volume and therefore its velocity. Finally, the exhaust gases mix with the hot air, and the mixture shoots out through a series of vents along the trailing edge of the wings. This produces a considerable rocket-like thrust which materially assists the work of the propeller. Due to the aerodynamic and streamline requirements of the arrangement it is said to be applicable only to machines which are designed for speeds of over 300 m.p.h.

Mercury Turbines

TURBINES driven by mercury vapour in their high pressure stages have been developed in America. Mercury naturally has a very heavy vapour so that it provides a powerful motive force in a turbine. It becomes a vapour at 360° C. when pressure is the ordinary atmospheric pressure. The result is that instead of using very high-pressure steam in the first stages of a turbine, *i.e.* on the first sets of moving vanes, mercury at ordinary pressure can be used. Less robust construction can therefore be used on a mercury turbine as the pressure is low. The mercury is condensed at 360° C. and returned to its boiler. But at this high temperature the water used to cool the mercury condenser itself forms steam. This steam can then be used in the low pressure stages of the turbine. In place of a turbine using high and low pressure steam, the mercury turbine uses mercury in the high pressure stage and steam in the low pressure. It is an extremely ingenious arrangement.

Electro-plated Plastics

A METHOD has been discovered of plating metals on to Bakelite and other plastic resins. The metal can be laid on to the Bakelite to any desired thickness and

WORLD OF INVENTION

afterwards buffed and polished to give a highly burnished surface. One advantage over a plating on metals is that the Bakelite does not rust or corrode in any way. This, of course, is natural. But it must be remembered that ordinary chromium, nickel, copper and other electro-plating fails not because the plating goes, but because the steel or other metal underneath the plating gets attacked through pinholes. Rust spreads from the pinhole so that eventually the plating flakes off. A permanent effect can therefore be got on Bakelite which will find many practical and decorative purposes. Undoubtedly plastic resins are rapidly becoming materials finding many new uses as new ways of using them are developed.

A unique motor-cycle coach which will shortly be used for expedition purposes.

A New Ship Propeller

A GERMAN inventor has produced a type of propeller which is completely novel to marine engineers. It consists of a horizontal wheel driven by a gear off the ordinary propeller shaft. From this wheel or disc project downwards a number of blades. The blades rotate with the disc, but they are set by a mechanism so that they drive the ship forward by exposing their full face to the water as they rotate backwards, and then as they come round to the side of the disc which is rotating forwards they turn edge on to the water. It is exactly like a flat stern wheel with adjustable paddle blades. But the automatically feathering mechanism can be set from the engine room to come into operation at any point of rotation, so that at will the stern can be pushed to either side or the ship can be driven backwards without ruddering or reversing the engine. A ship can thus be manœuvred in a very small space. Tugboats have therefore been equipped with the wheel in several instances, and it is now to be used on larger motor-ships.

A Unique Motor-cycle Coach

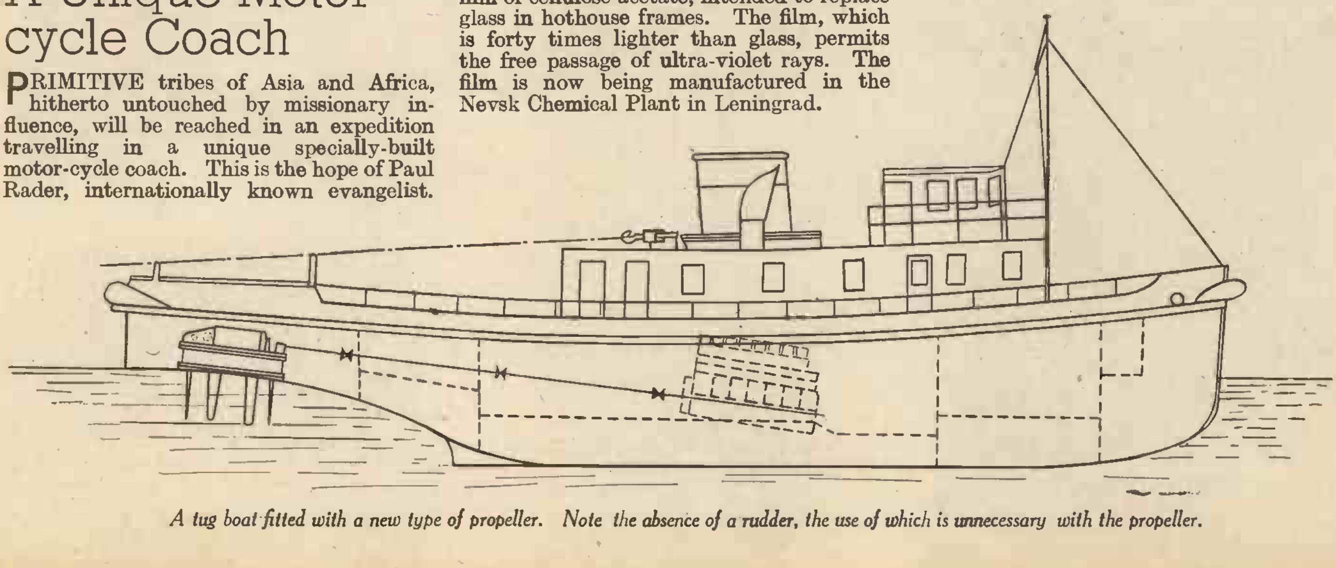
PRIMITIVE tribes of Asia and Africa, hitherto untouched by missionary influence, will be reached in an expedition travelling in a unique specially-built motor-cycle coach. This is the hope of Paul Rader, internationally known evangelist. David Griffin, shown in the illustration, son-in-law of Rader, will be in charge of the trip, to start from America June 22nd. More than 600 primitive races will be visited. The coach contains petrol tanks capable of carrying enough fuel to last 1,000 miles, and food for two persons for a month. The entire outfit is demountable into three pieces for carrying over bad stretches.

Seven Crops in One Year

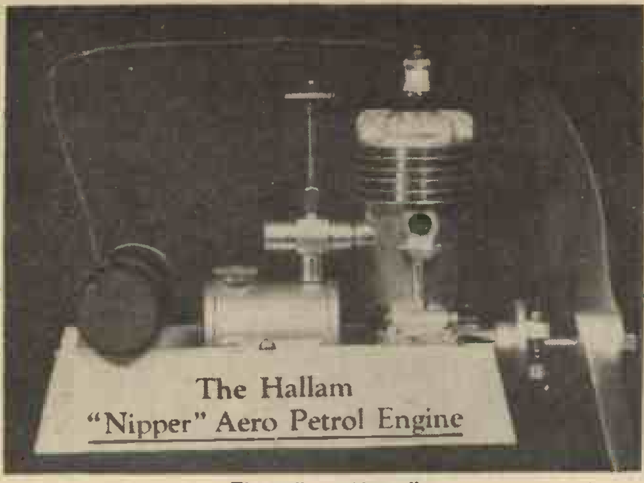
SEVEN crops of spring wheat in one year, three crops of tomatoes and four crops of flax were obtained by the Leningrad Physico-Agronimical Institute, as the result of an experiment in which the shoots of sixty varieties of grain, vegetables and industrial crops were irradiated by powerful electric lamps. This Institute has also worked out a formula for the production of a colourless film of cellulose acetate, intended to replace glass in hothouse frames. The film, which is forty times lighter than glass, permits the free passage of ultra-violet rays. The film is now being manufactured in the Nevsk Chemical Plant in Leningrad.

Seasoning Wood by Wireless Waves

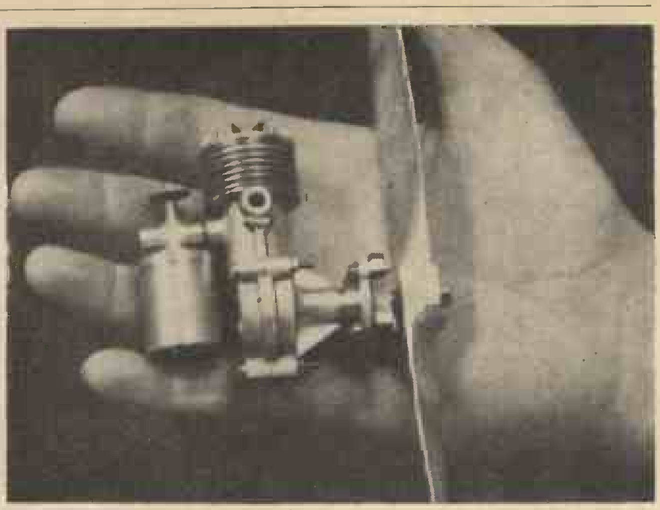
HITHERTO, attempts at rapid drying of wood by ordinary methods have been unsuccessful owing to the interior moisture being imprisoned by the quick drying, and the hardening of the outer skin of the woods. A Russian scientist has now, however, made use of radio-diathermy, using a wavelength of between 5 and 6 metres, which has the effect of driving the interior moisture quickly towards the surface of the wood. This process is so rapid and satisfactory that it is said that an oak board of 5 centimetres thick, which normally would require four to six weeks' air drying, can be seasoned in half an hour, and, moreover, there is not the slightest trace of warping.



A tug boat fitted with a new type of propeller. Note the absence of a rudder, the use of which is unnecessary with the propeller.



The Hallam " Nipper "



The Hallam " Baby "

MODEL AERO TOPICS

BY F. J. C.

Petrol-model Record Broken

MR. G. RICKARD and A. T. Fraser flying Comet II machines, recently attempted to break the British Duration Record for petrol-driven models, previously held by Capt. Bowden, at 12 minutes 48 seconds. As most readers know the record is timed from the moment it leaves the ground until the time-keeper loses sight of it. The latter must not follow the model. Mr. Rickard's machine passed out of sight 11 minutes 30 seconds after it left the ground, but Mr. A. T. Fraser's attempt was successful, for after getting off in fine style and making a rapid climb, his machine gained considerable altitude, and passed out of the time-keeper's field of vision 16 minutes 25 seconds after leaving the ground, thus beating the existing record by about four minutes. Mr. Fraser's machine was not recovered, however, and at the time of writing it has not been traced. It is thought that it landed somewhere within a radius of 5 to 10 miles of the Kingsdown district, near Wimborne. If any of our readers know of its whereabouts they are asked to communicate with the Hon. Sec., Bournemouth Model Aircraft Society; Mr. H. F. Weller, 55, Victoria Avenue, Winton; with the Wimborne police, or with Mr. Fraser, telephone number Bournemouth 3418. The official time-keepers were Messrs. A. E. Brookes, and Mr. E. G. Penhall. Capt. Bowden, holder of the previous record, was formerly a member of the Bournemouth Model Aircraft Society.

The Bowden International Trophy for Petrol-engined models.

The Hallam " Nipper " and " Baby " Engines

THE photographs at the top of this page show the Hallam " Nipper " and " Baby " Engines. The " Baby " is $\frac{9}{16}$ in. bore and 3 in. overall height. It weighs $3\frac{1}{2}$ oz. and drives a 9-in. propeller at 5,000 revolutions per minute, developing $\frac{1}{25}$th h.p. and a static thrust of 10 oz. I am told that it starts very easily and is not temperamental. It can be supplied with a neat cone mounting if required.

Catalogues

HUNTS, Model Aero Supplies, 5, South End, Croydon, have sent me a copy of their *Guide to Flying Scale Model Aircraft Constructional Kits, Balsa Wood, and Accessories.* This is a well illustrated list and details a great number of kits, petrol engines, wood, cements and glues, and all of the materials necessary for making every type of model aeroplane. This catalogue will be sent to any reader enclosing 2*d.* in stamps.

Lord Londonderry encourages Air-minded Modellers

LORD AND LADY LONDONDERRY, accompanied by their daughter, Lady Mairi Stewart, who is a keen modeller and leader of Club 300, attended the Fourth Annual Rally of the Skybird League, at the Imperial Institute, South Kensington.

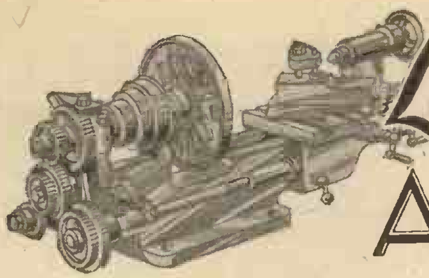
Lady Mairi Stewart presented the awards to some forty-eight competitors, many of whom had travelled long distances. District Commodore F. C. Moldenhauer, a typical blonde young Scandinavian, marched up to the platform to collect his own and eight other prizes awarded to his countrymen. He had made the long journey from Norway for this special event, and he was given a great reception which demonstrated clearly the admiration felt for his keenness. Another long-distance traveller for this special event was Mr. N. J. Campbell, from Whitley Bay, Northumberland, who had come with his wife to receive his award, a return ticket for two from London to Paris, presented by British Airways Ltd. The Skybird League Challenge Cup was won by Club 274, Orpington, Kent—this Club won the Cup in 1935. The Air League Shield was won by G. B. Atkinson of Catford, for the second time in succession. The Chairman gave an account of the activities of the League, and speeches were made by Air-Commodore Chamier, followed by Lord Londonderry, former Secretary of State for Air, who referred to his own activities in model construction, and the excellent work being done by the Skybird League.

S.M.A.E. Notes

THE S.M.A.E. recently considered an application from Mr. A. H. Lee, of the

(*Continued on page* 504)

Mr. A. T. Fraser's Comet II just taking off for its record-breaking flight of 16 mins. 25 secs.



Lathe Work FOR AMATEURS

Two-to-one Gears

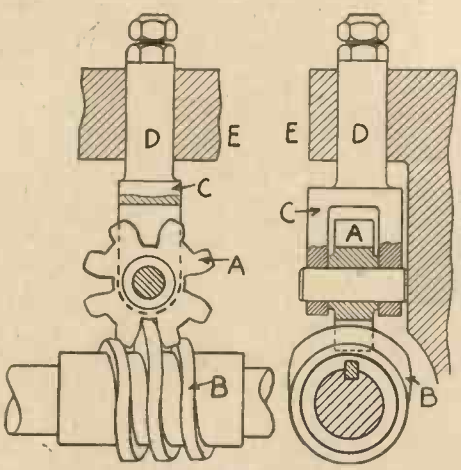
WHEN building small power or model petrol, oil or gas engines acting on the conventional four-cycle principle, it becomes necessary to provide some form of two-to-one gearing to operate the valves so that they can be lifted and dropped back on their seats once in every two revolutions of the crank-shaft.

The simple and generally adopted method of doing this is to use a pair of toothed gear wheels or a pair of skew gears with one member having twice the number of teeth of the other; the wheel with the smaller number of teeth being on the crank-shaft and that with the larger number on the cam-shaft or its equivalent.

Cutting Toothed Wheels

Amateurs are seldom equipped with plant or appliances for cutting toothed wheels, and therefore some consideration of alternative methods of providing this two-to-one gear for the valve may be of interest. As the methods shown have been used by the author and found efficient, they may be adopted with confidence. The keen mechanic will be able to adopt one or the other to his particular design of engine. The principle is shown in its simplest form in each case.

In Fig. 1 we have a star wheel A engaging with a worm B; the latter is on the crank-shaft. The worm B is of the single start (single thread) type. The star wheel A may have any convenient number of teeth so long as the number is even. It is carried in a yoke C formed in one piece with the tappet D which lifts the valve. As the worm B rotates, its thread engages with the teeth on the star wheel which it rotates at the rate of one tooth pitch space for each rotation of the engine crank-shaft.

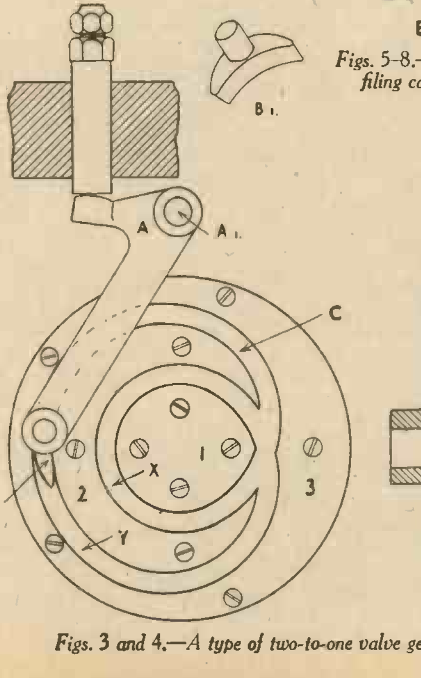


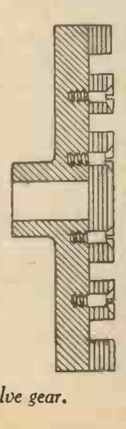
Figs. 1 and 2.—(Left) Details of the star wheel. (Right) An end view of the worm.

The end view of the worm, Fig. 2, shows that the periphery of the thread is concentric with the axis of rotation except in one place where the thread rises and forms, in end view, a cam to lift the valve. This cam is not the same shape as would be the cam on a two-to-one shaft since it must raise the valve during a whole half-turn of the crank-shaft, *i.e.* during one stroke of the piston—downwards in the case of an inlet valve and upwards in the case of an exhaust valve.

The Star Wheel

The worm gears with the teeth in the star wheel or rather between the teeth. Alternate spaces between these teeth are deep enough to allow the section of the worm shaped as a cam, to pass through without lifting the star wheel, its yoke and the tappet. This is the position shown. The other alternate spaces between the teeth of the star wheel are shallow and when these come, in turn, into engagement with the worm the cam formation bottoms in the tooth space and lifts the star wheel, its yoke and tappet, and the valve. Thus we get the valve lifted only once every two rotations of the cam, and therefore only every two turns of the crank-shaft, and eliminate the need for a cam-shaft with its two-toothed gear wheels to drive it.





Figs. 3 and 4.—A type of two-to-one valve gear.

The star wheel should be set out and filed to shape out of mild steel.

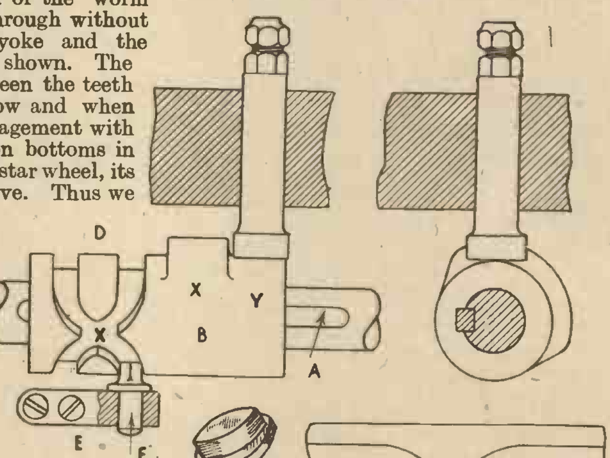
The worm should be screw-cut with deep threads standing up from the axis the height of the part which forms the cam. Only three turns of the screw thread are necessary. The two threads each side of the cam can be turned down, and then the thread which forms the cam will be standing higher and can be shaped to form the cam as shown in the end view. This can be done with a file.

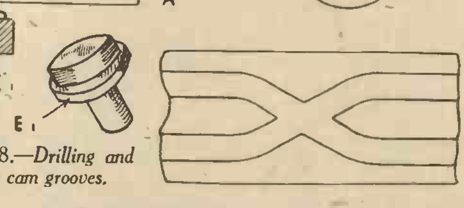
The worm, before turning, should be bored to fit the engine crank-shaft and mounted on a mandrel between the lathe centres. The star wheel should rotate on a hardened headed stud, a tight fit in the holes each side of the yoke. A split pin will locate it endways.

The yoke should be made of mild steel turned to a parallel shank to act as a tappet, and should fit a tappet guide E which may be of gun-metal and screwed to the side of the engine crankcase or suitably mounted as determined by the design of the engine.

Two-to-one Valve Gear

In Fig. 3 we have a type of two-to-one valve gear which was used on the successful Geneva made, "Motosacoche" motor bicycle. The valve lifting lever A, has, attached pivotally at its bottom end, a hardened shuttle B which engages with a shuttle race C of special configuration. This shuttle race can be arranged on the side of





Figs. 5–8.—Drilling and filing cam grooves.

the flywheel inside the crankcase or on the face of a disc mounted on the crank-shaft. The shuttle, which is shown separately at B_1 as the disc is rotated, traverses the double convolutions of the groove on the disc. One convolution, X, is practically concentric with the axis of rotation, and while the shuttle transverses it, the valve is not raised. When the shuttle is led, during the next rotation, into the outer convolution Y, it will be seen that the lever carrying the shuttle is displaced because the shuttle has passed across from the inner concentric to the outer eccentric convolution, and the displacement of the lever end will raise the valve during one half of the rotation of the crank-shaft and one stroke of the piston.

To make this device, the disc is built up of laminations of mild steel plate to a thickness of the depth of the shuttle race or groove, and on the outer disc is set out one double cam convolution shown, with a pair of dividers, the outlines being then dotted in. A back plate of cast-iron, Fig. 4, with a central hole bored to key on the engine crank-shaft is prepared. To this all the discs are laid upon each other and are secured by countersunk head screws at the points shown in Fig. 3. The screws should have plain shanks for a length equal to the combined thickness of the laminated plate—*i.e.* all the discs, and they should nicely fit the holes in the discs and screw them all up tight against the plate. The screws, it will be seen, hold the three pieces which will be separate pieces when we have cut out the double groove forming the cam. These pieces are marked 1, 2, and 3.

The Cam Grooves

We now take the discs apart and, because of their individual thinness we can easily drill and file up the cam grooves: first in the outer lamination we have marked and then, using this as a template and the screw-holes as locators, in the other discs in turn. We shall have then a series of parts shaped like 1, 2 and 3, and since they have the screw-holes through them we can screw them in correct position, one on top of the other, on the cast-iron back plate and they will, when tightened up, form the cam plate with the deep groove to take the shuttle.

The arrangement of the bell crank lever A, which is pivoted on a stud A_1, screwed into the crank-case, will be to suit the particular design of engine. The short end of the lever lies horizontally and has a curved case-hardened top surface which comes up under, and lifts the conventional valve tappet or plunger.

A third arrangement is shown in Fig. 5. Along the crank-shaft is milled a long keyway A and the valve-lifting cam B can slide along the shaft but cannot rotate upon it, a key, loose in the keyway in the shaft and screwed to the cam locating it radially.

The Shuttle Piece

The cam B is shaped as in the end view, Fig. 6, and it has two peripheries, one, X, which forms the cam and the other Y which is concentric. On the suction compression and power strokes (we are dealing with the exhaust valve now) the concentric part Y comes below the valve plunger which is not lifted, but on the exhaust stroke (or inlet in the case of an inlet valve) when the valve has to be raised, the whole cam block is moved endways (to the right in our view) along the shaft by the device shown at D (Fig. 5) which is formed integral with the cam and consists of a cylinder having a double groove around it which crosses itself at X but runs parallel with itself around the other side. The shape of this groove laid out flat is shown at Fig. 7.

Below the grooved portion of the cam block B is a fixed block E screwed to some part of the engine. It has a shuttle piece E_1, on a pin in a hole. This shuttle piece is shaped as shown at Fig. 8 and engages with the groove. The effect is to move the whole cam block in one direction on one rotation of the crank-shaft, and in the other direction on the next rotation. This brings the cam X in line with the plunger on one rotation and away from it (as in Fig. 5) on the next rotation. In this way we get the valve raised every second rotation of the crank-shaft and without the need of accurately-cut toothed gears.

The groove in the cam block is set out from the template, Fig. 7, which is wrapped round the cylinder of the block and punched through.

Three-eighth inch holes are then drilled along the centre of the groove outline and close to each other and to a depth of ⅜ in. They are then given a flat bottom by an end mill or cutter to register the depth of ⅜ inch. The metal remaining in the sides of the groove is cut away with a fine chisel and the groove sides filed smooth.

The shuttle which is capable of oscillation in block E, and which should be hardened, will fit the groove and its pointed nose each end will lead it from one groove circle to the other and so move the cam X alternately into line with the tappet foot, and then out of engagement with it so that the valve will be lifted only every alternate rotation of the crank-shaft as is required.

Streamlined Trains

AMERICA'S NEW MONSTER OF THE IRON ROAD

AMERICA is intensely proud of its latest progeny, the two 12-car trains that bear the name "City of Denver," and which run between Chicago and the Colorado capital over the Union Pacific and Chicago & North Western on 16-hour schedules, the fastest long distance passenger schedule in the world. Service was recently started simultaneously from the two cities, and from the beginning it has been a matter of practically capacity handling, even before the summer vacation season ended.

"The Denvers" bring the Union Pacific's streamline total to six, the others being the "City of Los Angeles," the "City of San Francisco," and the "City of Fortland"; the first two of which, the M-10,000 and M-10,001 began their trans-continental service last May and June, respectively.

65½ m.p.h.

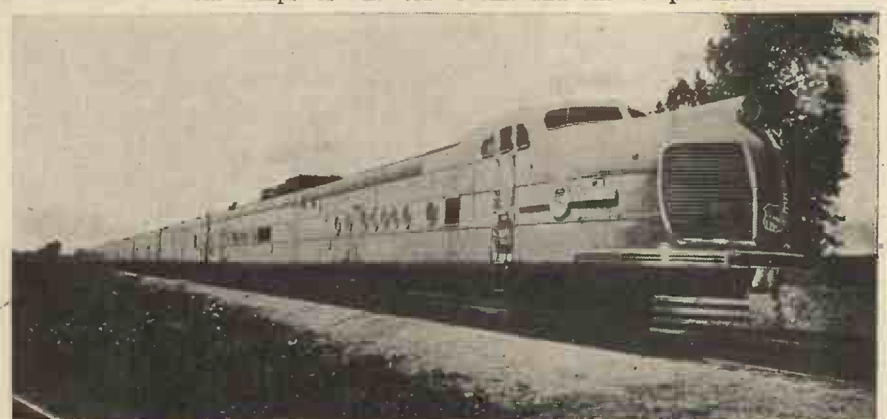
The "Denvers" averaged 65½ miles an hour on the 1,048-mile trip, although a speed of 91 miles was attained at times. The accompanying photos give some idea of the travel joys to be found on these trains, to say nothing of the feeling of security engendered by the motor-cars. A brief description of the twin trains is of interest. They are straight sided and of even more than standard width; the power cars are of alloy steel, and the cars of aluminium alloy; they are air-conditioned, and the original U.P. streamline colours—canary-yellow sides, streaked with scarlet, with autumn brown atop and below—are followed.

The overall length of the train is 864 ft., and the total seating capacity 276 ft. The leading power car is different in detail from those heretofore turned out, the cab being set back somewhat farther from the nose. It is 68 ft. 3 in. long, and the training power car is 5 ft. shorter. Each car contains a 1,200-h.p. Diesel engine. Next comes a baggage car with a 100-h.p. auxiliary engine for lighting and air-conditioning, then a baggage-mail car. One of the train's novelties must now be considered, the forward section being for baggage, and the remainder is styled the "Frontier Shack," a careful reproduction of a typical bar-room in the pioneer days of the West. The walls are of unfinished and unmatched face-nailed white pine boards; the flooring, of scrub oak, is likewise eccentric. Although the bar has a mahogany top, it, too, is of pine, and is decorated (for atmosphere) with the unhygienic towels that used to prevail in those now remote days. Tables and chairs are rough, and the walls are ornamented with old photographs of stage and pugilistic stars, clips from the *Police Gazette* and genuine old advertisements. Illumination is from lamps of the old oil and wick type, but electrified.

