BUILDING THE "P.M" CANVAS CANOE

NEWNES

PRACTICAL MECHANICS

JULY

6D

IN AUSTRALIA & NEW ZEALAND

Full Constructional Details Inside

EDITED BY F. J. CAMM

SUBSCRIPTION RATES

Inland and Abroad, 7s. 6d. per annum

Canada - - 7s. per annum

Editorial and Advertisement Offices: "Practical Mechanics," George Newnes Ltd. Tower House, Southampton Street, Strand, W.C.2.

'Phone: Temple Bar 4363.

Telegrams: Newnes, Rand, London.

Registered at the G.P.O. for transmission by Canadian Magazine Post.

PRACTICAL MECHANICS

VOL. IV. JULY, 1937 No. 46.

Fair Comment

By The Editor

Our Query Service—New Rules

IN future three penny stamps, a stamped and addressed envelope, and the Query Coupon cut from the current issue must be sent with every question. Our Free Advice Bureau has been considerably augmented since it was introduced, and this has been rendered necessary by the enormous number of technical questions on almost every conceivable scientific and mechanical subject which our readers are submitting for solution. Those subjects cover electricity, chemistry, wireless, television, lathe work, boat building, invention, machine design, aviation, careers, hydraulics—and an almost endless variety of cognate subjects. We therefore have instituted this small charge, not to cover the cost of the service rendered, for in the normal course this would cost each reader a considerably greater sum; but to contribute towards the cost of handling and booking the enormous number of letters. Our Free Advice Bureau handles thousands of letters every year, and really helpful advice is speedily forthcoming. We feel that our readers could make greater use of the annual indexes which we issue for a nominal sum purely for their convenience. These are produced at a loss, and it is regretted that a greater number of readers, even though they do not wish to have their copies bound, do not purchase this handy alphabetically-arranged key guide to the contents of past issues. Not only would it save the reader the trouble of having to write for information which we have given many times before, but the index would provide him at once with the information which he requires, and would thus save time.

The reader must not construe this as meaning that we do not like to hear from them. We cheerfully attend to their queries and shall continue to do so. It is merely to help them that we make the suggestion.

We receive letters from all over the world, and some of them touch upon a great variety of subjects. It would help us, therefore, if in future queries relating to different subjects were written on separate sheets of paper with the name and address of the querist also written on each sheet. This enables a number of experts on particular subjects to handle readers' queries more promptly than when one letter has to be handed round.

One reader the other day submitted a letter containing no less than sixty involved questions embracing over twenty subjects! He asked for a reply by return, but omitted to enclose the Query Coupon and a stamped and addressed envelope. We must be provided with evidence of the purchase of the paper, and hence we insist upon the Query Coupon. It appears regularly in each issue. If you require a postal reply (and we suggest that readers should take advantage of this because only a limited amount of space can be devoted to replies and we cannot guarantee that a reply will appear in the succeeding issue) you must enclose a stamped and addressed envelope as well as the 3*d.* in stamps. If the reply is to appear in the paper you merely have to send the 3*d.* in stamps and the Query Coupon. Additionally, readers are limited to not more than three questions. We are sure that readers will not mind this small alteration to our existing rules.

Rubbish About Rays

I READ the other day that Marconi had discontinued his experiments on the use of rays for stopping aircraft, motor cars, and other mechanical devices. From time to time lay journalists with no knowledge of scientific matters will despoil the columns of the daily press with idiotic rubbish about the wonders of a new death ray. The effect of any ether-propagated ray on an aeroplane would be equal to that produced by a speck of dust colliding with a battleship, and I hope that this scare subject, which provides the yellow-press of this country with its periodic startling headlines calculated to make your blood curdle, is now suitably interred for ever. Unfortunately a credulous public will believe most of this rubbish and will write to me for details as to how they can experiment on similar lines. The most that Marconi could do was to kill a rat at 3 ft.! You do not need expensive ray apparatus to do that!

Perpetual Motion

ANOTHER problem which dies hard concerns methods of producing perpetual motion. I regularly receive a number of letters from readers who claim to have invented such a device. Of course, they have not made it, and once the fallacy has been pointed out to them they realise their mistakes. Here and there, however, an individual firmly believes that he has invented perpetual motion. You must believe me when I say that perpetual motion is quite impossible, but if you do not believe me please do not write and ask my advice about it. If I could discover some means of producing perpetual motion I should vacate the editorial chair at once! As it is, with the welter of duties I perform, it sometimes seems to me that I myself personify that age-old dream of the scientific inventor.

London County Council Approves "Practical Mechanics"

THE Committee of the London County Council whose duty it is to select authoritative journals for use in Evening Institutes have approved PRACTICAL MECHANICS for this purpose, and have added it to their list. The L.C.C. Committee only approve journals whose contents are reliable and authoritative, and it is an honour to be placed on their list. Although PRACTICAL MECHANICS is but four years old it has attained this position of authority in priority to many journals of much longer standing—a tribute to its contents, its staff and its contributors.

Building the "P.M." Canvas Canoe

Cost and Simplicity of Design Have Been Carefully Considered in the Construction of This Canoe

THE canoe about to be described is designed to make construction as simple as possible, and to place the task well within the scope of those having a fair knowledge of the more common woodworking tools.

Where however, definite boat practice has to be employed, such operations will be fully described.

Only easily obtainable materials will be used, but it must be understood that the quality must be good and all timber free from knots and shakes.

The Keel, Stem, and Stern

The first task to take in hand will be the construction of the "backbone" of the canoe, and this consists of the keel, the stem and stern posts. The keel may be made from deal provided it is clean and free from knots. Obtain a piece 11 ft. × 2 in. × 1 in. thick. This piece of timber must be planed

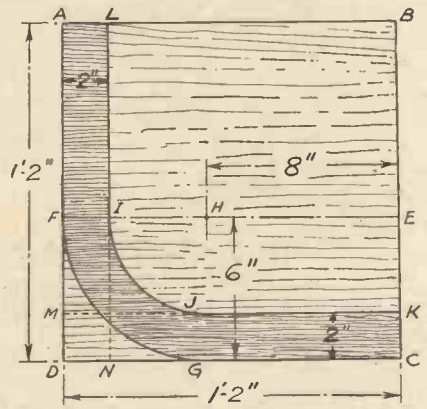


Fig. 1.—The stem, two of which are required.

all over, and should be specially ordered to comply to these sizes, finished.

If ordinary 2 in. × 1 in. deal is ordered it will be only 1⅞ in. × ⅞ in. when planed. Remember, therefore, that all sizes given are regarded as finished sizes after planing, so specify this when ordering. Having obtained a length of 2 in. × 1 in. deal, square up the ends and see that it measures exactly 11 ft. in length.

It can now be laid aside while the stem and stern posts are made, and since these are exactly alike, one illustration and description suffices.

Obtain two pieces of elm measuring 1 ft. 2 in. × 1 ft. 2 in. × 1 in. thick (finished size). This wood should be obtained having a curly grain. The rectangle *A B C D*, Fig. 1, represents one of these pieces of timber.

Down the side *B C*, mark a point *E*, 8 in. from *B*, and consequently 6 in. from *C*, and similarly down the side *A D*, mark *F* 8 in. from *A*. Join *F E* by a light pencil line, and along *F E* mark the point *H* 6 in. from *F* and 8 in. from *E*. This will be the centre for marking out the radius part of the stem.

Mark *K* 2 in. up *C B* from *C*, *L* 2 in. along *A B* from *A*, *N* 2 in. along *D C* from *D*, and *M* 2 in. up *D A* from *D*.

LIST OF MATERIALS

Item 1.—12 ft. deal, 2 in. × 1 in.
Item 2.—One piece elm (curly grain), 1 ft. 2 in. × 2 ft. 4 in. × 1 in.
Item 3.—One piece plywood, ¼ in. thick, 2 ft. 3 in. × 2 ft. 4 in.
Item 4.—Two 14 ft. lengths, 2 in. × ½ in. deal.
Item 5.—9 ft. length, 2 in. × ½ in. deal.
Item 6.—Twenty 14 ft. lengths, ¾ in. × ¼ in. deal (selected).
Item 7.—Two 12 ft. lengths, ½ in. × ¼ in. elm or ash.
Item 8.—3 ft. 6 in., 3/16 in. round copper rod.
Item 9.—Twenty 3/16-in. copper washers.
Item 10.—Eighteen No. 8 brass screws 2½ in. long.
Item 11.—Two gross ½-in. No. 4 brass screws.
Item 12.—¼ lb. ½-in. galvanised tacks.
Item 13.—2 oz. ¼-in. galvanised tacks.
Item 14.—Canvas. Thickness a little stouter than unbleached calico (unbleached calico may be used). Length according to widths available to cut:—
Two pieces 14 ft. × 1 ft. 8 in. for bottom.
Two pieces 5 ft. × 2 ft. 6 in. for decks.
Two pieces 5 ft. × 5 in. for side decks.
Note.—All timber is given finished sizes planed all over.

Join *K M* and *L N*, and with a pair of compasses or dividers, with *H* as centre and radius 6 in., describe the arc *F G* and with radius 4 in. describe *I J*.

This will give you the figure *A L K C*, which may be sawn out with a bow saw. Make two such pieces, and as the waste timber will be required at a later stage, store it away carefully. The next operation will be to join the stem and stern pieces, one to each end of the keel. The joint is shown in Fig. 2, and is known as a "scarf." This is really a modification of the ordinary half joint except that the vertical sides of the joint are only ¼ instead of ½ of the depth and are joined by an inclined line, thus making the two halves resemble flat-ended wedges.

Fig. 2 clearly shows how to cut this joint which is 6 in. in length, and both ends of the keel must be shaped, and one end (the end *K C* Fig. 1) of stem and stern.

The joint is made by passing four copper rivets through it and these are prepared from 3/16 in. copper rod in the following manner.

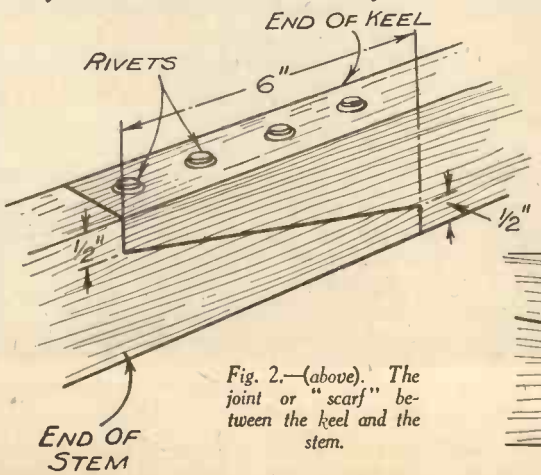


Fig. 2.—(above). The joint or "scarf" between the keel and the stem.

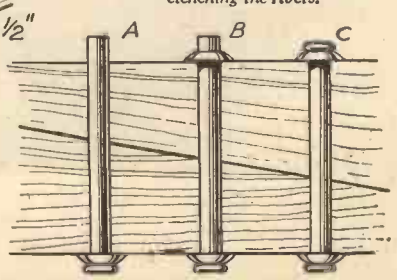
Take a piece of 3/16 in. copper rod 2¾ in. long and hold it in the vice vertically with only a ¼ in. projecting above the jaws.

Now with a small hammer, work this end up into a head by a series of sharp, quick blows.

Since repeated hammering has the effect of hardening copper it may be necessary to soften the end once or twice before the head is completely formed and this is done by heating to dull red heat and quenching in cold water.

When you have prepared your eight rivets, obtain sixteen copper washers known alternatively as rooves, or burrs, having a 3/16 in. hole and see that they slide freely but without slack down the shank of the rivet.

Fig. 3.—(below). Three stages in clenching the rivets.



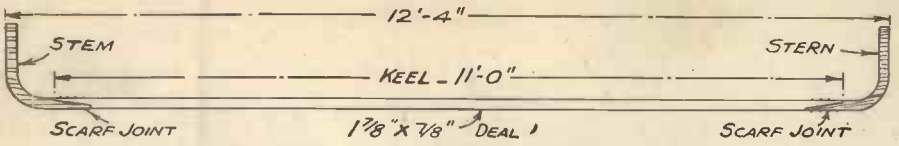


Fig. 4.—The assembled keel, stem and stern post.

Your rivets and washers, thus prepared, clamp the joint together (stem one first) and drill four $\frac{3}{16}$ in. holes through it as shown in Fig. 2.

Try the rivets in these holes; it should be possible to lightly tap them through.

If they will not go with light tapping, either ease the hole out or file down the shank of the rivet, but on no account attempt to drive them hard, as copper rivets tend to expand on being hard driven and will jamb in the holes.

When these holes are drilled and you are ready to fit your joint, give the surfaces a good coat of paint and assemble it with the paint still wet.

Slide a washer on each rivet and push them into the holes, two from the top and two from the bottom on each joint.

Now place a washer over the projecting end of each, and cut off any surplus shank leaving only $\frac{1}{8}$ in. above the washer.

With a weight against the head or by laying the joint head down on some hard surface, proceed to clench the rivets with light quick hammer-blows in a manner similar to that employed in forming the heads.

Fig. 3, *A*, *B*, *C* shows the three stages in fitting these rivets, and if they are driven good and tight, the resulting scarf will be perfectly rigid.

Fig. 4 shows the keel with the two posts fitted and gives the diamensions which should be 12 ft. 4 in. overall. The keel is, of course, 11 ft., and the scarfs each 6 in.

The Frames

The frames, of which there are two, are made from $\frac{1}{2}$-in. plywood, since this can be conveniently obtained in large enough pieces, and is very strong and light.

The two frames are similar in all respects, so when one has been marked out and made, it can be used as a template for the other.

Cut a piece of $\frac{1}{2}$-in. plywood 2 ft. 3 in. × 1 ft. 2 in., which is represented in Fig. 5 by the rectangle *A B C D*. First draw in the vertical centre line *E F*. Now from *B* down the side *B C*, mark *G* 3 in. from B, then *I*, *K*, *M*, *O*, *Q*, at 2 in. intervals (*Q* should then be 1 in. from *C*). Mark out the points *H*, *J*, *L*, *N*, *P*, *R* on the side *A D* in a similar manner. Join *GH*, *IJ*, *KL*, *MN*, *OP*, *QR*, and draw a line from *E* to *G* and *E* to *H*.

Now along *KL* mark K^1 1 in. from *K*, and L^1 1 in. from *L*. Along *MN*, M^1 2 in. from *M*, and N^1 2 in. from *N*. On *OP* mark in O^1 P^1 4 in. inwards, and on *QR* mark Q^1 R^1 8 in. inwards.

Starting on the right-hand side, mark in the curve as shown in Fig. 5. Extend these lines down to within $\frac{1}{2}$ in. on each side of *F*, leaving a 1-in. flat bottom to the frame.

We can now roughly saw out the frame and finish off the curves to a gentle sweep with a plane afterwards.

Taking care to get each side alike, we can now saw along *EG* and *EH*, which completes the shaping of the frame.

Points to Note.

Take careful note of the following important facts. (1) There is a 1-in. flat centrally at the bottom of the frame at *F*. (2) The upper sides of the frame are parallel for 2 in. at *GI* and *HJ*. (3) The centre top of the frame is 3 in. higher than the outer edges.

The frame should now be sandpapered, and if you are satisfied that both sides are equal, you can use it as a template for making the other one, finally clamping them both together and finishing them off as one to make sure they are exactly alike.

We can now lay them aside whilst we make suitable strengthening brackets with which to secure them to the keel. These brackets may be produced from the elm cut to waste when making the stem and stern posts.

They are simply right-angle brackets 5 in. along each arm, and shaped as shown in Fig. 6. Four will be required, and holes are drilled through the edges to permit of them being screwed to the frame and keel as shown in Fig. 7. The screws used should be brass No. 8, $2\frac{1}{2}$ in. long, countersunk heads. A further fixing for the frame is by passing a screw up through the keel and into the edge of the frame, well countersinking it in the keel.

When fixing the frames, take care to see that they are central and perfectly at right angles to the keel. It will be seen that the 1-in. flat on the bottom of the frame, beds on the 1 in. width of the keel, and since the brackets are 1 in. thick, they also take up the whole width of the keel. Thus we have in these dimensions a check on correct assembly, provided that care has been taken in making the components and that the material is as specified, 1 in. finished size.

The positions which the frames occupy will be as follow. The first one, or forward frame 2 ft. in front of the exact centre of the keel, and the second one or aft frame 2 ft. behind the centre point, thus they will be 4 ft. apart.

The Gunwales

These are a very important item and great care must be taken in fitting them.

Obtain two pieces of good clean deal 2 in. wide, $\frac{1}{2}$ in. thick and 14 ft. long.

Now from the top of the stem and stern posts measure down 1 in. and draw a line across it (the two-inch face) on either side, and, measuring a further 2 in., mark another line parallel to the first.

Between these lines the ends of the gunwales will be secured to stem and stern respectively.

Take the two lengths of batten and mark the exact centre of each, measuring outwards a distance of 2 ft. on each side of this centre mark. These will be the points where the gunwales will be secured to the frames.

Fit the gunwales to the frames first, screwing them with $1\frac{1}{2}$-in. No. 6 screws (three per batten per frame) so that they butt on the 2-in. parallel sides of the frames (*GI* and *HJ*, Fig. 5).

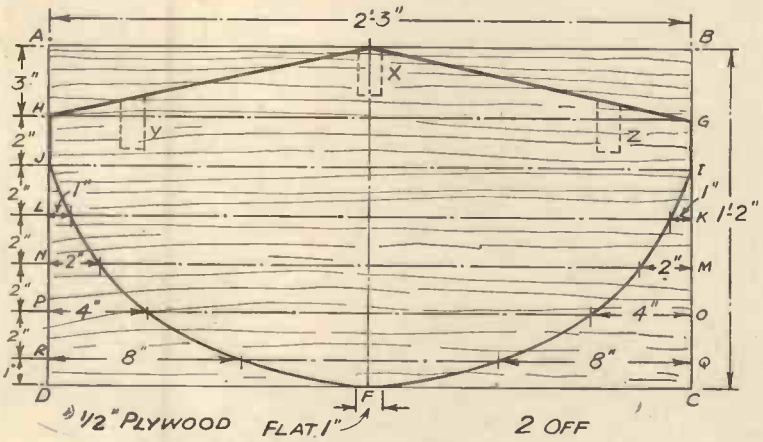


Fig. 5.—Details of the frame, two of which are required.

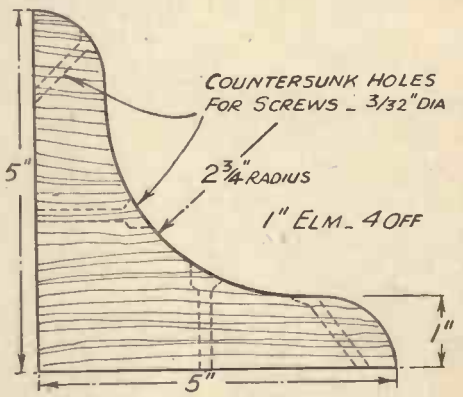


Fig. 6.—The method of making the brackets.