Features

Two day coaches with a capacity for fifty passengers follow, both with aluminium type ornamentation on ceiling and walls in natural wood veneer. Seats are of the twin reclining and rotating type, with rubber cushions, and mohair upholstery, and concealed serving trays in the back. The unusual lighting system is a part of the luggage racks. A 15-valve radio serves both cars.

The dining car, next in order, is finished in redwood burl veneer with aluminium trimmings. The seat coverings are genuine pig-skin. There are two sections, the diner proper, and the cocktail lounge, the latter having bench-type seats of red leather, runnings lengthwise of the car. On each train are two 12-standard section cars; one with eight enclosed sections, two bedrooms and one compartment; and last, the observation, which also has five bedrooms and one compartment.



The "City of Denver," Pullman-Standard's latest streamlined train.

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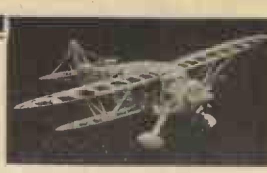
6D. MONTHLY

M.S.S. VALUE KITS



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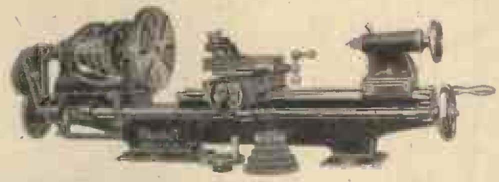

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Enlarging Made Easy

By G. L. WAKEFIELD

SOME LABOUR-SAVING HINTS WHICH WILL SAVE TIME AND TROUBLE IN THE DARK-ROOM

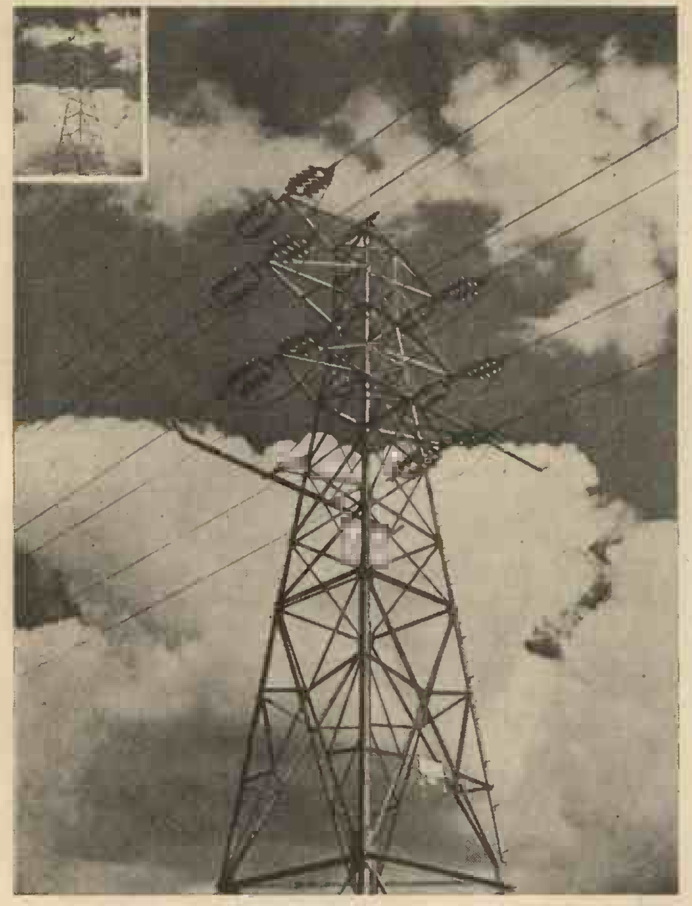


Fig. 1.—This gives a good idea how much a good negative can be enlarged without any loss of quality.

THE increasing popularity of the miniature camera with its accompanying small negatives, makes the use of an enlarger a necessity to reveal the full beauty of a picture. Here are a few useful hints which will enable the enthusiastic amateur to save himself much time and trouble in the dark-room.

When mounting film negatives for placing in the carrier of the enlarger, it is not wise to sandwich them between two pieces of glass, owing to the number of surfaces liable to collect dust, which will cause a plentiful crop of white spots on the prints. Use only one sheet of clean glass, and fix the negative in position by means of narrow strips of gummed paper along each edge of the film. Rolls of opaque, black gummed paper tape can be obtained in various widths from any large stationers, for a few pence. Any clear glass around the negative should be blocked out with further strips of gummed paper.

Accurate Facsimile

To secure accurate focusing on the easel, rule several long scratches on a discarded, over-exposed negative, and mount this on a piece of glass to fit the negative carrier. Roughly focus the negative to the size required, and then replace it with the scratched film. Perfect sharpness can easily be secured, as the scratches are brightly projected on to the easel, and any lack of definition is soon detected. When focusing is completed, the proper negative can be returned to the enlarger, with the certainty that the enlargement will be as sharp as possible.

A red cap for the enlarger lens is useful, as it enables the image to be plainly seen while adjusting the bromide paper on the easel. One can be made very quickly. Fix out a small piece of old film, and wash thoroughly. Soak the wet film in ordinary red ink, until it has absorbed enough to make it deeply coloured. Wash off the surplus ink, and hang the film up to dry.

A pill-box to fit the lens makes an efficient cap. Replace the bottom of the box with a circle of the dyed film. If a box of the right size is not available, a substitute can be made by glueing into a ring, a long strip of stout brown paper, about ⅜ in. wide. When the cap is complete, give it a coat of black Indian ink.

Fig. 2.—Just a clean sheet of glass, with strips of black paper gummed along each edge, will give a perfectly clean white border to the enlargement.

Improving Prints

A narrow white border improves the appearance of any print, and the best way to obtain this, is shown in Fig. 2. Stick strips of black gummed paper tape along each edge of a clean sheet of glass the same size as the enlargement to be made. The glass will effectively hold the bromide paper on the easel during exposure, and at the same time give a clean white border to the print. The glass should be placed on the paper with the paper strips downwards, and of course, in the case of a horizontal enlarger, the glass will have to be held in place with drawing pins. The border can be trimmed to any width when the print is dry.

For timing exposures and development, an easily made gadget is shown in Fig. 3. It is just a wooden bracket to hold the dark-room clock, and is made from two odd pieces of wood, and in the front of the clock is fixed a small red lamp. A strip of brass screwed on to the top of the bracket holds the lamp-holder, and the latter is fitted with a small shade cut from a white postcard. The red light is made by covering an ordinary 3·5-volt miniature screw bulb, with several thicknesses of red waxed paper from a roll-film wrapper.

Fig. 3.—A handy idea for the dark-room clock so that by the touch of a button the dial is illuminated.

The light is wired up to a battery and a bell-push fixed in a convenient position near the enlarger. By pressing the bell-push, exposure times can be noted with the minimum of trouble. The idea is also very useful when developing plates or roll-films.

When enlarging, it is as well to have a few sheets of thick blotting paper handy.

Fig. 4.—The charm of this modern portrait is due to the fact that the face has been enlarged to fill completely the picture space.

When it is necessary to print up a dense sky, a sheet of blotting paper can be torn to the shape of the sky-line, and used as a mask to shield the rest of the print. Keep the mask moving gently, a few inches away from the bromide paper, so that there is no risk of a hard line where the printing up is done.

Bromide Paper

For developing bromide paper, the same metolhydrokinone formula as recommended in the April issue for roll-film, will be found quite satisfactory.

Metol . . . 20 grains.
Hydrokinone . . . 60 grains.
Sodium Sulphite . . . 1½ ounces.
Sodium Carbonate . . . 1½ ounces.
Potassium Bromide . . . 16 grains.
Water to . . . 20 ounces.

Dissolve the chemicals in the order given, using warm water, and for use, dilute one part of developer with one part of water.

An acid fixing bath should always be used for bromide paper, to prevent yellow stains. Acid hardening fixing salts can be bought in tins from any photographic chemist, and these are preferable to a hypo bath acidulated with potassium metabisulphite.

After fixing for fifteen minutes, wash the prints for at least half an hour in frequently changed or slowly running water. Blot off the surplus water with fluffless blotting paper, and pin up by one corner to dry. Never leave prints to dry between blotters, as they are almost sure to stick.

MODEL AERO TOPICS
(*Continued from page* 498)

Bristol and West M.A.C. for recognition for an indoor spar tractor R.O.G. record. The model was flown at the Royal Albert Hall by proxy, the proxy flier being Mr. C. H. Needham. The time was 2 min. 23 sec., and the record was granted. The S.M.A.E. also approve Mr. A. T. Fraser's petrol-driven record dealt with above.

* * *

The Bowden International Trophy (illustrated on page 498), was presented by Capt. C. E. Bowden, a vice-president of the society for an international competition to be held yearly in England, for petrol-engined models. The Trophy is silver and is in the form of a cup with a lid. The lid carries a silver replica of a petrol model. It is 18 in. high with a plynth, the plynth carrying a silver collar on which will be engraved the names of the winners. The first competition is in August this year, the main rules being as follows:

1. The competition is open to all nations and all types of petrol-driven models, except "stick" fuselage type. Foreign machines may be flown by proxy.
2. There will be no postponement from date fixed for contest.
3. The order of starting will be drawn for.
4. Each Entrant sill be allowed three flights; 30 marks being possible for each. Each flight shall be not less than 40 sec. and not more than 1 min. 30 sec. duration. Any variations from these time limits will result in a total loss of marks for that flight. Models must R.O.G. without push or assistance.
5. Timing will commence on release of model by Competitor.
6. Immediately after each Competitor's last flight a Judge will inspect the model and if it is undamaged from its original inspection, will be awarded 30 extra marks; very slight damage 10 extra marks; damage other than slight will disqualify for extra marks. (If the Judge is in doubt he will call the other two Judges and their decision shall be final.)
7. The competition to start at 2.30 p.m. Competitors are not eligible unless their machines are in the enclosure by 2 p.m.

* * *

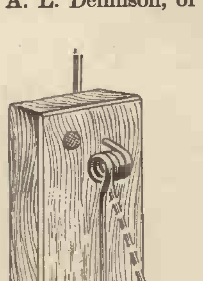
The first Annual Dinner, Dance and Prize-giving was held on Wednesday, April 7th, at the Lysbeth Hall, Soho Square, London. Dr. Thurston was in the chair. Mrs. Thurston presented the cups, medals, prizes, and record certificates won last year. Dancing followed.

Stuart Turner's "Lightweight" Engine

I HAVE received details of Stuart Turner's Petrol "Lightweight" Engine, which is a 3-port, 2-stroke developing ·3 b.h.p. at 3,600 revolutions per minute. The bore is 34·5 mm. and the stroke 32 mm.; yielding 29·9 c.c. It is 7½ in. in height, whilst the length over crankshaft is 5¼ in. It weighs 3 lb. 12 oz. including flywheel. Lubrication is on the petroil system with auxiliary drip-feed direct to intake. It is supplied in two styles—air or water cooled, and is supplied finished at £9, or as a set of castings and parts at £1 17*s.* 6*d.* A fully machined set of parts cost £6 12*s.* 6*d.*, and for a small extra charge those who purchase castings can have all holes drilled and tapped. Messrs. Stuart Turner Ltd., of Henley-on-Thames also undertake the machining work for any particular part. This well-known company has been making engines for so long that the "Lightweight" can confidently be recommended for aero and boat purposes.

Birmingham's First Lighting Switch

IT is believed that the Dennison factory was the first industrial building in the Midlands to enjoy electric lighting, and we are indebted to Mr. A. L. Dennison, of the Dennison Watch Case Company, for sending us one of the switches used on the original installation.



The first lighting switch.

Date Unknown

The exact date is not known precisely, but it was about 1880 that Mr. Franklin Dennison installed a Chamberlain and Hookham 50-volt dynamo, driven by a gas engine, and enlisted what help was available locally in order to carry out the necessary wiring.

The "electricians," of course, were not all that could be desired. One man who was engaged for the job had but an elementary knowledge of the subject and, fearing that the electricity would run out of the ends of the two mains if they were left open, he joined them together—with disastrous results. When the dynamo was started up, the wires got hot enough to cause a fire which burnt the shop down! Ultimately, however, the installation was made, and worked well.

Made by a Local Plumber

The individual lighting switches, of which the illustration is typical, were made up by a local plumber, and call for little description. The switch consisted of a wood block in which holes were drilled to take phosphor bronze wires of approximately $\frac{1}{16}$ in. diameter—one of which was coiled to obtain a tension engagement with the other, the latter being formed in the shape of a hook. The incoming cables were soldered to these wires at the back of the block, and the switch was then fixed by nails in a convenient position.—*From The Crabtree.*

MAKING STEEL

STEEL TUBE MANU- THE TRIUMPHS OF NEERING. BELOW TUBES ARE MADE WORKS AT

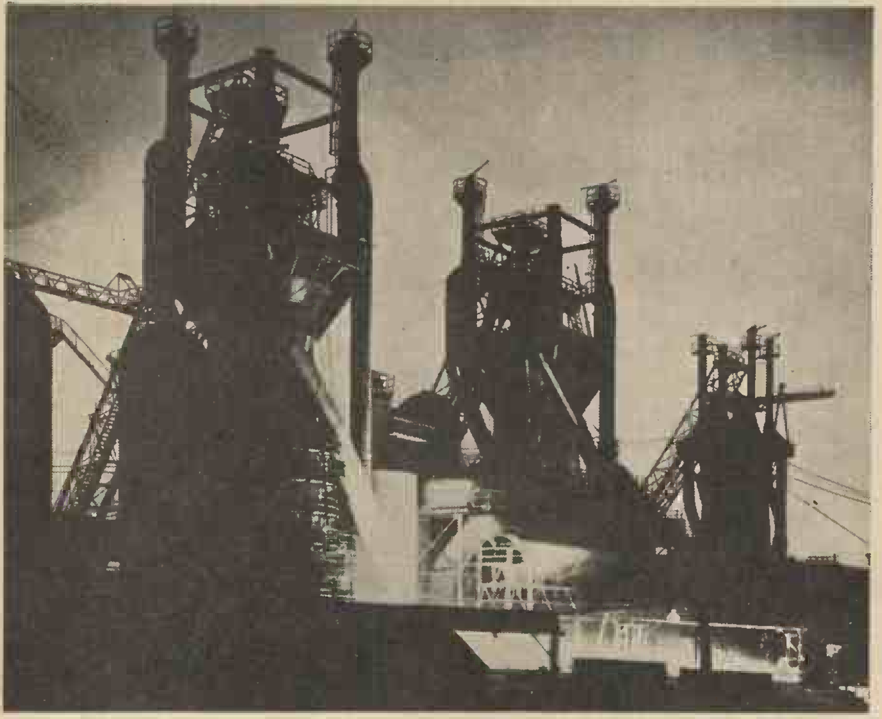


Fig. 1.—Blast furnaces at Corby by night.

In modern manufacture the tendency is to concentrate all operations from raw material to finished product on one-unit works. Recently at Corby, in Northamptonshire, steel tube manufacture has been organised in this way on the largest scale. We find the spectacle of blast furnaces, coke ovens, Bessemer steel plant and rolling mills organised to the conversion of iron ore and coal into millions of feet of small steel tube. At one point on these works there are two welding machines which turn steel strip, moving through at nearly ten miles an hour, into steel tube. Through these two bottle necks flows half the total steel production of the works. It is a triumph of modern organisation that so much material can move smoothly through such a bottleneck, hour after hour, twenty-four hours at a stretch without one single hitch.

To understand steel tube production, one should go right to the heart of the process, that is to the tube-making benches. At Corby, steel tube is made by two methods. Some tube is welded up automatically from strip steel, but larger tubes are made by pushing out steel ingots on push benches.

Welded Tubes

The principle of the Fretz-Moon welding method is illustrated in Fig. 3. Coiled steel strip comes from the rolling mills as shown in the illustration, Fig. 4. It is unrolled and straightened through rolls before going to the heating furnaces. Coil is fastened to the end of coil as they unreel by a flash-welding machine. As this process takes a minute or more to carry through, an accumulating device has to be incorporated in the flow schedule. The strip therefore doubles back on itself in a big loop, and while the strips are being joined, the loop gets smaller. It again extends and gets bigger as the new coil unreels, and although it is a simple device, it enables the mill to run smoothly with perfect continuity.

Fig. 2.—A view of the Wellman mill, showing the finished tubes in the foreground.

The Loop Pit

From the loop pit the steel strip is drawn through a long gas-heated furnace. Temperature and time of travel in the furnace are exactly controlled so that the strip leaves the furnace at the correct temperature for welding. It immediately enters the welding rollers. One pair of rollers are curved to bend the tube round into a circular cross section, the next pair of rolls force the edges of the strip together, and a third pair give the final seal to the weld. In one short foot of travel, at the rate of ten miles an hour, strip has become tube. If you examine a piece of gas or water pipe you may detect the line of this long weld running longitudinally, but it is so perfectly executed that you will have to look very closely to find it.

The continuous worm of steel is then seized on by a flying saw which cuts it off into lengths as it still travels on its way. As soon as one cut is completed, the saw lifts, flies back, drops again and makes another cut. It is a most unusual kind of mechanical synchronisation. The cut lengths are cooled, scaled, brazed, then threaded at the ends on a multi-threading machine, the sockets at the end are spun on and the tubes are all ready to be bundled into batches for despatch.

Wellman Push Bench

The Fretz-Moon process is used for tubes up to 2 in. gauge. Tubes larger than this up to 6 in., are made by drawing steel ingot over mandrils. A diagram of this method is shown in Fig. 3. It starts with steel billets, that is steel blocks cut off to exact size and weight from bar. Each billet is heated under pyrometer control in a rotary gas furnace, and the billet is put in one side. By the time the furnace has rotated to bring that particular billet to working heat it is alongside the push bench. It is seized by tongs, put in a press and pierced with a blind hole. Then a mandril bar is pushed into the hole, bar and billet are slung on to the push bench positioned in front of a hydraulic ram. In front is a run of rings of gradually diminishing diameter. Power is

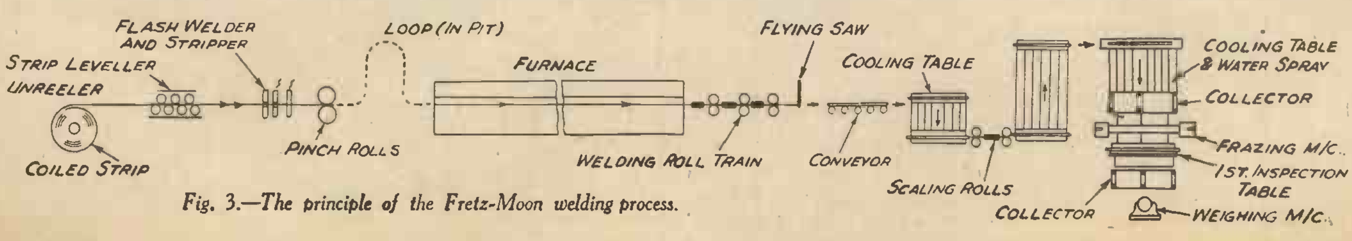


Fig. 3.—The principle of the Fretz-Moon welding process.

TUBES

FACTURE IS ONE OF MODERN ENGI- WE DESCRIBE HOW AT THE CORBY NORTHAMPTON

put on the ram and at a pressure of thousands of pounds the red-hot billet is shot down through the rings with a clattering rush. As in all pressing operations, mechanical force raises the temperature of the steel and the metal flows smoothly round the mandril bar in a tube of even diameter and thickness.

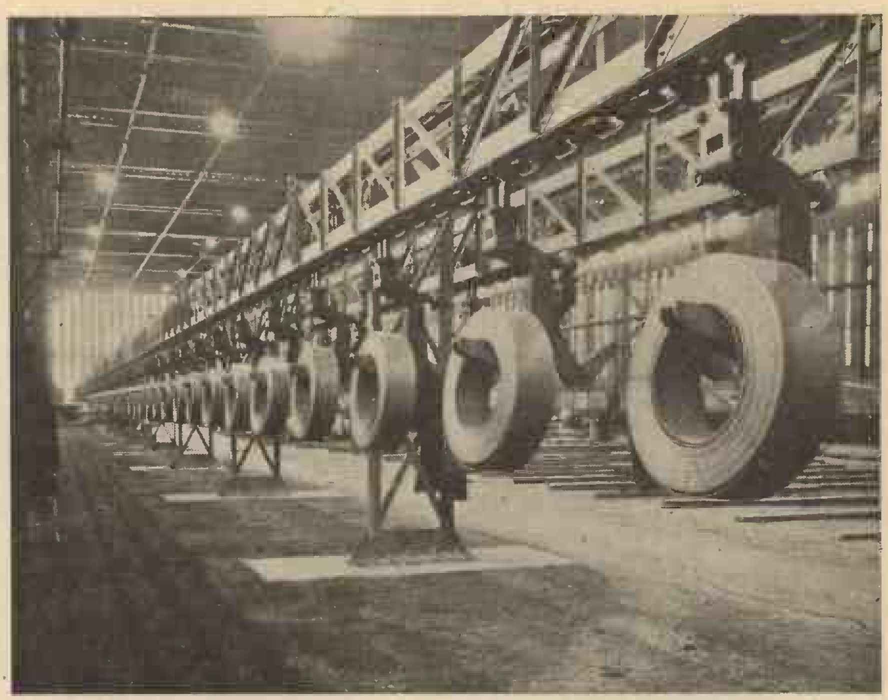


Fig. 4.—Reels of steel strip travelling on a hook conveyor from rolling mills to tube mills.

Smoothing and Polishing

The newly formed tube, still on the mandril, shoots out from the last ring on a set of spinning rollers which smooth and polish it. It cools here and shrinks on the mandril. To release it a quick reheat is applied, which expands the tube from the mandril so that the latter can be slid out free of the tube. The mandril travels back to the head of the pushing bench along one of those automatic conveyors which are standard in modern mass production work. The tube itself goes off to the finishing benches and quickly reaches the despatch wharfs.

Steel Production

Back of all these operations are the steel mills, the Bessemer steel converters, the blast furnaces and coke oven batteries. These take raw materials, the iron ore, coal and limestone from nearby supplies and turn out the steel for the tube mills.

Steel needs pig-iron and pig-iron requires coke so that the first unit is the coke oven batteries. These take raw coal and carbonise it to coke in great vertical gas-heated ovens built of fire-resistant brick. But coke is only one of the products. There are the by-products of tar, ammonia and motor benzol and most important of all—coal gas which is sufficient in quantity to supply all the gas needed for the many soaking pits and reheating furnaces of the whole series of processes.

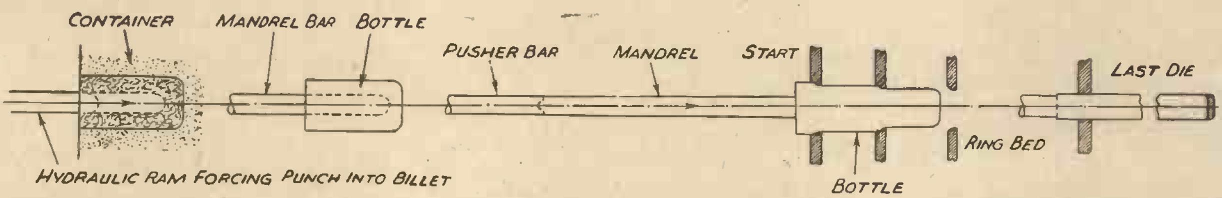


Fig. 5.—Diagram illustrating the Wellman push bench process.

Coke from the ovens goes to the blast furnaces, where it meets iron ore from the iron fields and lime from lime-burning kilns. When pig-iron is tapped from these great furnaces, it is taken red hot in ladle cars to the steel plant. The blast furnaces also have a by-product—blast furnace gas which is used for heating the coke ovens and for steam raising in the boilers which power the whole works.

The pig iron is turned into steel by blasting it with air in Bessemer converters. The process is essentially the burning out of the impurities in the iron, such as carbon and phosphorus, until these reach their low concentrations of fractional percentages which are allowable in steel. The Corby Bessemer plant is of great interest as it represents a revival of this process in England.

When steel is poured from the converters it is already for casting into ingots, and these ingots are then ready for rolling down to bar or strip to feed the tube mills. Thus in full circle we are back to the making of the tubes themselves.

There are many amazing things about Corby. The vast size of the works and its high organisation for one, and the vast output of the works for another. It amounts to train loads of steel tubes per day, but the most amazing thing is that the world finds use for such vast quantities of small steel tube.

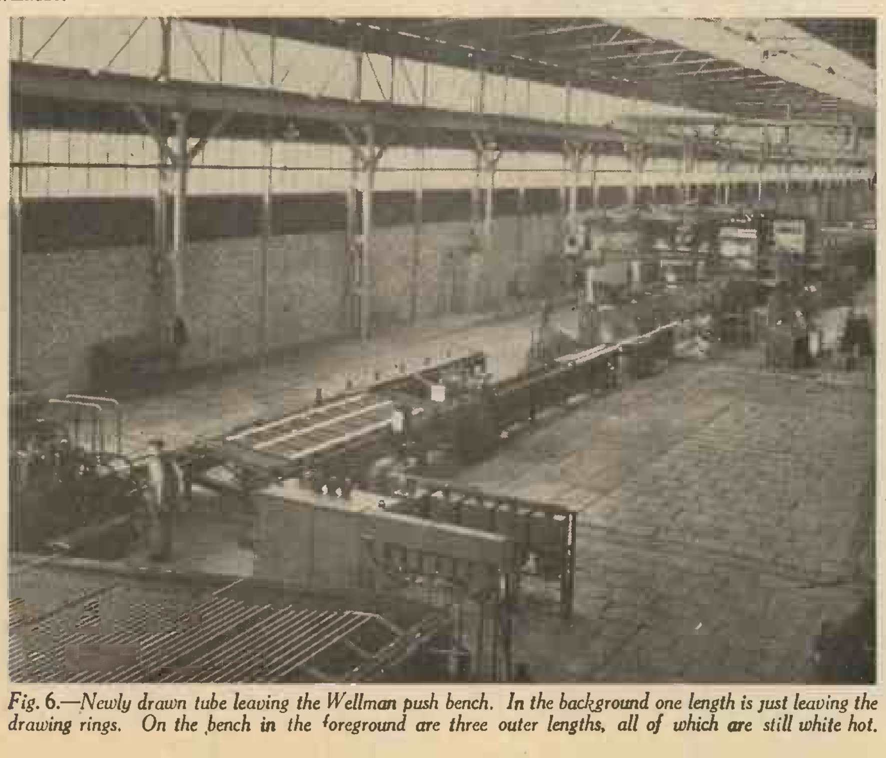


Fig. 6.—Newly drawn tube leaving the Wellman push bench. In the background one length is just leaving the drawing rings. On the bench in the foreground are three outer lengths, all of which are still white hot.

A FOUR-WHEELED

Further Constructional Details of the Design Introduced Last
Originally Described in this Journal. For P

By F. J. CA

THE four-wheeled midget car which I introduced last month does not greatly differ in general construction from the £20 three-wheeler described in this journal last year for which blue prints are still available at 10*s*. 6*d*. for the four sheets. I deal this month with the constructional details which break away from the original design owing to the introduction of the fourth wheel. The layout of the wooden chassis is illustrated, from which it will be seen it is wider and longer. Only straight-grained birch should be used, and in order to secure the correct alignment, the various members should be drilled together under a drill-press, so that the holes are vertical. If the holes are drilled separately, there is always a risk that they will not line up, and also that they will be drilled at an angle which would cause the chassis to wind. Use large washers under the bolt heads, and see that the nuts are properly locked and split-pinned. The birch must be well-seasoned, otherwise the nuts will eventually become slack due to shrinkage of the wood. It is a good plan to draw the chassis full size on the floor of the workshop, and to nail wooden blocks round the outline to form an assembly jig.

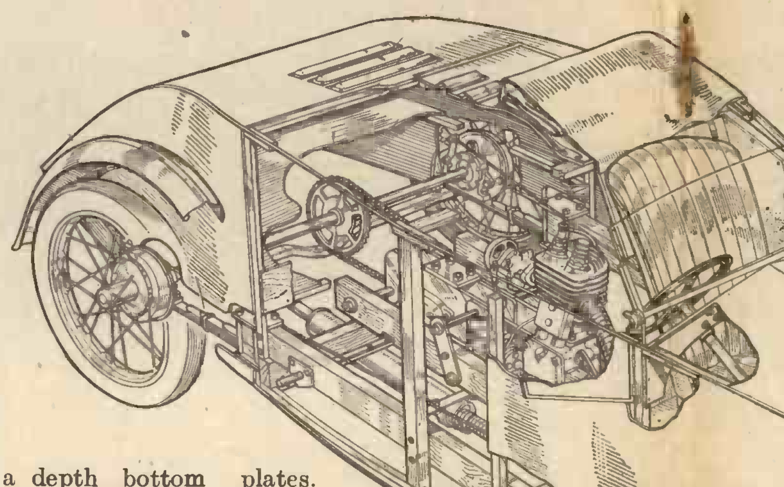
The Rear Suspension

A detailed sketch shows the method of anchoring the quarter-elliptic rear springs. It will be quite easy to obtain a pair of these from the car breakers, but care should be taken to see that they are of the light-car type, and have been removed from a car of not more than 9 h.p. The strength will then be just right.

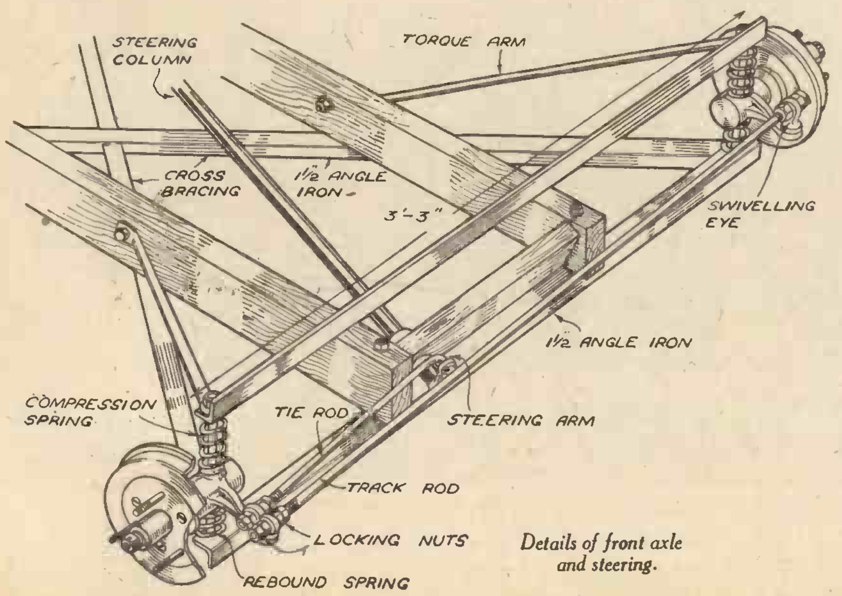
The side plates which are used at the attachment of the rear spring to the chassis frame must be of a depth slightly less than that of the springs, in order that the bolts may draw up and compress the springs without drawing up the side plates. Slight modifications in the length of the securing bolts and the dimensions of the side plates may need to be made according to the cross-sectional area of the springs, and the materials used. Before assembling the springs compare them to see that they have the same degree of set. If they appear to be too stiff for such a light car, remove one of the leaves. Notice that a security bolt passes through the leaves of the springs and the top and bottom plates.

The front suspension is, of course, as for the three-wheeler, and the front axle is cross-braced.

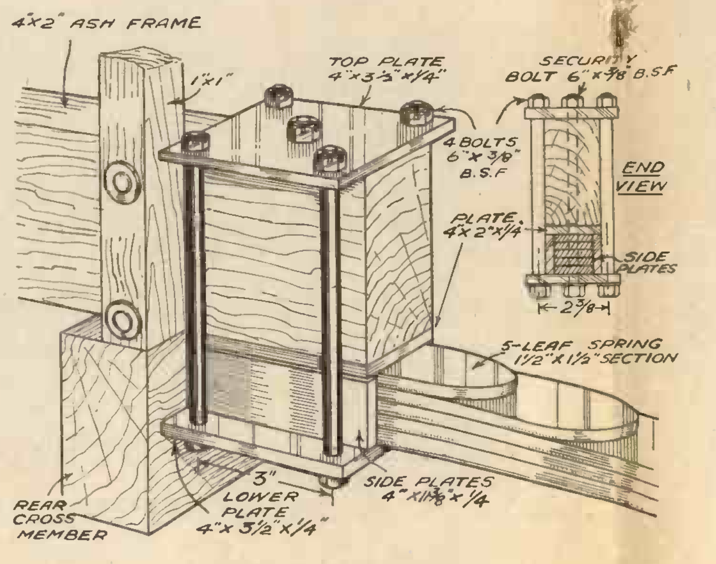
This cross-bracing imparts enormous rigidity. It consists of angle irons secured to the bottom angle iron member of the front axle and the two forward chassis members and it is welded at the point of intersection. The same section of angle iron as is used for the axle members should be used. Grease all bolts to prevent rusting, and rotting of the wood.



This cutaway view shows the engine, gearbox and transmission, as well as the simplicity of construction.



Details of front axle and steering.



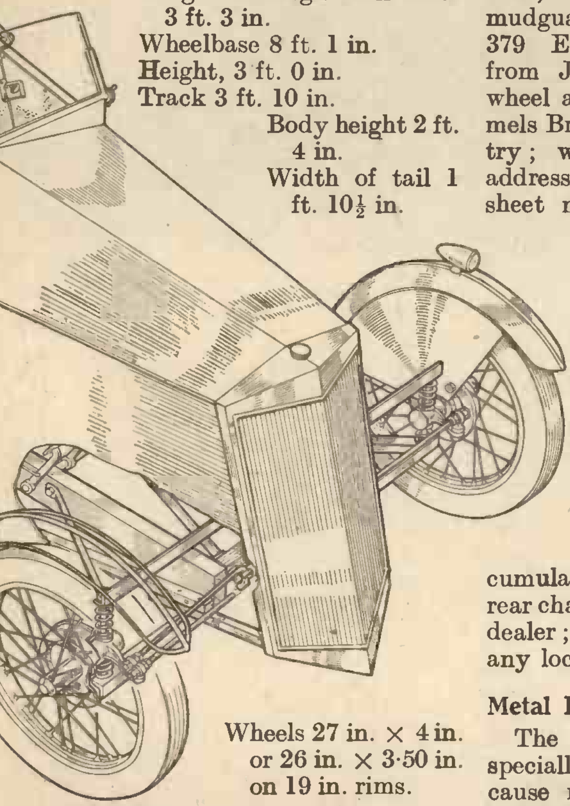
Method of securing the rear springs.

D MIDGET CAR

Month. This car is based on the £20 Three-Wheeler

Plan and Side Elevation see page 510

MM



Dimensions

The following are the important dimensions :

Length of angle iron axles 3 ft. 3 in.
Wheelbase 8 ft. 1 in.
Height, 3 ft. 0 in.
Track 3 ft. 10 in.
Body height 2 ft. 4 in.
Width of tail 1 ft. $10\frac{1}{2}$ in.
Wheels 27 in. × 4 in. or 26 in. × 3·50 in. on 19 in. rims.

Accessories

The wheels are obtainable complete with hub from the British Hub Co., Ltd., Weaman Street, Birmingham, 4 ; the hood is supplied by Messrs. Auster, Ltd., Crown Works, Barford Street, Birmingham ; a suitable three-speed gearbox with reverse gear is made by the Albion Engineering Co., Ltd., Upper Highgate Street, Birmingham ; the chains from Renold & Coventry Chain Co., Ltd., Burnage Works, Didsbury, Manchester ; the engine from Burney & Blackburne, Ltd., Atlas Works, Bookham, Surrey ; mudguards from James Grose, Ltd., 379 Euston Road, N.W.1 ; lamps from James Grose, Ltd. ; steering wheel and number plates from Bluemels Bros., Ltd., Wolston, Nr. Coventry ; windscreen from Auster, Ltd., address as above ; angle iron and sheet metal from E. Gray & Sons, 18-20 Clerkenwell Road, London, E.C. ; cellulose from The County Chemical Co., Ltd., Chemico Works, Bradford Street, Birmingham ; ply-wood from Venesta, Ltd., Vintry House, Queen Street Place, London, E.C.4 ; seat cushions and upholstery from Auster, Ltd., address as above ; horn from James Grose, Ltd., address as above ; accumulator from Exide (local agents) ; rear chain wheel from any motor cycle dealer ; screws, bolts and fittings from any local hardware stores.

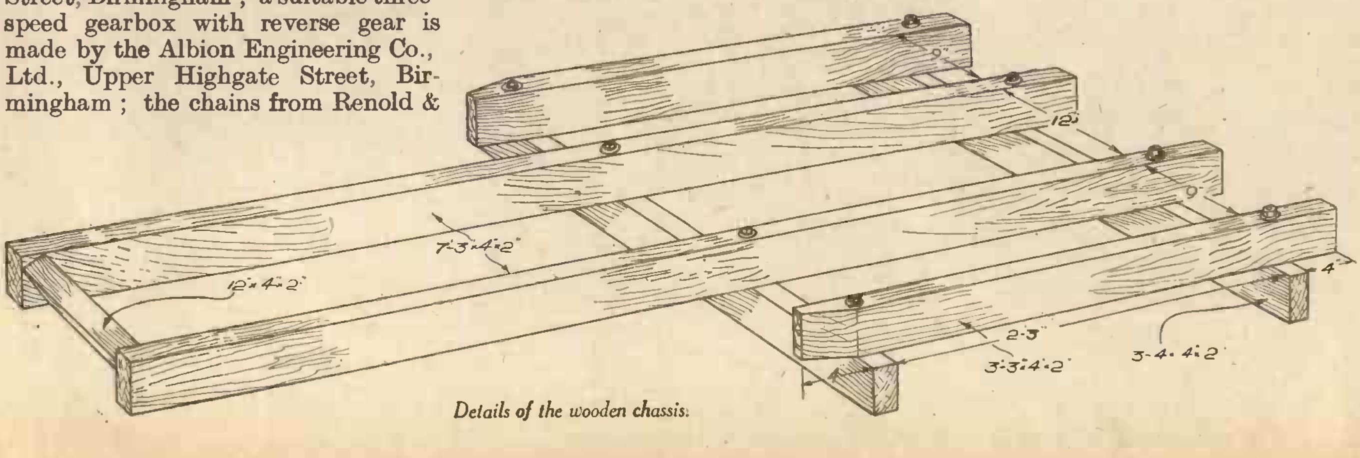
Metal Fittings

The metal fittings have to be specially made. I mention this because many readers are writing to ask where they can obtain them already made. It is not the intention that the reader should merely purchase a set of ready-made parts, bolt them together, and then think that he has built the car, which has been specially designed for the amateur to make himself. It is possible that he may be able to obtain from local timber stores the wood members already to section, but he should be prepared to do a certain amount of planing, and trueing.

It is possible to operate all brakes by one pressure of the pedal, although I do not recommend independent operation. The hand-brake can, as with the three-wheeler, couple up to the cable connected to the foot-brake, and provide a parking brake. Additionally, a dynamo can be driven by a suitable rig-up and so charge the accumulator—a refinement which was not fitted to the £20 three-wheeler, for reasons of price. The Zenith Carburetter Co., supply a special carburetter suitable for the Burney & Blackburne engine. If this carburetter is not used larger jets will have to be fitted to the carburetter supplied with the engine which would have been tuned up to suit a motor cycle and would not supply a sufficiently rich mixture for the extra load and the extra tractive resistance.

In finishing the bodywork, first carefully sand-paper down and then apply a coat of cellulose fillers. Spray the body with cellulose paint by means of one of the cheap spray-on guns supplied by the County Chemical Co., Ltd., whose address has been given.

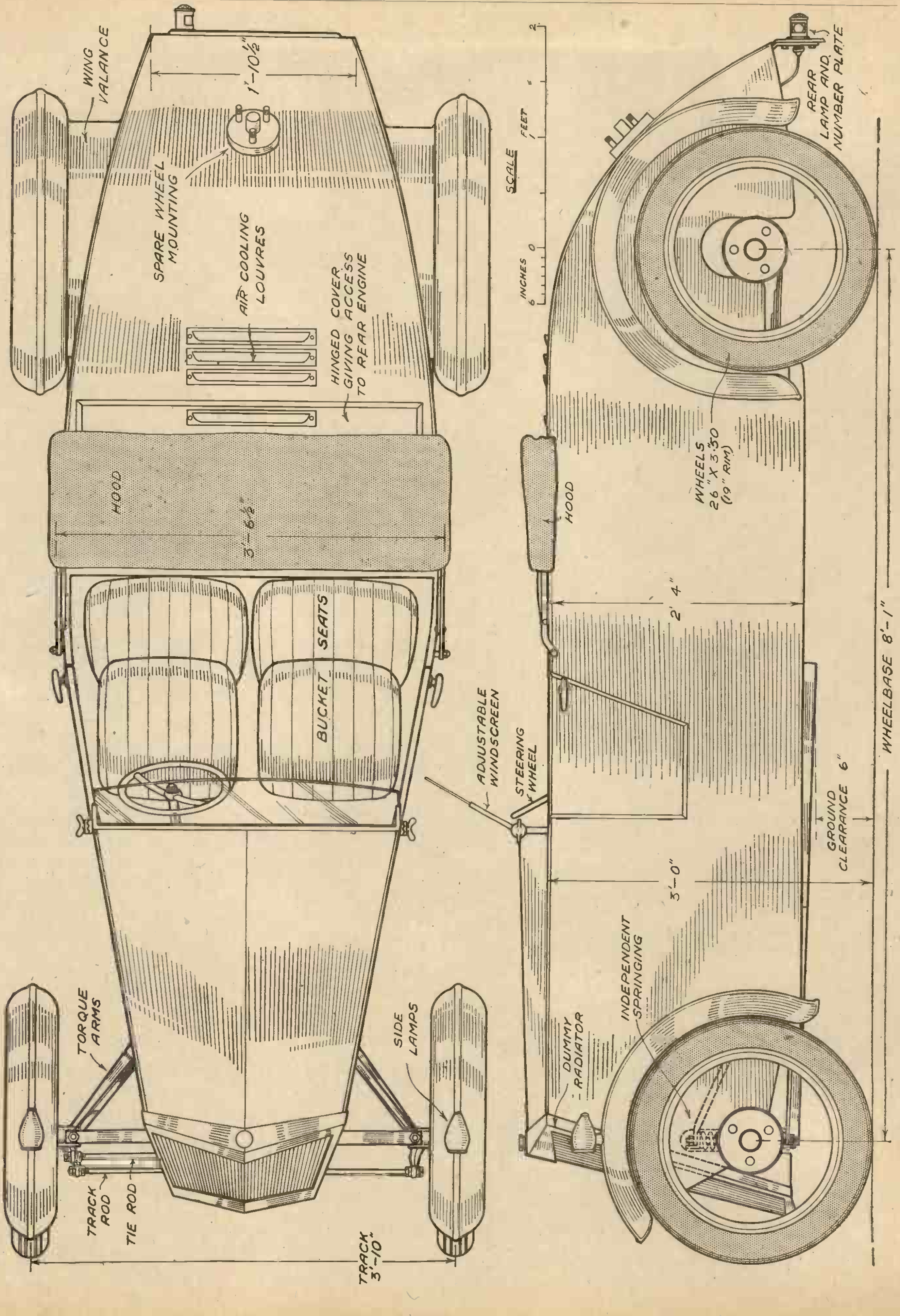
Needless to say as this midget car is a two-seater its speed will not be so high, but it is certainly a fascinating little vehicle to drive, and perfectly safe when properly built.



Details of the wooden chassis.

A FOUR-WHEELED MIDGET CAR Plan and Side Elevation

(See pages 508 and 509)



High Temperature Measurements

If you Built the Electric Furnace described in last month's Issue, this Article will prove very helpful for Experimental Work

Fig. 1.—The calibrated meter with two five-day tubes in front.

We hope that by this time several readers will have made the furnace described in an earlier issue and if you are interested in any particular branch of furnace work at high temperatures, it is essential to know the range of the apparatus so that experiments can be duplicated at any future time. Apart from research work, temperature indications are necessary in metallurgy, heat treatment and porcelain work, and, in fact, any experiment where a known temperature must be reached and held.

Two Methods

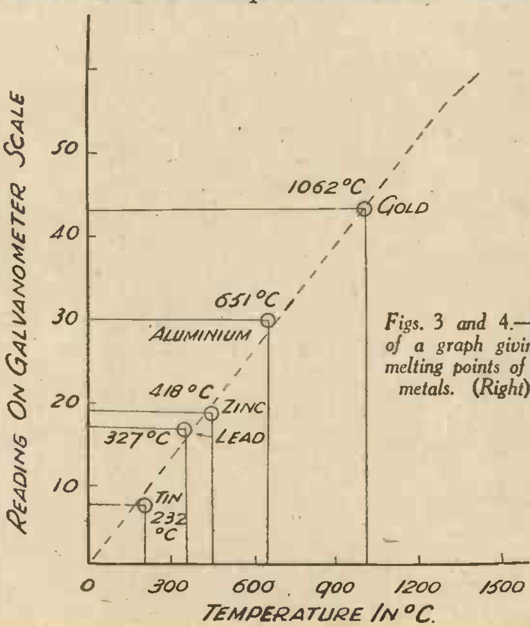
There are two methods of high-temperature measurement in general use, the platinum resistance thermometer and the thermo-couple. In the first case the change in resistance of a spiral platinum wire when heated is measured, and by including the spiral in a suitable circuit a direct indication of the temperature can be obtained. We might point out that this method can be used over practically any range, both high and low. In the second case, a thermo-couple consists of two different metals joined together, the free ends of which are connected to a galvanometer which is calibrated in degrees of temperature. When the join is heated a small voltage is produced in the circuit, and consequently the current that flows causes the galvo to indicate a temperature. The voltage produced is proportional to the temperature, but it does not follow that the graph is a straight line. This means that if the temperature is doubled the voltage does not increase twice as much. There are, of course, other methods of temperature measurement such as the Optical Pyrometer, etc., but as in every case except the thermo-couple, the apparatus is very costly, we will only consider the thermo-couple as being within the reach of our readers.

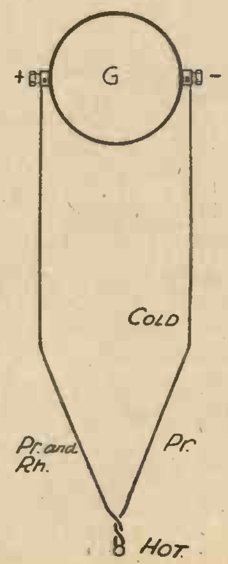
Thermo-couples are divided into two main groups—base and rare metal. The former are of the copper constantan type, and the latter of platinum and platinum in alloy with another rare metal such as irium and rhodium. The latter are expensive while the former are quite cheap. You can at once see that a base metal thermo-couple cannot be used for temperatures in the region of its melting point, but they are quite successful for low temperatures, that is from about 450° to 950° C. In our case we wish to go above 1,000° C. and have to consider a rare metal couple. The metal selected is platinum for one wire, while the other may be irido or rhodio platinum. The alloy generally used consists of a 10 per cent. alloy and is comparable in price to platinum. Actually it is slightly more, but in the small gauges we use, this is hardly noticeable. To give an example, a thermo couple was required 6 in. long for a tube furnace, and the cost of each wire was 1*s.* 10*d.* platinum, and the alloy, 2*s.* 2*d.*

Fig. 2.—The general layout of the apparatus.

Ohm's Law

Before selecting either a wire or instrument, we must consider for a few moments a simple electrical principle, briefly Ohm's Law. We know that a voltage is produced at the ends of the thermo-couple, and as this is in the region of micro volts, a very sensitive meter will be required to detect it. As far as we are concerned the voltage at the ends of the wire is independent of the gauge, i.e. the same voltage will be given at the same temperature if we use either No. 30 or No. 18 wire. But you may say, surely a much heavier current will flow in the No. 18 wire because of the lower resistance. This is correct, and as a result we can measure the current that flows instead of the voltage, to get an indication of the temperature on a milli-ampere meter instead of a micro-voltmeter. Of course, the current produced is proportional to the voltage. The main reason for pointing out the above is that by using slightly more expensive wire we can use a vastly cheaper instrument. Thus, a saving of £2 can be easily made. The advantages of the system are that the milliameter is far more robust than the micro-ammeter or voltmeter, and gener-





Figs. 3 and 4.—(Left) Details of a graph giving the correct melting points of the commoner metals. (Right) The circuit.

ally it has a larger scale, thus giving a more easily read indication, and is, of course, much cheaper. To give an example, one of our advertisers supplies a moving coil meter movement for 5s. and these are ideal for recalibration to temperature indication. With 18 gauge wire as above, a meter with a range to 50 milliamps and an internal internal resistance of not more than ½ an ohm will do for temperatures over 1,000° C. It is essential that the resistance of the instrument be as slow as possible. If you possess a sensitive instrument, it may be necessary to add an external resistance or shunt so that it will give a full scale deflection for a temperature of say 1,500° C., but this is rarely reached.

The Hot Junction

The length of wire required depends on the position of the hot junction as regards the furnace. It must be understood that the hot junction indicates the temperature of itself, and in the case of the furnace, the internal temperature, while the other ends of the wires must be outside the furnace, i.e. cold. The standard lengths of pyrometer tubing are 6 in. and we would advise readers to make up a thermo-couple of about this length so that the instrument can be used for a variety of purposes. Twist the ends of the wire together for a distance of ½ in. and then weld the end with a small oxy-coal gas or other high-temperature flame. You need not weld the ends if they are twisted up tightly, but on no account must they be soldered or brazed, as base metal will ruin the couple at high temperatures. A garage man will weld the tip for you. Push the wires through the fire-clay couple tube, and to the ends braze two stout copper leads just long enough to reach to the instrument, i.e. keep the external resistance as low as possible. For leads use stout copper of No. 14 or 16 gauge, anneal it and insulate with fire-clay beads.

Calibrating the Instrument

The instrument is now ready to be calibrated, and to test, put the couple in a bunsen flame and observe that the needle deflects over half of the scale. If the deflection is in the wrong direction reverse the connections at the meter. Now set up the apparatus and furnace with the thermo-couple in the position it will normally occupy for circuit and general lay-out (*see* Fig. 1). In the muffle and just under the couple, place a small piece of pure tin or lead, switch on, close the furnace door until you can just see the metal. As soon as the metal begins to melt switch off and observe the deflection. A good plan is to have the metal in the form of a cube with sharp corners, take the temperature at the moment that the corners become rounded. Repeat with aluminium, copper and then gold. Remember that the samples used must be perfectly pure. You can now re-draw the scale of the instrument in degrees of temperature or you can draw a graph and use this in conjunction with the instrument. The graph will be, as near as possible, a straight line so that temperatures above 1,062° C. can be determined. Fig. 2 shows a calibrated instrument with two fire-clay tubes and a thermo-couple in the foreground. Fig. 3 shows a graph used in conjunction with an ammeter.

A New Powerful Magnet

Alnico—A New Permanent Magnet Alloy

RESEARCH in the field of permanent magnet alloys has resulted in a new alloy, Alnico, so much more powerful than those commonly used hitherto as to open entirely new fields of application for permanent magnets, it has been announced. Small motors and various control devices hitherto operated by electro-magnets can now use permanent-magnet fields at a considerable saving in cost and greater simplicity of construction; and Alnico already has been applied by electrical manufacturers in a variety of applications including blow-outs for relays, holding in magnets of large switches, in latching and special timing relays and in different control devices. Alnico magnets will lift about sixty times their own weight, when designed for that purpose.

The new alloy is usually a cast material and is finished to shape by grinding. Alnico generally should be cast in quantities for commercial application, and is not available in standard bars for individual fabrication.

An alloy consisting of the ingredients present in Alnico was originally developed as a heat resisting alloy which resists scaling and deterioration at high temperatures. Some work on the magnetic properties of alloys of this type were later carried out by Professor T. Mishima of the Imperial University, Tokyo. General Electric, in America, has perfected a process of heat treating of the alloy by which its magnetic properties are fully developed.

Market improvements in permanent magnet materials have been made in the past few years as the result of intensive metallurgical research covering both their composition and their heat treatment and preparation. Less than a quarter of a century ago the best magnets were of hardened plain carbon steel, developed by cut and try methods. By metallurgical methods it was later found that the form of distribution of the iron carbide in hardened steel was one factor that determined its quality as permanent magnet material. Consideration was therefore given to the properties of alloy steels in which alloying metal elements, other than iron, would form carbides. Thus the chromium and tungsten magnetic steels were developed. The addition of cobalt to the tungsten-iron-carbon alloys resulted in another advance in the production of permanent-magnet steels.

Only a few years ago an alloy of iron, aluminium, and nickel was discovered to possess suitable permanent-magnet properties. This alloy contains no carbon and belongs to the precipitation-hardening type of alloys, quite distinct from the steels. The addition of cobalt was the next step; and thus was born Alnico. With the discovery that a precipitation-hardening alloy may possess excellent permanent-magnet properties, an entirely new field of alloys for magnets was opened for research.

Properties of Alnico

The coercive force is higher and residual induction lower for Alnico than for other magnetic materials. The maximum available energy is higher for Alnico, and occurs at a lower flux density and a higher demagnetising force. Alnico magnets may, therefore, be of smaller volume, but generally should be designed with greater cross sectional arc and shorter length to maintain a given magnetic field in an external air gap.

The magnets are less subject to demagnetisation by stray field. Tests on Alnico bar magnets resulted in a decrease in total flux of less than 1 per cent. after being subjected for one minute to an alternating field of 100 ampere turns per inch. No further decrease was observed when the alternating field was maintained constant for one half hour.

The magnet is capable of holding a typewriter suspended in the air as shown.

OUR GREAT NATIONAL MODEL AIRCRAFT CONTEST

1st PRIZE: £50

Many other Valuable PRIZES

NO ENTRANCE FEE!

This photograph shows the 2·3-c.c. "Spitfire" mounted in the "Petrel."

START BUILDING THE "PETREL" NOW!

Further Constructional Details of this Fine Petrol-driven Model, and Rules of this Important Contest.

By C. E. Bowden

Alterations necessary for larger Engines of 6 c.c. and 9 c.c.

The Value of the Competition

MR. F. J. CAMM has given the petrol-model aeroplane a tremendous fillip by offering the largest prize in the history of model aviation.

Fifty pounds is a sum for which it is well worth putting forward one's best efforts. There are also many other prizes being offered in this competition.

There are certain aspects in connection with the competition that may not have occurred to all readers.