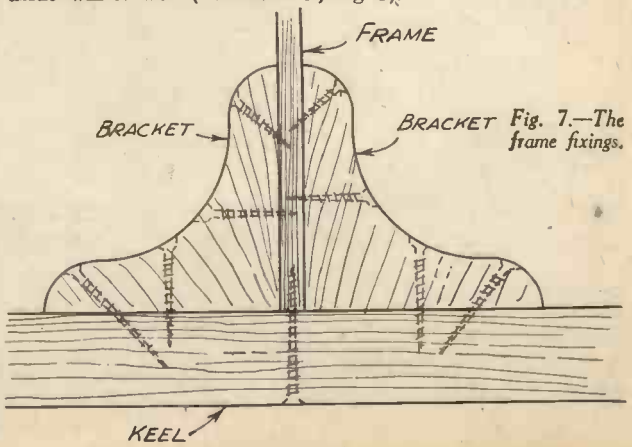
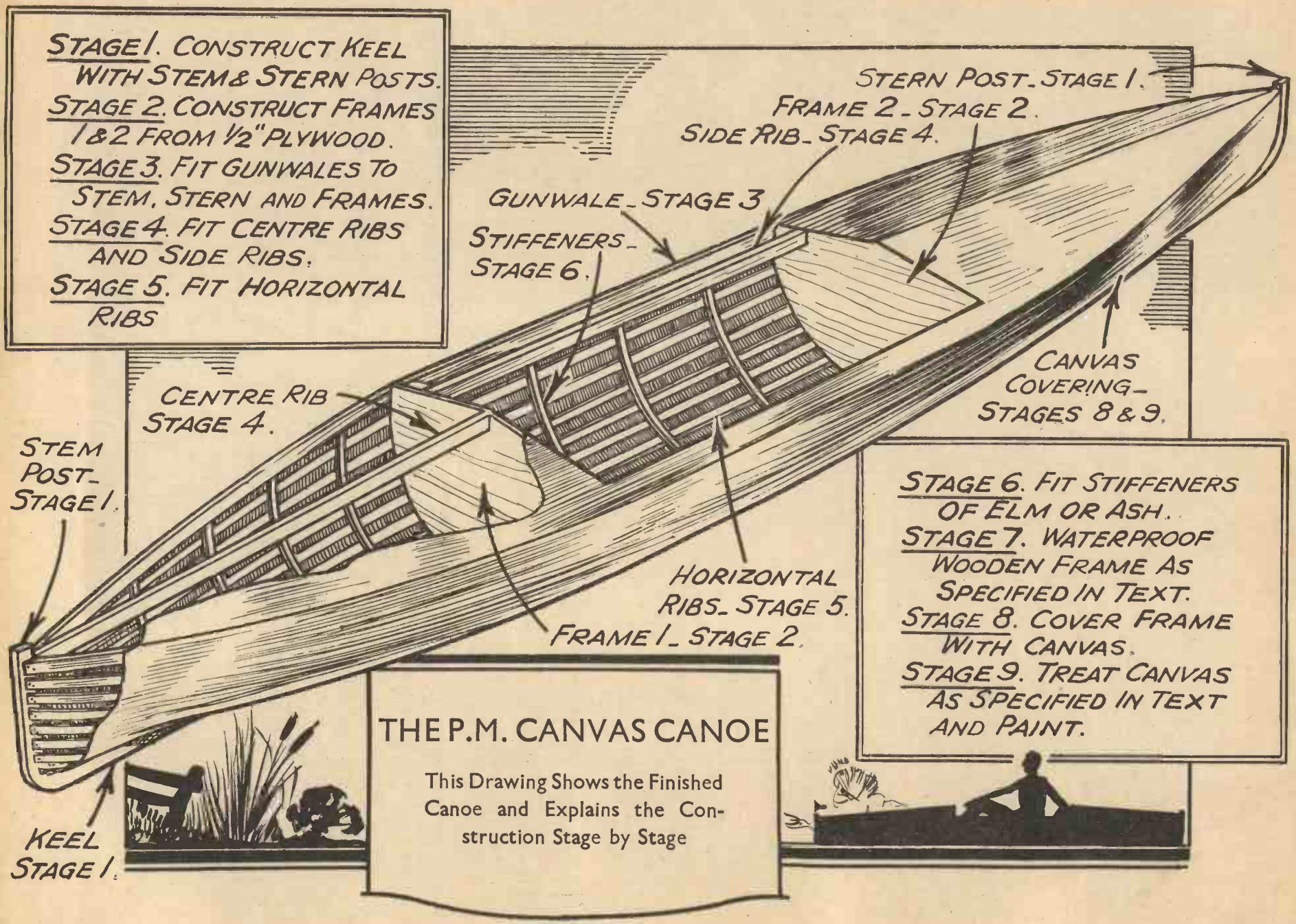


Fig. 7.—The frame fixings.



THE P.M. CANVAS CANOE

This Drawing Shows the Finished Canoe and Explains the Construction Stage by Stage

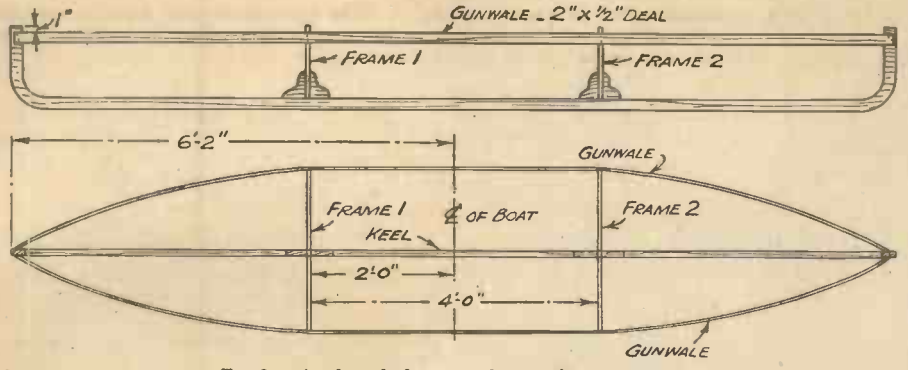


Fig. 8.—A side and plan view showing the construction.

The ends may now be drawn in towards the stem and stern post, and cut off to the required length and bevelled, after which they may be secured between the pencil marks previously made, that is to say, the top edge of the gunwale should be 1 in. from the top of the stem and stern posts, and flush with *G* and *H* on the frames.

Fig. 8 shows them fitted and should remove any doubt not covered by the foregoing instructions.

Take care in this stage of the work that you do not strain the frames out of square.

Forming the Cockpit and Deck

The cockpit is formed fore and aft by the two frames and at the sides by a batten running fore and aft 3 in. from each side. These battens are shown in the deck plan Fig. 9. They are fitted between the two frames on a level with the sloping top edge 3 in. from the gunwale. (Their position is shown in Fig. 5 at *Y* and *Z*), and are secured by nailing or screwing through from the reverse side of the frame and further strengthened by small brackets similar to those used in fitting the frames, made from scrap.

The deck which will, of course, be of canvas is prevented from sagging by a centre rib running from the apex of the sloping top edge of each frame to the stem and stern post respectively, and finishing at those points flush with the gunwales.

Small fillets are fitted between the gunwales and the sides of the cockpit at each end in order to form a means of tacking the canvas down. These are shown in the deck plan (Fig. 8).

With the deck and cockpit ribs fitted, the frame will be strong enough and sufficiently rigid to permit of the ribs of the hull being fitted.

Fitting the Ribs

The ribs may consist of deal battens, ¾ in. wide and ¼ in. thick, provided that really good clean timber can be obtained, and it will be well worth the builder's while to pay a little extra for selected material, for it is hardly necessary to point out the serious consequences of a knot or shake in a batten of such small dimensions.

We shall require 18 lengths of ¼-in. × ¾-in. batten, each 14 ft. long, which allows a little waste for handling. It will be as well, however, to order a few extra lengths to allow for possible breakages, so make it 20 lengths, the cost will be very small.

Now it will be seen that the distance from the gunwale round the edge of the frames to the keel is greater than the distance from the gunwale to the keel (measured down the stem post), therefore it is obvious that the ribs must be spaced farther apart at the frames than the stem and stern post.

Taking the first rib, secure this with its uper edge 1 in. below the gunwale on both frames and the ends on the stem and stern post ¼ in. below gunwale. Add the other ribs with similar spacing until the keel is reached, this will mean nine battens per side each spaced 1 in. on frames and ¼ in. on stem and stern posts. It is not, however, vitally important that the spacing should be exact provided that a good support for the canvas is obtained.

The ribs are best secured by 1-in. No. 6 countersunk-head screws as these are less likely to work loose than nails and so perforate the canvas. If, however, nails are used, they must be galvanised, or the heads will rust, causing the canvas in contact with them to rot. One per point of contact is sufficient. Fig. 10 shows how the battens are fixed to frame 1 at the stem, and the fixings to frame 2 at the stern post will be similar.

When these horizontal ribs are fitted, it will be seen that they are somewhat flimsy or easily bent, so they must be made more rigid.

Adding further frames would serve this purpose, but would add considerable weight, and as we cannot have further frames in the cockpit or between frames 1 and 2, some other method must be devised.

We must therefore resort to bent "timbers" or vertical ribs, and space them 1 ft. apart from stem to stern.

These should be made of some wood that does not easily split and that can be readily bent. Either elm or ash conform to these requirements, and the choice will best be left to the stocks of the dealer.

Obtain 24 ft. in such lengths that you can cut twelve 2-ft. pieces of ½ in. × ¼ in.

Having cut your twelve pieces each 2 ft. long, start 1 ft. from the stem and bend the timber as shown in Fig. 11, tying it temporarily with string to every other horizontal rib.

Where the bend is sharp it will be necessary to assist the bending by steaming the timber, and if a steaming box is not available, soak it in very hot water for a few minutes, a little experimenting will show just how long it must remain in soak.

Where the timber crosses a rib it is secured by a ½-in. No. 4 screw. These vertical timbers finish at the gunwale as shown in Fig. 11, and need not be secured thereto.

When all these timbers are in, it will be seen that the hull is much more rigid and we can now prepare to canvas it, but first it is as well to give all woodwork a coat of some preservative.

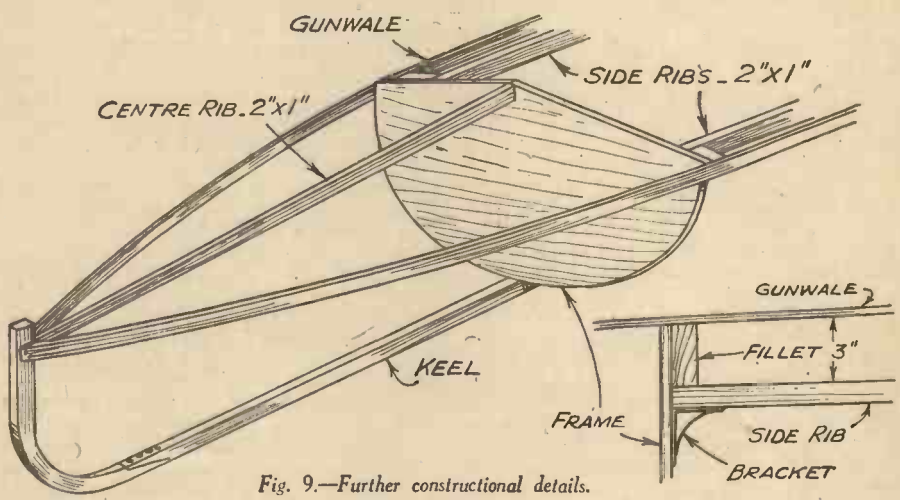


Fig. 9.—Further constructional details.

If the wood is left bare it will not only be subject to deterioration, but will absorb a lot of moisture which will add very considerably to the weight of the craft and will be very much more noticeable than expected when it comes to carrying the canoe any distance.

First give the edges of the frames a good coat of paint to fill the pores of the ply wood, and then give all woodwork two liberal coats of creosote. When dry give one coat of size, and two coats of varnish. This will render the wood almost non-absorbant, and although adding a little to the labour and cost, is more than worthwhile, and you may have reason at a later date to congratulate yourself on your care.

Covering the Canoe

The canvas used for covering the canoe need not be very heavy since the craft is well ribbed.

The use of too heavy a covering is, in

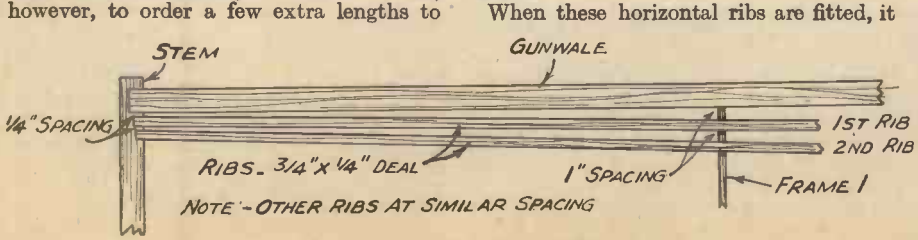


Fig. 10.—How the battens are fixed.

fact, a disadvantage to the beginner, as it calls for more skill in getting on.

A canvas, a little heavier than unbleached calico, is most suitable, in fact, unbleached calico may be used with success.

Turn the canoe over and canvas from the keel downwards to the gunwale.

It is better to complete one side first in the case of this type of canoe where the keel is exposed.

Tack the canvas along the side of the keel, previously turning the edge for strength, then stretch downwards, levering it up over the gunwale, ultimately tacking it on the upper edge.

For tacking to the keel and gunwale, etc., use ½-in. galvanised tacks, and for securing to ribs, use ¼-in. galvanised tacks.

For the initial tacking, place tacks about 3 in. apart, and when you have got the canvas stretched reasonably well, you can remove creases by placing tacks between those already driven, then further tacks between these, until you have a seam free of creases and watertight.

The deck is covered with canvas in a similar manner. The fore and aft decks are dealt with, with one piece of canvas each, stretched over the centre rib like a tent and tacked along the upper edges of the gunwales, thus the joints of the hull and deck canvas will meet here and can be

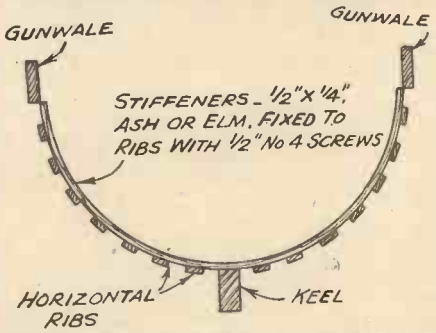


Fig. 11.—Showing how the vertical timbers finish at the gunwale.

covered by a light batten or fillet to improve the finish. Naturally, the canvas is tacked over the top of each frame and here again a fillet may be put on for neatness.

The side decks are simply canvassed by tacking a piece of canvas along the opening formed between the gunwale and the cockpit batten and terminated each end by the frames, fillets again being used to hide the rows of tacks.

Painting and Preserving

Method 1.—The canvas should be given two coats of boiled oil, allowing each to dry thoroughly, then painted inside and out with good quality paint.

Method 2.—Use no boiled oil, but paint first inside then out with fairly thin paint, put the outer coat on while the inside on is still wet, use a liberal quantity so that the canvas is saturated, the inner and outer coats key each other. When dry, give a finishing coat of normal thickness.

Method 3 (*recommended*).—Paint inside and out with Jefferies marine glue "Liquid Glue," D quality. When dry, paint in the usual manner. One gallon of this glue covers 90 sq. ft. Obtainable from A. Jeffery & Co., March Gate, Stratford, London, E.15. Price 16s. per gal. Obtainable in ½ gals. and quarts.

THE SCIENTIST TURNS CLOCK-MAKER

By William G. Pike, F.B.H.I.

THE laboratory, a place usually associated with glass jars and evil smells, is rapidly becoming the cradle of accurate time-telling machines. Here, through the efforts of the scientist, wonderful instruments are making the usual methods of telling time appear dull and old-fashioned.

What is considered the most remarkable achievement in the clockmaking world and probably the nearest attempt at perpetual motion is the clock that derives its power from the atmosphere.

A carefully balanced drum contains two glass bulbs connected by a small tube. Each bulb contains quicksilver, ammonia and a saturated vapour. One bulb is enclosed within a vacuum. Any change in temperature has effect upon the vapour and in turn upon the quicksilver, thereby causing the drum to move one way or the other.

Change of Temperature

Even the slightest change in temperature produces sufficient power to drive the clock for a considerable time. The movement of the ten small wheels that transmit the power to the hands is so slow that it would take years for them to wear out. The torsion pendulum which takes one minute to make a complete vibration is absolutely silent in action.

Electricity has been used for years to operate clocks of various kinds, but the modern edition of the electrical timekeeper departs widely from ordinary practice. The majority consist solely of a tiny electric motor which is connected to the same mains that supply the household light. This motor to which the hand wheels are geared revolves slowly but surely at a speed of 200 revolutions a minute.

The engineer in charge of the Grid power station regulates these clocks by the accurate generation of the current. Fifty cycles per second is the standard. The popularity of these simple instruments is a proof of their reliability.

Speaking Clocks

Londoners are able to enjoy the benefits of the new Post Office speaking clock. This ingenious installation consists mainly of four revolving glass discs. Each disc is provided with a number of sound tracks similar to those of the edge of a talking film. When a subscriber dials "TIM" a ray of light is automatically directed upon the required disc, afterwards falling on to a photo-electric cell. The electrical current produced is amplified and the listener hears the correct time. Extreme accuracy is ensured as the clock is synchronised with Greenwich time every hour.

As 280,000 people ask the time every week, it is hoped in the near future to extend the service to other large towns.

Minerals, too, are being employed in place of the pendulum for controlling clocks. The crystal clock is an invention of the Bell Telephone Laboratories. The temperature controlled quartz crystal which is placed within a hermetically sealed glass box controls a constant frequency generator which in turn operates the time indicating mechanism.

These clocks possess a number of advantages. Quartz being very hard and stable is ideal as a controlling element. The vibration of the clock has little effect upon the crystal. The nearness of electrical machinery has no effect, and it is possible to place a number of such clocks close together without interference.

The Six "Pips"

The radio has provided millions of homes with an accurate timekeeper, far beyond the expectations of clockmakers of only a few years ago. The six "pips" that are so familiar are the actual beats of the clock at Greenwich Observatory.

Placed in a long cylindrical glass case and known as the SHORTT free pendulum clock this weird instrument is really a slave of the standard free pendulum that is housed in the deepest part of the Observatory.

The advent of miniature portable wireless sets as used by the police offers a new opening. Watches of a few years hence may have developed into tiny receivers. Instead of an intermittent time signal we may have a wave-length allotted to a permanent "pip-pip" to which the watches would be specially tuned.

Greenwich time would then be virtually at the finger tips.

A REMARKABLE MODEL

Exide Publicity Helps King George's Jubilee Fund

ONE of the most colourful panoramic displays we have seen for some time is on view in a window of Exide House, Shaftesbury Avenue.

The case is 10 ft. long by 3 ft. deep and 6 ft. high and fills the whole window. With their usual perspicacity Exide have made arrangements to supply the power to work the model—two banks of 12 volt Exide Indicator cells have been fitted for this purpose, and can be seen at the foot of the display. (See illustration on page 558.)

The model runs for one minute for a penny—and its popularity was assured on May 12th when more than 110 people paid to see it working (the coins included a penny from Tunis).

Steam and electric trains run the whole length of the display which also shows a busy arterial road along which run motor cars, vans, buses, coaches and electric vehicles.

On the other side of the road is a model of Exide Works complete with an Exide flashing sign, a hospital, church, flats in course of construction, a model Exide Battery Service Station, a mine with the pit-head gear working and a mine truck busily doing its job.

Houses and roads run down to a harbour filled with ships loading at jetties.

The Exide Company have made arrangements whereby the proceeds from the model will be handed over to King George the Fifth's Jubilee Trust Fund. The first week's takings amounted to £2 2s. 4d. (508 pennies).

LAND SURVEYING

A Practical Series for the Amateur Map-maker

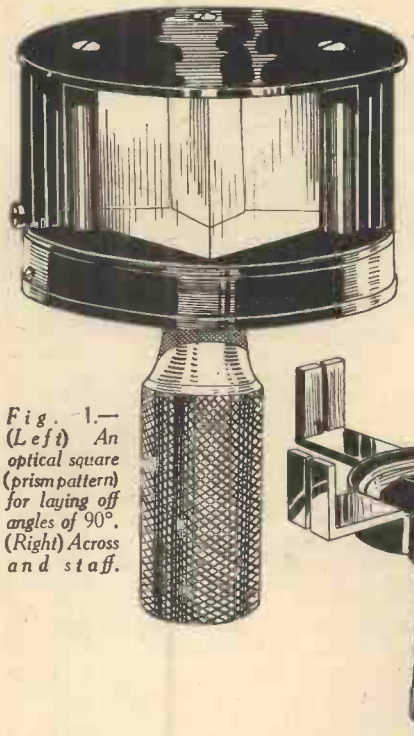


Fig. 1.—(Left) An optical square (prism pattern) for laying off angles of 90°. (Right) Across and staff.

TRIANGULATION forms the basis of all accurate surveying. In this article it is proposed to deal with chain surveying, and the fundamental rule in all chaining work is to build up a series of triangles which are well checked and "well-conditioned," i.e. not too long and narrow—their angles should be kept not less than 30° and not more than about 120°.

Planning a Chain Survey

First, a rough sketch of the property to be surveyed is made, and a base line is fixed, generally the longest line running across the land. On this base line a series of triangles is built; the sides of these triangles will consist of chain lines running close to the boundaries or other detail on the property. Across these triangles run "check lines," also following detail if possible. These provide a check on the chaining and plotting of the survey.

Fig. 3 shows a typical small estate of about twenty acres with proposed chain lines drawn in. *AB* is the base line, and two triangles *ACB* and *ADB* are constructed on it. The check line is *CD*, which intersects *AB* at *E*. Lines 5, 6, and 7 have been inserted to measure other hedges; they will also provide an additional check on the main triangles.

Having fixed the survey lines, the surveyor decides in what order he can most conveniently chain the lines; he numbers them in this order, and puts an arrow next to the number (see Fig. 3) to denote the direction in which the line is to be chained—this is important, to avoid error in plotting.

When this is settled, the surveyor is ready to go on the site and carry out the chaining.

Equipment

The necessary equipment for such a survey would be a chain, offset staff, or tape, ten steel "arrows," and several poles or ranging rods.

The chain is of iron or steel, and is 66 ft. long, divided into 100 links of 7·92 in. each. Eighty chains therefore equal 1 mile, and 10 square chains equal 1 acre. The 66-ft. chain is known as a Gunter chain, and is the standard English chain; what is known as the Engineer's chain is 100 ft. long, and one link on this therefore represents a foot. The Gunter chain is generally used in land surveying. From Fig. 2 it will be seen that the chain is fitted with a handle at each end, and at every ten links there is a tally. It will be noted that the tallies at 10 and 90; 20 and 80; 30 and 70; and 40 and 60 links are the same, so that the chain may be used either way round—there is not much likelihood of error in, say, reading "20" for "80" if it is noted whether or not the reading is past the "50" tally.

The Field Book, in which the surveyor enters his notes, consists of a long book about 7 in. by 4 in. with two parallel lines about ¾ in. apart ruled down the middle of each page. The space between these lines is used for all readings on the chain line, while the margins are used for detail running along or crossing the chain line (Fig. 6).

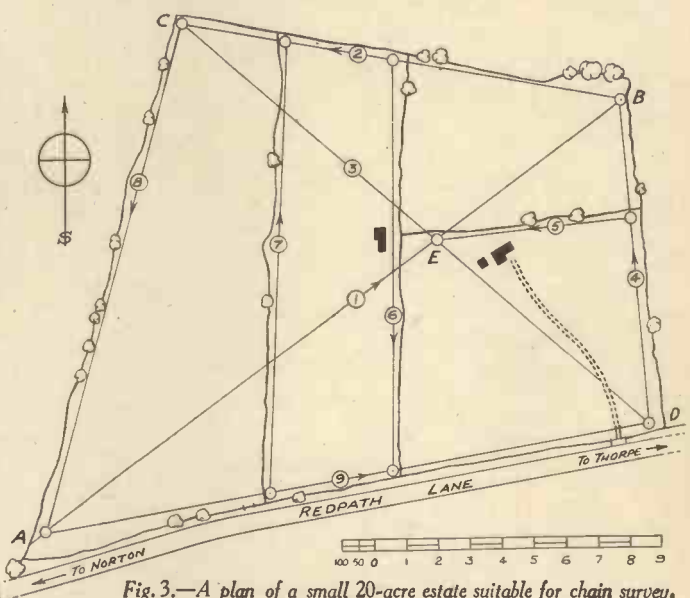


Fig. 3.—A plan of a small 20-acre estate suitable for chain survey.

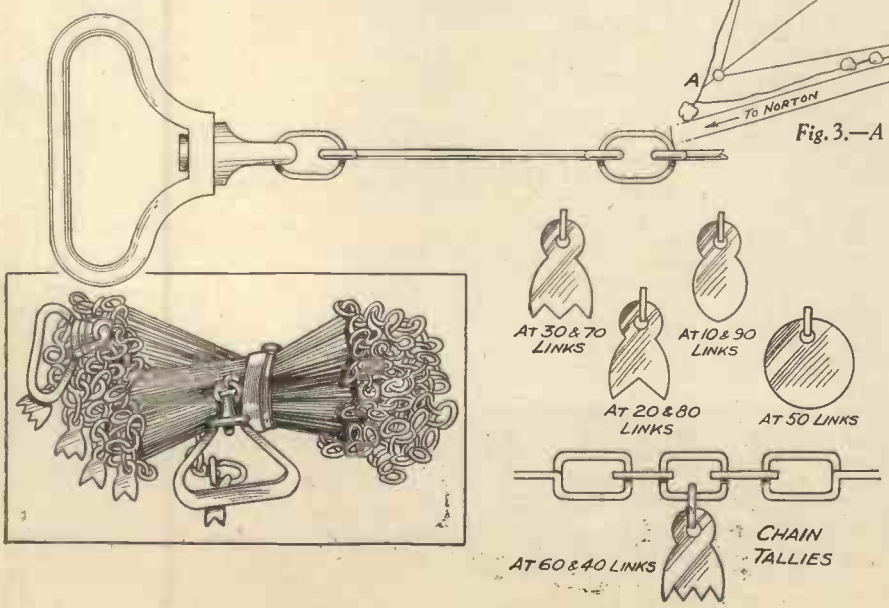


Fig. 2.—Details of the 66-ft. chain.

Procedure on the Site

Having arrived on the site with one or two assistants, the surveyor first marks out the ends of his chain lines with poles (steel-shod and usually painted red, white, and black). If the ground is fairly level, a pole will be visible from the other end of the particular chain line, but if it is not so visible due to the contour of the ground, further poles will have to be put in between the two end poles to mark the direction of the chain line; these intermediate poles are "lined-in" by the assistants—(see Fig. 5).

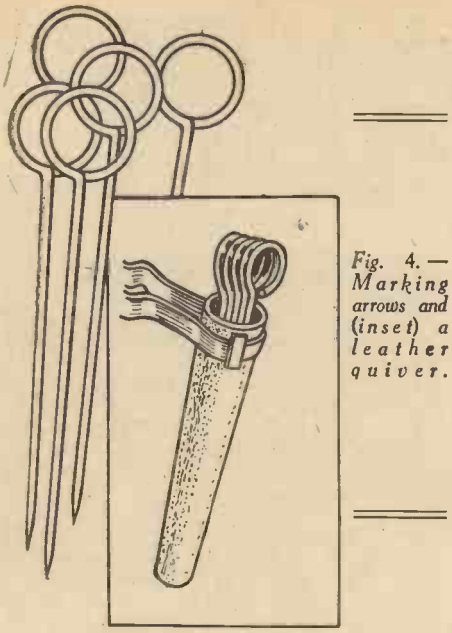


Fig. 4.—Marking arrows and (inset) a leather quiver.

A and *B* are the ends of the chain line, and *Y* and *X* are the intermediate poles. The assistant at A "lines-in" *Y* with *X*, i.e. he tells the assistant at *X* to move his pole until it is exactly in line with *Y* from *A*. The first assistant now goes to *B*, and lines-in *Y* with *X*. This procedure is repeated until all poles are in line.

With the ends of the chain lines marked out on the site, the surveyor (or an assistant) takes the chain, and starting at *A* on line 1 (Fig. 3) walks, holding one end in the direction of the far pole at *B*. The "follower" keeps the other end of the chain on the starting-point, and when the chain has been pulled taut he lines-in the surveyor with the point *B*, i.e. tells him to move his end of the chain until the latter is lying exactly in the direction of *B*.

The surveyor then notes any measurements in his field book, an example of which is given in Fig. 6.

Steel Arrows

The ten steel "arrows" before mentioned are carried by the surveyor, who puts one in the ground to mark the end of the first chain length. When he pulls the chain on again, the assistant follows until the rear end of the chain comes up to the first arrow. The front end of the chain is again lined-in, and any measurements taken. The follower then takes the arrow out of the ground, while the surveyor inserts a second arrow at the front end of the chain. This procedure is repeated until the other end of the chain line is reached.

It will be seen that the number of arrows held by the follower indicates the number of complete chains lengths measured. For instance, if the surveyor wishes to note the distance at which a particular hedge crosses, he looks at the chain tally, sees that the chain reads, say, 56; then the follower has 6 arrows; therefore the distance is 656 links or 6·56 chains from the starting-point.

At 10 chains, the arrows are handed back to the surveyor by the follower; this distance (ten chains) is known as "tally-point" and should always be noted in the field book.

Offsets

Not only should it be noted where all hedges, other chain lines, etc., cross the chain line being measured, but where the latter runs parallel to hedges and other detail, offsets are taken to the hedge from the chain line. These offsets are merely measurements taken of how far away the hedge is from the chain line at any particular point.

Measurement is made with an offset staff or tape, and is always at right-angles to the chain line. Offsets should not exceed about half a chain in length (unless an instrument such as a cross staff or optical square is used to ensure a right angle) and may be taken on either side of the chain line. The actual offsets are not shown in the field book, but the distance the hedge, etc., is away from the chain line (i.e. the length of the offset) is shown by a figure in the margin opposite the particular reading on the chain line (see Fig. 6).

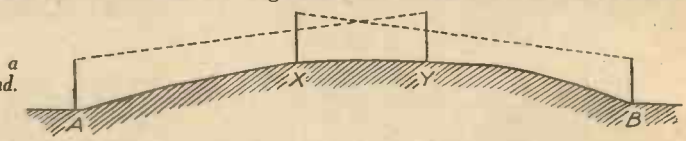


Fig. 5.—"Lining-in" a chain line over hilly ground.

"Ties" are more accurate than offsets, and are taken to important detail, such as the corners of the house measured from lines 3 and 5. Ties are small triangles consisting of two offsets measured from two points on the chain line. A tie is shown in Fig. 6, together with the method of booking it.

The surveyor chains all his lines in the manner described above, and in the order and direction decided upon, and as he goes on he makes rough notes of the hedges and other detail in the margin of the field books together with chain distances and offset distances to marginal detail.

Generally, while on the site, the surveyor takes the bearing of the base line (or any other convenient line) with a compass, and notes this in the field book.

This procedure completes the work on the site.

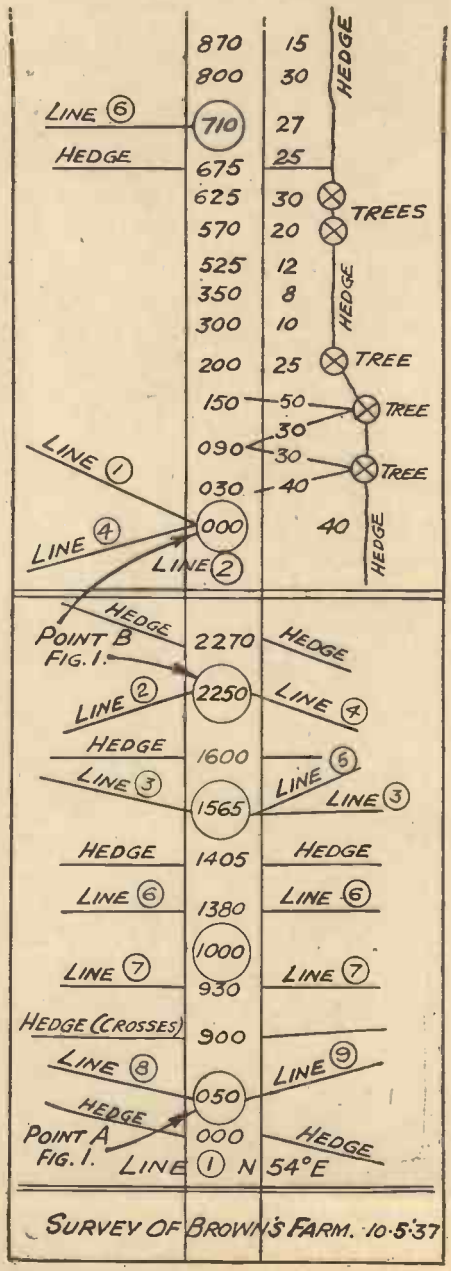


Fig. 6.—Field Book entries (read from the bottom upwards) showing bookings for line 1 and part of line 2.

Plotting

Plotting comprises re-constructing the chain-line framework on a sheet of paper to the scale desired, and drawing in the detail of the property surveyed by marking off along points fixed by offsets from the chain lines.

If the survey has been worked out on correct principles, plotting should present no difficulty. The surveyor first draws his base line (1) on the paper. He notes the length of this line as shown in the field book, viz. 2,250 — 050 = 2,200 links (see Fig. 6) and he marks out this distance to scale on the line he has drawn. Then, since lines 8 and 2 form the other sides of the triangle *ABC*, he describes an arc of radius equal to the length of line 8 and with centre *A*, and another one of radius equal to the length of line 2 and with centre *B*. These arcs intersect at *C*. Similarly, the surveyor constructs triangle *ABD* using lines 4 and 9 as sides.

Having thus constructed the two main triangles, he measures the distance *CD* and compares it with the measurement of line 3 in the field book. This is the first check on the plotting, and if it agrees he can proceed.

He next draws in lines 5, 6, and 7, using the distances along the other chain lines to mark their starting- and finishing-points, and checking their measurement with the distances chained as shown in the field book.

The detail of the survey is then ready to be drawn in. Taking any particular line (such as line 2), the surveyor puts a pencil mark 40 links away from the line at distance 000, another mark 25 links away at distance 200, another mark 10 links away at distance 300, and so on. All these measurements are of course reduced to scale, say one chain to an inch.

When the end of the line is reached, all these points are joined up, and they give the line of the hedge. Fig. 6, which shows part of line 2, shows a "tie" to a tree at 030 and 090 links. The position of the tree is plotted by describing two arcs of radius 40 and 30 links respectively from these points on line 2, the position being where the arcs intersect; similar procedure gives the position of the next tree, which also has a "tie" to it.

When all detail is plotted, the plan can blinked in, and the survey or construction lines rubbed out.

A scale should be drawn on the plan, and the north point shown drawn at the correct angle from the base line or from whichever line was used to take the bearing.

THE STORY OF THE FIRE ENGINE

BY G. LONG, F.R.G.S.

It is only in Recent Years that Firemen have Obtained a Mastery over The Fire Menance. Fires to-day Seldom Spread far Beyond the Buildings in which they Originate

Taking a plunge into the safety net held by firemen below.

THE appalling possibilities of a real warfare, have made fire protection for our great cities the topic of the hour. At long last, those in authority have realised that the fire engine will be at least as necessary for the defence of our homes, as the battleship if that "next war" should unhappily arrive, and there are many who consider it will be a far more vital necessity. Two recent public announcements have brought these grim facts home to the nation. The first was a statement that British Insurance Companies would not undertake *war fire* risks, because claims were likely to exceed their total resources. The second was an official decision to prepare vast emergency fire-fighting equipment, in addition to the peace-time material, for London and other large cities. No less than this would give us any prospect of security in an air raid, when hundreds of great fires might be raging at the same time, but I venture to suggest that if we show sufficient energy, even this peril can be overcome.

It is only during quite recent years that our firemen have really obtained a mastery over their dread enemy. Fires to-day seldom spread far beyond the building in which they originate, but history reminds us that *for many centuries big fires in crowded cities were quite uncontrollable.*

Great Fire of London

We all remember the story of the Great Fire of London, but few realise that it lasted for four days, and consumed 400 streets, 13,200 houses, 88 churches, and St. Paul's Cathedral. The ruins extended from the Tower to the Temple, and from the riverside to Holborn. This was only one of many Great Fires of London, and the following towns and cities in England were almost or *quite destroyed by fire* during the last eight centuries, York, Northampton, Tiverton, Gravesend, Stratford-on-Avon, Blandford, and Beaminster. In Europe the tale is even more tragic. There were many gigantic fires, three of which were greater than London's big fire. These were two of Constantinople's many conflagrations (it had fifteen in a single century), and the fire at Moscow in 1736. The great fires at Copenhagen in 1728, and Montreal in 1852, almost totally destroyed the respective cities, while Nero's famous blaze at Rome, was one of the biggest on record.

Inadequate Equipment

At the time of London's Great Fire (1666), the fire-fighting equipment was pitifully inadequate. There were ladders, wooden buckets, and a few toy squirts. These were made of brass—each 2 ft. 6 in. long, and was worked by three men, two of whom held it by side handles, while the third dipped it into a bucket and discharged the contents. There was also a by-law requiring householders to keep a tub of water at their doors. While such equipment might serve to stifle a very small fire, it was totally ineffective when a great conflagration was raging. Owing to the heat, the firemen could not approach near enough to a building to play on the flames, and the jet of water was miserably small and non-

Nineteen fire engines shooting geysers of water into the air. The engines project about 100 tons of water per minute.

continuous. This is why this, and many other great fires of history, could only be checked by a wholesale blowing up, or pulling down, of buildings, in the path of the flames, so as to form a gap which the fire could not cross.

Divided into Four Districts

In 1667 the City of London first grappled with its grave problem, and an Act of Parliament ordained that the city should be divided into four districts, each of which should be provided with 800 leather buckets, 50 ladders, and two brazen hand-squirts. A start was also made to provide firemen, so twelve companies of men were formed, each of which had an *engine* in addition to the equipment mentioned above. They were only spare-time workers, however, as properly trained firemen were unknown in England until nearly two centuries later.

The first effective manual fire engine was invented five years after the Great Fire, by a Dutch engineer, Van de Helde—it was provided with a flexible leather hose. Details are lacking, but it is likely that this hose was for suction purposes only. All the ancient English fire engines which I have seen have had a brass swivelling nozzle fitted to the car, and no hose at all, but instead a kind of tank on the engine which was kept filled by lines of men with buckets. In 1721 Richard Newsham of London patented an improved engine of this kind, and most of the ancient manuals now to be seen are of this type.

Engines Destroyed

Having no delivery hose, the engines had to be taken very close to the conflagration and so were often burnt. This happened in the Fire of London, and again in 1731, when the little town of Blandford was burned out, all the engines were quickly destroyed.

Power for these machines was provided by two sets of men, who pushed long handles up and down. Some of them were large enough for twenty men to work at once, and could deliver 160 gallons a minute, and raise a jet to a height of 165 ft.

Organised fire-fighting began at the end of the nineteenth century, when fire insurance companies were formed, and owned their own fire engines, which, of course, only attended their insured property.

A metal badge was placed on the houses covered by assurance, some of which can be seen to this day.

James Braidwood

The father of the modern fire brigade was James Braidwood, who organised the first full-time professional brigade at Edinburgh, in 1824. They had a manual engine of remarkable size and efficiency, which was worked by forty men and served two lines of hose. The delivery was 140 gallons a minute, and it is said to have thrown a ¾-in. jet to a height of 65 ft. Braidwood was so successful that in 1833 he was invited by the fire assurance companies to come to London and form the first London Fire Brigade—properly speaking, since earlier firemen had only been half-trained, part time workers.

Braidwood worked in London with much zeal and efficiency, and died a fireman's death. He was killed in the terrible Tooley Street fire, in 1861, which is said to have been the most disasterous outbreak in London since the Great Fire.

His brigade was taken over by the Metropolitan Board of Works in 1865, under the command of Captain E. T. Shaw, and when the London County Council was formed in 1887, the London Fire Brigade was transferred to them.

First Steam Fire Engine

During the last half century, progress has been rapid. The first Steam Fire Engine was built by Shand, Mason & Co., in 1860. It was, of course, horse-drawn, and the first steamer had a capacity of 150 gallons a minute, but this was soon increased to 450 or even more. The Steam Fire Engine was a most picturesque feature of London life during pre-War days, as it dashed through the streets with smoke pouring from its funnel and a hoarse clanging of its gong to clear the way.

One of the very first fire engines.

While the engine was standing in the station awaiting a call, the water was kept warm in the boiler by means of a gas jet, and its water-tube boilers were so efficient that steam could be raised in about four minutes.

Owing to the vast docks and warehouses near the Thames, river fire floats form an important part of London's fire-fighting equipment. There was a fire float of sorts, belonging to an insurance company in the eighteenth century, but up to 1852 all the fire floats were fitted with manual engines. The largest of these required 80 men to work the pumps.

As compared with this, let us consider Beta 3, constructed by Messrs. Merryweather, in 1928. It has oil engines of 120 h.p., driving twin screws for navigation, and fire pumps with an output of 2,000 gallons a minute.

Motor Fire Engines

The latest London motor fire engines, built by Merryweathers, are operated on the turbine principle. They have a road speed of 45 m.p.h., and can ascend any hill in the metropolitan area. Power is obtained from a 4-cylinder engine of 80 h.p., both for road travel, and driving the turbine pumps. This works 4 lines of hose, and can deliver 800 gallons a minute at 50 lb. pressure, 650 at 100 lb., and 410 gallons at 150 lb. This means, of course, that when the water does not have to be pumped very high in the air, a much larger amount can be delivered.

The march of progress, while increasing the efficiency of fire-fighting apparatus, has created new problems.

Dangerous Fires

Thus fires caused by electric sparks and petrol fires cannot be extinguished by a jet of water. In the first case the current may travel up the stream of water and kill or injure the fireman holding the branch, and in the second the effect of water on blazing oil or petrol is to spread the fire, because the blazing liquid floats on the surface of the water. New technique is, therefore, needed. Small electric fires are extinguished with buckets of sand, and small petrol fires—such as when a motor-car tank takes fire—are put out by squirting on small quantities of carbon tetrachloride. This produces a blanket of carbon-dioxide gas, which extinguishes the fire. Large blazes of oil or petrol are dealt with by a foam spreading device. One of the best of these is Merryweather's "Pneumasuds," which will deliver 200 gallons a minute of foam, whose myriad bubbles are full of inert gas which form a blanket over the blazing petrol and smother the fire. The plant consists of a gun-metal mixing chamber, into which a supply of water and air is conducted under pressure. The foam is produced from a special solution, one gallon of which will make a thousand gallons of fire-stifling foam.

Chemical Extinguishers

Still another type of chemical extinguisher now in common use, is the soda bicarbonate apparatus. Metal vessels of two or four gallons capacity, are filled with a solution of bicarbonate of soda, and a fragile glass bottle of sulphuric acid is held within the container near a brass plunger. When a fire occurs a smart knock on the plunger fractures the bottle, and the acid mixes with the soda solution. Carbon-dioxide gas (CO_2) is immediately generated, and the stream of gas and water rushes out at a pressure of 150 lb. to the square inch. These are exceedingly efficient for dealing with small outbreaks of fire.

Fully fledged army firemen demonstrating how to rescue comrades from a "fire" with their pupils as "victims." These firemen compare well with the majority of civil brigades and are taught all branches of fire fighting, including first aid and rescue work. They deal not only with barrack conflagrations, but an abundance of heath fires that frequently occur during the summer months.

Making A Simple Oscillograph

Straightforward Instructions for the Construction of a Scientific Implement which has many Uses

Showing the home-made six-sided mirror-drum of the oscillograph apparatus mounted on the spindle of a gramophone turntable. The mirrors are secured in position on their supporting block by means of rubber bands.

AN oscillograph, as the name itself implies, is an instrument which is capable of producing graphical representations of, or, in other words, actual pictures of, vibrations. Usually, such an instrument is employed for the delineation of sound vibrations, its most up-to-date, as well as its most perfect form being the nowadays well-known cathode-ray oscillograph, the parent of many television systems.

The amateur, needless to say, cannot hope to construct for himself a cathode-ray oscillograph. At the same time, however, there is another simple form of oscillograph, a form which, for want of a better phrase, may be termed the "mechanical" oscillograph, which may easily be constructed by any amateur scientific worker and which, used intelligently, is capable of affording many interesting results.