Firstly, it is absolutely essential to the future of our Empire that the youth of to-day becomes air-minded, so that the nation of to-morrow takes to the air as our ancestors took to the sea. We must admit that we owe our freedom and position in the world to our sea-minded ancestors.

Air power and air communications have not yet taken the place of sea power, but they are yearly becoming vastly more important, and there can be little doubt that in the years to come the air will be the deciding factor, however conservative we may feel.

We *must* therefore understand the air. And what better way to gain the preliminary knowledge than through model designing, building, and flying.

Set People Experimenting

Practically every one of our great aeroplane manufacturers to-day started by making models and winning the small sums of money offered in prizes during the early days. The largest sun ever offered of £50 should stir the imagination and set people experimenting with this fascinating hobby of model aeroplane making.

The second point that occurs to me, and may not be generally agreed to by all, is that in the future it is most probable that freight carrying aeroplanes and bombing aeroplanes will be flown without pilots. They will in effect be large automatically stable petrol models, but will fly either by wireless control or, in the case of the freight carrier and commercial aeroplane, may be controlled by and fly along a route marked by rays from a cable laid over or just under the ground. Everything will be done automatically. The aeroplane will fly over its cable route, and rays from this cable will shut off the engines on reaching the aerodrome, and the machine will glide down to a landing. Far-fetched, you say! But actually not so very far from realisation even now if you study some of the blind-landing methods used to-day.

At the moment these methods show the pilot by instruments if he is on the correct line and gliding path when coming into an aerodrome. But what is there to prevent these instruments operating controls through relays, and dispensing with the pilot.

Stable Machines

But we shall have to have really stable machines, and this is where you model enthusiasts can start thinking.

And what better, more interesting or instructive type of model to investigate future problems can you encourage than the petrol-driven model aeroplane?

I therefore feel that the £50 prize of PRACTICAL MECHANICS, sponsored by Mr Camm, will give model aviation and all it means just that extra fillip that is needed.

The "Petrel" Model

Mr. Camm happened to choose one of my models to form a basis of construction for the competition, chiefly because it is simple to construct. But naturally it is not his intention to restrict types and sizes of engines that may be fitted. The model that I designed was produced for a 2·4-c.c. engine—the "Elf," and therefore is not suitable for larger engines, as the wing loading is incorrect. I have therefore been asked to make the necessary modifications that will enable larger engines to be fitted.

In the case of the 2·5-c.c. type engine, the Canadian "Elf" is practically unobtainable in this country. A few examples have trickled over here. I happened to obtain two of the first engines, and I then produced and designed the "Petrel" model for

RULES

(Competition Rules to be given next month)

1. *Only models built according to the designs and specifications here given are eligible.*
2. *Notification of intention to compete must be sent on a postcard, so that a register of competitors can be compiled. Address postcards to The Editor, Practical Mechanics, George Newnes, Ltd., Tower House, Southampton St., Strand, London, W.C.2, to reach us not later than June 21st, 1937.*
3. *The Editor reserves the right to refuse an entry without assigning a reason.*
4. *Professional model-makers, those engaged in the making of models for profit, or as a livelihood, are excluded from this competition.*
5. *Models must be the unaided work of the competitor, but they are allowed to purchase the usual finished parts—airscrew, ribs, wheels, engine, etc.*
6. *The competition is open only to regular readers, and competitors must, at a later date, send us the query coupons, as evidence of purchase, cut from the April, May and June issues of this journal.*
7. *The Editor of this journal, in conjunction with the S.M.A.E., will frame the competition rules (to be announced in the next issue) and will act as judges. Their decision is final and legally binding.*
8. *Each competitor may enter only one model.*
9. *Any variation in the design may entail disqualification, within the discretion of the judges.*
10. *Those competitors who will be unable to attend to fly the models themselves may appoint a delegate, approved by the judges, to do so.*
11. *The competition will be for time-controlled flight, marks being awarded for take-off, stability, duration of flight and landing. The model with a quick take-off may thus score points.*
12. *Other prizes will be awarded for workmanship and finish.*
13. *The date of the competition, which will take place at one of the large aerodromes, will be announced later.*

Blueprints Available—5/- Per Set

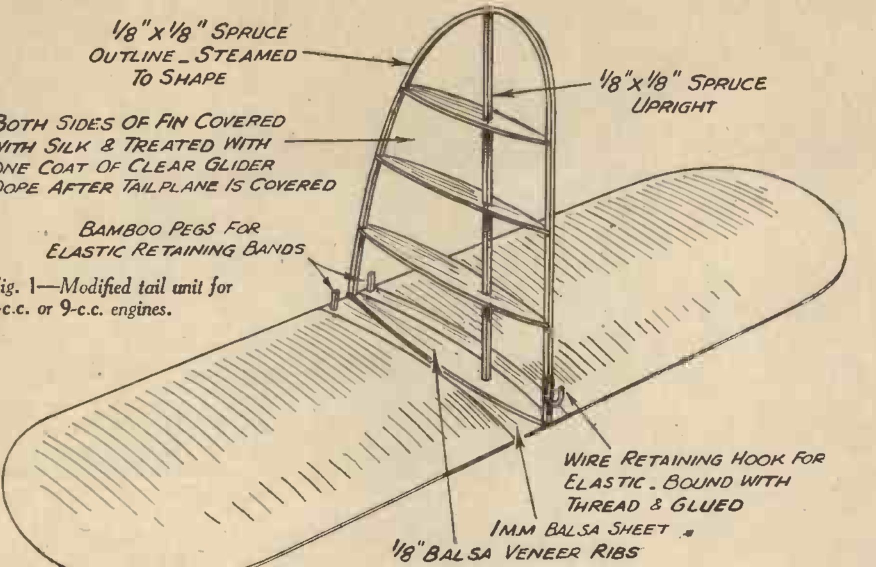


Fig. 1—Modified tail unit for 6-c.c. or 9-c.c. engines.

these. However, since then several similar-sized engines have been placed on the British market, which are easily obtainable at reasonable prices, and it may be that some constructors will make their own little engines to their own designs. If they can do this satisfactorily, all the more credit is due to them.

Information Regarding the Competition

There are one or two points that have cropped up and on which I have obtained information from Mr. Camm. Perhaps these are worth mentioning.

Intending competitors will be allowed to carry out minor modifications to the general design of the "Petrel." Thus if you wish to fit some other type of clock-timing device for control of duration of flight, such as the "Autoknips" camera-timing device, this is permitted. If you fit another type of engine, such as the 2·3-c.c. "Spitfire," you will naturally not require a gravity-feed petrol tank in the wing, for this engine has its tank bolted up behind the crankcase. If you wish to construct your fin with the more orthodox method of wooden outline, you may do so. You can have a wing in two halves or in one piece. If you wish to carry your flash-lamp battery for flight inside the fuselage and not as I have done, slung to the bottom, you may do so, but do not forget that your C.G. position may be slightly altered.

I am informed by Mr. Camm that it is his intention that these minor points of detailed design are to be left to the competitor, but the general design must be similar to the "Petrel" model. The final decision of the judges is, of course, binding. It is therefore not wise to take too many liberties with the design with £50 at stake!

Some Useful Hints and Tips

There are a few hints that I would like to suggest. Whatever type of engine you fit, keep the thrust-line as high as you can, and you will then not have to use too much down-thrust, for do not forget that a low thrust-line in a high-wing model tends to pull the nose up when under power and cause a stall, although a high wing in many other respects is very stable.

I have recently fitted a 2·3-c.c. "Spitfire" engine to this model, and as the engine can be inverted, I produced an elektron mounting that permits the crankshaft of the engine to be positioned really high.

A "Baby Cyclone" engine can be similarly inverted, as no doubt several other types can be with a little thought.

My second tip is to ensure that the model is *a perfect glider* before flying under power, by setting the tail and mainplane incidences exactly correct in relation with each other, by experiment, to suit your particular model, and also getting the weight distribution correct by sliding the battery along the fuselage. *Now keep these gliding settings and mark the wing position, and on no account move it to alter the power flight.*

Alter your climb and turn by alteration of down-thrust or offset of thrust.

This is very easily done with the detachable type of engine mounting fitted, by placing packings between mount and No. 1 fuselage former. When these are correct glue them into position, cover with silk, and dope so that they remain in position, and the settings are constant.

I find, for *reliability*, that it is better not to economise too much on battery weight. Therefore I now always use a 4-volt, 4-oz. flash-lamp battery for flight, even with the

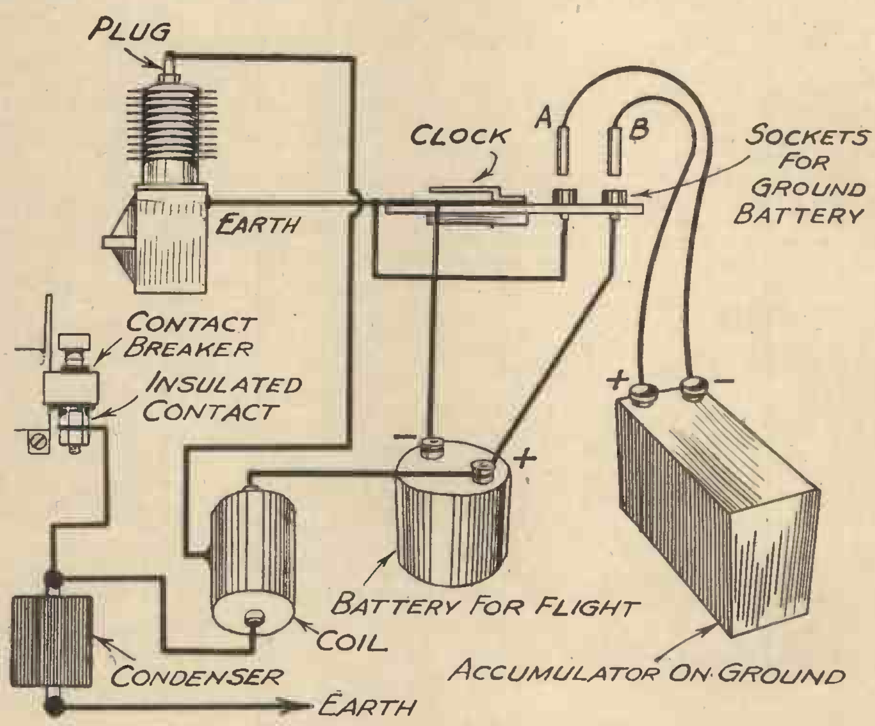


Fig. 2.—A revised ignition wiring plan.

COMPONENTS AND MATERIALS REQUIRED

ENGINE MOUNT.—Elektron, as described.

UNDERCARRIAGE.—8 ft. 14 S.W.G. wire and 2 reels of florist's wire; 2 pneumatic wheels; 1 length 1/8-in. sheet balsa for fairing of undercarriage legs; strip of silk for binding fairing.

FUSELAGE.—1 large tin of photopaste adhesive for silk covering; 1 pint of clear glider dope (full-strength); 1 pint of coloured dope; four 3-ft. lengths 1/8 in. × 1/8 in. birch or spruce for longerons; three 3-ft. lengths 1/8 in. × 1/8 in. balsa for uprights and crosspieces; 12 in. × 4 in. of 1/8-in. three-ply for special formers; 4 in. × 4 in. × 1/4 in. three-ply for circular nosepiece; small tube plastic wood for reinforcement; 12 in. × 3 in. × 1 m.m. three-ply for fuselage floor (forward); four sheets of 3 ft. × 6 in. × 1/16 in. balsa sheet for side, top and bottom covering of fuselage; 12 in. of duralumin or brass tube to take 14 S.W.G. wire for undercarriage anchorage in fuselage; 6-in. brass tube for tail wheel anchorage, to take 20 S.W.G. wire; 1 light tail wheel; 5 in. aluminium tubing, and cycle tubing to connect tank in wing; 6 in. × 4 in. thin celluloid for cabin windows; 6 in. × 1½ in. balsa block to make stops for mainplane and tailplane; 36 in. × 20 in. silk for covering fuselage; 9 in. × 5 in. green baize to make anti-slip platform coverings for wing and tail unit; 2 reels binding thread; 3 ft. 18 S.W.G. wire for hooks.

MAINPLANE.—Four lengths of 3 ft. × 1/4 in. × 1/8 in. spruce for mainspars; four lengths 3 ft. × 3 in. × 1/8 in. balsa sheet for ribs and riblets; two pieces 1/16-in. three-ply for central ribs; 18 S.W.G. piano wire strengtheners at dihedral angle, fin, and undercarriage hooks; four lengths hard balsa 3 ft. × 1/4 in. × 1/8 in. for leading and and trailing edges; 2 ft. round cane 1/8 in. diameter for wing tips; two solid balsa wing tip inserts, 3 in. × 6 in. × 1 in.; four pieces of jap silk 35 in. × 10 in. to cover wing.

TAILPLANE.—One sheet balsa 3 ft. × 6 in. × 1/16 in., and one sheet 3 ft. × 1/8 in. balsa for ribs and riblets; one length spruce 1/4 in. × 1/8 in. for mainspars; two lengths 1/4 in. × 1/8 in. balsa for leading and trailing edges; two pieces of silk 23 in. × 7 in. to cover tailplane, and two pieces silk 7 in. × 8 in. to cover fin.

ODDMENTS.—Insulating tape; ignition wire; rubber bands; two wireless terminal clips; valve tubin g for petrol connections; two wireless plugs and sockets; glasspaper; cellulose aeroglue (six large tubes).

ENGINE.—Spitfire, Hallam, Graysper, Brown Junior or any engine up to 9 c.c.

Another view of the 2·3-c.c. "Spitfire" mounted in the "Petrel."

The "Petrel" a few minutes after taking off.

smallest type engines. The model was given a generous wing area for 2·5-c.c. engines to allow for this, and light wheels can be fitted. Even Balsa wheels are quite reliable if well bushed and the bushing reinforced with plastic wood around it. The battery I suggest only weighs 2 oz. more than the "Bijou" type mentioned in the previous articles.

Finally do not forget to give the wing tips a slight wash out or negative angle of incidence. This will add enormously to the stability.

Alterations Required for 6-c.c. Engines

The same diameter nose, No. 1 former, can be retained for either 6-c.c. or 9-c.c. engines. Thus a similar type of electron engine mounting, or built-up mounting as already described in back numbers of PRACTICAL MECHANICS, can be used, provided the engine bearer arms are altered to suit the different engines.

On my models I keep all my engine mountings of a standard diameter and with a standard raised square on the back. I merely make different patterns and castings from these, with engine mounting arms to suit different types of engines. In this way any type of engine that I have is interchangeable in any of my models by simply disconnecting the ignition wires and taking off the rubber retaining bands and fitting the new-type engine on its new mounting—straight on to the standard-sized No. 1 former of the fuselage.

7-ft. Wing Span

If we scale up the "Petrel" to a 7-ft. wing span—that is to say, add one-third of the original span—we shall have a light model that is capable of being flown slowly by a good 6-c.c. engine, or faster by a 9-c.c. engine such as the "Brown Junior."

I have frequently flown my old record-holder the "Blue Dragon" high-wing monoplane, which now weighs over 6½ lb., by a 6-c.c. "Baby Cyclone" engine. The "Blue Dragon" has a wing span of 8 ft.

The "Petrel," with its far lighter type of construction, should weigh about 4½ lb. if scaled up one-third all round. The method of construction will be found to be sufficiently strong.

It is a perfectly simple matter for anyone to make new drawings from the 5 ft. 3 in. span blueprint, which is obtainable from PRACTICAL MECHANICS, or complete with materials from various model stores advertising in this journal, by merely dividing each given measurement by 3. This will give one-third of that measurement, which can then be added to the original measurement.

In this way anyone wishing to use a 6-c.c. or 9-c.c. engine can do so with a scaled up by one-third "Petrel" model, *i.e.* with a wing span of 7 ft.

The methods of construction and design of this particular model will not require to be altered in any way except that probably the larger fin or rudder will be cheaper to make by steaming a ⅛-in. by ⅛-in. spruce outline to shape on a board, with pins on either side until set dry.

Streamline shaped ribs of ⅛-in. veneer Balsa can be used (see Fig. 1).

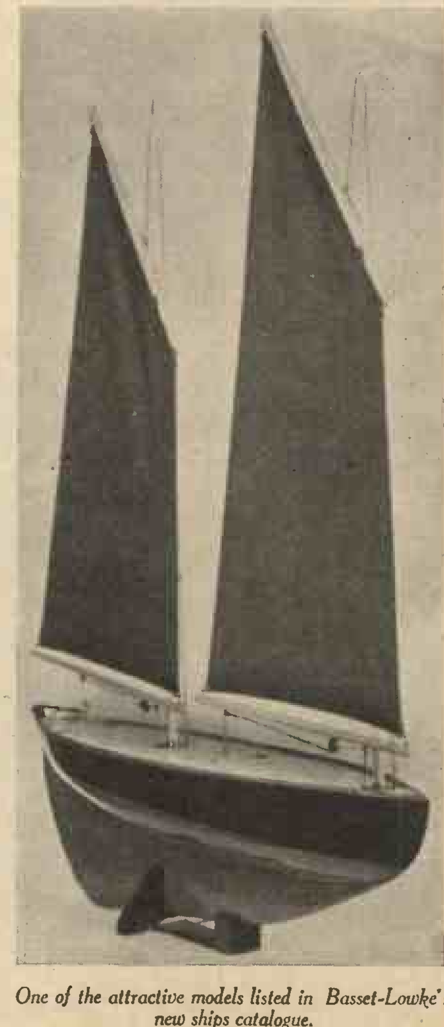
The only other modification will be the wheels. A pair of 4½-in. diameter air wheels, such as the B.B. wheel, would meet the area and weight requirements.

A NEW SHIPS CATALOGUE

Bassett-Lowke's Latest List

BASSETT-LOWKE announce that their new Ships Catalogue is now ready. As usual, the new issue will contain several new items of interest both to model sailing yachtsmen and power-boat enthusiasts.

Among sailing yachts the new Pilot Lugger is featured. This is a very interesting example of sailing craft, and is simple to handle and capable of a fairly high speed. Both lug sails are spread by booms and the general rig is similar to the Yarmouth beach yawls and the sardine fishing luggers off the coast of France. For practical sailing purposes the model has many features of interest. The lines are double ended and graceful. The model has a deep raking keel and rudder, and the simple form of tiller and rack control the latter, which is normally set amidships. At present it is made in one size only and retailed at 57*s.* 6*d.* Among motor-boats the well-known "Iolanthe" has been considerably improved, and a mahogany cabin added giving the craft a better general appearance. At the standard price of 2 gns. it is one of the best value models in inexpensive motor-boats and the steady sale of it is a tribute to its reliability. The fast motor-boat "Streamlinia," one of the smartest craft commercially made, is still further improved this season and complete sets of parts are available. The number of new yacht and sailing fittings, new books, etc., at the end of the catalogue is remarkable, and there are a number of pages devoted to high-class publicity and exhibition models of every description, including some of the latest models executed by Bassett-Lowke, Ltd., for the leading shipping and engineering concerns. Altogether the catalogue is a valuable sixpennyworth, and is most useful as a book of reference. Additions to their popular series of waterline models is a new model of the German Africa liner *Pretoria.*



One of the attractive models listed in Basset-Lowke's new ships catalogue.

A Model G.W.R. Broad Gauge Locomotive—Part IV

By E. W. Twining

THE next question is that of the riveting. The rule for rivet diameters is: thickness of plate multiplied by 2. For the pitch: diameter of rivet multiplied by 3; and centre of rivet from the edge of plate: one and a half times the rivet's diameter. Now if we adhere to the accepted rule—which, be it noted, is that applying to full-size boilers —we should have to use $\frac{1}{8}$-in. diameter rivets pitched $\frac{3}{8}$ in. from centre to centre, but I do not like these proportions in model work. It makes the job look terribly clumsy and I have obtained far neater results without sacrificing strength by using smaller rivets at closer pitch. We may safely do this when we have such a big factor as 10. I recommend, therefore, that $\frac{3}{32}$-in. diameter rivets be used pitched $\frac{1}{4}$ in. apart centre to centre and $\frac{7}{32}$ in. from the edge of the plate. The edges, of course, refer to the front tube plate and to the inner and outer firebox plates.

Another Method

There is another method, of course, which permits of some departure from accepted practice, that is the fact that all the seams in this boiler are going to be sweated with solder; that is to say, the outer shell. The inner firebox I strongly advocate shall be silver soldered, and therefore in the inner box we can use still smaller rivets since they are mainly required merely to hold the plates up closely together whilst silver soldering is being done. Therefore, the flanges and wrapper of the inner box, after being cleaned bright, can be put together with $\frac{1}{16}$-in. diameter rivets at about $\frac{5}{16}$-in. or $\frac{3}{8}$-in. pitch. Some model locomotive men would recommend that the whole boiler be silver soldered, but I do not think that this is necessary. For one thing it is not easy to get sufficient heat except with a very big blowlamp and I do not like the extent to which this heating softens or anneals the plate. I think it probably does more harm than good. I would not recommend silver soldering the inner box were it not for the risk that at some time or another the water level may be allowed to fall below the crown of the box. If this were to happen with the boiler under pressure the solder would fuse and be blown from the joints. It would then be a case of taking the box out of the boiler and re-soldering it. So the best way is to use hard solder and well stay all the flat surfaces.

The Boiler

The procedure in constructing the boiler will be to build the shell complete and the box complete. Then file up and fit on the inner firebox the foundation ring. Next pass the inner box into the outer box, rivet up and sweat with solder the foundation ring and finally pass into the flue tubes, expanding and beading them at both ends. It is needless to say that the steam collecting pipe as well as every other fitting on the boiler, such as the firebox supporting brackets, the safety-valve ring, etc., should all be secured before the firebox is put in place. This also applies to the firehole ring, the surfaces of which should be tinned with solder and finally riveted at the same time as the foundation ring.

The firebox supporting brackets can be soft soldered and riveted, but the roof stays on the inner box should be riveted and silver soldered. These roof stays can be of either cast gunmetal or of steel of T section. Perhaps the latter is the better material. They can be formed from short lengths of $\frac{5}{8}$-in. × $\frac{5}{8}$-in. × $\frac{1}{8}$-in. steel T filed down to $\frac{1}{2}$ in. × $\frac{1}{2}$ in. The under surfaces, where they fit upon the firebox, should be filed bright before riveting so as to readily take the silver solder.

Fitting the Stays

When the inner firebox and the boiler are assembled and, in fact, finally finished off, the longitudinal stays which run right through the barrel can be inserted. Stainless steel rod may very well be used for these. It should have a diameter of $\frac{1}{8}$ in. and be screwed at the ends to take $\frac{1}{8}$-in. nuts. Four of them will be introduced in the positions shown in Figs. 13 and 14.

Advantage of Copper

The firebox stays are the next thing to deal with. These are important since they have to support the flat surfaces of the inner and outer boxes. They should have a diameter of about $\frac{5}{32}$ in. and be made from hard copper wire. I would not recommend the use of brass because one can never be sure of what one is buying when brass is obtained. Very frequently it is an alloy or extruded brass, which is not sufficiently dependable for use as boiler stays and although the copper recommended has perhaps an initial lower tensile strength it will have a longer life without deterioration, besides which the riveting over of the ends of the stays can be more readily done. A length of rod should be taken and screwed from end to end with a fine thread, say No. 3 B.A. The plates are drilled through both boxes at once and tapped to correspond. The rod is then screwed through both plates and cut off inside and out, leaving a bare $\frac{1}{16}$-in. projection. These projections are then closed over to form snap heads just as I have shown in the cross section through the firebox, Fig. 14.

(*To be continued*)

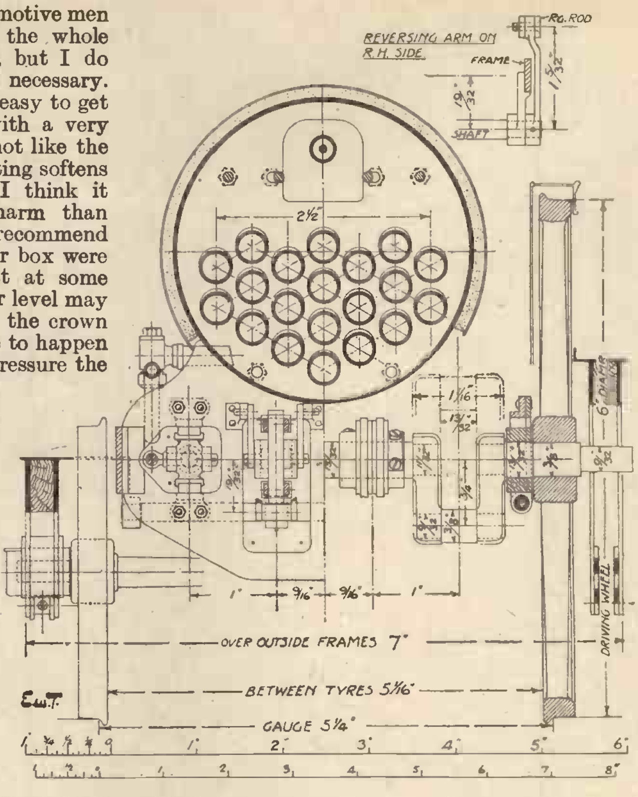


Fig. 13.—Cross section through motion and driving axle.

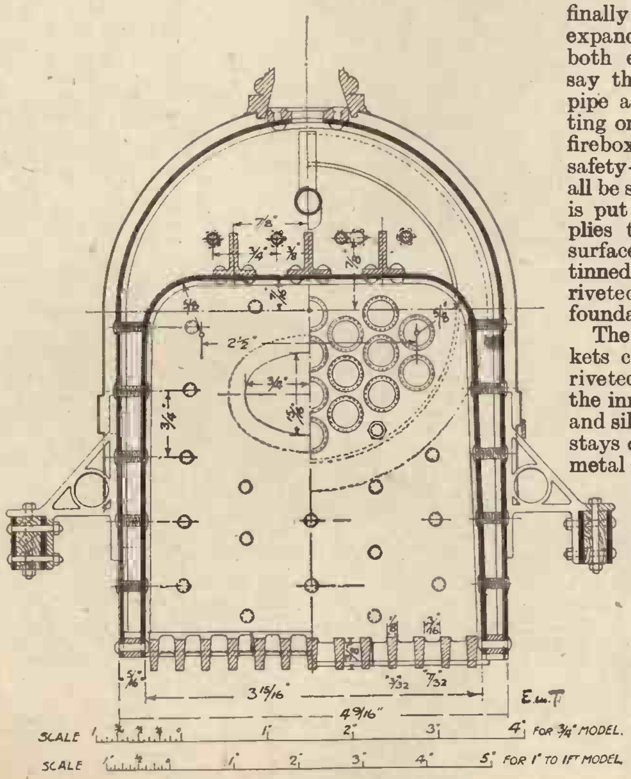


Fig. 14.—Cross section through firebox.

STARGAZING FOR AMATEURS

A NEW SERIES

By N. de Nully

A GUIDE FOR JUNE

THE sun enters the Zodiacal Sign Cancer (the Crab) at 9.0 a.m. (B.S.T.) on the 21st. This marks the Summer Solstice and the conventional commencement of that season. Owing to its higher altitude in the heavens in these latitudes at this time of the year, our luminary does not sink very far below the horizon after setting. Consequently twilight merges into dawn and the sky remains faintly lit up throughout the night. When clouds are absent possessors of quite small telescopes can readily detect the presence of the so-called "spots" on the Sun's brilliant disc; but a shaded screen or special eyepiece must invariably be used to protect the sight. The screen may be in the form of a piece of deeply tinted or heavily smoked glass, either fitted into a screwed cap or merely held up in front of the eyes. The special solar eyepiece gives more pleasing views and is essential with large apertures on account of the great heat generated at the focal point.