To make our "mechanical" oscillograph, we need a loudspeaker, a gramophone, some mirror glass, and some type of light-projector. For the light-projector, even the simplest type of child's magic lantern will suffice, whilst, if a gramophone be unobtainable, a substitute for it may generally be contrived in the form of some analagous revolving mechanism.

The Loudspeaker

Let us begin the construction of the oscillograph with the loudspeaker. This should be of the usual moving-coil type. Obtain a 2- or a 2½-in. length of springy wire and exactly in the middle of it cement, by means of a tiny drop of sealing-wax, a small mirror about ⅜-in. square. This mirror should be selected with care. It should be as thin and as light as possible, since, to function efficiently, it should possess a minimum amount of weight. Usually, such a small scrap of mirror glass may be obtained from scientific supply stores or even from jewellers' emporiums.

The short length of springy wire with the mirror attached to the middle of it has one end stuck with sealing-wax to the spider of the coil speaker, and the other end of the wire is similarly attached to the cone of the speaker.

The Mirror Drum

We have now to make a simple type of mirror drum. This is best constructed by cutting out of a block of wood a six-sided piece, the length of the six-sided block being about 3 in., each of the sides having an equal width of ¾ in. or 1 in. We must now obtain six strips of mirror glass to fit the sides. These may readily be cut with a diamond from any odd sheet of mirror glass, and a local glazier or woodwork-store dealer will usually do the job of cutting up the mirror glasses to size for a few pence.

Having obtained our six equal-sized strips of mirror glass, each strip being, say, 2½ in. by 1 in. in dimensions, we arrange these around our six-sided wooden block, securing the mirror glasses in position by means of strong rubber bands placed at the upper and lower ends of the mirror-glass assembly.

The lower end of the six-sided wooden supporting block has a hole drilled centrally up into it, and by means of this central hole the completed mirror-drum is slipped over the spindle of a gramophone turntable, so that the mirror-drum rotates with the turntable.

Light-projecting Apparatus

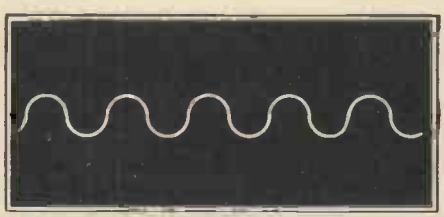
We must now provide some type of light-projecting apparatus. A small magic lantern, even of the toy variety, will suffice for this purpose. Whatever projection device we employ, however, must be masked by a very small hole, so that only a narrow pencil of light is projected by it.

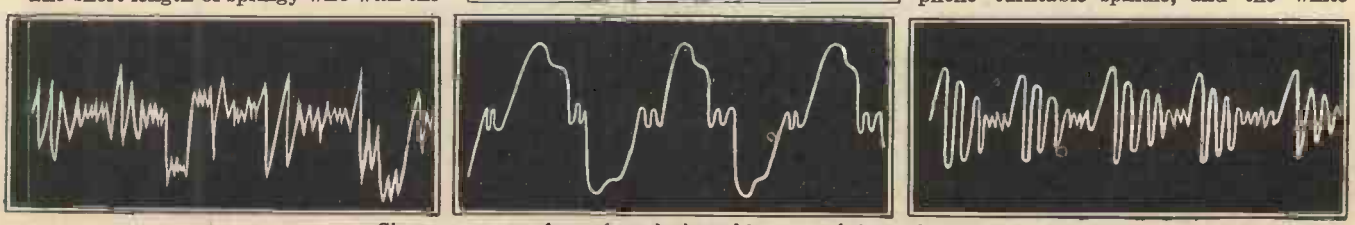
Finally, we require some sort of screen—a sheet of white card or paper, or a suitably-mounted sheet of cloth.

The components of our "mechanical" oscillograph will now be complete. It but remains for us to co-ordinate them and to set them in correct adjustment.

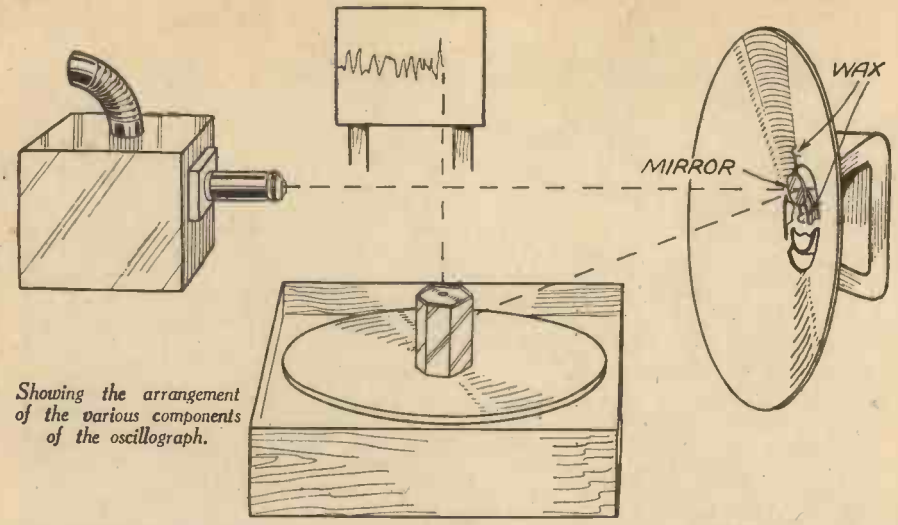
Placing the gramophone centrally on a table, we fix the loudspeaker at one side and the projection lamp at the other, while on the third side we hang the white screen.

The above arrangement will be seen quite clearly in the diagram. The loudspeaker, projection lamp, and gramophone are so arranged and positioned that the narrow pencil of light from the projection lamp impinges upon the tiny mirror attached to the loudspeaker. The light-beam reflected from this mirror is then made to fall upon the mirror-drum mounted on the gramophone turntable spindle, and the white





Characteristic wave forms of sounds obtained by means of the oscillograph.



Showing the arrangement of the various components of the oscillograph.

screen is so arranged that the light from the mirror-drum falls upon it.

In practice it will be found necessary to tilt the gramophone upwards or downwards slightly in order that the light beam reflected from the mirror-drum will not cross the path of the projector-lamp beam.

The Spot on the Screen

When the oscillograph components are correctly positioned and adjusted a white spot should appear on the screen immediately the projector lamp is switched on. When the gramophone turntable is set into rotation, the spot on the screen should spread out into a thin line. If, now, the loudspeaker is switched on, the luminous line on the screen will at once break up into innumerable and ever-changing complex wave-forms which constitute, of course, the graphical representations of the sounds which are emanating from the loudspeaker.

The clarity of the projected wave-forms and, also, their fidelity depends upon the narrowness of the projected light-beam, the lightness of the loudspeaker mirror, and the speed of the revolving mirror-drum. Rotated at "ordinary" gramophone speeds, i.e. about 80 revolutions per minute, a carefully constructed mirror-drum will give effective results.

The graphical representations of sound which are obtainable with the aid of this simple "mechanical" oscillograph are interesting in the extreme. They become doubly interesting when they can be repeated at will, which requirement may be effected by connecting the speaker to a radiogram or record-playing desk and by playing the same record over and over again.

For purposes of study in connection with the oscillograph representations of sounds, records of a "simple" character should be chosen, i.e. records of single instruments, test records of varying sounds, pitches, and the like.

Voice Graphs

It is also possible by means of the oscillograph to obtain graphical representations of one's own voice. For this purpose, we require a microphone connected up with an amplifier, the output from the latter being fed to the loudspeaker. Upon setting the oscillograph into operation and speaking into the microphone, one may experience, if not the pleasure, certainly the absorbing interest of actually "seeing" one's own voice cast, in all its peculiar wave-forms, on the screen. As before, however, the simpler sounds and syllables will be found to be more interesting, the more complex sounds and utterances being, at times, rather too complicated for the simple oscillograph to handle with satisfactory clearness.

Refuelling Outboard Motors

WHEN extended runs are being made with small outboard craft, the problem of refilling the small tank provided often arises, and is made worse if the sea is at all rough, or it is raining.

The use of can and funnel in these circumstances is awkward, frequently wasteful, and the risk of introducing rain or spray into the tank considerable. A structural alteration to the existing tank and the fitting of a pressure-feed system is a good way out of the difficulty. It has, however, the effect of altering the engine unit as a whole from standard, and may affect the guarantee and the second-hand value.

Materials Required

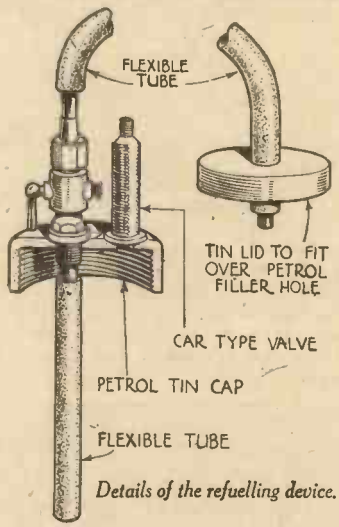
A simple device to overcome the trouble can be made from the brass cap of an ordinary petrol can and a few common fittings. The lugs on top of the cap should be sawn off, and the entire top filed up flat.

To one side a small petrol tap is fitted, by screwing it into a hole previously drilled and threaded. Into the base of the tap is soldered a short piece of copper pipe about ¼-in. diameter, the existing hole being bored out larger if necessary.

At the other end of this pipe is soldered a length of metal flexible petrol pipe of such a length, that when the cap is screwed to the can, the lower end of the pipe clears the bottom of the can by about ½ in. The tap must be fitted sufficiently in towards the centre of the cap to allow the pipe to clear the screwed neck of the can, on to which this cap fits, and allow for a washer.

Fitting a Tyre Valve

A small hole is now drilled opposite the tap and a light-car type tyre valve soldered over it in such a manner that the bore of the valve registers with the hole. Float plenty of solder round the joint, previously preheating the cap to assist the solder to run. A drill can now be run through the hole from underneath, and into the bore of the valve, to make sure that no solder has blocked the air passage.



Details of the refuelling device.

The outer end of the tap is furnished with a union, and a length of flexible pipe is fitted, in a similar manner to that used inside. This pipe should be long enough to extend from the position where it is intended to put the can, to the petrol filler orifice on the motor, and allow it to be done in a gentle curve. The other end is soldered through a tin lid large enough to cover the petrol-filling orifice, so that, when in operation, spray or rain cannot enter.

Using the Device

The pipe should project an inch or so, and can be provided with a copper-pipe nozzle if a neat job is required.

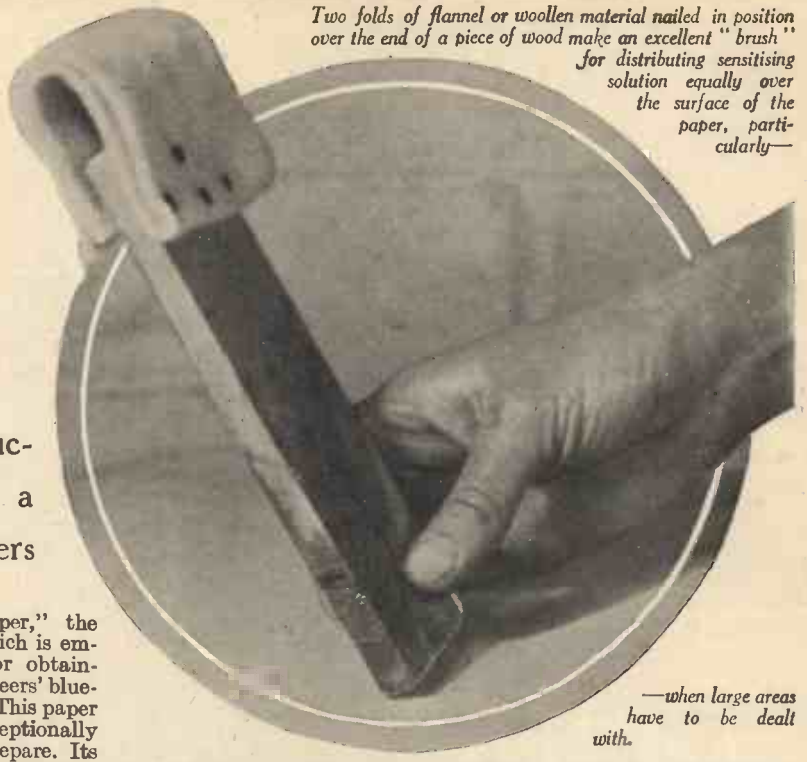
To use the device, a petrol can is filled not more than two-thirds full with the petrol-oil mixture, and the device screwed home. A tyre pump is employed to fill the remaining space with compressed air, and on opening the tap the petrol is forced up the pipe and delivered to the tank.

If a good pressure has been pumped up, and the washers fit properly in the cap, it will hold for a considerable period, and refuelling can be done single-handed without stopping the engine.

The device has in its favour that it is compact, and can be taken about with the engine. A can can be hired locally. The only care necessary is to see that the tap is a good one and that a proper leather washer is used in the cap.

Making Sensitised Paper

Practical and Straightforward Instructions for the Home Preparation of a number of Photographic Printing Papers



Two folds of flannel or woollen material nailed in position over the end of a piece of wood make an excellent "brush" for distributing sensitising solution equally over the surface of the paper, particularly—

—when large areas have to be dealt with.

WHILST it would be an extremely difficult matter for the amateur to prepare for himself photographic printing paper of the superb quality of the gelatine-surfaced papers which are produced by photographic material manufacturers, it is, nevertheless, not at all difficult to manufacture in the home workroom or laboratory a number of different varieties of sensitised papers which, for rough use, and even for the production of special and "out-of-the ordinary" effects in photographic printing will prove to be very serviceable and effective.

With some of the photographic printing papers detailed in this article, effects which are quite artistic can be obtained, particularly if fairly rough-surfaced papers are chosen for sensitisation. It should be remembered, of course, that, for the purpose of obtaining maximum printing detail from a negative, only smooth surface-papers should be employed.

The sensitised papers dealt with in this article will yield satisfactory prints from negatives of average quality. Exceptionally thin or "ghost" negatives are unsuitable for them, but, apart from this exception, a negative of almost any density may be employed for printing on them.

Blueprint Paper

The first of the sensitised papers which we shall deal with is the well-known "blueprint paper," the paper which is employed for obtaining engineers' blueprints. This paper is exceptionally easy to prepare. Its production is inexpensive and the paper has the advantage of requiring development in water only.

In order to prepare blueprint paper, make up the following solutions, storing them in amber-coloured bottles until wanted:

Solution A.

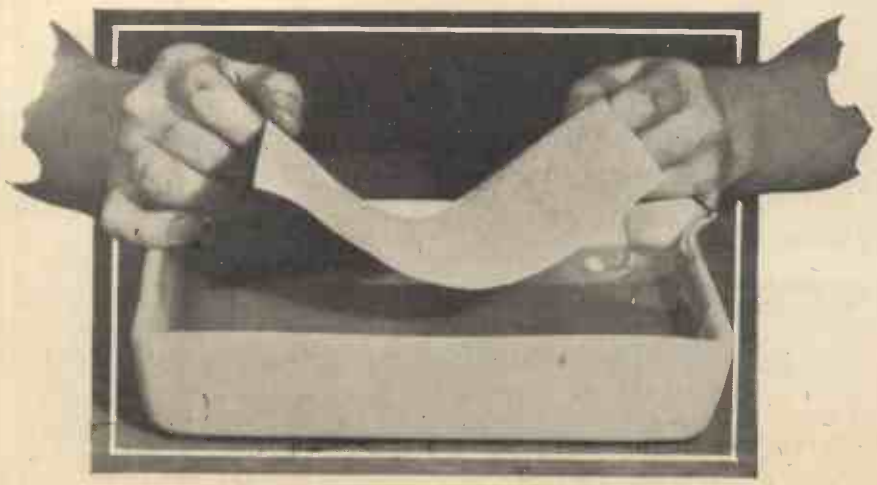
Ferric ammonium citrate	½ oz.
Gum arabic	50 grains.
Water	2 ozs.

Solution B.

Potassium ferricyanide	90 grains.
Water	4 ozs.

In making up Solution *A*, it is best to soak the gum arabic in the water for a few hours in order that it may swell up and dissolve more or less completely before the ferric salt is added. The ferric ammonium citrate can be had in the form of green or brown "scales." Either of these varieties will suffice, but the green form is the preferable.

Choose good quality paper, rough or smooth, lay the paper sheet flat down on a level surface and in a small vessel mix equal parts of solutions *A* and *B*. By means of a fragment of sponge, a flat camel's-hair brush or a piece of cotton wool charged with the mixed solutions, wipe the latter evenly over the surface of the paper. Subsequently hang up the paper to dry in a dust-free place. This operation of sensitisation and the subsequent drying must, of course, not take place in daylight, although it may be carried out under ordinary household artificial illumination.



"Floating" a sheet of paper upon the surface of the sensitising solution.

Developing

Print the blueprint paper under a negative until the darker areas of the paper are brown-black or "bronzed." Then immerse the print in cold water and allow it to soak (changing the water occasionally, if necessary) for a short time. The picture will develop itself and will become bright and clear, the image, of course, appearing in a rather bright blue shade. The developed print does not require any fixing. Simply take it out of the water and allow it to dry.

A blueprint which has been exposed too long under a negative and has become almost entirely "bronzed" may often be saved by developing it in a ½ per cent. solution of hydrochloric acid, finally washing it in water.

It is possible to tone blueprints and to obtain them in other colours, although prints which are thus toned are rendered not very permanent. For instance, if a blueprint be immersed in a bath of water to which five drops of strong ammonia has been added to every ounce of water, the colour of the image will vanish. After this, the print is washed and placed in a weak solution of tannic acid (cold strong tea will do). The image will thereupon develop up in a brown or brownish-purple shade.

Lilac tones can be obtained on blueprint papers by immersing them in a bath of borax or in a *hot* solution of lead acetate. A very weak solution of sulphuric acid or a solution of ferrous sulphate acidified with a little sulphuric acid will turn the blueprint green.

Interesting as the production of photographs on blueprint paper may be, it is the silver-printing papers which give the most

permanent results. Plain " salted " printing-out paper (" P.O.P.") can be made at home with very little trouble. Carefully prepared, it gives prints of good density from average negatives. What is more, the paper keeps well before use and is, in fact, the home-made counterpart of the commercial " P.O.P." sensitised papers.

P.O.P.

In order to make ordinary P.O.P. or " plain salted paper " it is essential to size the paper before we apply the sensitising solution to it. Any paper may be employed but, since it is easier to get an evenly sensitised surface on the slightly rough papers, the beginner would be advised to commence operations with a slightly rough good-quality drawing paper.

The paper is sized by being floated upon or brushed over with the following sizing solution :

Arrowroot powder . .	100 grains.
Ammonium chloride . .	60 grains.
Water	10 ounces.

" Floating " the paper on the sizing solution is carried out by pouring the solution in a dish and by lowering the paper on to the surface of the solution until the whole of the area of the paper makes contact with the liquid. Some amateurs find the brush method of sizing, whereby the size solution is evenly brushed over the paper, easier to carry out. No matter which of these two methods is employed, the object is to obtain a perfectly even and thin layer of size upon the surface of the paper. Hence, if the brush method is employed, too much size solution should not be brushed over the paper.

Drying

The sizing of the paper and the subsequent drying can be carried out in full daylight, but the subsequent sensitisation of the paper, which consists of floating it for 2½ minutes on a solution of silver nitrate in water (50 grains of silver nitrate to every ounce of water, the water being preferably distilled), must be performed in artificial light. The sensitised paper is hung up to dry—in the dark or in artificial light—and finally cut up into useful sizes and suitably packeted. It is printed in the usual manner under a negative in daylight.

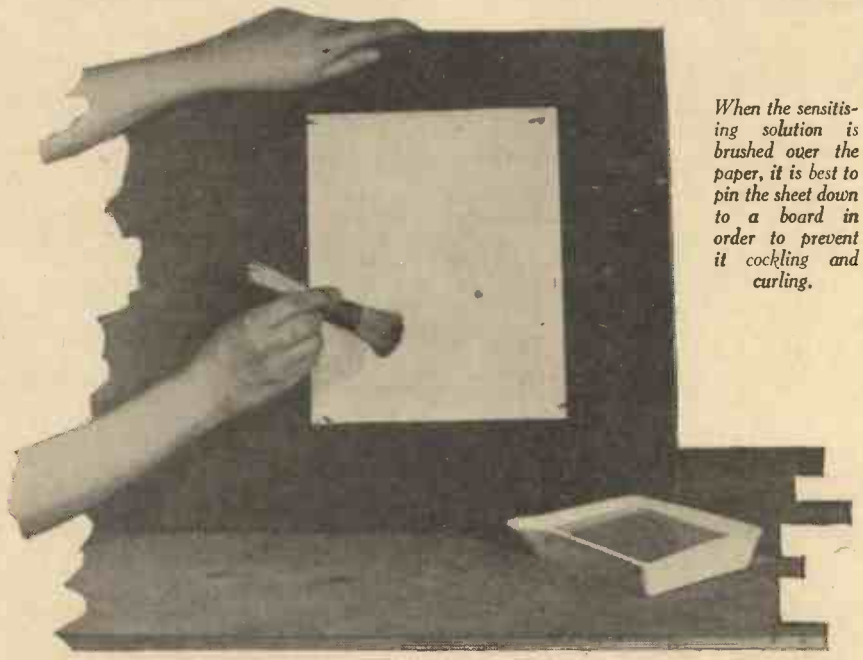
After printing, the above sensitised paper may simply be fixed by immersion in a hypo fixing bath of the usual type. This will produce a yellow image which will not be very pleasing. For the best results, therefore, the above paper must be gold toned. The print is washed in running water until the milkiness disappears from the water, after which it is placed in a toning bath consisting of a weak solution of sodium acetate containing a few drops of gold chloride solution. Any other gold toning bath may, of course, be employed for the purpose. The print may also be platinum-toned, but this, usually, will not be possible in view of the prohibitive price of platinum salts at the present time.

After toning, the print is rinsed in water and fixed in an ordinary hypo bath. Finally it is washed in water and dried.

Besides ordinary paper, good quality cloth can be sensitised in the above manner, as, also, may wood, leather and other surfaces. Ordinary plain post cards take well to the sensitisation.

Another Method

Another simple method of sensitising paper consists in brushing it over with a strong solution of potassium bichromate. On printing this paper under a negative, quite a strong image will be obtained, which, however, is weakened in the subsequent washing which is necessary to remove the unchanged bichromate from the paper.



When the sensitising solution is brushed over the paper, it is best to pin the sheet down to a board in order to prevent it cockling and curling.

Uranium printing papers are easily made at home and some very delightful results may be obtained by their use. Contrary to many opinions, uranium salts are not very expensive, uranium nitrate—the uranium salt concerned in the uranium sensitisation of paper—costing about half a crown an ounce and being procurable from any firm of laboratory suppliers or wholesale chemists.

Dissolve 1 part of uranium nitrate in seven or eight parts of water and, by means of a sponge or a piece of cotton wool, mop the solution over a sheet of good quality paper, the operation, of course, taking place under artificial illumination. After drying the paper, print it under a negative. The brownish print so obtained is merely washed in two or three changes of water. No other form of development or fixing is necessary.

Uranium Prints

Like blueprints, uranium prints can be subjected to a number of toning processes whereby the colour of the print is changed. For instance, by placing such a print in an approximately 5 per cent. solution of potassium ferricyanide acidified with a few drops of nitric acid the colour of the print will change to red. If the red print is immersed in a weak solution of cobalt nitrate, its colour will change to green. A 3 or 4 per cent. solution of ferrous sulphate, acidified with a little weak sulphuric acid, will have a similar effect upon the red-toned uranium print.

Again, if an untoned uranium print be immersed in a weak solution of silver nitrate, its image will acquire a grey or grey-black colour, whilst violet tones will be given to it by immersion in a gold chloride bath.

Uranium prints, it must be stated, are not very permanent. Sometimes they tend to fade or to discolour and when once this takes place nothing can be done to save them. Apart from this drawback, however, uranium prints are capable of affording some very fine tones.

Flower Petals

Many of the colouring matters of flower petals are light-sensitive and a number of most interesting experiments in the production of printing papers can be conducted with them.

If, for instance, we take a small quantity of rectified spirit or even high-grade methylated spirit and macerate a quantity of strongly coloured flower petals in the liquid, the colouring matter of the petals will dissolve out of them into the spirit. Take, now, a sheet of white paper and brush some of the flower-dyed spirit over it (the operation, as usual, being carried out under artificial light). The paper will be tinged with the flower colour. On drying, it may be printed under a negative in sunshine and an image will result, thus howing the light-sensitivity of the colouring matter.

Not all colouring matters of flowers are light sensitive. Nevertheless, the majority of such colouring matters are thus characterised, that of the dahlia being especially sensitive.

Unfortunately, the images obtained in the above manner are anything but permanent. They cannot be fixed and if any attempt is made to remove the unchanged colouring matter on the paper by dissolving it away with spirit, the image, usually, is removed at the same time.

A Form of Sensitised Paper

An interesting form of sensitised paper may be made by floating paper on a bath composed of the following ingredients :

Ferric chloride . .	8 grams.
Citric acid . . .	5 grams.
Water	250 ccs.

The paper is dried in the dark and then printed in daylight under a *positive* or a lantern slide (not a negative) until a clear image is seen. It is then developed by being immersed in glycerine which has been weakly coloured with Indian ink. It will be found that the ink will only stain those parts of the paper which have not been affected by light. Finally, the print is quickly washed and dried.

With the above paper it is difficult to get pure whites. Nevertheless, the process of ink printing outlined above is interesting and, in careful hands, will afford some very pleasing results.

STARGAZING FOR AMATEURS

A NEW SERIES

By N. de Nully

A GUIDE FOR JULY

THE Earth will be at its greatest distance from the Sun—94,456,900 miles—on the 5th. This is over 3,000,000 miles farther away than in mid-winter. But, were it not for the fortunate circumstance that the maximum distance is reached when the Earth's northern hemisphere is turned towards the Sun, our summers would be hotter and our winters colder than they are. In the opposite hemisphere conditions are reversed, and one of the results is a more extended antarctic polar ice cap than that covering the arctic regions. During July in these latitudes, the Sun does not sink more than 18 degrees below the horizon after setting. There will, therefore, be no true night again this month, as twilight merges into dawn.

Mercury and Venus are "morning stars"; but Mars is still a bright object late in the evenings, low in the south-west. Saturn rises due east shortly after midnight, and will be fairly high up in the early morning. The rings are gradually opening out, but at present are still merely a broadening streak of light; like a luminous bar across the disc, and projecting on each side. Jupiter, the giant of the Sun's planetary retinue, makes its nearest approach to us this year, on the 16th, when its distance will be reduced to 384,590,000 miles. The term "nearest" is, of course, relative; for a young space voyager, leaving the Earth to-day at the age of twenty-five, and travelling non-stop at 1,000 m.p.h., would find himself an old man of seventy by the time he reached Jupiter. Meanwhile, the planet would have made nearly four of its protracted "annual" circuits.

Jupiter

Jupiter may be seen low down in the south-east as dusk sets in. The illustration on this page shows its appearance through a small astronomical telescope; but even a good "three draw" will give an impressive view of the disc of the planet with its four principal "moons." At the predicted times the latter may be seen to instantly vanish in eclipse and reappear with equal suddenness. Through large instruments the conspicuous parallel bars ruled across the brilliantly floodlit surface, are found to be complex chocolate-coloured zones separated by a broad lustrous equatorial band. On either side of these three features lie the shining north and south tropical belts; with narrower dusky and gleaming streaks stretching as far as the polar regions. The latter are usually pearly grey though sometimes delicately tinted. The brindled texture of the dark equatorial girdles is crowded with wisps, patches and spots. Many of these are evanescent, while others endure for years. Notable among the persistent ones is the Great Red Spot, an oval brick-hued area 30,000 miles long and 7,000 miles wide. It seems to be set in a bay or hollow scooped out of the southern edge of the south equatorial belt and has several times faded to the verge of extinction.

A Remarkable Photograph

A striking photograph taken at the Lowell Observatory and reproduced here (with acknowledgments), gives a clear delineation of the principal visible markings on Jupiter, though it is shorn of the wealth of intricate detail seen by direct vision. Observe the evidently disturbed state of the north equatorial belt and the spots on both of them; as well as the faint wisps along the bright equatorial band. The notch at one end of the south equatorial belt represents the situation of the Great Red Spot, which was unusually prominent last year. It should be borne in mind that, owing to the rapid rotation of the planet, any markings that may have passed out of sight will reappear at the opposite rim after an interval of about five hours.

From what can be gleaned of Jupiter, it is believed to consist of a semi-plastic core

An illustration of Jupiter. The shading along the rim is due to absorption of light by the planet's atmosphere.

of an unknown substance; light in character, but highly concentrated towards the centre. This core is hidden from us by an opaque shell of cream-tinted vapours, the outer surface of which is seemingly in a state of perpetual cyclonic commotion. Until comparatively recently, Jupiter was supposed to be gaseous throughout and still too hot to solidify. Modern radiometric measurements however yield no evidence of internal heat. On the contrary, they suggest an extreme frigidity of about 200 degrees (Farenheit) below zero! The existence of an atmosphere of some kind is nevertheless, indicated both visually and photographically; but its constitution has not as yet been determined.

Tremendous Size

The dimensions of Jupiter are prodigious. Its equatorial diameter of 88,700 miles is over eleven times that of the Earth, and its huge mass contains more material than all the other planets put together. Jupiter revolves round the Sun in 11 years 314 days, at an average distance of 483,300,000 miles; but its rotation period is accomplished in less than ten hours—a speed that probably accounts for the abnormal flattening at each pole. Seasons it has none; for its axis, unlike that of the Earth, is almost perpendicular to the plane, or level, of its path in space. Jupiter belongs to an order of solar satellites differing entirely from those circulating within its orbit. After crossing the zone of the asteroids (those midget planets whirling round the Sun in tangled tracks between the orbits of Mars and Jupiter), worlds on a monstrous scale are encountered, oblate in shape and accompanied by several instead of only one or two "moons." Saturn, Uranus and Neptune, are all in this class; though, so far, but a single satellite has been detected attached to remote Neptune. It probably, however, possesses others which may prove to be within range of the mammoth 200-in. Reflector, now under construction.

Jupiter is well furnished with attendants, having at least nine under its sway. The four largest vary from 2,000 to 3,245 miles in diameter. Not only their eclipses, but also their transits with their accompanying shadows while passing in front of the brilliant background of the planet's surface, may be discerned with telescopes of 3-in. aperture and upwards. The other five "moons" are beyond ordinary instruments.

Discrepancies

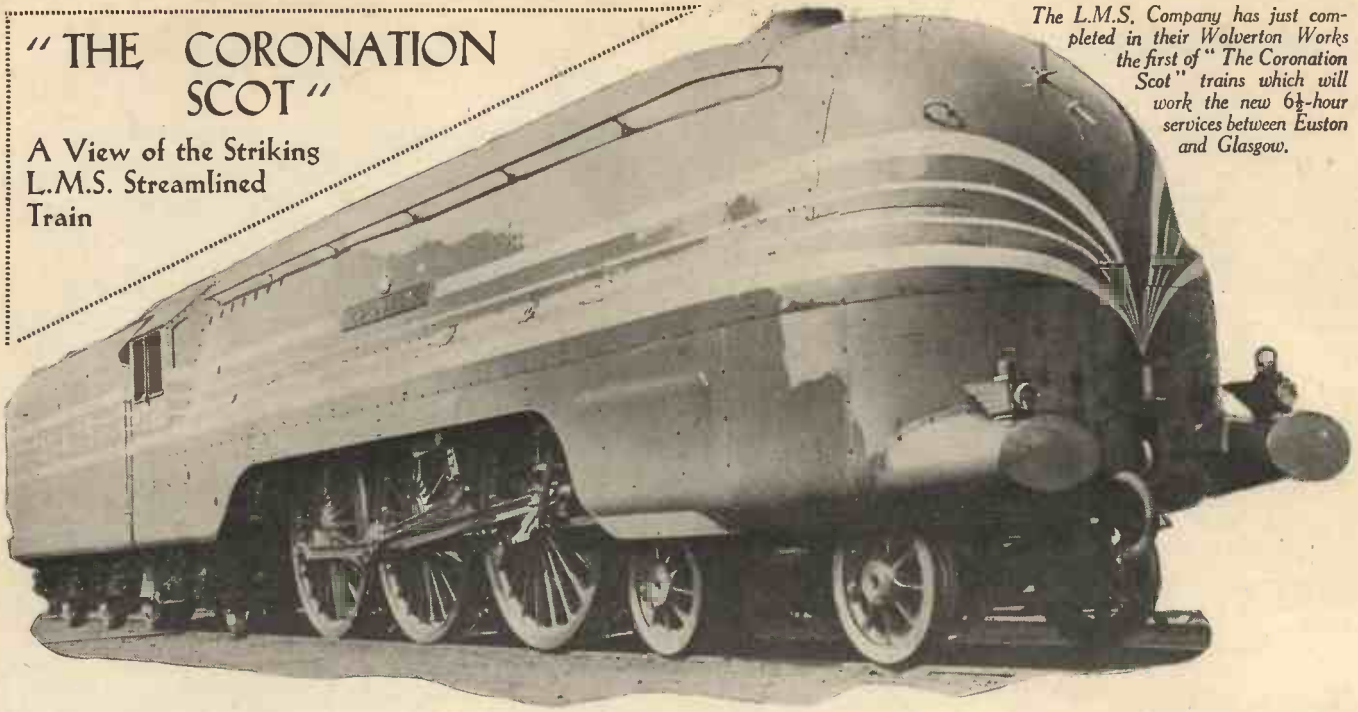
In this connection it is interesting to recall that it was due to discrepancies between the calculated and observed times of the occurrences of Jupiter's satellite phenomena, that the speed of light was first approximately measured. It had always been regarded as instantaneous; but it is now realised that we never see Jupiter where it appears to be, but where it actually was about forty minutes previously. The colossal mass of this ponderous planet is not without its effect upon any smaller bodies that may happen to wander into or across the solar system and come within its powerful attractive influence. By its terrific gravitational pull Jupiter has thus succeeded in appropriating quite a family of faint short-period comets. It is also suspected that the five almost invisible "moons" are really stray asteroids that have been thus forcibly captured and added to an already adequate retinue.

Stellar objects are rather dimmed by the present luminous nights; but the brighter stars can be readily located when the Moon is absent.

This sketch shows the appearance of Jupiter as seen through a small astronomical telescope.

"THE CORONATION SCOT"

A View of the Striking L.M.S. Streamlined Train



The L.M.S. Company has just completed in their Wolverton Works the first of "The Coronation Scot" trains which will work the new 6½-hour services between Euston and Glasgow.

THIS MONTH IN THE SCIENCE AND

A New Air Service

AN eight-seater air liner flew from Aberdeen to Stavanger, Norway, as a test flight before the inauguration of a daily air service between Newcastle and Norway.

World's Largest Telescope

IT will take only one ounce of aluminium to coat the reflecting surface of the 200 in. telescope which will be installed at Mount Palomar when the construction of the parts have been completed at Philadelphia. But in order that astronomers will be enabled to see farther into space than ever before, about 446 tons of steel will be required to make the mirror function. There will also be about 15 tons of glass.

The structure will be large enough to accommodate a two-storey house.

Astronomers have calculated that the new telescope will make it possible to see objects 1,000,000,000 light years away.

A light year is the distance travelled in a year by a wave of light at a speed of 186,000 *miles a second.*

An 835-ft. Raft

THE world's largest raft will shortly be starting on its 1,100 mile journey from Cath Lament, Washington, to San Pedro, California.

It contains thousands of logs, and is bound with 175 tons of chain. It is 835 ft. long, and 28 ft. of it is under water.

New Gliding Record

A NEW world altitude record for gliders has been set up by Herr Sternig, of Breslau, who, during a competition at Grunau, reached a height of 19,600 ft., beating the former record of 14,190 ft., set up at Rio de Janeiro by Herr Dittmar.

A £2,000,000 Liner

THE first steel plates of a new Cunard-White Star liner, to cost nearly £2,000,000, one of a group of several, was recently laid at Cammell Laird's shipyard at Birkenhead.

An All-metal Airship

THE construction of an all-metal airship is being considered by America.

The airship, which will be about half the size of the Graf Zeppelin, will be used for naval experiments. £1,200,000 will be spent on its construction.

At the North Pole

FOUR members of the Russian North Pole scientific expedition have established a camp on a drifting ice-flow, 15 miles from the Pole, and they will remain there, according to present plans, for a year to conduct investigations into Polar magnetic conditions, ice-flow movements, depths of Arctic waters and meteorology.

They will be in constant communication by wireless with Rudolf Island, about 550 miles from the North Pole. Here the remaining 38 members of the expedition, including Prof. Arthur Schmidt, the famous arctic explorer, and M. Vodopyanoff, who piloted the four scientists to their lonely base, are stationed.

A French Midas

Producing Synthetic Gold on an Industrial Basis

A FRENCH scientist claims to have discovered a way of producing synthetic gold on an industrial basis. He is M. Jollivet Castelet, who has been working on his system for 15 years.

Seven experiments were carried out with the formula by Dr. Ramond Lautie, of the Chemical Institute of Montpelier. Four experiments showed negative results and two showed traces of gold. The third experiment produced .010 gram of gold to 10 grams of the formula mixture.

Here is the formula :

Five grams of pure silver, two grams of arsenic sulphurate, one gram of pure tin, two grams of pure sulphurate of antimony. Heat it all in a quartz tube to a temperature of 1,300 degrees centigrade. Maintain this temperature for three hours, then cool gradually to 20 degrees centigrade.

Dr. Lautie is now going to carry out another series of seven experiments to find out why gold was produced only once in the former series, although the same mixture was used every time.

This is why M. Castelet makes no secret of his formula :

"I am making the process public because I have no other aim than the triumph of truth and the demonstration that transmutation can be realised by my process. All that is now necessary is the clearing up of a few technical details which will make the production of gold possible on an industrial basis."—*Evening Standard.*

WORLD OF INVENTION

"The Flying Motor-car"

FLYING and road tests have begun in America with a new type of "Autogiro," fitted with a British aero-engine, which is designed to fly through the air at 115 miles an hour, and run along a road at 25 miles an hour. When not in use the rotating wings can be folded along the top of the machine, which has a saloon body similar to that of a motor-car. The power-plant which operates the airscrew while flying can, when the machine is on the ground, be diverted by a clutch mechanism to the running wheels; whereupon the machine can be steered and handled like a motor-car.

North America's Highest Mountain

IN a series of flights from the aerodrome at Fairbanks, an air expedition has just succeeded in obtaining magnificient close-up photographs of Mount McKinley, North America's highest mountain, which towers to a height of 20,300 feet. Both still and motion pictures were secured.

In a single exposure, by the use of infra-red photography, it was found possible to show not only the white summits of Mount McKinley, but also neighbouring peaks more than 100 miles away.

The steeply-sloping western face of Mount McKinley has been called the world's highest cliff—an almost sheer drop of over three miles. When flying 500 feet above the top of the mountain, the aerial photographers encountered many violent air eddies.

The Great Volga Scheme

Changing the Geography of the U.S.S.R.

WHAT is known as the Greater Volga Scheme, which provides for the building of gigantic hydro-electric power stations on the Volga and the Kama, and the deepening of these rivers for the purpose of linking up the southern and northern seas and irrigating the dry steppes of the Volga, was described in a recent issue of *Pravda*, by Professor A. Chaplygin.

The hydro-electric power stations to be built under this scheme will have an aggregate capacity of 10 million KW and will generate 50,000 million kilowatt-hours of electricity a year. High-tension transmission lines will unite the electricity supplies of the Volga districts into a single system, which will be linked up in the west with the power system of the greater Dnieper, and in the south with the systems of the North Caucasus and the Donetz basin.

A channel, about seven metres deep, will be made along the entire Volga-Kama waterway, which will then be navigable for sea-going vessels, finding an outlet in the north to Moscow through the Uglich junction and the Moscow-Volga Canal. Through the Sheksna and Vytegra rivers (in the Mariinsk waterway system), an outlet will be opened from the Volga to the Baltic and White Seas. In the south, the Volga-Don and Manych canals will connect the Volga with the Black Sea.

The carrying out of the scheme has already begun with the building on the Upper Volga of the power stations at Rybinsk and Uglich and the Perm power station on the Kama. The aggregate capacity of these stations will be 950,000 KW and their annual output 3,000 million kilowatt-hours. The completion of the first part of the scheme will provide a deep waterway between the Volga and Moscow rivers and the Baltic and White Seas.

Giant Liners

WHEN No. 552, sister ship of *R.M.S. Queen Mary*, and the Cunard-White Star liner now under construction at Cammell Lairds' shipyard, are completed, Britain's fleet of giant liners (over 30,000 tons gross) in the North Atlantic service will have a gross tonnage of more than double that of her nearest rival in the same class.

The world's largest liners now in service in order of sizes are: *Queen Mary, Normandie, Berengaria, Bremen, Rex, Europa, Conte di Savoia, Aquitania, Ile de France, Empress of Britain, Paris, Columbus*, and *Augustus*, all of which are of over 30,000 tons gross. Four of these ships are British, with an aggregate gross tonnage of 220,870. Three are French (160,818 tons); three are German (135,967 tons); three are Italian (129,982 tons) and all are engaged in the Trans-Atlantic service. With the exception of the motorship *Augustus* they are turbine-driven, and the lubrication systems range from 10,000 to 20,000 gallons capacity. No less than 80 per cent. of this gross tonnage is lubricated with the high grade products of the Vacuum Oil Company.