Projecting an Image of the Sun

A convenient and simple method of projecting the image of the Sun with a refractor, may be employed by attaching a light wooden frame to the lower end of the telescope body. A thin board or stiff card is fixed to the bottom part of the frame at right angles. To this is pasted (or pinned with drawing pins) a sheet of smooth white paper to serve as a miniature cinema screen, the eyepiece acting as a projector. The frame should be clipped firmly to the instrument if a refractor, or to the eyepiece carrier if a reflector; but permitting both rotation and movement up and down. By these means the position and size of the expanded disc or sunspot may be regulated. Focusing can be done in the usual manner. A large square of card—preferably black—should be fitted over the object glass end of the telescope in the case of a refractor, to cut off direct sunlight; and a dark cloth used in either instance to cover as much of the frame as practicable. These adjuncts will help to sharpen definition. Magnifying powers of from 30 to 100 diameters will generally suffice.

The Surface of the Sun

With an astronomical telescope of fairly good quality, the curious granular structure of the Sun's lustrous surface (or photosphere as it is called) can be clearly perceived. The shading round the rim, most noticeable in one of the photographs, is due to absorption of the shorter wave lengths of light by the almost transparent solar "atmosphere." It is, however, in the visible photo-sphere that sunspots are formed; but, owing to the foggy nature of the ionised bases of the enveloping atmosphere, we can see probably less than a few hundred miles below the surface of the latter. Beyond that lies the opaque dazzling background of the impenetrable layers of deeper and still hotter gases. Typical sunspots consist of dark openings with darker centres. The latter are black only in contrast, being actually brighter than our electric arc lamps. The centres are bordered by semi-luminous fringes composed of elongated shreds of shining matter placed side by side and pointing radially inwards towards the middle of the spots. Their appearance suggests irregular subsidences with steep sloping margins. They are really huge cavities created by violent whirlwinds of super-heated vapours tearing and perforating the flocculent texture of the photosphere. The spots are often thousands of

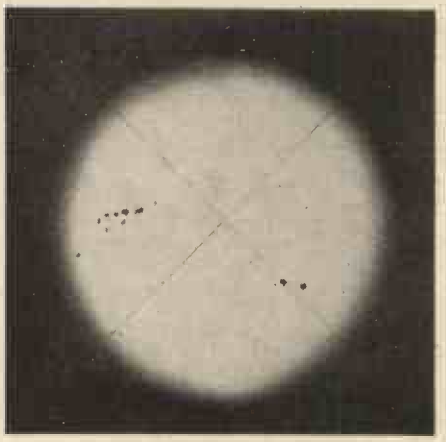
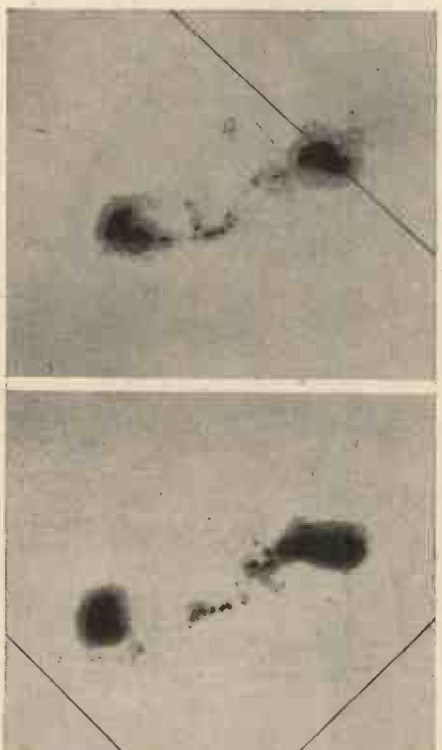


Photo by courtesy of Astronomer Royal.

The sun during an outbreak of sunspots.

miles across and are believed to be at temperatures of about 1,000 degrees below their surroundings. Their funnel formation and surface aspect are maintained by expansion of the vast ascending vortices of hot gases that rise from the profound depths below and are carried to the higher regions above, where pressure is much reduced. Here they burst in colossal bubbles, and spread out over their immediate neighbourhoods to cool and consequently darken.



A pall of large sunspots showing alterations of form and arrangement within two days.

Solar Cyclones

As will be seen from the photographs reproduced on this page, changes in size and shape of these swirling solar cyclones take place quite rapidly. Two exposures were made of the same large pair of spots at an interval of two days, and the transformations in so short a period are remarkable. Note also the alterations in the chain of perforations linking up the main openings. A seemingly insignificant outbreak may, within a few hours, similarly develop into an extensive area of disturbance covering several thousands of millions of square miles. Single spots may grow into bigger ones or split up into groups. There is, moreover, a curious tendency for spots to occur in pairs, one following the other round the rotating Sun; this is exemplified in the whole disc view. Occasionally they persist until they disappear over the edge, or limb; and, more rarely, survive to reappear at the opposite side twelve or thirteen days later. Now and again sunspots are of such dimensions as to be discernable to the naked eye through a veil of fog or morning or evening haze. With the advanced progress of the present cycle towards its maximum in 1938-39, these instances are likely to become more frequent and a look-out should be kept. Sunspots are always associated with patches of gleaming "faculæ" floating at immense heights in the Sun's atmosphere. Brilliant fragments of these solar clouds sometimes appear to "bridge" the black gulfs over which they may happen to be suspended; but they are best seen shining against the shaded margin of the disc. The striking photographs illustrating this article were taken at Greenwich Observatory and are reproduced by kind permission of the Astronomer Royal. The black cross-lines originate in the telescope and camera.

The Planets

Mercury, Venus and Saturn are "morning stars"; but Mars is still a bright object low in the south in the late twilight. It now sets at 3.30 a.m. and will do so half an hour earlier by the end of each week. By getting up very early in the morning enthusiasts with astronomical telescopes may learn to what degree Saturn's rings have reopened since they closed up last December. The planet may be found low in the east during the couple of hours preceding sunrise. Jupiter rises in the south-east about midnight and will remain above the horizon until 8.0 a.m. On clear evenings between "new" and "full," the Moon will offer fascinating fields for exploration through the smallest telescope. As the broken line of the terminator creeps across the disc, each previously hidden feature of the weird landscape will become suddenly flood-lit by the glare of advancing day unsoftened in the airless void by any gradual half-tones of coming dawn. After the "full" phase, when sunshine begins to withdraw from the opposite edge, the same formations may be examined again under afternoon illumination.

A premature vacuum pump of the type used by Hooke in his experiments.

MASTERS OF MECHANICS

No. 22.—The Scientific Work of Robert Hooke, Pioneer of Mechanics and Invention

AN ill-tempered fellow; cantankerous, shrivelled in body and seemingly, also, in mind, irritable, suspicious, haggard of countenance and furtive in habits. Such, in brief, is the picture of Robert Hooke which has been drawn for us by his contemporaries and, also, by many of his biographers. Added to these unenviable traits was a crazy and almost insane mania possessed by Hooke of endeavouring to claim the discoveries of other men as his own. Posterity, perhaps, may have been unduly severe in its judgment of Hooke as regards his personal character, yet, upon the whole, it has not failed to credit to him an almost unparalled genius in many branches of science and, in particular, in the realm of mechanics.

Hooke lived in an age which saw the rise to fame of a number of great men. The renowned Sir Isaac Newton was a contemporary of Hooke. So, also, was the celebrated Dutch astronomer and mechanician, Christian Huygens. Dr. Denis Papin, an early pioneer of the steam engine, lived in the time of Hooke. Sir Christopher Wren and many other notabilities were numbered among his acquaintances and he claimed the especial friendship of the great Dr. Robert Boyle, an intrepid pioneer of mechanical science and the "father of modern chemistry."

Personal Jealousy

It may be that many of Hooke's fellow-pioneers during the early era of scientific discoveries in which he lived have strongly coloured their several interpretations of his character by tinges of personal jealousy and of acrimony. Yet there is no doubting the fact that Hooke, despite the brilliance of his investigations into the science of mechanics and physics, was an almost impossible man to get on with and habitually contrived to upset nearly everybody whom he came in contact with.

Robert Hooke is the father of more than a thousand inventions and discoveries of scientific importance. His wonderfully fertile and ingenious mind brought forth a continual stream of mechanical devices with almost the same readiness as a musical composer brings into being melodies and harmonies. Hooke was the first curator of the then newly-established Royal Society, and when any scientific or mechanical problem was to be investigated, he usually invented the apparatus necessary for the purpose.

In some respects, Hooke's was even a more fertile mind than that of his great contemporary, Newton. True it is that the latter first formulated the theory of gravity, but Hooke, at an earlier date, almost hit upon the same conception and certainly would have done so if his activities had been directed to somewhat less practical aims.

An early microscope of Hooke's day. It is made out of wood and cardboard.

Suffered from Ill-health

Hooke was born at Freshwater, in the Isle of Wight, on July 18th, 1635. He was a sickly child and constitutional ill-health remained with him throughout his life, a fact which goes far to explain the irritability of temperament which so grossly characterised his adult career.

When Hooke was thirteen years of age, his father died, whereupon the lad was sent up to London by a relative and there apprenticed to one Peter Lely, a fashionable portrait painter. The youthful Hooke, however, did not stay long with Lely. Instead, he became a pupil at Westminster School, acquitting himself brilliantly in that Institution, particularly in mathematics and mechanics, and thereafter proceeding to Christ Church, Oxford, in which he had secured a chorister's appointment.

It was during his residence at Oxford, that Robert Hooke first became acquainted with John Wilkins, afterwards Bishop of Chester, but at that time the Warden of Wadham College. Wilkins was a man of more than ordinary learning. He was also a pioneer in mechanical science, having several inventions to his credit. Hooke, apparently, became greatly inspired by the work of Wilkins and having, also, formed a friendship with the Honourable Robert Boyle, of Oxford, he seems at this period of his life to have determined to devote his future career to the pursuit of mechanical science.

Hooke acted as Boyle's assistant while he was at Oxford. He constructed the famous air-pump with which the celebrated Boyle made so many of his experiments. Indeed, in after years, Hooke, in consequence of the previously mentioned regrettable mania for claiming the discoveries of others as his own, claimed actually to have invented the air pump, although, nowadays, we know that this claim was not a true one.

Watch Balance-spring

The career of Hooke at Oxford was an extraordinary fertile one. One of the most important discoveries which he made there is that of the balance-spring for regulating watches. Controversy has long been waged over the rival claims of Hooke and his contemporary, Huygens, for the invention of this important piece of mechanism, but it now seems beyond all doubt that we nowadays carry in our watch-pockets or on our wrists a tiny memorial not of the Dutchman, Huygens, but of our own countryman, Robert Hooke.

Within a space of two years, Hooke brought out about thirty separate ideas for the purpose of effecting mechanical flight.

These, of course, came to nothing. Nevertheless, they indicate the inventive ingenuity of the young man at this period of his lifetime. Hooke, too, was the first to point out that the motions of the planets in the sky must be regarded as mechanical problems, since the various heavenly bodies were all bound by the strict laws of mechanics. It was about this time, also, that Hooke first brought out a wave-theory of light, which, however, was overshadowed by the corpuscular theory of Newton which postulated that light consisted of a stream of tiny corpuscles shot out from the luminous body. Nearly a hundred and fifty years had to elapse before our present wave-theory of light was introduced by Young at the beginning of the nineteenth century, yet the theory of Young was, to some extent, anticipated by that of Hooke.

After his sojourn at Oxford, Hooke became the curator of the Royal Society, which was then in the second year of its existence. The Society required an individual of some learning and mechanical aptitude to be responsible for its apparatus and not merely to conduct but, also, to *devise*, experiments for the entertainment and benefit of its members.

His Appointment

The appointment of Robert Hooke to the Curatorship of the then infantile Royal Society is thus recorded in the Society's Journal:

"Nov. 12, 1662. Sir Robert Moray propos'd Mr. Hooke as a curator of experiments to the Society; who being unanimously accepted of, it was order'd, that Mr. Boyle should have the thanks of the Society for dispensing with him for their use; and that Mr. Hooke should come and sit amongst them, and both bring in every day of the meeting three or four experiments of his own, and take care of such others, as should be mentioned to him by the Society."

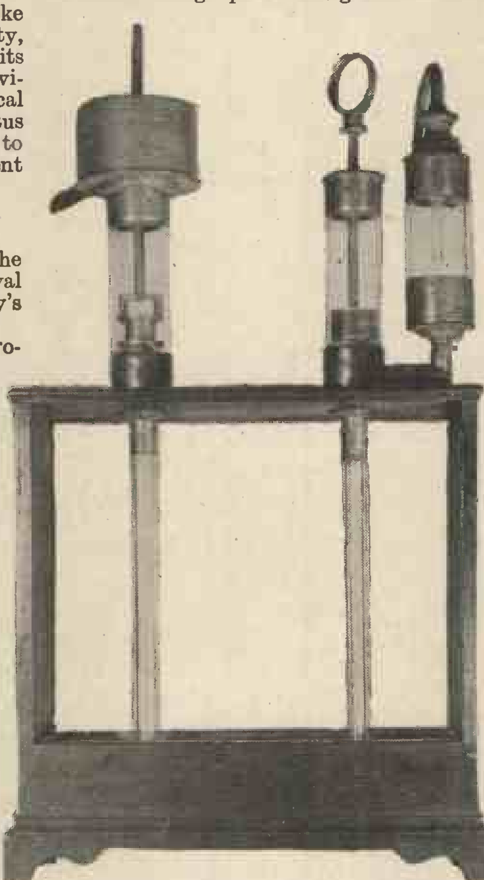
In this manner began Hooke's long association with the Royal Society. For forty years, until his death, the irritable but nevertheless ingenious Hooke became the servant, the handmaid, as it were, of the early and frequently dilettante members of the Royal Society and "sat amongst them" devising, not only for the benefit of curious members but, also, for that of posterity, innumerable scientific mechanisms and ingenious ideas. As a reward for his duties at the Royal Society, Hooke was paid the salary of £30 per annum with free lodgings in Gresham College. Unfortunately, the Society was by no means regular in its disbursement of salary to Hooke, another fact which may be offered in excuse for his irritability and instability of temperament.

Hooke, having settled down as the Royal Society's curator, or, in a word, as its general factotem and "all-round man," embarked upon a career of scientific application in which discoveries in mechanical, physical and many other branches of science followed in close succession. Hooke's discoveries, too, were, for the most part, no mere trivialities. Many of them were of an absolutely fundamental nature and had much bearing upon the future applications of mechanics.

Mechanical Gearing

The practical mind of Hooke showed its genius for discovery in many ways. Hooke was one of the first mechanicians, if not, indeed, *the* first to appreciate the principles of mechanical gearing. He studied closely the properties of various gear trains and applied them in numerous ways. Hooke, also, was a pioneer of the steam engine. There seems, indeed, to be little doubt that if he had remained content to devote his attentions to the subject of steam power, he would have elucidated its main principles at a very early date. As it is, Hooke proposed the plan of a steam engine which, from its description, would have been very similar to the "atmospheric" engine invented years later by Thomas Newcomen, but, for some reason or other, he failed to construct an actual model of his projected engine.

It is interesting to note that among Hooke's miscellaneous inventions are to be enumerated the spirit-level, the wheel mercurial barometer, the "anchor escapement" of clocks, many mechanical devices for determining specific weights and for measuring the velocity of moving and falling bodies.



A very early mechanical model of a "water-raising engine," apparently constructed for the purpose of demonstrating the possibility of pumping water from deep wells. Robert Hooke was responsible for many appliances and inventions of this nature.

Hooke, also, gave us our modern thermometer in that he was the first to mark the freezing point on a thermometer scale by 0° or Zero.

"I adjust the thermometer," he said, "putting all the degrees of heat and cold above and below the freezing mark, where I begin my account, or 0, and marking them with + 1, + 2, + 3, etc., above that mark; and with − 1, − 2, − 3, etc., below the same."

Early Science of Chemistry

The influence which Hooke brought to bear upon the early science of chemistry does not, perhaps, concern us here. Hooke, however, developed the very important science of microscopy. He made microscopes of designs which we should now characterise as being the most primitive, for the lenses which he was able to construct were of low magnification and almost totally uncorrected. Yet, in spite of all these drawbacks, Hooke found it possible to make many important discoveries in the realm of microscopy, among which was the fact that metals, when viewed under the microscope, show a grained or crystalline structure. Hooke seems to have realised in his shrewd way that the brittleness of a metal is connected with the coarseness of its crystalline make-up. The microscopical discoveries of Hooke were published by him in a folio volume entitled "Micrographia," and from the plates inserted therein one is enabled to obtain a realisation of the profound accuracy of this pioneer's observations.

In consequence of his investigations into the microscopical appearances of bodies, Hooke seems to have obtained a remarkable prevision of one of the most modern of our present-day industries, to wit, that of artificial silk manufacture. He observed under the microscope the formation of natural silk and the manner it is ejected from the spinnerettes of the silkworm. During the course of some remarks written upon this topic, he says:

Artificial Silk

"And I have often thought that probably there might be a way found out, to make an artificial glutinous composition, much resembling, if not full as good, nay better than that excrement, or whatever other substance it be. out of which the silkworm wire-draws his claw. If such a composition were found, it were certainly an easie matter to find very quick ways of drawing it out into small threads for use. I need not mention the use of such an Invention, nor the benefit that is likely to accrue to the finder, they being sufficiently obvious. This hint, therefore, may, I hope, give some Ingenious inquisitive Person an occasion of making some trials, which, if successful, I have my aim, and I suppose he will have no occasion to be displeas'd."

Hooke's "inquisitive Person," however, was long a-coming, for after the death of Hooke, nearly two hundred years elapsed before the first artificial silk fibre was made experimentally by Count Hilaire de Chardonnet and exhibited at the Paris Exposition of 1889.

In addition to being a pioneer physicist, chemist and, above all, a mechanician, Hooke was, also, an architect. After the Great Fire of London in 1666, he prepared a model of a new City of London. He designed and supervised the building of Montague House, the College of Physicians, and the great Bedlam Hospital. Indeed, it has been averred that many of the London buildings which have been attributed to Wren and others are, in reality, as regards their designs, the creations of Robert Hooke.

Hooke, as his life drew to its close, became more and more morose in his character and habits. Yet he continued his scientific investigations into the principles of mechanics with a mind almost undiminished in alertness and inventive fertility. So actively engaged was he in his mechanical pursuits that during the two or three years immediately previous to his death it is said that he never went to bed at night or even took his clothes off to rest.

At last, worn out as a result of his protracted activities, almost blind, and with hardly a friend to comfort him, he died on March 3rd, 1702, and was buried in St. Helen's Church, Bishopsgate Street, London.

MAKING AN EPIDIASCOPE

By "Handyman"

A Device for Projecting Ordinary Photographs and Pictures Direct on to a Screen.

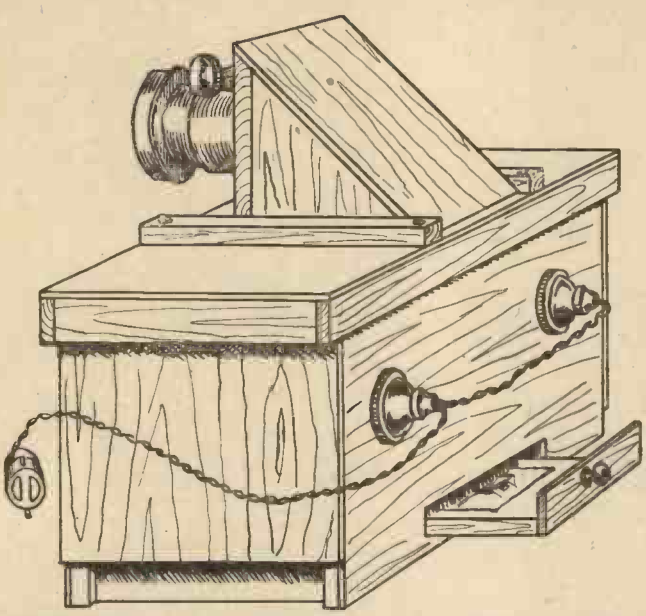


Fig. 1.—An exterior view of the epidiascope.

THE object of this apparatus is to throw an enlarged image of any picture or flat object on to a screen without first making a "transparency" or lantern slide, such as is used in ordinary projection lanterns. The success of the apparatus to be described depends very largely upon two things: first, intense illumination of the picture to be projected, and, secondly, a suitable lens. It is quite hopeless to attempt to make this apparatus without obtaining a suitable lens first and building the other parts to suit. Such a lens should have a focal length of about 8 in. and a working aperture of about F/4, or, in other words, one-fourth of the focal length. Now, the cost of a good quality lens of this size and description would probably be altogether prohibitive. The only useful alternative is to try to pick up an old portrait lens from a second-hand photographic dealer. These may frequently be obtained for a few shillings, and are usually fitted into a focusing mount, which will suit our requirements admirably. They were (as their name implies), used for portraiture in the early days of photography, when enormously long exposures were required, and these lenses were introduced with apertures of about F/3 or F/4 to reduce the exposure as much as possible. The type we have in mind is called a "Petzal" lens, after the name of its inventor. Such a lens should give a good sharp image near the centre of the picture, though both the sharp definition and the illumination will not be so good near the edges.

Electricity as a Means of Illumination

Electricity from the mains is the most practical form of illumination, and it is assumed that the constructor of the projector has access to such an electrical supply. Gas is not a practicable proposition, because so much light is required that it would be difficult to devise an arrangement that would not get too hot for safety. It would probably be possible to arrange a series of motor-car head-light bulbs to work off a motor-car accumulator, suitable reflectors being provided, but the arrangement described below is specially designed for the mains.

Figs. 2, 3 and 4 show sectional drawings of the apparatus, and Fig. 1 shows an exterior view. The picture from which the image on the screen is projected is placed upon a sliding drawer arrangement, as shown in Fig. 4, and pushed into the box-shaped body. It is there illuminated by two electric lamps. The light from the picture shines on to a mirror arranged at 45 degrees, and this mirror reflects the light into the lens, which throws an image on to the screen. It should be possible to obtain a satisfactorily illuminated picture on the screen about two or three times as large as the original picture; if greater enlargement is attempted, the illumination is likely to be poor.

The Wrong Way Round

The reader may perhaps wonder why it is necessary to use a mirror. Why not arrange the picture at the back of the box and the lens in front and project the picture direct? The reason is that without the mirror the picture on the screen would be the wrong way round, *i.e.* reversed from left to right; the use of a mirror corrects this.

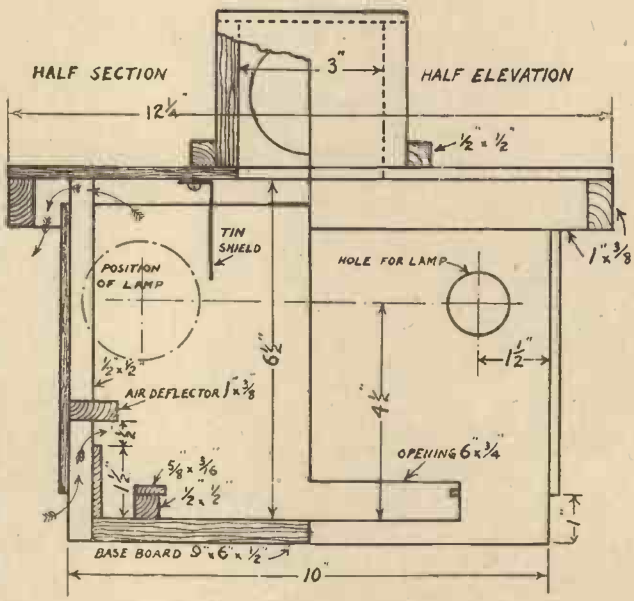


Fig. 2.—A sectional sketch of the apparatus.

The base of the apparatus should be ½ in. or more thick, while for the sides, ends, and top ¼-in. three-ply wood may be used. If the projector is used for lengthy periods, the three-ply may show a tendency to blister, owing to the heat from the lamps, but this will not affect the working. It is essential that proper ventilation should be provided to keep the apparatus reasonably cool; the small arrows in Fig. 2 show the direction of the air circulation, the heated air rises to the top and passes to the outside, while cool air enters at the bottom.

The construction of the apparatus will be obvious from the drawings. The dimensions given will suit a lens of 8 in. focus, when used to give an enlarge-

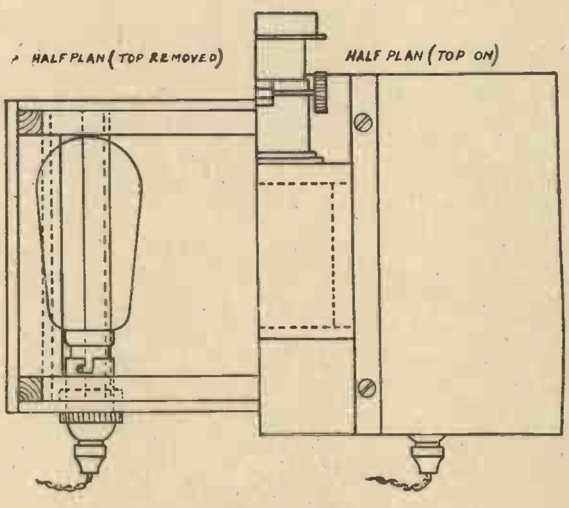


Fig. 3.—Details of the lamp mounting.

ment of between two and three times. If your lens has a longer focus than this, increase the height of the box accordingly, arranging the extra height between the lamps and the flat top. It is advisable to screw this top portion down by four screws, one at each end of the cross pieces which support the mirror box; the four screws can soon be withdrawn when it is necessary to replace a lamp or clean the mirror. The two tin shields are to stop the direct rays of light shining into the mirror box; blacken the shields on the mirror side.

"Cockling" of the Wood

Screws should be used throughout for this job, for the wood will become very dry owing to the heat from the lamps, and the tendency to "cockling," of the three-ply wood may be strong enough to pull out brads.

Paint the underside of the top and the inside of the vertical sides and ends white, but the floor of the box and the inside of the mirror compartment should be black. The top of the "drawer" to carry the post card (or other picture) should be covered with a piece of black cloth, and the post card may be clipped down by pushing the corners under four short pieces of elastic provided for the purpose, or little flat springs like turn-buttons may be used instead.

The mirror should be clipped to the slanting surface of the mirror box by means of little clips of wood held by screws; metal clips are liable to crack the mirror unless they have a small piece of rubber or cork interposed between the clip and the glass.

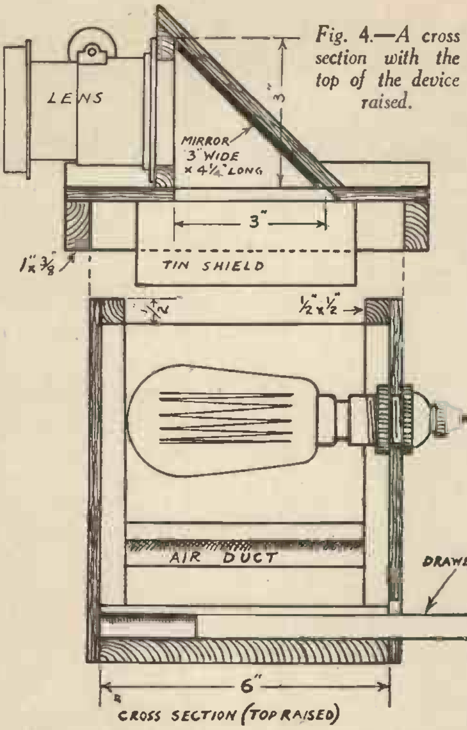


Fig. 4.—A cross section with the top of the device raised.