Over Two Feet Thick

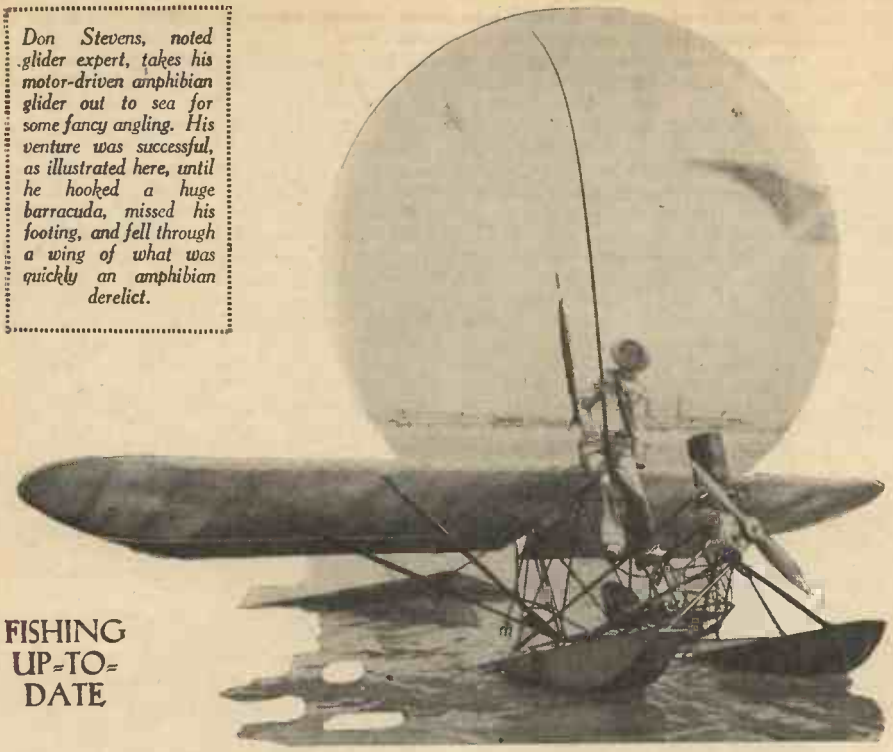
World's Largest Aero Tyre for New Plane

THE largest aeroplane tyres ever made have just been fitted to the new Armstrong Whitworth planes about to be delivered to Imperial Airways.

Two of these tyres, which are six feet six inches overall diameter and two feet three inches thick, can be used for an aeroplane weighing more than 22 tons

One of the most striking features of the Empire Air Day display at the Leuchars Aerodrome, Fife, recently, was the catapulting into the air by means of a cordite charge, of a Fairey machine. The catapult was the only one of its kind on view in Britain, and is similar to that used on battleships.

FISHING UP-TO-DATE



Don Stevens, noted glider expert, takes his motor-driven amphibian glider out to sea for some fancy angling. His venture was successful, as illustrated here, until he hooked a huge barracuda, missed his footing, and fell through a wing of what was quickly an amphibian derelict.

(50,000 lbs.) The weight of air contained at 40 pounds per sq. in. is approximately ten pounds for each tyre.

Enormous stresses were involved in the making of the tyre at Fort Dunlop. To permit proper moulding of the airbag an internal pressure of 250 pounds per sq. in. was required, giving a total pressure of some 390 tons that the mould had to withstand.

A ten-ton ladle was required for pouring the steel necessary for the mould castings.

Hot Water from Newspapers

Dancer's Plight leads to a Valuable Discovery

"ISOLDE" was appearing in a Scottish fishing centre. Her landlady at her apartments experienced great difficulty in heating a sufficient quantity of water late at night to enable "Isolde" to remove her grease paint.

In desperation one night "Isolde" decided to put some coals in a small bucket, and some water in a larger one, so that by placing one bucket inside the other she succeeded in heating the water far more quickly.

So struck was she with the success and convenience of this method that she evolved and perfected a patent water-heater capable of heating more than a gallon of water in 90 seconds with nothing more in the way of fuel than a couple of old newspapers. The amount of hot, or even boiling water which can be drawn off in this way is only determined by the amount of fuel used: sticks, shavings, straw, wood chips, waste packing or wrappers are most suitable.

"Isolde's" Scottish experience and subsequent invention look like providing a real boon to thousands of housewives, farmers, shopkeepers, motorists and indeed anyone requiring hot water quickly or in emergencies.

"Isolde's" invention has been named the "Merlin" Water Heater and is being manufactured in quantities.

Robot Radio

An Ingenious Wireless Set Produced in India

AN ingenious wireless set has been invented and is being produced by the Research Department of All-India Radio to meet the needs of villagers.

As far as is humanly possible, this set dispenses with the need for attention, having such fittings as a time-switch to bring it into action at just the right moment and to switch off when the village programme ends.

This set is the result of intensive research into the wireless needs of India's villagers by the new Research Department. Engineers were faced with a number of difficulties. Costs had to be kept down, efficient batteries had to be supplied, and the possibility of careless handling provided against.

For protection against rough usage, wet weather, animals and other dangers, the delicate mechanism has been housed in a metal box fitted with a padlock—cheap and very effective.

Every now and again sets in villages have failed, because the man in charge has forgotten to switch off—with disastrous effects on the battery. This cannot happen with these sets, now that an automatic time-switch has been incorporated. This switch will only need winding-up once a fortnight.

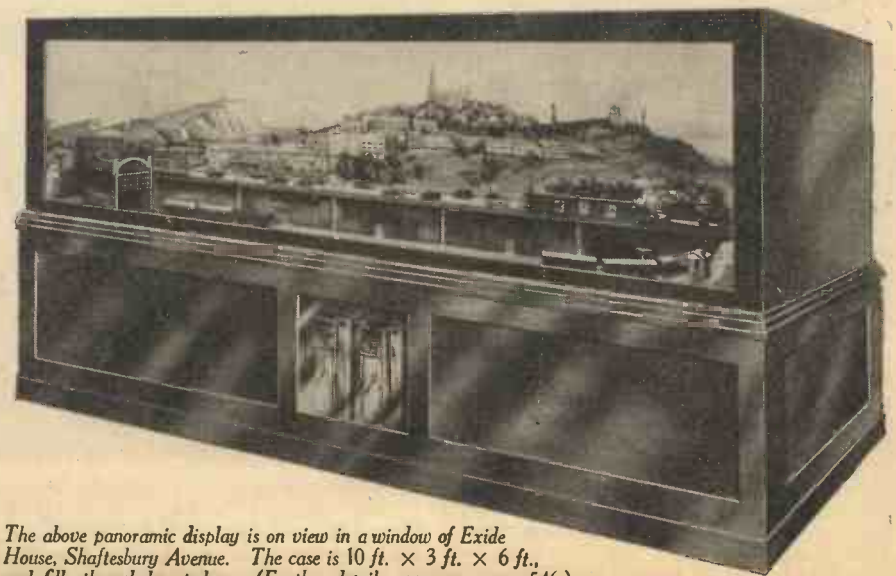
Battery troubles will not only be reduced by the automatic time-switches, but as a result of the modern design of the set, the amount of electricity used has been reduced to one-third that consumed by an ordinary receiver.

Already a number of these sets have been built by the All-India Radio Research Department for one of the Provincial Governments. It is not proposed, however, that manufacture should be confined to the Research Department. Steps have been taken to encourage private manufacturers to build these sets. As no patent is being applied for, there will be no question of royalties. This is a part of the policy of the Research Department to give manufacturers of wireless sets every assistance and guidance possible.

Fighting Forest Fires by Air

IN America and Canada plans are now being developed for improved systems whereby aeroplanes and wireless can be employed in fighting forest fires. New ground equipment is being provided, and fresh methods introduced for still further increasing the efficiency of the aeroplane as a fire-fighting machine. The Forest Service is to experiment with dropping chemicals on to small fires to hold them in check till ground crews can reach the danger zone. Bombs, too, are to be dropped from the air on small fires, the idea being that they will scatter enough earth on the flames to check them until the arrival of the fire-fighting crews.

A COLOURFUL PANORAMIC DISPLAY



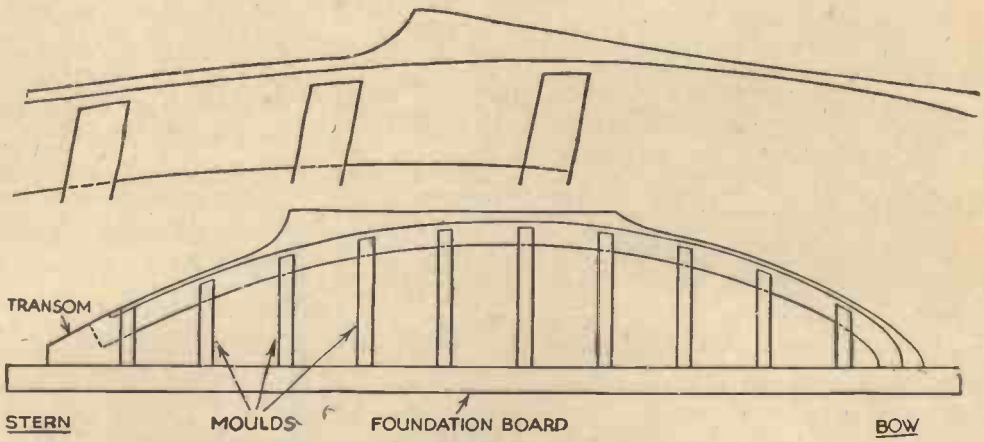
The above panoramic display is on view in a window of Exide House, Shaftesbury Avenue. The case is 10 ft. × 3 ft. × 6 ft., and fills the whole window. *(Further details appear on page 546.)*

MODEL BOAT BUILDING

By "Home Mechanic"

(*Concluded from page 528 of last month's issue.*)

WHEN sailing into the wind, i.e. with the sails fairly close-hauled, a good model yacht should keep a fairly steady course without any assistance from the rudder; but when running before the wind the mainsail will be well out over the side, which will have a tendency to turn the boat. It is therefore necessary to arrange some form of steering gear to counteract this tendency. The "Braine" steering gear, or a modification of it, is almost universal for this purpose. The principle of this is that the rudder is centralised by a length of elastic, but the main sheet (i.e. the line that holds the main sail), is fixed to the tiller so that the wind pressure on the sail pulls on the tiller, and, overcoming the tension of the elastic, moves the rudder to an extent depending upon the adjustment of the gear, which can be quickly altered to suit the conditions.



This illustration shows how the notches are cut on the mould for fitting to the keel.

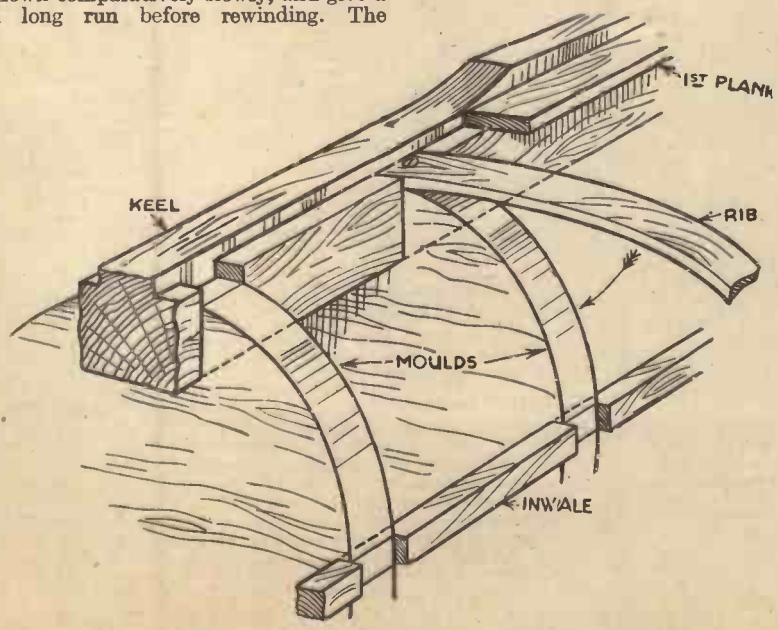
The "Spinnaker" Sail

A special sail called a "spinnaker" is frequently used on racing yachts when running before the wind. This is a large sail which fills out like a balloon, and is held out over the side opposite to the mainsail by means of a special spar called the "spinnaker boom."

Turning again to power boats, there are various means by which these may be driven. The simplest is twisted elastic after the manner of a model aeroplane. Quite good results are obtained on small models, but the winding up is usually a rather tedious proceeding unless gearing is provided A very large propeller should be used, having a coarse pitch; this will run down comparatively slowly, and give a good long run before rewinding. The thrust bearing should be well lubricated, otherwise it may absorb a lot of power.

Next in order, as a simple source of power is clockwork, and suitable clockwork motors specially made for model boats can be obtained from model stores. They are fairly cheap, are easily installed by an amateur mechanic, cost nothing to run, and give good results. Various sizes are obtainable to suit different lengths of boat.

Electric models are very clean and give little trouble in use; they are particularly suitable for working models in which appearance plays a larger part than speed. There are many different makes of motor to choose from, and there is no limit, as far as models are concerned, as to the size of boat for which they are suitable. The power developed depends very much on the battery used. An accumulator of suitable voltage and capacity will give reliable and consistent running, but dry batteries are really only suitable for small toys, and even then will not last very long. Electricity is not much used on racing boats, no doubt because of the weight of the battery necessary for a heavy power output.

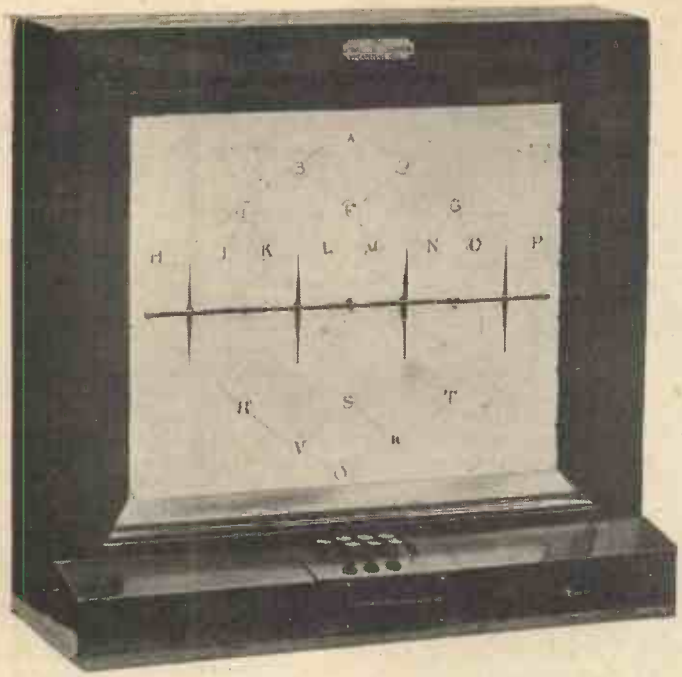


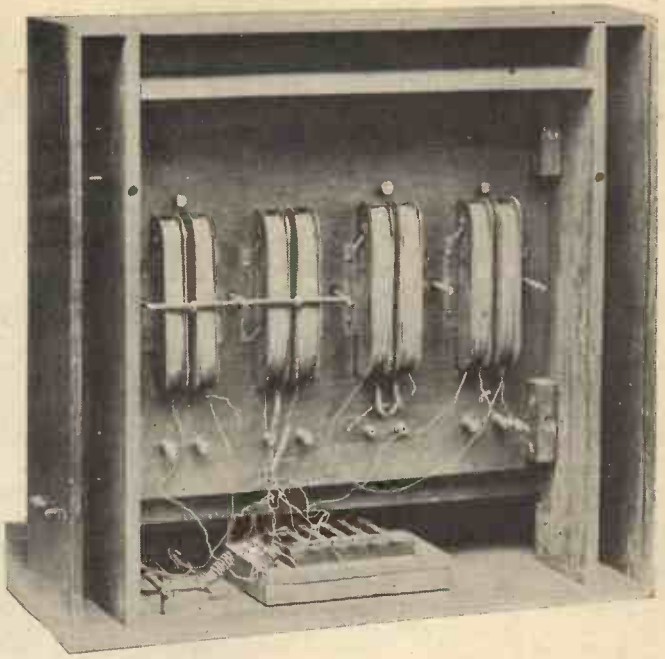
Notches for the ends of the ribs are also cut in the keel as shown.

Power Plants

Steam models are universally popular, and this type of power plant may be used for almost any size or class of model. One or two well-known firms supply a very well made $\frac{1}{2}$ in. bore by $\frac{1}{2}$ in. stroke double acting engine for a little as 5*s*., and a boiler to suit costs 8*s*. complete with casing, funnel and a lamp for methylated spirits. This plant is suitable for a boat up to about 2 ft. long. All sizes and types of steam plant, from this upwards, are in use, and some very fine samples of model engineering may be met with. Very high speeds may be obtained by using light water-tube boilers, or flash boilers and blow-lamps. The latter boiler is particularly favoured for racing craft on account of its light weight for a given duty.

For racing craft of the hydroplane type petrol engines are becoming more and more popular. These may be either of the valveless two-stroke type or they may work on the four-stroke principle, and may be air-cooled or water-cooled. They have a high power to weight ratio, and are therefore just the thing for racing. Such craft have little to recommend them apart from their speed, which is really astonishing, some models of a metre in length having exceeded a speed of 40 m.p.h. Such models are most fascinating to watch; they skim over the surface of the water, instead of ploughing their way through it.





(Left) The original Cooke-Wheatstone telegraph instrument now preserved in the Post Office Museum (Right) A rear view of the instrument, showing the deflecting coils.

THE CENTENARY OF THE TELEGRAPH

EARLY in the evening of 25th July, 1837, a keen-faced individual sat in front of a curious piece of electrical apparatus in a little room in a railway office in Euston Square. Wheatstone was his name, he being no less than the Professor of Natural Philosophy at King's College, London, whose renown as an electrical pioneer was soon to be world-wide. In the room also were a number of distinguished engineers, among them being the famous Robert Stephenson.

The occasion was that of the trial of a newly-devised electrical telegraph, the joint production of Professor Wheatstone and a certain William Fothergill Cooke, a retired surgeon of the Indian army. Cooke was stationed at the other end of the telegraph line in the railway office at Camden Town, and slowly, almost painfully, Wheatstone transmitted to Cooke the first commercial telegraph message to be dispatched in this country.

"Never," said Wheatstone, recounting the incident afterwards, "did I feel such a tumultous sensation as when, in the still room, I heard the needles click; and as I spelled the words I felt all the magnitude of the invention pronounced to be practical without cavil or dispute."

Semaphore Systems

Systems of telegraphy had, of course, been known and used for many years before the above-related occasion. Such systems, however, were mostly of a semaphore nature, information being conveyed from place to place by means of the waving of flags and by other similar methods. Such modes of conveying information were naturally severely restricted in that they could only be operated at visual ranges. True it is that, as early as the middle of the eighteenth century, it had been suggested that a form of telegraph might possibly be devised by making use of the "electrical influence," but little or nothing was done as regards an electrical telegraph until the early years of the nineteenth century.

The very first electrical telegraph to be constructed in our country and, perhaps,

This month, Commercial Telegraphy reaches its Hundredth Anniversary. Read in this Article the Interesting Story of the First Beginnings of Telegraphy in this Country.

indeed, in the world, was one which was erected at Hammersmith, near London, in 1816, by one Sir Francis Ronalds, an amateur electrical experimenter. Ronalds' telegraphic apparatus, despite the fact that it was hardly practicable as a commercial instrument, was an interesting one and, fortunately, an early drawing of the apparatus (reproduced on the next page) has been preserved for us.

Ronalds' Telegraphic Apparatus

Ronalds' telegraph took the form of two large wooden frames which the inventor erected in his garden. The frames were fixed at a distance of twenty yards apart and approximately eight miles of insulated wire were stretched between them. One end of the wire system was charged electrically with the aid of a Leyden jar, the charge being indicated at the other end of the eight-mile line by means of a sensitive electrometer. Ronalds suggested that his telegraph might be of use to the Government; but, to his suggestions, the Government of his day turned a deaf ear, merely uttering, with characteristic conservatism, the dictum that "Telegraphs of any kind are wholly unnecessary, and no other than the one now in Admiralty use will be adopted!"

After Ronalds' abortive attempt at a telegraph, nothing further was heard on the matter of telegraph construction until the time of Cooke and Wheatstone, some twenty years later. William Fothergill Cooke, the retired army surgeon from India, in 1836 happened to be present at a demonstration of a telegraph which was given at the University of Heidelburg, Germany, by a certain Professor Möncke. Cooke became fascinated by the crude results which Möncke obtained with his instruments and, returning to London, he gave up nearly the whole of his time to making practical a system of electrical telegraphy which might fulfil a commercial purpose.

A Working Partnership

In the early part of 1837, Cooke formed the acquaintance of Professor Wheatstone, who was also interested in the possibilities of electrical telegraphy, and, together they formed a working partnership. The combination of the two individuals was a happy one, for, although Wheatstone had the requisite scientific knowledge, he was no practical worker, whilst Cooke, although possessed of considerable mechanical ability, lacked a thorough grounding in scientific principles. Together, therefore, Cooke and Wheatstone worked out the theoretical and practical details of their telegraph. The system was patented in the June of 1837—

the month of Queen Victoria's accession to the throne—and, as we have read at the beginning of this article, the first working trial of the Cooke-Wheatstone telegraph was made on the old London and Birmingham Railway between the Euston terminus and Camden Town station.

The trial was an unqualified success and it demonstrated to those present the essential practicability of the telegraph. Judging from present-day standards, the telegraph instrument used by Wheatstone and Cooke was a very curious one and, incidentally, this pioneer telegraph instrument is still preserved in the Post Office Museum. On the large dial of the instrument were inscribed the letters of the alphabet, each letter being indicated by the movements of a pair of magnetic needles. In the earliest trials the transmitting and receiving instruments were connected together by a pair of wires, but it was soon found that the "return" wire was unnecessary, since the earth itself could be made to function as the telegraph "return."

The Cooke-Wheatstone Telegraph

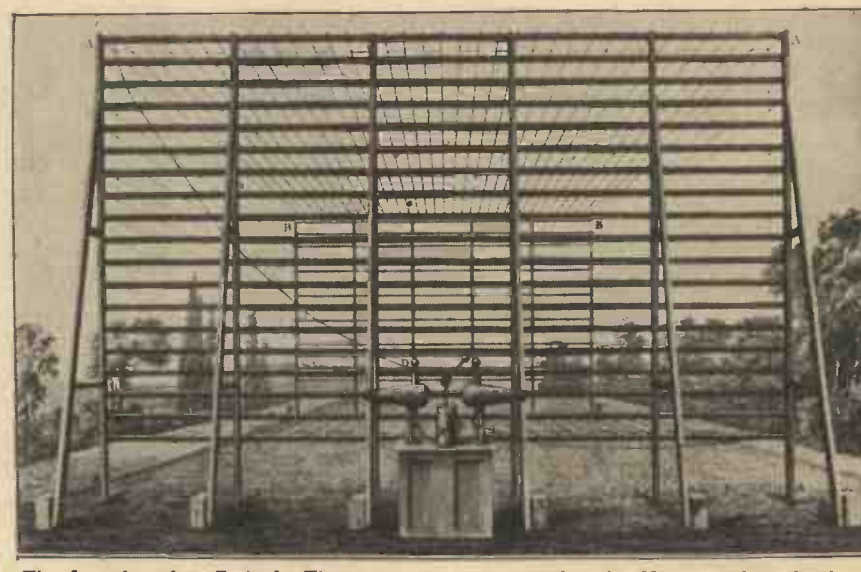
After the preliminary trials with the Cooke-Wheatstone telegraph on 25th July, 1837, a line was put into operation on the Great Western Railway between Paddington and Slough. Apart from this, however, it was some time before railway directors realised the great convenience and, indeed, the essential nature of an efficiently-working telegraph.

From the point of view of the public, also, the cult of the telegraph spread very slowly. It was not until some years afterwards that the convenience of the telegraph was fully understood by the nation at large. Just as in the early days of wireless communication, public attention was sensationally directed to the possibilities of radio telegraphy in consequence of the arrest of Dr. Crippen, the murderer, through the instrumentality of wireless messages, so, too, the land telegraph was first brought prominently into the public's notice by similar means.

Catching a Murderer

A man named Tadwell had foully murdered a woman at Slough. After the murder, he was seen to board a train for Paddington. A description of the man was telegraphed to the latter station and upon his arrival there he was promptly arrested. The apprehension of Tadwell by means of the telegraph created quite a sensation in the country and years afterwards, individuals who remembered the event, were at times wont to point to the telegraph wires running along the railway line between Paddington and Slough and to exclaim reminiscently, "Those are the cords which hanged Tadwell!"

The needles on the Cooke-Wheatstone telegraph instruments were deflected by means of current passing through coils of wire fixed at the back of the dial. It was not until some time afterwards that Professor Morse, of America, introduced his telegraph "sounder" and thus rendered the Cooke-Wheatstone needle instrument obsolete.



The first telegraph in England. The curious instrument erected in his Hammersmith garden by Sir Francis Ronalds in 1816.

NEW INVENTIONS

The following information is specially supplied to "Practical Mechanics," by Messrs. Hughes & Young (Est. 1829), Patent Agents, of 9 Warwick Court, High Holborn, London, W.C.1, who will be pleased to send readers, mentioning this paper, free of charge, a copy of their handbook, "How to Patent an Invention."

Button Causes Friction

THERE are many methods of getting a light. These range from rubbing two pieces of wood together—the practice of the shipwrecked mariner—to the latest thing in alleged lighters. Some folks strike a match on the sole of the shoe. To accommodate such persons, an American has designed a button with an embossed criss-cross pattern on the surface. It is on the principle of those tiny nutmeg graters one finds on the side of a window in a railway carriage.

This novel button, affixed to a coat, might enable a stranger wanting a light to strike an acquaintance with the wearer. But it would undoubtedly cause a little friction.

Tennis Ball Bandolier

Another American has just patented in the United States a tennis-ball holder made of wire, which can be attached to the garment of the player. However, while a player may not object to carry one ball, *à la* the spare wheel in a car, should the idea be extended, he or she would, probably, not care to be equipped with a bandolier of balls.

In Case of Crash

The parachute is the lifebuoy of the aeroplane. In view of the possibilities of an untoward happening in the air, the aviator naturally welcomes any effective means of making terms with the law of gravitation. There has appeared on the horizon an improved parachute. For this it is claimed that it permits the user to control at will the rate of descent by adjusting the pressure of air confined in the parachute. An escape port can be increased or reduced by pulling cords. It is interesting to note that the inventor hails from the Land of the Rising Sun whence the record-smashing flight was recently made to Croydon.

Bogus Umbrella

It is not a far cry from the parachute to the umbrella. The modern Beau Nash carries a neatly-folded umbrella in preference to a walking-stick. The latter seems to be almost obsolete with the exception of the ash favoured by the hiker. An inventor has thought that this vogue of carrying an umbrella sufficiently obsesses the smart youths of our day to make it worth while to devise a bogus "gamp." He has aimed at producing a walking stick which closely resembles an umbrella. The stick is impregnated with colouring matter to represent the fabric, and the folds are simulated. Even the elastic band and button are imitated. Whether the inventor has overrated the craze of the umbrella carrier remains to be proved. His view is that the device will relieve the bright young things of our time of the necessity of carrying an expensive umbrella which, if not lost, is subject to wear and tear. In the same way, a lady sometimes dons paste diamonds, while her genuine brilliants are secure in the safe deposit. This sham "brolly" will, at least, always retain the appearance of being neatly folded, whereas in the case of the real "gingham," when once unwrapped, it is not easy to make it return to the fold.

Sting-Proof Glove

The busy bee not only improves the shining hour but occasionally stings the keeper. The apiarist—as the bee-keeper is styled—is now provided with a newly devised sting-proof glove. This has a mesh so fine that even a bee addicted to slimming cannot pass through it. And it is so spaced that a sting inserted through the network is unable to reach the skin of the wearer of the glove.

Wrist Sundial

The shining hour, to which I allude above, is the psychological moment—if I may be allowed that expression in relation to a period of 60 minutes—for testing a pocket sundial. I have in the past dilated upon one of these portable timepieces. But this handy solar horologe is somewhat different from its predecessors. In shape, it is like the tyre of a wheel in Lilliput. In other words, it is a small flat circular band with means for hanging it up. There is a pinhole for the projection of sunlight on to the opposite inner face of the band, on which a moveable graduated strip is situated. The form of this device suggests that it is first cousin to a bracelet. I am tempted to term it a wrist sundial. DYNAMO.

TRICK HATS AN

By No

(The Well-known Conjurer

Further Articles on the Secrets of Conjuring v

Fig. 1.—A hat with a trap. Note the small metal lug which causes the trap door to open automatically as the hat is slid on to a table.

IF you were to ask the average person what object they associated in their minds with conjuring, I suppose he would say "a top hat." Certainly this article has proved of very general use to conjurers for a good many years. They have taken rabbits and flags from it, pushed things through it, used it to cause articles to change places and transform themselves into different things. They have even destroyed the top hat in order to make a trick out of magically mending it again.

But top hats are out of fashion. And do conjurers' worry? Not they. Magicians are so used to substituting one thing for another that substituting the modern opera hat for the old time topper was a very easy one. And the substitution had advantages. Opera hats can be closed flat which makes them very handy to carry about. Also opera hats are black inside which makes them very amenable to all sorts of tricky stunts.

Borrowing Apparatus

You might be inclined to think that a conjurer could not make use of a specially prepared hat because the audience would expect him to borrow a hat for his trick. Well this idea of borrowing things to conjure with is also going out of fashion. Nowadays a conjurer does not waste time borrowing his apparatus. In fact he usually borrows a thing only if he is going to make the apparent destruction of it and its restoration his magical effect. Then the borrowing adds to the effect. It is much funnier (to the audience) for a conjurer to smash someone else's watch than to smash his own.

This brings me to the first trick hat. As you will see on referring to Fig. 1, this hat has a trap door in the crown. The trap opens inwards. It is a very simple thing to make once you have the hat, and second-hand opera hats in very good condition can be picked up cheaply in most of the street markets.

With a sharp knife or razor blade a square or oblong piece is cut from the crown. You will find as you cut, that there are two separate pieces of material forming the crown and that there is a space of a quarter of an inch between them. The pieces cut out are carefully preserved and four pieces of quarter-inch wood are glued and tacked round the opening, between the two pieces of material. Next a piece of wood is cut of a size to fit snugly in the opening. This slab of wood should be the same thickness as the thickness of the top of the hat, or a frame can be made from four pieces of stripwood. The two pieces of fabric cut from the hat are then glued one on each side of the slab or framework.

The Trap-door

The edges of trap-door are painted dead black and the door is hinged to the wooden edging of the hole with tiny hinges, also painted black. If the work is neatly done the inside of the hat may be shown with impunity without revealing the presence of the trap but it should not be held up to the light or the cracks between the trap-door and the hole will be evident. In using the hat care is taken not to expose the outside of the top.

Looking again at Fig. 1 you will notice a little metal lug standing out at an angle from the trap-door on the hinge side. This acts as an automatic opener for the trap. If the hat is placed crown down on the edge of a table and slid firmly on to the table, the lug catches the edge of the table and opens the trap. As the trap-door cannot open much beyond the vertical owing to the sides of the hat being in the way, it will close again as soon as the hat is lifted.

Figs. 2 and 3 show these movements while Fig. 4 explains how the trap is used in conjunction with a bag fastened to the rear edge of the table. The article to be vanished is placed in the hat as it stands on the table. Actually it rests on the table top within the opening of the trap. The hat is slid back off the table, the article drops into the bag and the trap automatically closes by its own weight. The hat may then be shown empty or simply pressed flat to prove that the object has disappeared.

An Improvement

An improvement consists of wrapping the article to be vanished in a handkerchief. A duplicate handkerchief is already in the hat, having been concealed under the folded part of the hat when in a closed condition. The hat is sprung open, placed on the table and the vanish accomplished as described. But at finish the handkerchief, really the duplicate, in which the object was seemingly wrapped, is found in the hat so that apparently only the object vanished, leaving its wrapping behind.

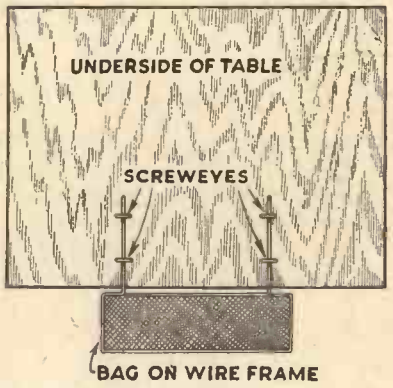


Fig. 5.—The underside of the table showing fixing of the servante.

The bag behind the table, known as a servante and of considerable use in conjuring, is simply a wire frame something like a bath tidy but with a cloth bag or a knitted one in place of the wire basket. It may be permanently fixed to the table but a better plan is to have four small screw eyes driven

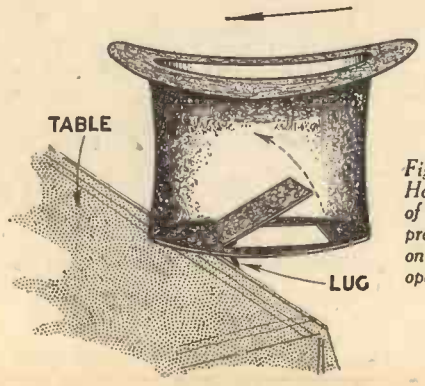


Fig. 2.—(Left) How the edge of the table presses the lug on the trap and opens the door.

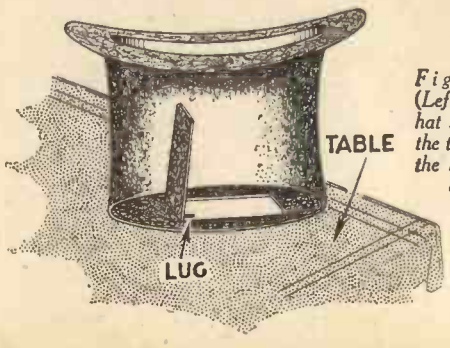
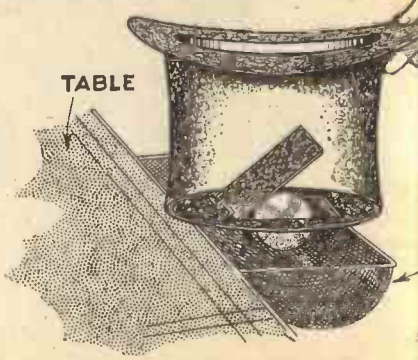


Fig. 3.—(Left) The hat slid on to the table, with the trap fully open.



D HAT TRICKS

rman Hunter
of "Maskelyne's Mysteries" Fame)

will appear Regularly and Exclusively in this Journal

into the underside of the table and insert the wire arms of the bag frame into them, as shown in Fig. 5. Of course a cloth must be used on the table to mask the presence of the bag.

Concealing a Handkerchief

I mentioned just now concealing a handkerchief under the folded part of a closed opera hat. This little dodge can be amplified to make a quite astonishing hat production trick. When an opera hat is closed the springs fold inwards, taking the lining with them and making four triangular flaps inside the hat. Quite a number of silk flags, ribbons and other compressible articles can be tucked out of sight beneath these flaps, particularly if the black part of a flag such as the Belgian, is arranged to

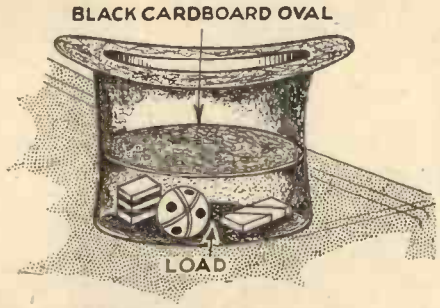


Fig. 6.—A block oval of cardboard wedged into the hat conceals the articles underneath it.

cover the small space in the centre of the four flaps.

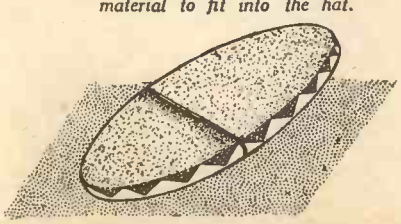
A hat so prepared can be brought on closed and shown freely before being sprung open. If it is placed aside and a little later the production is made from it the audience will have assumed that it was empty to begin with, from the fact that it was closed.

The idea may be still further developed by packing the hat with a large load of soft or folding articles. This will cause the four flaps to rise up at an angle and it will no longer be possible to show the hat on all sides. If, however, the hat is brought on crown to audience and held in this position while it is casually opened and placed on a table, the audience, seeing that the hat is closed, will accept the apparent fact that it is empty.

Yet another development is shown in Fig. 6. A piece of blackened cardboard is cut to the shape of an oval and pressed into the open hat on top of whatever articles are to be produced. Viewed from a little distance, and in artificial light, the hat appears to be quite empty. To produce the articles it is necessary only to pull up the oval. For the sake of finish it is a good idea to decorate the reverse side of the oval to represent some object such as a photo in a frame and produce it along with the other articles. Or it may be fastened to the centre of a big flag which, when produced is held up with the oval cardboard fake hanging on the back out of sight.

Fig. 4.— (Left) The hat drawn off the back of the table. The article placed in the hat falls through into the servante.

Fig. 7.—(Below) An oval metal frame with overlapping pieces of black elastic material to fit into the hat.



A Bowler

The same idea applied to a bowler hat is even more effective since the curving sides of the bowler present an effect of intense blackness of which the dead black disc gives a perfect imitation. Used in this way the oval is usually a metal framework consisting of a strip of soft metal bolted or rivetted into an oval shape to fit the hat. The metal is drilled at intervals and two pieces of wide black elastic material are sewn across, overlapping an inch or two in the centre. Such a device, illustrated in Fig. 7, permits of easy extraction of the secret contents of the hat by simply pulling aside one of the pieces of elastic and taking the things out through the opening formed in the centre. When released the elastic springs back, covering the opening so that the hat may be shown empty at any time. In fact the same apparatus may be used to cause articles to vanish, they being simply thrust through between the pieces of elastic to remain hidden in the depths of the hat.

Another Fake

To return to our opera hat, Fig. 8 shows in operation a fake somewhat similar to the oval cardboard already described, but having a flap hinged to its centre. Reference to Fig. 9 will show the construction of this, while Fig. 10 shows a section of a hat fitted with it. The flap is oval shaped at its free end and may be swung to either side of the hat at will. In either position it is held in position by the fingers or thumb of the hand holding the hat. By its aid articles may be changed to other articles, vanished or produced. It is, however, chiefly used for making changes, one article or group of articles being placed in one part of the hat and hidden by swinging the partition over to that side. The hat is then shown empty with a rather sweeping movement so that the audience do not have time to look very long into the hat, after which the articles to be changed are dropped into the hat, the partition swung over to cover them and the previously concealed objects either taken out or allowed to drop out. One very effective change is that of a number of those coloured papier mâché balls used at carnivals, to a coloured scarf. The scarf is already hidden by the flap as explained. The balls, contained in a shallow basket, are shown and poured with a certain amount of ostentation, into the hat. The hat is passed from one hand to the other which gives excellent opportunities for moving the partition across. The hat is then turned upside down and instead of the balls, out flutters the coloured scarf. I use this change frequently in my own performances and the appearance of the scarf always produces applause.

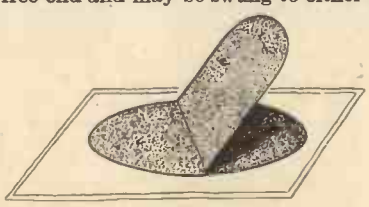


Fig. 9.—An oval of black cardboard with hinged flap to fit in opera hat.

Fig. 8.—How the hinged partition in an opera hat is swung over to change one article or group of articles to another.

Changing Articles

While on the subject of changes it will be of interest to note that the actual act of secretly changing one article or set of articles for another can be made to give the effect of a piece of magic not in the least like a change. For example half-a-dozen bangles and a length of cord are dropped separately into the hat. The cord is im-

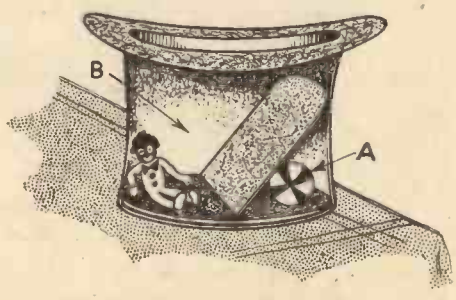


Fig. 10.—The fake shown in Fig. 9 in the hat ready to change article B to article A.

Fig. 11.—The crown cut from an old bowler hat used as an inner lining for another hat, to conceal a load of handkerchiefs.

mediately withdrawn and the bangles are seen to be firmly knotted at intervals along it. To the uninitiated this feat seems almost a miracle. Actually it is a simple exchange, the cord and bangles produced at the finish being a duplicate set, already knotted together and concealed under the partition of the hat. This too, is an effect which I performed at Maskelyne's twice a day for a ten week season and it was one of the best received items in my programme.

Finally we return to our bowler hat for an idea which is to some extent an adaptation of the oval black disc. Fig. 11 gives a general idea of the apparatus. The bowler hat is an ordinary one, preferably of large size. The crown is neatly cut from another hat and trimmed down so as to be rather lower than the crown of the whole hat. The label is removed from this loose crown and a hole is cut in the crown as shown. The label may be sewn back to act as a flap covering the hole or it may be stuck to a piece of card board furnished with a hook at the back so as to make a temporary lid for the hole.

Producing Silk Handkerchiefs

The hat is used for producing silk handkerchiefs. As many as forty of these, if they are small and of fine silk, may be used. They are folded one into the next as shown in Fig. 12 so that when the top one is drawn off it pulls up part of the next one. The reason for this arrangement will presently be clear. The batch of handkerchiefs is placed inside the hat, the leather band of the hat is turned up and the false crown is pressed down into the hat until its edge comes just below the edge of the whole hat. The leather band is then turned down again and the hat, although well loaded with handkerchiefs appears to be empty. Indeed the presence of the inner crown is so completely concealed that the hat may be held a few inches from a spectator's eyes and even given to someone to hold, without their becoming aware that it is specially prepared.

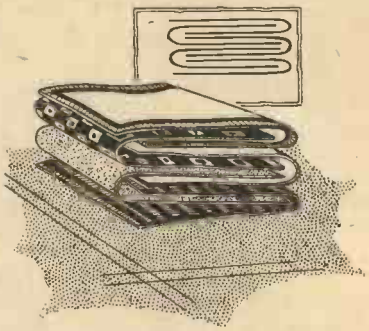


Fig. 12.—How the handkerchiefs are folded for production.

To produce the silks, the flap or sliding label is pushed aside and the first handkerchief pulled out as shown in Fig. 13. The hat is, of course, held with its mouth upwards and slightly away from the audience. Each handkerchief as it emerges from the space between the crowns draws out part of the next one through the hole, thanks to the interleaving arrangement already referred to.