A good flat piece of mirror must be used, otherwise the image will not be sharp, even though the lens may be faultless, and the mirror should be of thin glass. For the very best results a mirror silvered on the surface should be used, but this is not essential.

A screwed flange should be obtained for the lens if possible, but if this cannot be obtained the lens mounting may be screwed direct into the wood, if the hole is cut very carefully to the required size. If the lens is not provided with a focusing mount, it will be necessary for the reader to devise a sliding arrangement on the lines of a telescope, to provide for focusing.

The Two Lamps

The arrangement of the two lamps is quite clear from Figs. 3 and 4. Standard bayonet holders are required, and they are just pushed through holes in the three-ply and held in place by the ring nut which ordinarily holds the lamp-shade in place. The lamps are wired in parallel by running the wires into one lamp-holder and out again into the second holder, sufficient flex wire being, of course, allowed between the box and the plug to reach a convenient lamp-holder.

This instrument will take pictures up to post-card size, either horizontal or upright, and a screen of white paper or cloth about 2 ft. square should be arranged about 30 in. away from the lens, and a sharp picture will fill the screen at that distance.

THE VEE-VEE INFINITE SPEED VARIER

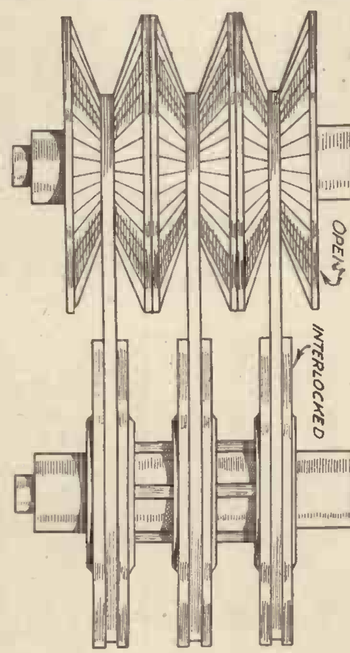
SPEED variation is very often essential in modern manufacture and operations. To obtain an adequate variation—the method to be simple, efficient, smooth in operation and not costly, has been a problem confronting engineers for a long time and the increasing use of alternating current has aggravated their need. Until recently their choice lay mainly between a commutator type of motor or else apparatus of limited performance and efficiency. The cost of a commutator type of motor was often prohibitive. Other apparatus sometimes required the machinery to be stopped until necessary adjustments were made to a different speed. Generally a sufficient variation could not be obtained, the number of steps being limited, so the machinery was usually run at an economic speed all the time. This was particularly noticeable in the case of printing machinery.

A Speeds Varier

A Speed Varier has been patented recently however, and is now on the market, which bridges the gap and make it possible for such machinery as printing machines, embossing machines, presses, fans, compressors, conveyors, friction hoists, mixers, machine tools (including drills, lathes, shapers, grinders, saws, flexible shafts, milling machines, etc.), to not only have a speed variation but an infinite speed variation.

Model C.S. driving a slotting machine.

Briefly, the Vee-Vee Infinite Speed Varier consists of one or several pairs of cones which intersect with each other, forming a "V" shape pulley carrying a standard "V" belt. By allowing the cones to expand or contract the diameter of the "V" is varied, which increases or decreases the velocity of the "V" belt with a corresponding alteration in the speed of the driven pulley.



The "Vee-vee" patent infinite speed varier.

A.C. or D.C.

Either alternating or direct current constant speed motors can utilise this speed varying device to obtain variable speed. There are a number of models, each designed to meet the varying requirements of users. For instance the model "F" has a variation of 2 to 1 or 3 to 1, is a self-contained unit made for independent drive by motor, engine or line shafting. Both driving and driven shafts are fixed—each shaft is fitted with one or several pairs of cones. C.S. type is used where a speed reduction is required in addition to a speed variation.

The obvious advantage of this arrangement is that a higher speed and more efficient motor can be employed with a better final drive. A further model C.S.S. is somewhat similar but has two countershafts in series—giving a larger speed variation. Speed control is effected by a mechanical controller either placed as standard above the motor or it can be removed and fitted remote from the motor.

Model C.S.S. driving a printing machine. Variation 4 to 1.

CUTTING STRIPS OF PAPER

Simple Devices for facilitating the Cutting of Strips of Paper

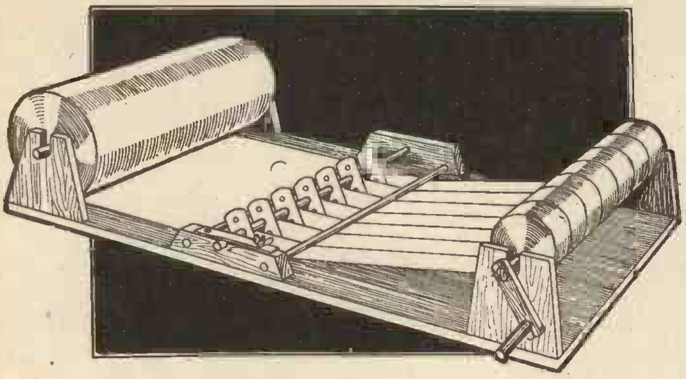


Fig. 1.—A machine for cutting a roll of paper into strips.

THERE must be dozens of different uses for strips of paper of all sizes, such as patching the binding of a book, edging flimsy papers which have to be filed, covering and insulating aerial wires for car-radio, and the very narrow and accurately cut strips for lining out scale models. Narrow shaped strips of paper or card can be cut with the device shown in Fig. 2. Here there are two razor blades bolted together with a wood spacer between them. The width of the spacer should be the width of the strip required, less the thickness of one blade, for the tips of the blades are ground equally on both sides.

Long Strip

Parallel but wider and longer strips of paper, which may not be so essentially accurate, can be cut with the device shown in Fig. 4. The blade is stuck into the bench or in a separate piece of board and a guide bar secured at the required distance from the blade. The paper is then fed at the edge of the blade and, when the cut ends grip the paper, it is drawn through. Two fingers pressed lightly on each side of the blade, immediately before the cutting edge will prevent the paper buckling. The surface of the board near the blade should be sandpapered quite smooth and will greatly assist in easy cutting.

For cutting narrower strips of paper from a strip already cut, for example, the common gummed paper rolls, the cutter shown in Fig. 5 has its advantages. It can be made from thin three-ply wood pinned or screwed together or from cardboard glued together. Two slips of material are first secured to the piece forming the base, which might be extended to that shown in the illustration in order that the device may be fixed to the bench, at such a distance apart that the paper strip can pass through easily. The top piece is then fitted and the razor blade worked through the top and bottom on an angle. It is best, when commencing to cut the strip, to first withdraw the blade from the device, fix the end of the paper through the slot and then press the blade in again.

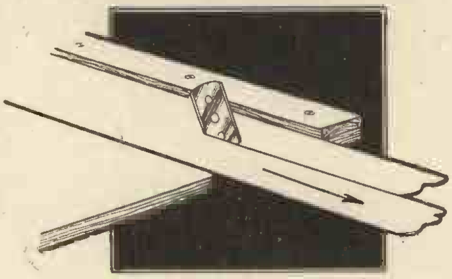


Fig. 4.—Cutting wider and longer strips of paper.

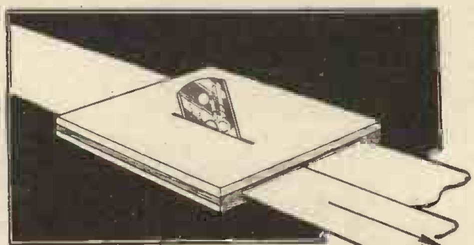


Fig. 5.—Strips of paper may be cut into narrower strips with this device.

The paper can then be pulled through continuously. This device can also be used for cutting narrow strips of linen and passe-partout.

An arrangement which will cut several strips from one piece of paper at the same time is shown in Fig. 3. The principle is the same as shown in Fig. 4, but in order to keep the paper down flat on the board between the blades, two pieces of smooth dowel rod are placed, one before the cutting edges and one after, into two uprights fitted to each side of the baseboard, which also act as guides for the outside edges of the sheet. If the paper is thick, the blades may have a tendency to draw out, but this should not happen if the dowel rod is sufficiently close to the cutting edges. If the trouble persists, a piece of board may be fixed across the guides and pressing down on to the upper corners of the blades, to prevent them rising up out of the baseboard.

Cutting a Roll of Paper

If the paper which has to be cut is on a roll a machine may be built as illustrated in Fig. 1. The principle is the same as Fig. 3, but the razor blades are mounted on a steel rod, and spaced by turned collars, the end of the rod being threaded to take a nut by which the assembly is tightened up. Should the blades have a tendency to rotate, after the nut has been fully tightened up, paper washers inserted between the blades and the collars will prevent this. The blade assembly is fitted into the supports on each side of the machine, being clamped with a bar and a wing-nut to prevent the whole rotating. The ends of the blades drop into narrow slots in the baseboard, so that by turning the blades a little a new cutting edge can be found, in addition to the four positions obtainable by reversing the blades.

A simple rotary trimmer for paper-hangers, which is just as effective as machines sold for the purpose is shown in Fig. 6. The two end pieces are cut in ¾-in. thick oak, and each have three slots. One in the front to carry the guide and cutter bar, one at the top to take the winding spindle and another at the back to take the ordinary screw table clamps. The cutter bar can be of soft wood so that the razor blades can be easily "stuck" in, in any desired position. The winding spindle can be a broom handle, and is cut from the free end down as far as the support at the other end. This slot is for the end of the paper to be inserted.

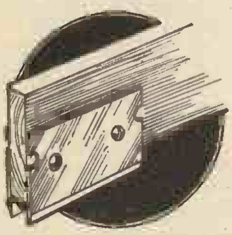
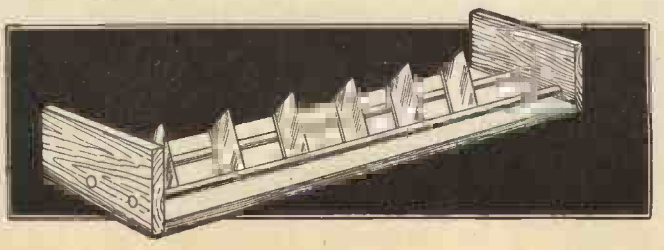


Fig. 2.—A device for cutting narrow strips of paper.

Fig. 3.—(Below) Cutting several strips from one sheet of paper.



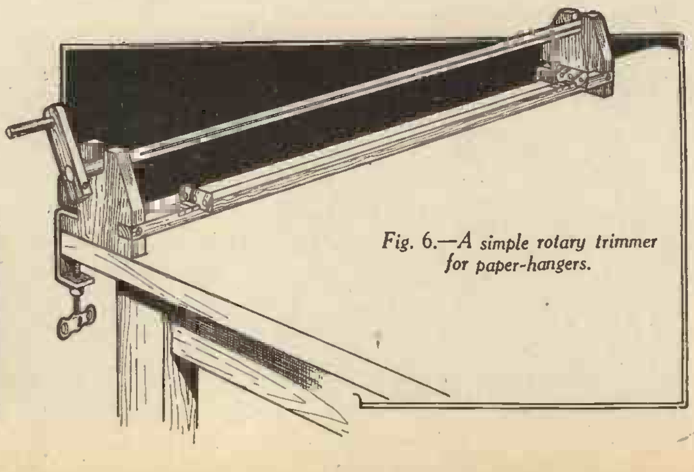


Fig. 6.—A simple rotary trimmer for paper-hangers.

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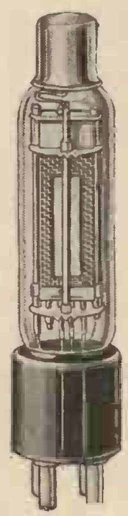

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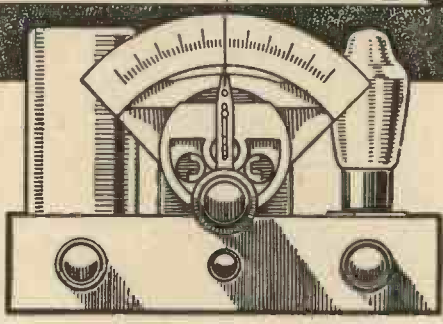


POCKET RADIO

The Short-wave Receiver Lends Itself Admirably to the Compact Form of Construction now referred to as Pocket Radio. The Main Features of Design are Explained in this Article

THERE is an increasing interest in the pocket type of portable, engendered partly by the increased publicity given to the police radio apparatus, and partly by the approaching summer months, when outdoor radio becomes the main interest of the amateur. The pocket set may be designed to cover any wave-band, but although the ordinary broadcast band will appeal to many listeners, there are many reasons why a short-wave pocket set is the most practical proposition. Firstly, the tuning coil for the broadcast band can only be reduced to a certain size by losing considerable efficiency, whereas the short-wave coil is naturally of small dimensions. Secondly, the range of certain short-wave stations is much greater than the medium or long-wave stations, and a much smaller aerial is required to provide good signals with a minimum of valves. It is true that the police radio apparatus is only designed primarily to operate over a small distance, say, in the precincts of a town or county, but a single valve short-wave set will provide signals from America at quite good headphone strength under favourable conditions, and thus there is a very wide field of entertainment available for the user of a pocket one-valve short-waver. There is no need, however, to restrict design to one-valve circuits, but naturally, as the main aim of the design is to enable the receiver to be made sufficiently compact to be contained in an ordinary pocket, the scope of the receiver design is naturally restricted.

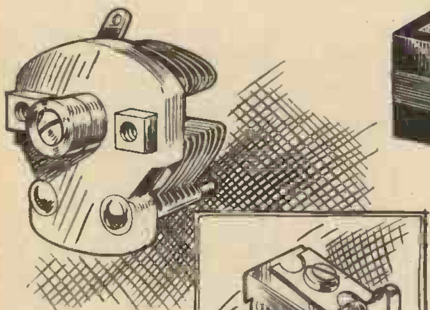


Fig. 1.—Ideal components for the pocket S.W. set are now obtainable from various manufacturers.

Valve Types

For the most effective types of pocket set the acorn valve cannot be improved upon. This has extremely low losses, is of very small dimensions, and oscillates very easily with a minimum of high-tension. The Hivac midgets are also very suitable and are now obtainable in three types suitable for any combination or circuit, other than the superhet, of course. The voltage supply is considered in many cases to be a problem, but it is obvious that a set cannot be made self-contained and then be of such a size that it may be placed in a normal pocket. A large pocket such as is found in certain types of overcoat will accommodate quite a large piece of apparatus, but in general the power supply should be in a separate container, ordinary flex being used to connect the two together. In this way, any tuning adjustments may more easily be carried out, as a much smaller and lighter piece of apparatus has to be held in the hand for the purpose.

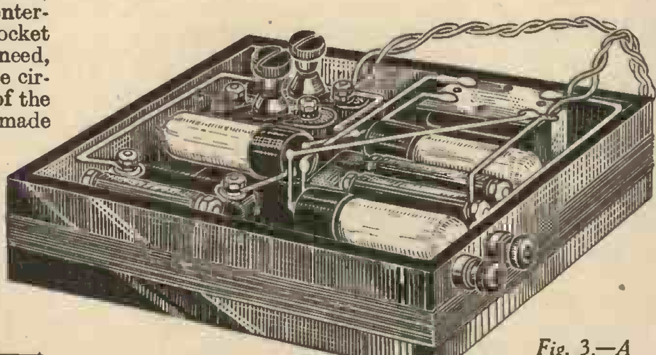


Fig. 3.—A pocket receiver built round the Hivac Midget valves, and fitted with a frame aerial.

Batteries

For the heater or filament supplies the type of battery designed for use in various lamps will be found very suitable. There are many of these to choose from, the actual choice depending upon the overall size which can conveniently be accommodated. There are batteries for small torches, as well as the larger models made for large inspection lamps, and where a longer period of life is desired, special small L.T. accumulators of the unspillable type may be used. These two batteries should be purchased first and then the container made, covered with leatherette or otherwise finished for neatness, with a hole to enable the four-way cord to be passed out for connection to the receiver.

Other Components

The coil will presumably be home-made, the size and number of turns depending upon the wavelength. For short-wave results this is an extremely simple job: 30 turns of 28 D.C.C. wire on a 1-in. tube for the grid winding, with a pile-wound coil of similar size for reaction, will enable the most useful section of the short-wave band to be covered by means of a 50-mmfd. condenser. This component may be one of the mica-dielectric trimmers sold for use with certain coils or I.F. components, or an air-spaced variable such as the Microdenser manufactured by Eddystone. Fixed condensers and resistors are now obtainable in extremely neat and compact units, the resistors of the half-watt type being ideal for a receiver of this nature, and the "manufacturer type" fixed condensers without casing taking their place with these components. If these are not available, an ordinary mica-type fixed condenser may be dismantled, the casing being broken away, or the wax filling being first scraped out and the terminals removed. No terminals should be used in a set of this type in view of the difficulty of finding a suitable small

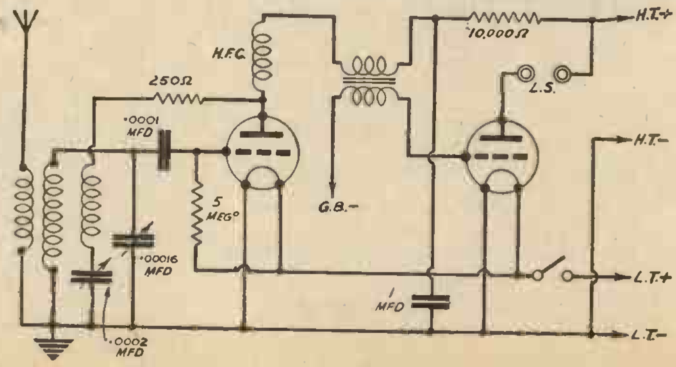


Fig. 2.—The simplest S.W. circuit. This simple detector-L.F. combination does not possess the range or reliability of the properly designed super-regenerative set.

terminal which will offer sufficient area of contact to maintain the efficiency of the remainder of the parts. Therefore, plug and socket connections should be adopted for aerial, earth and 'phoned. From the Clix range suitable components may be selected which will offer all that is required in this connection. To enable the aerial to be connected without the need for a serparate aerial coupling coil, and to preserve efficiency, a series-aerial condenser is indicated, and again the "trimmer" component may be used. The accompanying illustrations show these various parts and give some indication of their size.

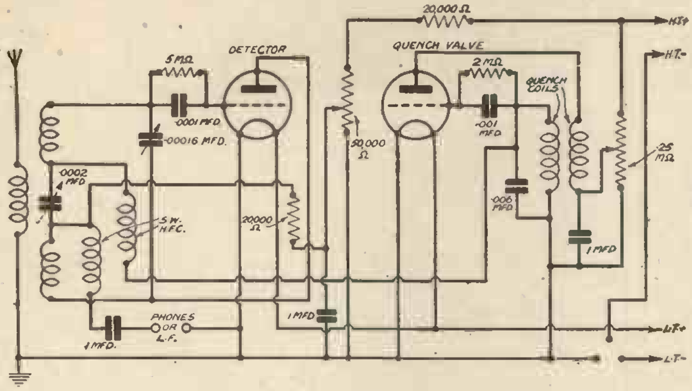


Fig. 4.—A super-regenerative receiver circuit which forms a good basis for a pocket receiver.

Construction

The method of assembly will depend upon the general overall dimensions which are to be adopted. Obviously, components will, as far as possible, be connected direct to each other without the intervention of connecting wires, and the acorn type of valve also may be used in a similar manner. The Hivac valve is provided with pins for insertion in a holder, and to facilitate changing the valves a small sub-baseboard arrangement would be required. This may be avoided, however, by soldering the connections direct to the valve pins, and holding the valves in position in the case by means of rubber bands or some similar scheme. Thin paxolin is obtainable from Messrs. Peto Scott from which the entire case, or the panel alone, may be constructed, and this is both light and strong enough for the purpose. It is also easily worked.

The Aerial

A number of interesting schemes may be introduced in the way of an aerial. A very short wire suffices for the majority of the shorter wavelengths, and if the receiver is to be used whilst walking, a length of copper wire may be stitched in the back of the coat. Thin wire will do and will be sufficiently flexible to enable the coat to be folded or otherwise used without any effect. The end may be taken inside the pocket in which the receiver is installed and a plug fitted for connection to the aerial terminal. An alternative scheme is to use a length of flexible wire, a clip at the end enabling it to be attached to any object raised above the ground. In most cases an earth may be dispensed with, the capacity effect formed between the batteries and the body acting sufficiently for this particular type of apparatus.

Headphones will naturally be used, and Ericcsons will prove very satisfactory. To prevent the normal outdoor sounds from affecting the other ear (in the case of very weak signals) a small pad may be made from cotton-wool and cloth to cover the ear.

Circuits

There are several interesting circuits which may be incorporated in pocket receivers of this nature, but in most cases it will be found that the simple reacting detector arrangement as shown in the sketch will be the easiest to set up and put into good working order. The super-regenerative circuit will give louder signals if it is made to work properly, but in many cases it is found that the amateur, especially the beginner, cannot get maximum efficiency from this type of receiver. The self-quenching circuit is easiest and requires fewest components, and lends itself well to experimental work. Reflex arrangements may be found useful, but on the short waves they are not so simple to set up as on the broadcast bands. Where the size of the H.T. is not of great importance, L.F. stages may be included to provide louder signals, but the main aim of the pocket set is to obtain a useful and easily-carried receiver, and thus the overall size and weight must be kept down to a minimum. Sufficient has now been said to enable a suitable receiver to be constructed, and we shall be glad to hear from readers who succeed in constructing an efficient set of this type, with, perhaps, some test reports.

A Giant Mosquito in Glass

MODELS of mosquitoes on a gigantic scale are now made of glass, this material being chosen mainly because it would serve most accurately to represent the appearance of the wings and certain other parts, when seen greatly enlarged. The scale on which they are built may be judged by the fact that each of the two wings of the female is a foot and a half long. Like the wings, the long "sting," which is really a case for holding surgical instruments, is of glass also, covered with multitudinous bristles of the same substance.

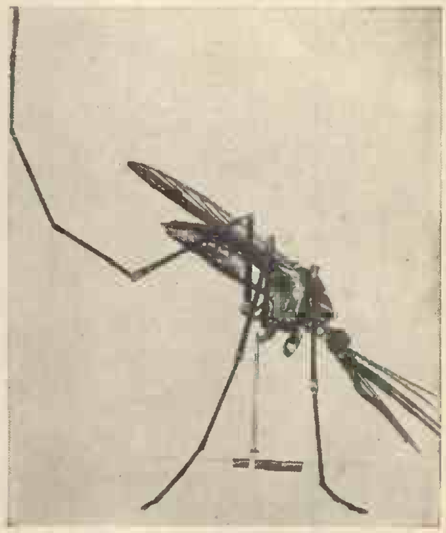
The models are three in number, representing respectively a female mosquito, a male, and a "wriggler." In order to make them perfectly accurate, anatomically speaking, an immense amount of study was required. The preliminary sketches were executed in clay or on paper; but the head of the "wriggler" was copied direct from observation under the microscope. When thus viewed, the entire body of the larva is seen to be covered with long, spiky hairs, which, numbering several thousand, had to be reproduced in glass.

With the aid of the microscope, sketches were made of the mouth parts, of the antennæ, of the feet—each of which has a pair of claws—and of the joints. The structure at the base of each wing, in a living mosquito, comprises several thousand lenses. The wings themselves were copied in glass from photomicrographs, and the legs were done in wood, long slender sticks put together with suitable joints and covered with a coating of wax, in which an immense number of celluloid scales were inserted, to counterfeit nature in every detail.

The processes involved were extremely elaborate and delicate, the making of the three moulds occupying the time of three experts *for nearly a year*. One of the men, who was a glass-blower, devoted his attention to producing the requisite parts composed of that material. Even the somewhat complicated "whiskers" of the male insect are of glass in the model. The poison gland of the female is likewise of glass, her internal anatomy being displayed to view. She is a malaria mosquito, and the parasite of malaria is actually shown in her salivary tract.

Since yellow fever and malaria have been blamed on the mosquito, it is interesting to know how the dangerous insect can be distinguished from the merely disagreeable one and how it does its deadly work.

All mosquitoes are not biters, and all biting mosquitoes do not carry malaria. Although the male mosquitoes outnumber the females two to one, only the female feeds on blood. Of all the females, one species alone is to be feared—the malaria mosquito. It can be distinguished by the fact that its hind legs are relatively very long, and that it therefore holds its body at an angle of 45 degrees while biting or resting. All mosquitoes except the germ-carrying variety rest horizontally.



A model of a mosquito made entirely of glass.

Thus distinguished, certain other characteristics follow. The germ-carrier flies only at night and cannot fly more than one hundred feet at a time. It is perfectly harmless unless it has had an opportunity to bite a malaria victim, for malaria is not inherent in its nature; it is simply a germ-carrier. But if the mosquito obtains any malaria germs while sucking blood, they remain in its stomach, breed myriads of other germs, and spread into the salivary glands, ready to be deposited with the saliva at the mosquito's next meal. The bill of a malaria mosquito is so constructed that it leaves a small drop of saliva, in which there may or may not be germs, while blood is being taken in through another duct.

MODEL BOAT BUILDING

By Home Mechanic

Working Drawings of Proved Successful Designs may be obtained from Model Supply Stores, and a Model Built to such a Design has More Chance of Turning out a Success than a Design Based on Rule-of-Thumb Methods by an Amateur

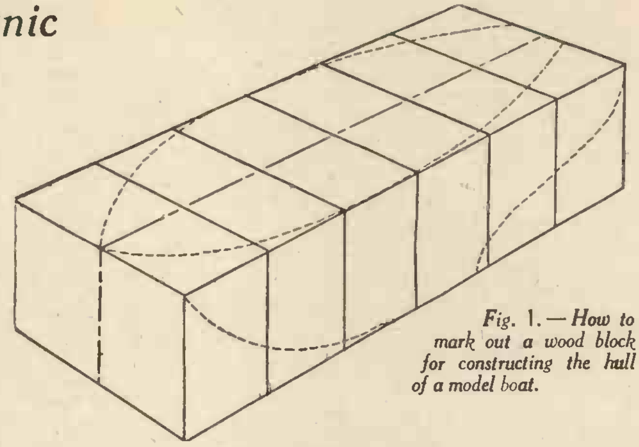


Fig. 1.—How to mark out a wood block for constructing the hull of a model boat.

MODEL boats may be classified into three broad classes, according to whether they are sailing, power driven, or purely exhibition models, and each class may include models costing anything from a shilling or so up to a hundred pounds, or considerably more in the case of specially fine show models such as those owned by steamship companies. These models represent in wonderful detail, and accurate scale, their full size prototypes.

The simplest type of model boat has the hull cut out of a solid block of wood and hollowed out inside, except for very cheap toy yachts. This method is quite satisfactory for small boats up to, say, 2 ft. in length. Larger sizes than this entail a good deal of tedious work, and other methods of construction are preferable.

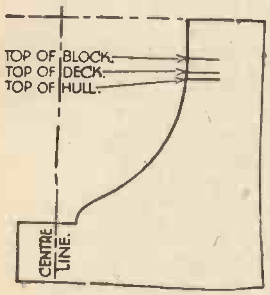


Fig. 3.—A set of templates, one for each section, should be made from sheet metal or thin wood as shown above.

In making any kind of boat full size drawings must be made of the profile or side view, the deck plan and sections of the hull, the number of the latter depending upon the size of the model.

The Wood Block for the Hull

The block of wood must be carefully selected so as to be free from all defects such as knots, splits, or irregularities of grain. The first step is to get it planed up perfectly square, and very slightly in excess of the overall dimensions of the hull to allow for finishing. The centre line must be marked accurately along the top and bottom, also across the ends, and transverse lines marking the position of the sections added. The deck plan should then be traced on the top of the block, and the side view on one side. At this stage the block will appear as in Fig. 1.

The next step is to cut out the side view with saw and chisel straight across the block, afterwards cutting round the deck shape vertically, thus producing the shape like Fig. 2, every section of the hull being a rectangle.

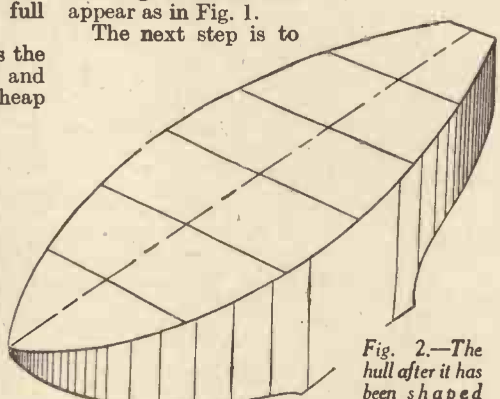


Fig. 2.—The hull after it has been shaped from the block.

A set of templates, one for each section, should be made from sheet metal or thin wood, something after the style of Fig. 3. The shape must be accurately copied from the drawings, and the centre lines and the deck lines carefully marked. The reason for the three lines at the sides is to ensure the correct allowance being made for the sheer (*i.e.* the longitudinal curve of the deck) and the thickness of the deck.

The hull is carefully carved away with chisel, spokeshave, and gouge until each template fits closely, the guide lines coinciding with the centre line and the top surface. Considerable care is necessary in doing this, for one careless cut with a chisel might spoil the designed shape of the hull.

The bulk of the wood may be removed from the inside by drilling numerous holes with a 1-in. centre bit, and chipping with a curved gouge. Great care is necessary to avoid perforating the hull, and the thickness should be continually checked by means of a pair of callipers. About ¼ in. thick is a reasonable thickness to work to amidships, the ends being thicker because the grain runs through the wood at the bow and stern. The top edge should also be a bit thicker to take the screws for the deck without risk of splitting. (See Figs. 2 and 3.)

The Fin Keel

This may be of wood or metal. Wood is easier to shape and to cut; it may also be more easily fixed by brass screws from the inside. In some cases long bolts formed from motor-cycle spokes bolt the hull, fin, and lead together, as shown in Figs. 4 and 5. This illustration also shows alternative methods of fixing the lead.

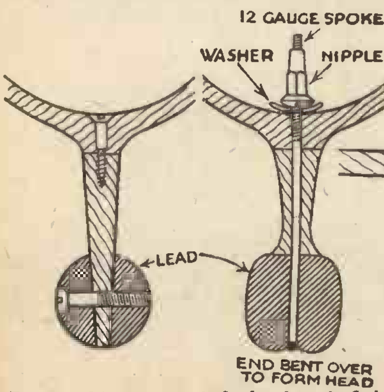
The weight of lead required will usually be given on the drawing. It should be enough to cause the hull to sink in the water down to its designed water line, allowance being made for spars, sails, and fittings.

The deck may be either fitted flush on to the top of the hull and held down by small screws, or it may be let into the hull, as shown in Figs. 6 and 7. Both methods are satisfactory, but the first is the simpler, the joint being made watertight with white lead in each case. Yellow pine, ⅛ in. thick, makes a good deck. The hull is finally finished with sandpaper, and given several coats of best paint or varnish. The inside of the hull and the underside of the deck must, of course, be painted before the deck is screwed down.

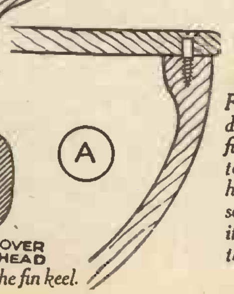
In any kind of sailing ship the hull should be kept as light as possible consistent with reasonable strength, because weight saved in the hull can be put in the lead, enabling the boat to carry its sails better in a stiff breeze.

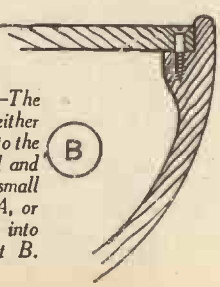
The "Bread-and-Butter" System

For larger boats the "bread-and-butter" system of construction saves a lot of heavy work. The principle of this method is clearly shown in the sectional view (Fig. 8). Each layer is from ¾ in. to 1 in. thick, and cut from a single plank by means of a jig-saw. The shape of each piece is ascertained from the drawings and accurately traced down on to a plank. The minimum overlap for gluing should be ⅜ in., but the



Figs. 4 and 5.—Two methods of making the fin keel.





Figs. 6 and 7.—The deck may be either fitted flush on to the top of the hull and held down by small screws as at A, or it may be let into the hull as at B.

overlap will be considerably more than this towards the bottom.

The planks are glued together with a good glue rendered more or less waterproof with acetic acid or potassium bichromate, and left until the joints are firmly set. The result will be a roughly-shaped hull made up of a series of steps both inside and out, and by cutting away the corners of these steps the hull is shaped to a smooth form. The shape of the hull at each section should preferably be checked by means of a set of templates, as already described for the solid hull. The inside is smoothed off with a curved gouge, and the thickness checked with callipers, as described above.

In this method of construction it is usual to strengthen the glued seams by binding them together with stitches of thin copper or brass wire, the wire being threaded through holes pricked through the hull—after the shaping is done—with a fine awl.

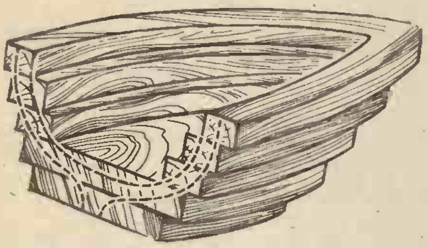


Fig. 8.—For larger boats the "bread-and-butter" system of construction saves a lot of heavy work. The principle of this method is clearly shown above.

Racing Model Yachts

These are, however, most frequently built up from planks in a similar manner to full size boats. There are several alternative methods of planking, but horizontally planked boats are most frequently met with, the planks being fitted edge to edge instead of the overlapping method frequently seen in pleasure rowing boats. A plank-built model entails a great deal of careful work, but it should not be beyond the scope of an enthusiastic amateur. He must be prepared to put in a lot of time on the job, however.

There are various methods of building, most of which involve the use of a false framework of "moulds" or dummy sections which are afterwards removed.

The usual procedure for the construction of a model with bent ribs is to cut a series of moulds from rough wood about ¾ in. thick. These moulds must be smaller than the hull section by the thickness of the planking plus the thickness of the ribs. If both of these are ⅛ in. the mould must be smaller all round (except the top) than the drawing giving the "lines" of the hull sections. Notches must be cut in the moulds for the keel and for the inwales, as shown in Fig. 9. The moulds are then screwed upside down on to a foundation board rather longer than the hull; this also is shown in the same illustration.

The keel must next be cut out and fitted into the notches on the moulds, as shown in Fig. 9. The stern will usually be made solid with a rebate for the ends of the planks, this solid piece—called the transom—being fixed to the keel proper. The bow end is generally a separate piece also, so that the grain of the wood can run along its length instead of through the keel which would weaken the latter at a vulnerable place.

The edges of the moulds must then be chamfered off at an angle to conform with the shape of the hull, and a rebate cut in the keel for the edge of the first plank; notches for the ends of the ribs are also cut in the keel. The keel is then laid in position on the moulds and the two inwales fitted. These are fixed at the bow and stern, but are not fixed to the moulds, they simply lie in the prepared grooves and are notched for the ribs. The ribs are then steamed until thoroughly pliable, screwed to the keel, and bent round the moulds, being held close to the latter by tying the ends down with string. After this stage of the work is completed planking may commence.

The Ribs

These are marked off round their peripheries into as many equal spaces as there are planks. The planks are usually about ⅜ in. wide by ⅛ in. thick, and may be of pine, cedar, or mahogany. The first plank to be fitted is one nearest to the keel. It must be carefully shaped along one edge to lie accurately in the rebate without forcing, the other edge being shaped to coincide with the first set of pencil marks on the ribs. The plank is then screwed to the keel after first painting the rebate, and the edge of the plank, with fairly thick shellac varnish. ¼-in. No. 0 countersunk brass screws are suitable. Brass or copper tacks are, however, frequently used. Two screws or tacks are usually put in at each rib.

The corresponding plank on the other side is next fitted in a similar manner, afterwards adding the other planks, working outwards from the keel, one plank at a time on each side, *i.e.* one side should not be finished off before starting the other.

After planking is finished the hull is turned over and some of the moulds are removed, cutting them to pieces, if necessary, to get them out, and deck beams fitted. It is not usually necessary to fit a deck beam at every rib. The beams are cut with a curve on the top edge to give a camber to the deck. All the remaining moulds are then removed, the protruding ends of the ribs trimmed off, and the inside of the hull varnished with shellac varnish.

The outside of the hull, instead of being quite round and smooth, will consist of a series of flats, which must be rounded off by planing, scraping and sandpapering before being varnished or painted, as the case may be. Only the very best oil varnish (not a spirit varnish) should be used, and each coat given several days to dry quite hard before applying the next coat.

Power Boat Hulls

This type of hull may either be carved from the solid or built up as for sailing yachts, though, of course, to different lines. Racing motor boats, although they differ greatly in their lines, may be built up on a system of moulds, but being almost rectangular in section the whole operation is much simplified, for the bottom and sides may frequently each be fitted in one piece instead of using a couple of dozen or so narrow planks. Alternatively, the hull may be soldered up from sheet metal.

A great problem of model yacht racing is that of handicapping, or "rating," to use the proper term, for a larger boat will usually be faster. It is extremely difficult to follow the various rules and formulæ that have been tried at various times, and it is beyond our present scope to attempt such a task. The oldest, simplest, and still fairly popular rating formulæ is the "Sail Area Rule" expressed as follows:

$$\frac{L \times S}{6{,}000}$$

Where L is the length in inches of water line and S the sail area in square inches, boats of equal rating are then sailed together in competition.

A favourite type of boat is the A class, for models not exceeding 1 metre in length, the formula of which is:

$$\frac{L \times V^s}{4} \times \frac{LV^s}{123VD}$$

L and S are as above, D being the displacement in cubic inches. The formula is, however, further complicated by the various limits and penalties which have to be considered, and the would-be model yachtsman is recommended to join a club, when he will in due course become conversant with the details.

The Sail Plan of a Model

Sail plans are usually obtainable as a separate sheet of drawings to suit the design for the hull. The sail plan should be followed closely, as a slight variation in the shape of the sails or the position of the mast may seriously upset the sailing of the boat. The object of the designer is to arrange the sails so that the centre of pressure due to the wind is almost directly above the centre of lateral resistance of the hull in the water. But as both of these points may vary appreciably under different conditions it is difficult to arrive at an exact balance, and the final compromise is usually made by trial, adjustment being carried out by altering the position of the jib, or by moving the mast in an adjustable fitting.

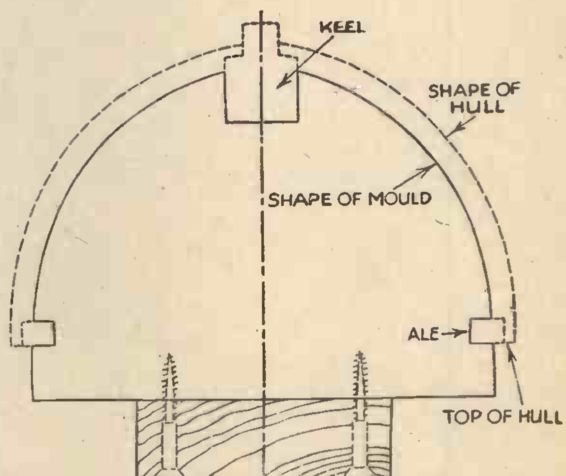
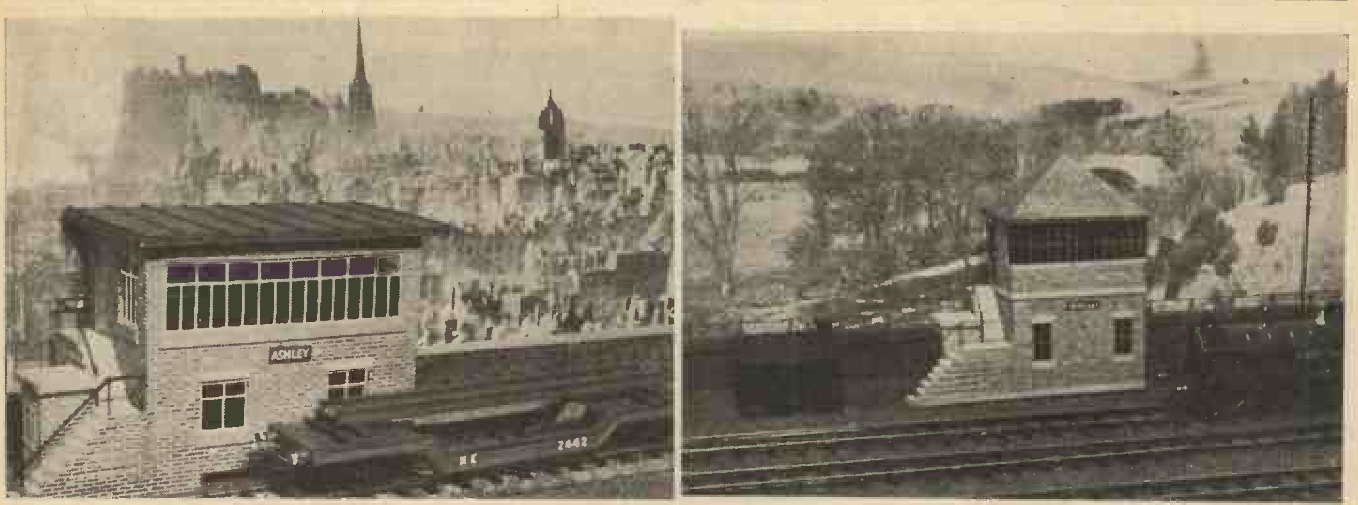


Fig. 9.—Notches must be cut in the moulds for the keel and for the inwales as shown.

Special sail cloth for model yachts may be obtained from model stores, and is the best material to use. Balloon fabric is also suitable, being light and strong, but it is liable to crease badly. The material is stretched lightly on to a board and cut out with a razor blade, no allowance being made for hem. The edges are finished by binding with folded tape.

(*To be continued*)



Two modern brick cabins.

THE LATEST IN RAILWAY MODELLING

BY EDWARD BEAL

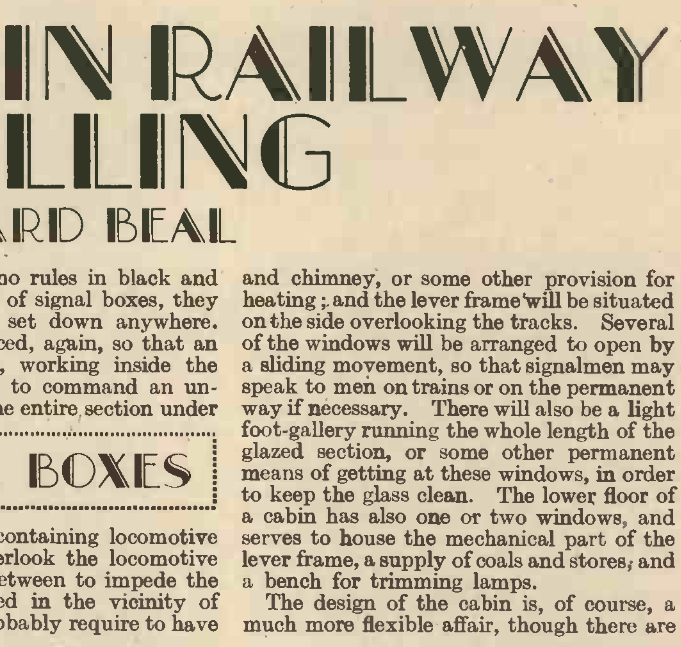
AN unlimited range in design, position and size is possible to the railway modeller when he begins to consider the requirements of his lay-out in the matter of signal cabin equipment. He may install a cabin having a single floor on a level with the platform surface at a station, or a large control box for an important junction which may demand as many as three floors and may be as large as a country goods shed. There are many ways of placing a signal cabin and there are very many different designs. Cabins may be built of brick, stone, timber, concrete, or a combination of any of these materials. The matter of size will, it goes without saying, depend solely upon the amount of work requiring to be done in the box, and there must be no incongruity between the dimensions of the section of layout under control (number of points and signals to be operated) and the dimensions of the building. A control-cabin 14 ft. long by about 11 ft. wide will roomily house some twenty levers, and the size of the building required will depend entirely upon the number of levers demanded by the lay-out section. Due regard to this point will make for general effectiveness and realistic appearance.

The Site

The question of site is equally important and just as little the question of a whim. A hump yard requires two boxes, normally, one near the hump, the other near the exit, and while there are no rules in black and white for the placing of signal boxes, they must not simply be set down anywhere. They must be so placed, again, so that an imaginary signalman, working inside the cabin, would be able to command an uninterrupted view of the entire section under

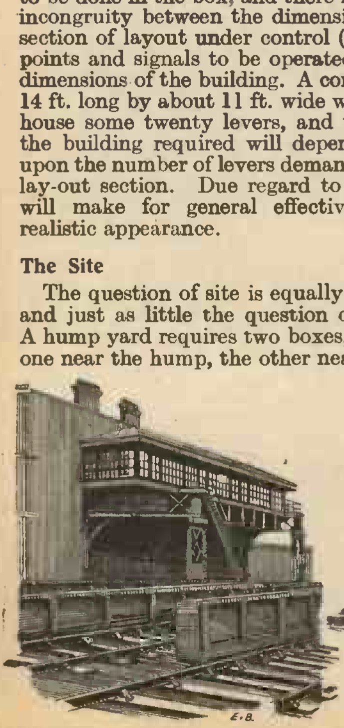
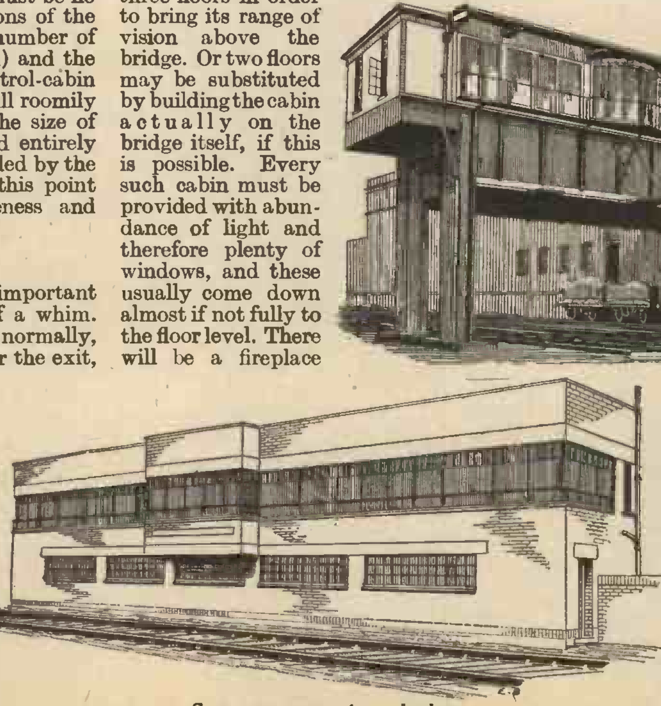
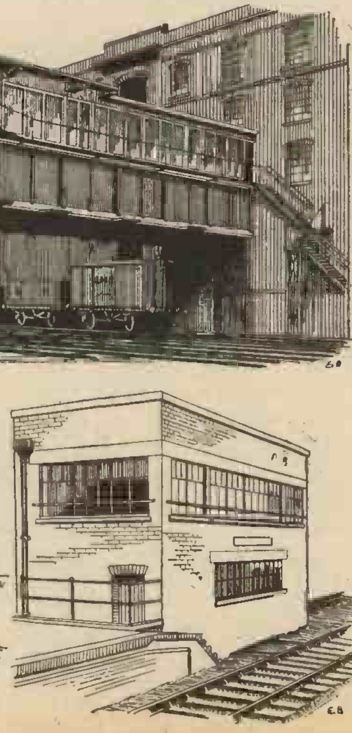
SIGNAL BOXES

his control. A box containing locomotive yard levers must overlook the locomotive yard, with nothing between to impede the view. A cabin placed in the vicinity of an overbridge will probably require to have three floors in order to bring its range of vision above the bridge. Or two floors may be substituted by building the cabin actually on the bridge itself, if this is possible. Every such cabin must be provided with abundance of light and therefore plenty of windows, and these usually come down almost if not fully to the floor level. There will be a fireplace



and chimney, or some other provision for heating; and the lever frame will be situated on the side overlooking the tracks. Several of the windows will be arranged to open by a sliding movement, so that signalmen may speak to men on trains or on the permanent way if necessary. There will also be a light foot-gallery running the whole length of the glazed section, or some other permanent means of getting at these windows, in order to keep the glass clean. The lower floor of a cabin has also one or two windows, and serves to house the mechanical part of the lever frame, a supply of coals and stores, and a bench for trimming lamps.

The design of the cabin is, of course, a much more flexible affair, though there are

Some recent types of signal cabins.

definite determinants, within limits, as to the material to be used. A small country station may have to be content with a timber structure, or one with a timber box on a brick foundation. But at important points on the line, or where the traffic warrants it, a more substantial and ornate structure will be erected. Most modern buildings of this order are of brick or concrete or both.

Excellent Prototypes

The designs here given represent an effort to get away from the more usual "model signal box" idea in which some early-Victorian style of architecture is followed. The four sketches depict some types which, while the writer has rarely seen them modelled, would form excellent and interesting prototypes. The first is a cabin built upon steel girders projecting from the wall of a large building to which they are bracketed. These undergirders are interesting in that they are so placed as to cross the ends of the cabin at an angle, as will be seen. Next we have a design again erected on steel girders, of the plate type, but in this instance arranged to span the tracks of a five-road railway. One end of the girder section is built into the wall of a warehouse, the outer end being supported on steel uprights. The building itself may be of brick or concrete. The smoke-shields on the underside of the girders should be noted, the longest serving to protect the windows on the projecting bay. A metal stairway is placed at one end near the warehouse wall. The third example, also a large type, is that recently built at Cardiff. This is of modern standard design and is of brick and cement throughout, the plain form of its architecture making it very simple to model and very effective in appearance. The fourth design follows the same standardisation in its main features, but is very much smaller, and is erected at the end of one of the platforms at Paddington. Red brick and concrete mountings are employed again in this instance.

Positioning the Cabin

Turning to Fig. 4, we find a large number of diagrams representing the varied methods of placing cabins in relation to the tracks they control. Fig. (1) is a simple box spanning three tracks on brick columns; (2) a box spanning three tracks on a girder underframe; (3) a diagonal arrangement spanning tracks. All these have outside stairways. In (4) we have a type spanning two tracks, resting on brick or masonry columns placed between the second and a third track, and having an inside stair. (5) shows a side-track erection; (6) spans two tracks but is built on one end only of a girder structure; (7) is a small wall-type cabin alongside tracks; (8) is between two pairs of roads; (9) is located at the end of a platform, with stairway giving on to the latter; (10) spans a double road but is built on a pair of station platforms and has a footbridge sharing its foundations; (11) is erected on the girders of a bridge; (12) spans two tracks longitudinally and rests on two rows of steel columns; (13) is of similar arrangement but resting on a single central row of columns. It will thus be seen that there is an infinite range of selection for the style of the building, though in real practice there would be many local determinants restricting the type.

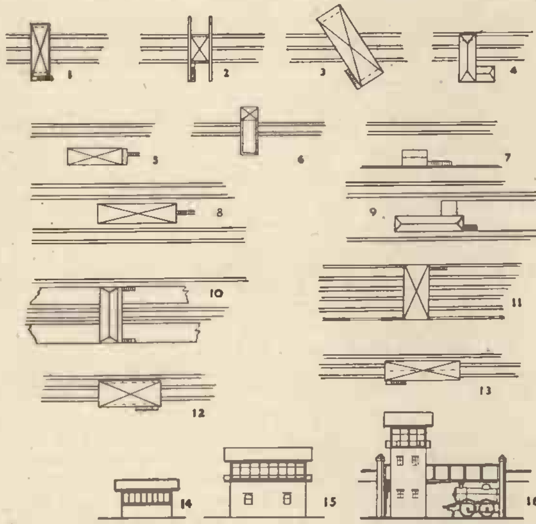
In (14), (15) and (16) we have one-, two- and three-floor buildings to suggest the need and possibility of variation in height. Sometimes, where land is damp and liable to permit subsidence, a series of piles are driven into the earth, a concrete frame erected on these, and the cabin is then built on this frame, as shown in another sketch. This is an actual and very recent example.

Two Designs

In building a cabin for the 00-Gauge scale there are a few general suggestions which may be applied to all types. Figs. 5 and 6 give dimensioned diagrams for the first two types discussed. The wall box on steel columns and girders provides scope for some nice girder work in cardboard and wood. For the columns, fine dowelling may be employed, the girders being made up, with the small lattice sections, in card and veneer strip-wood. A pair of Leeds Model Co.'s 0-Gauge signal brackets will serve admirably for the wall supports. The upper portion of the building is standard. The walls should be fretted out of cardboard with a razor-knife and steel rule. The windows may be in three sections of stout celluloid, which should first be scribed with a harsh metal instrument and a ruler to form the white sash-lines. Care must be taken that each of these is white, and that the lines are neither too fine nor too coarse. A good method is to secure a sheet of Meco black sash-paper and lay the celluloid strip upon it, scribing first the two extreme lines of the length, then the two long inner lines. Then the first two or three sashes may be completed with upright lines. Next the celluloid is moved slightly, keeping the long lines true, to give the $\frac{1}{8}$-in. gap for the heavy sash on the wall mask. Then the next section of window is scribed, and so on. A better method might be to do the celluloid work first, and to form the wall mask from the "finished glass."

In the second design (Fig. 6) the window work, having heavier sashes, may be done if desired in glass, which is stuck in one piece behind the walls and is lined out with very thin strips of white gummed adhesive paper. Stamp edging is good, but some types of passe-partout strip will peel off. The bay window is formed separately, with sections of card at top and bottom to form the shape. Celluloid may be used for this window section, but it must be sharply bent to shape over the edge of a ruler. Hand galleries are of pins and wire, soldered up. The pins should be forced through the projecting footboards heads downwards, with a touch of glue on each pin. The wire should then be soldered along the top after the pins have been trimmed even with the aid of an inserted piece of $\frac{1}{8}$-in. strip-wood to get the correct and regular height.

(*Continued on page* 534)



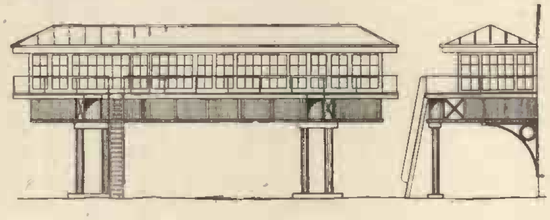


Fig. 5.—A cabin support on columns and brackets.

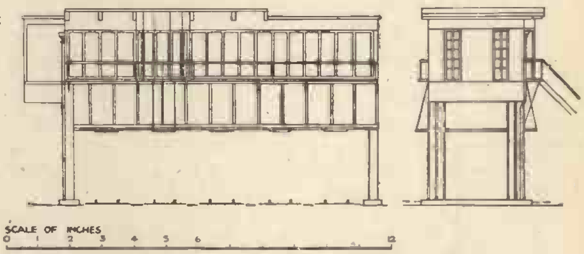
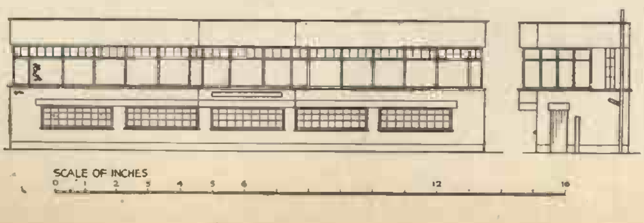
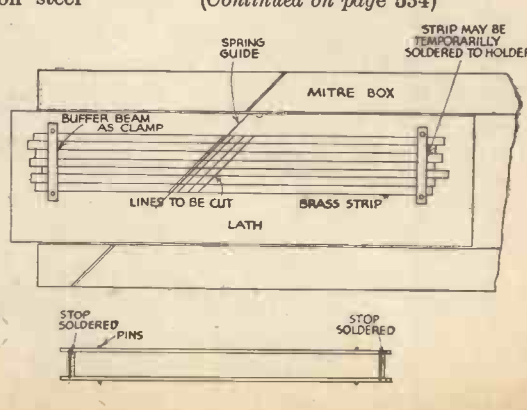


Fig. 4. — (Left) Positions for placing signal cabins. Fig. 6.—(Right) A cabin spanning multiple tracks.





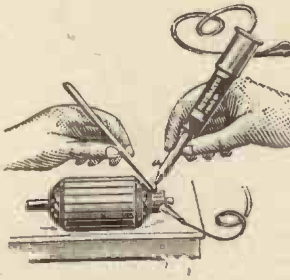
Figs. 7 and 8.—(Left) A simple modern-style cabin. (Right) Making metal stairways.

ITEMS OF INTEREST—
—NOW ON THE MARKET

A New Arc Solderer

RUNBAKEN Electrical Products, 280 Deansgate, Manchester, 3, have recently produced a new arc solderer, with which all kinds of difficult soldering jobs can be easily carried out.

Two models are listed, the workshop model, list No. 1126, at 12*s*. 6*d*. and an A.C. mains model, list No. 1126M, which sells at 50*s*. The workshop model is worked from a 6- or 12-volt accumulator. No preheating is necessary with the solderer; just switch on the current and it can be used instantly. The carbon electrode supplied with the instrument has a long life and is readily renewable at the low cost of 3*d*. The solderer is fully guaranteed.



The workshop model list No. 1126.

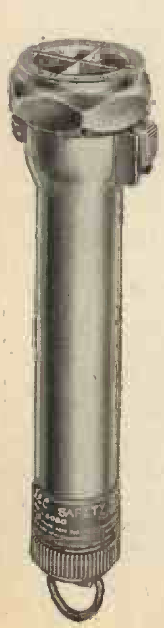
A Safety Battery Torch

AS a safe lighting medium specially designed for use in mines, cellulose-spraying industry, garages, petrol establishments, gas and by-product works, the new safety battery torch manufactured by the General Electric Co. fills a long-felt want. The case is strongly made of cast aluminium alloy, and the front lens of armour-plate glass, additionally protected by two blades of stainless steel.

The switch is of a ball-bearing variety, with particularly easy action, while the hexagonal-shaped head prevents rolling when the torch is placed down upon its side—a useful feature in marine work.

The torch head can be secured in position by a latch which in turn can be locked with a lead seal or plug to prevent unauthorised interference.

The flashlight bulb is carried in a separate holder with spring contact which obviates the crushing of the contact pip against the battery, and this holder can be adjusted in relation to the reflector to give either a flood or spot light. The torch is both waterproof and flame-proof and has been passed both by H.M. Mines Department and by the Home Office.



A new safety battery torch manufactured by G.E.C.

Scientific Welding Repairs

THE enormous advance made in scientific welding methods during recent years are admirably shown in a profusely illustrated booklet just published by Barimar, Ltd., the scientific welding engineers, entitled "Scientific Welding Repairs to Industrial Machinery."

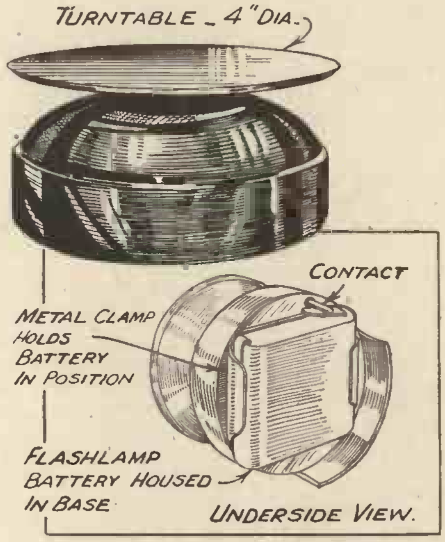
If there are any who are still sceptical regarding what can be achieved in the matter of repair work by modern fusive methods, this publication should immediately dispel their doubts.

This booklet is timely in view of the increasing difficulty in obtaining many replacements promptly and cheaply.

A copy of the booklet can be had upon application to Barimar, Ltd., 14/18 Lamb's Conduit Street, W.C.1.

Battery-operated Turntable

THE advantages of a moving exhibit in a shop window are well known to the go-ahead shopkeeper, but a turntable which will operate from a simple flashlamp battery is a novelty which will not only prove inexpensive to employ but which will enable many small items to be placed in a window to attract customers and provide an artistic display. The type of apparatus illustrated may also be used for various purposes by amateur mechanics, and in spite of the small dimensions and little power required the working of the device is most efficient. The turntable is 4 in. in diameter and of insulated material, whilst the casing is also insulated and slightly smaller in overall dimensions. Inside the case a miniature motor is mounted, operated by means of a single solenoid with a laminated pole-piece. The rotor of this motor is also laminated and connected to the turntable spindle through a high train of gears. An ingenious and delicate brush mechanism provides the necessary interruption in the electrical supply to keep the rotor turning and it is practically noiseless in operation. It is not self-starting, but a slight twist (in a clockwise direction) of the turntable starts the motor up and it falls into step and rotates at about 3 r.p.m.



A top and underside view of the turntable.

BOOKS RECEIVED

"Comets," 8/6 net, 204 pages. Published by The Technical Press, Ltd., 5 Ave Maria Lane, Ludgate Hill, London, E.C.4.

THIS book by Mary Proctor, F.R.A.S., and Dr. A. C. D. Crommelin, B.A., F.R.A.S., deals with the nature, origin, and place of comets in the science of astronomy, and students of astronomy, and general readers will find much to interest them in its pages. As pointed out in the preface, Miss Proctor is well qualified to write on comets. She made important observations of Halley's comet when near the earth in 1910, and is also well acquainted with the work of her famous father, Richard A. Proctor, who showed the untenability of the "Capture Theory" of comets. This subject is fully discussed in the book, which also gives an idea of romance of "comet hunting," and brief outlines of the careers of some famous comet hunters. A number of explanatory diagrams are given in the book which is printed in bold clear type.

PRACTICAL MECHANICS Replies to Queries and Enquiries

If a postal reply is desired, a stamped addressed envelope must be enclosed. Every query and drawing which is sent must bear the name and address of the sender and be accompanied by the coupon appearing on page 535. Send your queries to the Editor, PRACTICAL MECHANICS, Geo. Newnes Ltd., Tower House, Southampton Street, Strand, London, W.C.2.

BOAT QUERIES

"(1) IS a licence or any special permission required to row a small boat on a river? (It is the River Ingrebourne if it will help at all.)

"(2) What depth would be required for a canoe—collapsible?

"(3) How much does a canoe (collapsible or otherwise) cost—first and second-hand?

"(4) Where could I obtain such a boat?

"(5) If you would be so good as to add any information to help a total amateur, I should be very much obliged." (W. Jones, Essex.)

(1) NO licence is required.

(2) The depth required is not dependent on the draught of the canoe so much as the depth of water necessary to get proper immersion for the paddle without touching bottom. A skilled canoeist would do this in a foot of water.

(3) The cost of a canoe may vary from £4 4*s.* to £25 or £30.

(4) To obtain such a boat it would be best to advertise in say *The Yachting World*, *Motor Boat*, *Exchange and Mart*, or purchase a copy of the *Small Boat and Canoe*.

(5) If you desire to use the craft for fishing and camping or serious passenger carrying, a dinghy is a more suitable craft. A flat dinghy can be rowed in only a foot of water.

MICROSCOPIC SLIDES

"COULD you please let me know how to mount water objects on microscope slides, as nearly all the books that I have read stress the fact that moisture must be kept out of the cell." (H. C., E. Yorks.)

IT is quite impossible to give you in any detail an account of all the various methods available for the microscope-slide mounting of aquatic creatures and organisms, since these methods are very numerous and extremely varied. Also, as you will realise, a method suitable for mounting a comparatively large water-creature, would not be suitable for dealing with a plant section, a diatom, or an infusorium. For these methods, we have no option other than to refer you to any textbooks on microscope mounting, such as those which may be found in your local library. If, however, you are desirous of mounting to the best effect any particular type of object, we shall be pleased to assist you with any further details.

Generally speaking, it is, in all cases, absolutely essential to remove moisture from objects which are to be mounted on the microscope slide. This requirement is often effected by passing the objects through small batches of pure alcohol containing decreasing amounts of water, until, eventually, the object to be mounted is finally immersed for a short time in perfectly pure ("absolute") alcohol. It is then immersed in clove oil for a time, drained, and then mounted with a suitable mountant, the nature of which depends entirely upon the type of object being mounted.

In general, the mounting of microscope objects, although of absorbing interest, is a difficult operation, calling for nicety of judgment, chemical knowledge, manual dexterity and skill, considerable experience, and, above all, PATIENCE!

A WATERPROOFING COMPOUND

"I UNDERSTAND that a good waterproofing compound can be made of aluminium stearate dissolved in carbon tetrachloride. Could you tell me the quantities of each required, and method of using. Can I obtain these chemicals from a chemist, and, if not, how could I get them?" (R. L., Lambeth.)

ALUMINIUM stearate is really a form of aluminium soap, just as sodium stearate constitutes one variety of common soap. The fabric to be waterproofed should be rubbed over with a pad which has been impregnated with the stearate solution. The solution strength of the stearate in carbon tetrachloride is immaterial. To make this solution, it is best to dissolve the stearate in the *warmed* tetrachloride, adding the stearate only a little at a time, and stirring the liquid constantly.

You may be able to obtain carbon tetrachloride from a local druggist, but not the aluminium stearate. Both of these compounds are obtainable from the British Drughouses, Ltd., Graham Street, City Road, London, N.1. The carbon tetrachloride costs about 1*s.* per pound and the aluminium stearate about 1*s.* 10*d.* per half-pound.

OPTICAL PROJECTION

"I SHOULD like you to explain the following points relating to optical projection:

"(1) It is well known that, using an ordinary lens system, it is possible to obtain a two-dimensional image from a two-dimensional object, e.g. as in lantern-slide projection.

"Would it be possible to obtain a three-dimensional image from a three-dimensional object using a conventional lens system (or concave mirror)?

"For example, using a spherical object, would a hemispherical image result?

"(2) If such image production is possible, ordinary screens would, of course, be useless. Can you suggest a medium which would show such images?" (J. H. D., North Wales).

IT is not possible to obtain a three-dimensional image by any means. In the stereoscope, an apparent three-dimensional image is obtained by means of an illusion. A lens can only project an image in two dimensions, although, by using a series of enses, it might conceivably be possible to build up an apparent three-dimensional image in a transparent jelly-like medium by focusing a number of similar images in close position. The whole subject, of course, is a highly speculative one and no experimental work has been done on it.

MELTING RUBBER

"I HAVE a quantity of block rubber which I wish to melt so as to be able to pour it into various shaped moulds. I would be pleased if you could give me any information as to how this could be done.

"I have also been attempting to remove the tin coating from tin-plate by heat. I find that the tin burns instead of melts.

"Can you give me any information concerning this. Also, is there any kind of acid which will eat away iron and leave tin intact?" (H. D., Hull.)

IT is difficult and sometimes impossible to melt up rubber for moulding purposes, for many rubber articles are now impregnated with hardening, adulterating, and filling materials. In the circumstances, it would be best for you to cut your rubber into fine shreds and to dissolve these in warm solvent naphtha (taking precautions to avoid fire, since naphtha is a highly inflammable liquid). Having obtained a solution of pure rubber, the solvent naphtha could be driven off and the pure rubber would remain in a more or less plastic state, in which condition it would be quite fit for moulding.

You cannot possible remove tin from tin-plate by burning or heating, for, as you rightly point out, the tin layer burns away without melting. It is, in fact, helplessly impracticable to attempt the "detinning" of tin-plate on a small scale. Such a process, however, is commercially adopted on the large-scale, the operation of detinning being known as the "Goldschmidt process." In this process, the tin-plate is cleaned and freed from oil and grease and loosely tied into bundles. These bundles are then carefully stacked into a large iron cylinder and chlorine gas under pressure is pumped through the cylinder. Heat is generated and the exterior of the cylinder is water-cooled in order to prevent the heat from becoming excessive. The chlorine acts on the tin of the tin-plate and converts it into tin chloride, which is removed by suction. The iron plate remains more or less unattacked by the chlorine.

Cold sulphuric acid (moderately dilute) attacks iron rapidly, but only very slowly attacks tin. Dilute hydrochloric acid also has a similar effect, but there is no acid which attacks iron and is entirely without action upon tin.

SEALING BOTTLES

"I AM bottling a preparation and wish to capsule the bottle with a skin covering (used on many bottles). I have been informed this can be done by dipping the necks of bottles into a solution made by dissolving celluloid in amyl-acetate. Could you please tell me if this is correct, or, if possible, could you please tell me of a cheaper method, as I think the amyl-acetate is rather expensive to buy?" (T. H., London.)

A SOLUTION of celluloid in a mixture of equal parts of amyl-acetate and acetone will provide an air-tight "skin" covering for a corked bottle, as will, also, a thin film of paraffin wax or of a flexible varnish, such as collodion.

The most attractive bottle capsules, however, are made from gelatine. These can be procured fairly cheaply from a supply firm such as Messrs. Langheck & Co., Ltd., 5 New London Street, London, E.3. The Roberts Capsule Stopper Co., Ltd., 63 and 65 Canterbury Road, London, S.E.15, also supplies similar articles.

GOING ABROAD

"I HAVE obtained a post in the South Persian Oil Fields as an assistant engineer. I should be very pleased if you could give me some advice regarding kit, etc., medical supplies and suitable books for learning the languages spoken out there. I understand that Arabic, Hindustani, and Iranian are spoken." (K. C. A., Lincs.)

FOR use abroad in semi-tropical climates, the most suitable medical supplies would include quinine sulphate, potassium permanganate, boric and salicylic acid powders, carbolic acid, chlorodyne (for stomatic complaints), tooth powders, zinc ointment, vaseline, and other sundries, together with a reasonable supply of bandages, safety-pins, etc. An effective purgative, such as castor oil, is always useful to have in stock, also, in case of any accidental food-poisoning which might occur. Saline purgatives, such as epsom salts, etc., are also of value.

Take with you, also, a small spirit lamp and a supply of needles. Also a small surgical scalpel and tweezers. Such instruments may be required for small operations such as pricking a boil or a blister, removing a splinter, etc. The spirit lamp will serve to heat the needle to red-heat and thus to sterilise it.

Arabic and Persian are the best languages to form an acquaintance with in the oil fields in which your appointment has been fixed. You will obtain particulars of all available textbooks and grammars of such languages by writing to Messrs. W. & G. Foyle, Ltd., 119-125 Charing Cross Road, London, W.C.2, and asking them to forward you copies of their Catalogues, Nos. 21 and 22.

Regarding the matter of clothing, the Company which has appointed you will be in a position to give you the best advice as to the selection of an outfit most suitable to the peculiarities of the climate in which you will carry out your new duties.

A SUBSTITUTE FOR CHLOROFORM

"IS it possible to make a substitute for chloroform, that could be used with safety on animals. Further, can chloroform be bought commercially. Also, would you please give me formulas for making several perfumes, or is there a book that I could purchase on the subject?" (D. T., Willesden.)

(1) CHLOROFORM itself is the best substance you can use for the purpose you mention. Other anæsthetic liquids are ether, ether-alcohol mixtures, carbon tetrachloride, and trichlorethylene. Chloroform or a mixture of equal parts of ether and chloroform, however, gives the best anæsthetic results with animals and insects. All the above substances can be obtained from Messrs. A. Boake, Roberts & Co., Ltd., Carpenters Road, Stratford, London, E.15.

(2) Since you do not state the type of uses of the perfumes you wish to make, we are at a loss to know what varieties of perfumes are of particular interest to you. Here, however, is the formula of a "White Rose" handkerchief perfume:

Rose Oil	25 drops
Rose Geranium Oil	20 drops
Patchouli Oil	5 drops
Ionone	3 drops
Synthetic Jasmine Oil	5 drops
Pure Alcohol	10 ounces

All the above ingredients can be obtained from the firm mentioned above. You will find perfume-making an expensive business, mainly on account of the excessively high price of tax-paid pure alcohol.

Books on perfumes are expensive volumes. Three good works on perfume-making, however, are:

E. J. Parry. *Raw Materials of Perfumery.* (3*s.* net.) E. J. Parry. *Chemistry of Essential Oils and Perfumes.* 2 vols. (30*s.* and 21*s.* net.) G. Martin. *Perfumes, Essential Oils and Fruits Essences.* (12*s.* 6*d.* net.)

The Latest in Railway Modelling

(*continued from page* 530)

Fig. 7 shows a plain red-brick cabin which can be adopted to any suitable size. Celluloid may here again be scribed for the glazing. The roof is simply flat, with regular strips of cardboard for lead rolls. The spouting or guttering may consist of a length of 00-Gauge rail, bent to shape and soldered underneath to lengths of wire passing through the building. One of the photos makes this work clear. Small metal doors which are admirable for sticking in the recesses may be had from Hamblings. This building, and others like it, are of course covered with Merco red-brick paper. Cement mountings for sills, etc., may be done in strips of gummed parcel paper painted cement colour before use.

A Floor for Stability

All cabins not resting on girders should have an upper floor inserted for stability, though the lower floor may be left out, so that the box may serve to cover some appliance on the track if necessary. This is often desirable in using electric point motors, where the cabin itself is purely ornamental and does not house a frame.

Something may be said about making metal stairways, and a good method is shown in Fig. 8. Here, $\frac{1}{2}$ by $\frac{1}{16}$-in. brass strip is used for the sides. These strips cannot in this way be made in pairs, but they can be made in multiple, which is just as good. That is, enough sides can be made for several stairways of considerable length at one operation, the opposite sides being made at the next operation. A common mitre box is used, the strips being first set alongside each other on a lath which fits exactly into the mitre box. The strips are held down with Merco brass wagon buffer beams, which are ready drilled for the purpose. They are then scribed with a ruler and set-square for the step-slots as shown. The work involves some little care and precision and time. The slots are then cut with a metal saw in the mitre box, exactly on the lines. The slots should be about half-way through the thickness. Steps consist of Merco sleeper tinplate, and they must be cut exactly to the same length in every case, say $\frac{1}{2}$ in. Now take two steps, and your pair of sides cut to desired length. Slip the steps into the two outermost pairs of slots and lay the whole flat on a board, supporting the sides in an upright position with pins on the outside, placed quite near to the two steps.

The "Detectaray"

We are asked to mention that the "Detectaray" referred to on page 478 of last month's issue is now being marketed by Messrs. G. J. Fuller & Co., Ltd., of Central House, 34/6 Oxford St., London, W.1. An interesting pamphlet describing the various uses of the "Detectaray" will be sent on receipt of 6*d.* to readers who write to the above address.

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Advertisements are accepted for these columns at 2d. per word (minimum 12 words at 2s.—advertisements of less than 12 words are charged at the minimum rate of 2s.), subject to a discount of 2½% for 6 consecutive monthly insertions or 5% for 12 consecutive monthly insertions. TERMS:—Cash with order. Cheques, Postal Orders, etc., should be made payable to George Newnes, Ltd. *The Proprietors reserve the right to refuse or withdraw advertisements at their discretion.* All advertisements must be received on or before the 5th of the month preceding date of publication and should be addressed to the Advertisement Manager, "Practical Mechanics," George Newnes Ltd., Tower House, Southampton Street, Strand, W.C.2.

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ARTISTIC CINE FILMS. Exclusive 9·5-mm. and 16-mm. productions. List Free. Projectors, Ciné Cameras.—P.M. Dane, 64 Stanley Street, Liverpool, 1.

CINEMATOGRAPH FILMS.—Standard size from 6d. 100 feet. Machines, Accessories. Sample Films 1/- and 2/6 post free. Catalogues free.—"Filmeries," 57 Lancaster Road, Leytonstone, E.11.

WANTED for prompt cash. Home Cine cameras and projectors, films, accessories. Microscopes, telescopes and binoculars. Small lathes, precision tools and Modern Miniature cameras.—FRANK, 67, Saltmarket, Glasgow.

MOVIES AT HOME.—How to make your own Cinema Projector. Particulars free.—Moviescope (N), Pear Tree Green, Doddinghurst, Essex.

CLOCK MOVEMENTS

CLOCK MOVEMENTS of every description ready for cases. Lists and hints on case making post free.—Needham, 25 Stratton Road, Manchester, 16.

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A.C.-D.C. 1 & 3 PHASE MOTORS. All voltages, from 14/9. List free. REPAIR SPECIALISTS.—EASCO ELECTRICAL SERVICE, 18pm, Brixton Road, S.W.9.

SURPLUS ELECTRICAL and Engineering Materials, low prices.—The London Electric Firm, Croydon.

SUPER A.C. MOTORS. Brand new, 1/16 h.p., 26/-; ¼ h.p., 36/6; ½ h.p., 65/-; larger sizes. Electric Tools, Machines, Pumps, Compressors, etc.—John P. Steel, Clyde Street Mills, Bingley.

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ENGINES. Small power. Build BUTLER'S ½-h.p. engine. Most interesting—small power extent. Castings 9/9. Dynamo, boat propellers and motor catalogue 3d.—BUTLER'S Profit-Sharing Works, Wade Street, Littleover, Derby.

1928. 4-CYL. ENGINE and 3-SPEED and REV. GEARBOX UNIT. NEEDS ASSEMBLING, £1 10s. Also 1929 AUSTIN 7 CHASSIS. OFFERS WANTED.—48 WARMINGTON ROAD, SHELDON, BIRMINGHAM.

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GUARANTEED FORMULAS. New Fast Sellers. None better. Lowest prices. Catalogue FREE.—KEMICO, 110 Park Ridge, Illinois, U.S.A.

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LEARN "HYPNOTISM," 25 LONG LESSONS, complete 2/6. "VENTRILOQUISM" Course, with nine Dialogues, 1/3.—"DEVILLE," 41 Longford Place, Manchester.

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PRACTICAL MECHANICS, JUNE, 1937

MICROSCOPY *(continued)*

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356, Oxford Street, W.1.

MISCELLANEOUS *(continued)*

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FOR MODEL AND EXPERIMENTAL WORK send your requirements to—Models, 1 Waverley Place, Salisbury, Wilts.

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Square Brass Tubing ½" x 20 s.w.g. – 1/4d. per ft.
" " " ¾" x 20 s.w.g. – 1/9d. " "
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All orders, cash with order or C.O.D. (Charges to be paid by the consignee.) Ask us to quote for anything you cannot obtain locally. All orders are subject to postage charges, viz. 6d. up to 3 lbs. and 1d. for every additional pound above 3 lbs. Postage paid on orders of 20/- and over—ARTCRAFT ELECTRICAL PRODUCTS, Nasec Buildings, Manchester Street, Oldham.

400 dozen Tool-makers' Needle Files. An absolute necessity for small work. Clearing at 2s. 9d. per dozen assorted shapes.—Below.

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6 tons Bright Mild Steel, round, 1/8", 5/32", 3/16", 7/32", 1/4", 9/32", 5/16", 3/8", 7/16", 1/2". 5 feet each size. 5s. 6d. lot.

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500 Square Gas Dies, cutting ⅛", ¼", ½", ¾", 1" gas. Worth 6s. each. Best quality, gifts, 1s. 9d. each to clear.—Below.

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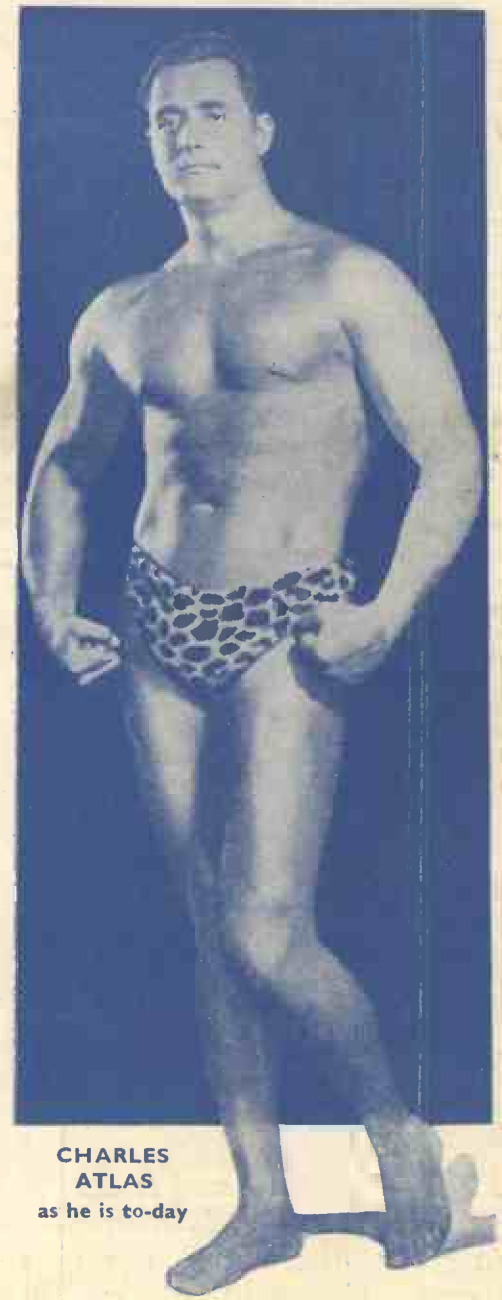

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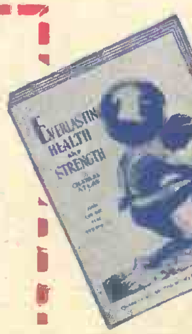

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