Substituting a Hat

An additional pretext sometimes adopted by conjurers who are going to use a prepared hat, is to borrow a hat and perform with it some trick for which an ordinary hat is needed, then the conjurer or his assistant goes behind a screen to get a brush to brush the hat before returning it and brings back, not the borrowed hat, but the prepared substitute, with which further tricks are then performed. A substitution having thus been effected, the trick of destroying and restoring a borrowed hat becomes understandable. The hat brushing business having served to change the borrowed hat for a substitute, this may then be knocked about and ill-treated as much as the conjurer likes, after which the pieces are magically disposed of by being placed into some piece of apparatus such as one of the boxes described in a previous article of this series. Meantime the assistant behind the screen has put the borrowed hat into yet another box or piece of apparatus ready for it to be produced after sufficient hilarity has been caused at the expense of its owner, who is quite certain that the trick is going to cost him a new hat.

Fig. 13.—How the handkerchiefs are produced from the space between the double crowns of the bowler hat.

SCIENCE OF SUCCESS

NEARLY everyone has heard of the Pelman Course which, during its 40 years, has been taught to more than six hundred thousand students. Covering the whole field of mind, memory and personality training, it has been successful in developing latent powers in thousands of students, who look to the system as marking a new and more successful era in their lives.

The Pelman Institute, which has branches in all parts of the world, is a mighty organisation that has been built up on an idea. That idea is that the key science is the science that deals with the mental make-up of the man, and so the course covers such widespread interests as "Remedy for Mind Wandering"; "Driving Out the Frustration Complex," "Developing the Will Power"; "Organising the Mental Life"; and the "Money Brain."

The work of every student who takes the Pelman course is supervised by an expert psychologist, who returns his work-sheets duly corrected, and is always available to give advice and assistance in any difficulty.

The Pelman Institute will be pleased to send entirely free and without obligation to interested readers of PRACTICAL MECHANICS a brochure entitled *The Science of Success*, giving a fascinating account of the Pelman course and how it will benefit you.

UNMIXED BATHING

THE tide of the swimming bath continues to rise in popular favour. A patentee proposes to divide the single water area of the pool into three sections—one for each group of bathers. This arrangement is on the principle of the road in which there is a track for each kind of traffic. One section of the bath is allotted to learners, another to swimmers generally, and a third to divers. It will certainly reduce the risk of collisions which is always present in the case of mixed bathing. I use that term not in relation to the sorting of the sexes, but with reference to water nymphs and mermen of varying degrees of proficiency in the art of keeping the head above water.

Surrounding this threefold pool are two paths at different levels. These paths are separated, but there is communication through a cleansing room. The latter enables the bather to make in the pool an appearance without spot, if not without wrinkle.

DYNAMO.

The Latest in Railway Modelling

By E. Beal

A Model Wagon-Repairs Depot

A rear view of the model.

ADJACENT to almost every freight depot of considerable size will be found a small or large workshop owned by the famous firm of Wagon Repairs, Limited. Sometimes this depot is merely a black wooden shed with an iron roof, sometimes it is larger and more permanent in character. It is, of course, used for the repairing of the various wagons on the roads, the contract and remuneration for the labour and material being arranged with the different companies. The depot located at the Laurenceton yards of the West Midland Company is shown in the two photographs and the drawings. It makes an altogether excellent adjunct to the layout, and I think the type I have modelled is of an interesting kind, being a plain red-brick two-storey structure, equipped with an overhead hoist gantry on both sides, as well as sliding doors and glazed windows.

It is not a large model, and will be found to fit into a small vacant site on most layouts, alongside a siding, of course. The railway approach is on one side and the road approach on the other. On the railway side the gantry is more robust in design, with supporting truss.

Materials Used

The workshops I made from cardboard about $\frac{1}{16}$ in. thick, cutting out the sides separately, complete with window apertures and doorways. Next, on the insides of the back and front I stuck a piece of glass of a size large enough to cover all the four apertures involved. It is a good plan, however, before sticking on this glass, to cover each side with brick-paper, cutting the paper after it is stuck on, and while the glue is moist, down the middle of each aperture and along the top and bottom window ledges. This enables the paper to be turned inside the apertures and gives a good brickwork edging to the windows. In setting on the paper leave an overlap of about $\frac{1}{4}$ in. at each end of the front and back, this serving later to join up the four corners of the building. When the four walls are dry and the glass stuck tightly in place, continue with the good work, but not until. For the wooden door runners either wood strip or passe-partout card strip may be used, and these consist of a $\frac{1}{8}$-in. length behind a $\frac{1}{4}$-in. length, the latter forming a rebate to retain the door. The doors are of cardboard, painted and lined in ink, with a small wire handrail opener made from a pin, stuck in with glue. All these features may be added before the walls are assembled.

The Walls

The walls are then joined in perfect symmetry, it being ascertained that the building stands quite straight. Then the whole is strengthened by the addition of the floor of the upper storey. There is no floor on the lower one. The roof is then added, and also consists of cardboard cut perfectly straight at the edges with a razor. It is simply glued in place like the floor. The building will now be quite rigid.

The gantry work I made from my faithful friend and standby, 00-gauge brass rail, which I use for all manner of jobs, including crane jibs, bridge girders, roof spouting, and so forth. The top oblong frame was first shaped and the ends soldered. As a matter of fact, I set it in the holes before the roof was fixed, but this can be left if the soldered joint is just inside the walls, as the gantry can then be slid forward and pushed in after the soldering. The end support and the chain-loop were then added. Ship's chain serves for the hoist, with a wire hook at the end, the loose end being coiled up inside the building. The window sashes are worked up from ivory-white gummed paper. For the plinth around the base strip wood or card serves well. In the model, the type of brick-paper used is that known as new red brickwork, and it was toned down with a coat of burnt sienna diluted with ink. Ordinary slate roof paper is on the roof. All the representative woodwork is painted red oxide, Reeve's artists' tube red being employed, with a little turps added. There is no guttering on the roof. The lettered sign can be had from a firm in Liverpool, along with any other sort of station name or sign. But it can be made easily from paper letters supplied by the same firm, these actual ones being yellow. The advertisements I obtained from several sources.

The Hoist

The hoist, of course, is mainly for lifting wagon ends to detach the wheels, as well as for lifting stores to the upper floor. A characteristic touch may be added by setting down a wheelless wagon on baulks near by, with perhaps one plank of its side newly painted. The gantry should be painted black, flat drying. The hand-cart with red wheels and body and yellow sides is a fifteen minutes' job.

A front view of "Wagon Repairs Ltd."

A FOUR-WHEELED MIDGET CAR

By F. J. CAMM

READERS will notice from the plan and side view given on the facing page that the Midget Four-Wheeler has a longer wheelbase and narrower track than the £20 Three-Wheeler. This is necessary since there is no differential in the back wheel for reasons previously explained, and the longer wheelbase makes for greater comfort since the seating is also arranged just forward of the centre of gravity of the car.

The cross-member between extremities of the rear spring made from channel section iron is important, for its purpose is to prevent undue twisting of the bearing when one rear wheel lifts in relation to the other. Additionally, it locates the races on the axle shaft, and prevents spreading of the springs. It should be most carefully fitted and its length nicely adjusted. A channel section cross member from a dismantled car might be used for this member; such are obtained cheaply from car breakers.

A detailed sketch below shows the rear brake and hub design. It is based on the use of a Morris Minor brake assembly such as can be picked up cheaply. If the back plate, brake shoes and drums of this or a similar light car, such as an Austin 7, can be obtained, considerable construction work will be avoided, otherwise the parts will have to be machined. Sufficient detail is given in the drawings for this purpose.

It is important to use high tensile bolts for holding down the axle, and the rear axle race housing should, for preference, be of phosphor bronze castings.

A detachable pull-up starting handle similar to that used on motor cycles is employed. Here again these may be obtained from most dealers in second-hand motor cycles. It is not possible to give scale drawings of all of the parts since each builder will be more or less tied to the parts which he obtains ready-made. If, however, he follows the lines of the three-wheeler so far as the general construction and form is concerned he cannot go wrong.

The rear of the seat is hinged to allow ready access to the engine, and it has been thought desirable to add louvres to assist cooling.

The rear driving sprocket is bolted to a flange welded on the rear axle.

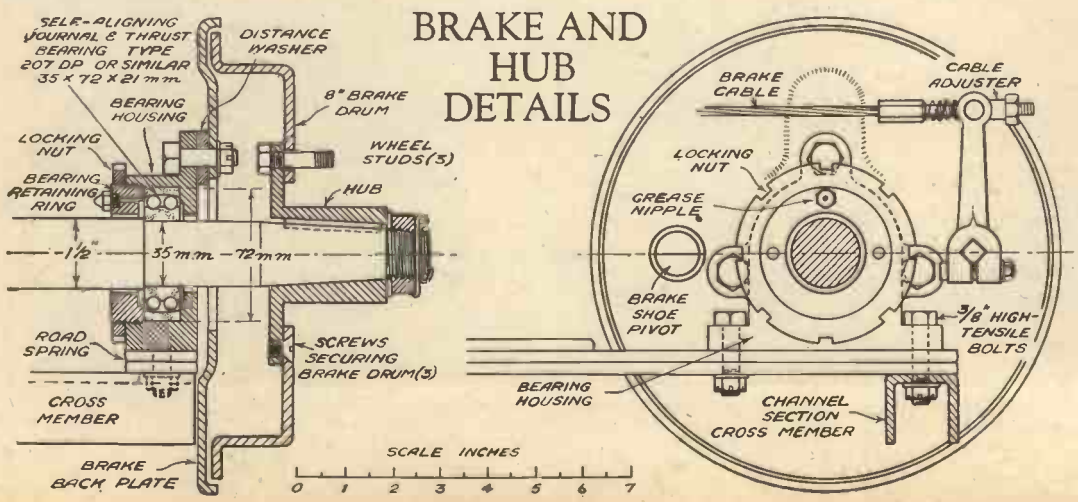
One or two readers have written asking whether the rear axle assembly of 12 or 15 h.p. cars can be used. These are quite out of the question and are far too heavy for the purpose. Another question which has arisen concerns the insurance. No difficulty will be experienced concerning this, and I shall be glad to put readers in touch with an insurance company who will issue a policy.

I repeat for the convenience of readers a list of the firms supplying the parts.

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; plywood 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.

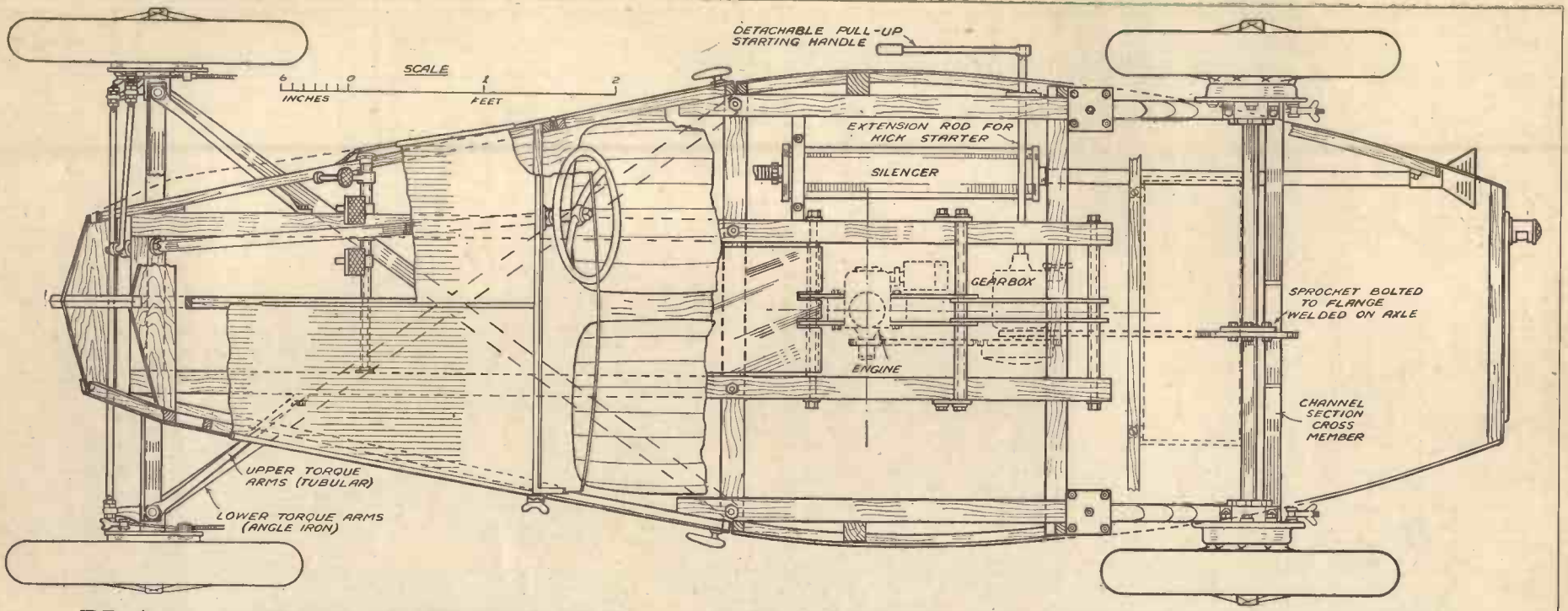
BRAKE AND HUB DETAILS



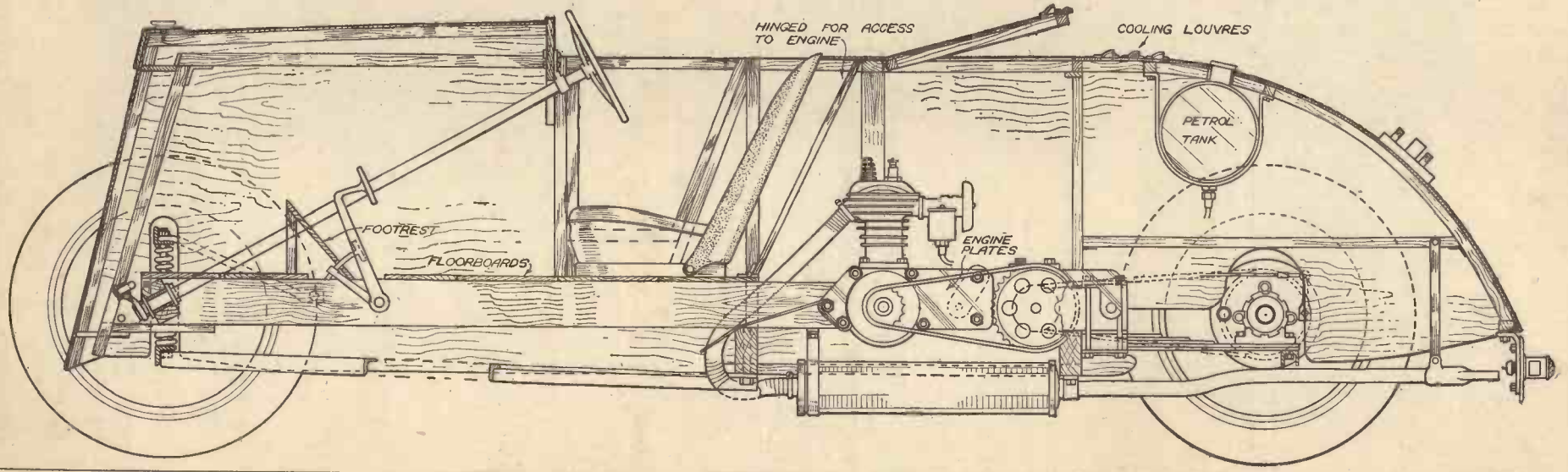
Dimensions

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. 10½ in.
Wheels 27 in. × 4 in. or 26 in. × 3·50 in. on 19 in. rims.



PLAN AND SIDE ELEVATION OF THE FOUR-WHEELED MIDGET CAR



MODEL AERO TOPICS

BY F. J. C.

This photograph shows the "Petrel." A £50 Prize is to be awarded in accordance with the rules printed below.

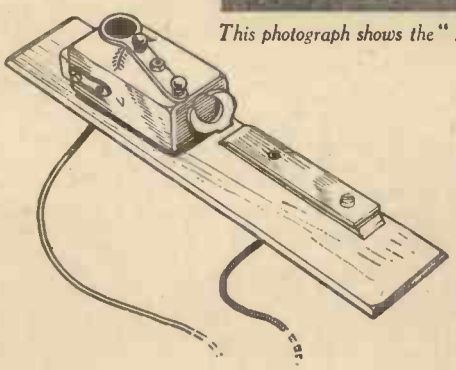
The "Petrel" Competition

WE have now a large number of entries for this competition, which it is hoped will be held at Fairy's Great West Aerodrome about mid August. By this time I know that many models have been completed and are under test. Many readers have reported immediate success, so the competition is likely to be successful in every way. The first prize of £50, plus the large number of other prizes we shall offer, is an inducement for every competitor to turn out a really first-class machine. The rules are reproduced below.

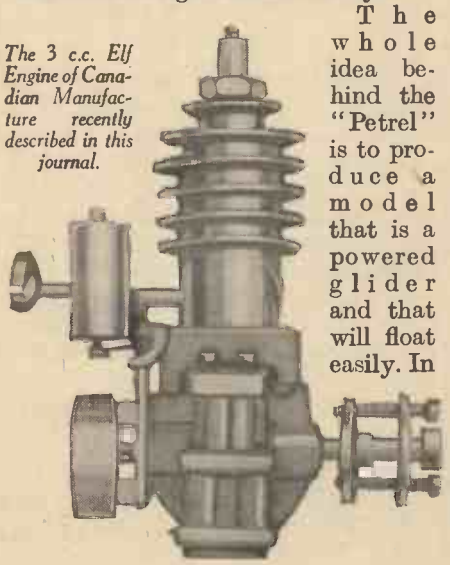
The machine as designed functions very well indeed, but Captain Bowder reports that he has recently been flying the "Petrel" with two different powered engines of about 2·5 c.c., and he has found that if the fin area is increased to the dimensions as given in the sketch on page 572, the model is less sensitive and more directionally stable with the more powerful engine.

He therefore advises those about to build the model to fit the rear fin, and to those who have already built the model and find it over sensitive to add the larger fin. This is easily done owing to the laminated system of construction. Merely slice off the old fin and glue on the new. The covering of silk at the joint will secure the new fin. If constructing the scaled up "Petrel" for 6 c.c. or 9 c.c. engines do not forget to scale up the new fin.

One other point. He saw recently the tests of a "Petrel" built up in his district and noticed that the constructor had altered the wing section to a fast section without the slight undercamber and with thinner contour. He had also altered the tail-plane section. His model glided like a racing machine, and of course the little 2·3 c.c. engine would not fly it.



A neat time-control Switch marketed by The Model Aircraft Stores, Bournemouth, at 8s. 6d.



The 3 c.c. Elf Engine of Canadian Manufacture recently described in this journal.

The whole idea behind the "Petrel" is to produce a model that is a powered glider and that will float easily. In this way very little power indeed is required to fly it. This suits the midget type engines. In full size practice it will have been noticed how successful lightly loaded gliders are when powered by motor-cycle engines.

If these machines had been heavily loaded and fast the low powered motor-cycle engines would not have flown them.

Society of Model Aeronautical Engineers

MAY, 1937, REPORT

THE Society held no Council Meeting during May. The chief activities during the month were two competitions. The Model Engineer Cup No. 1 for gliding was a decentralized competition, while the Speed Cup, a centralized competition, was held at Hurlingham Polo Ground.

The Gliding Competition had its usual bad weather; this naturally limited the entries, but added to the laurels of the winners. The Result was as follows:

1st. C. S. Rushbrooke, Lancs. M.A.S. Average of 3 flights, 77·83 secs.

2nd. N. Harris, Bristol W.M.A.C. Average of 3 flights 38·53 secs.

3rd. J. B. Parkinson, Midland M.A.C. Average of 3 flights 35·5 secs.

The Speed Cup Competition resulted as follows:

1st. H. L. Rogers, Northern Heights. 46·48 miles per hour.

2nd. R. J. Linfoot, Nomads. 26·22 miles per hour.

RULES

1. *Only models built according to the designs and specifications here given are eligible.*
2. *The Editor reserves the right to refuse an entry without assigning a reason.*
3. *Professional model-makers, those engaged in the making of models for profit, or as a livelihood, are excluded from this competition.*
4. *Models must be the unaided work of the competitor, but they are allowed to purchase the usual finished parts —airscrew, ribs, wheels, engine, etc.*
5. *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.*
6. *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.*
7. *Each competitor may enter only one model.*
8. *Any variation in the design may entail disqualification, within the discretion of the judges.*
9. *Those competitors who will be unable to attend to fly the models themselves may appoint a delegate, approved by the judges, to do so.*
10. *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.*
11. *Other prizes will be awarded for workmanship and finish.*
12. *The date of the competition, which will take place at one of the large aerodromes, will be announced later.*

3rd. W. Worden, T.M.A.C. 20·05 miles per hour.

Will intending competitors in the Wakefield Elimination Trials note that all entries must be sent to the S.M.A.E. Competition Secretary, Mr. J. C. Smith, 1, Treen Avenue, Barnes, S.W., before the 12th July. The Entry Forms may be obtained from Mr. Smith on receipt of a 1½*d.* stamped addressed envelope.

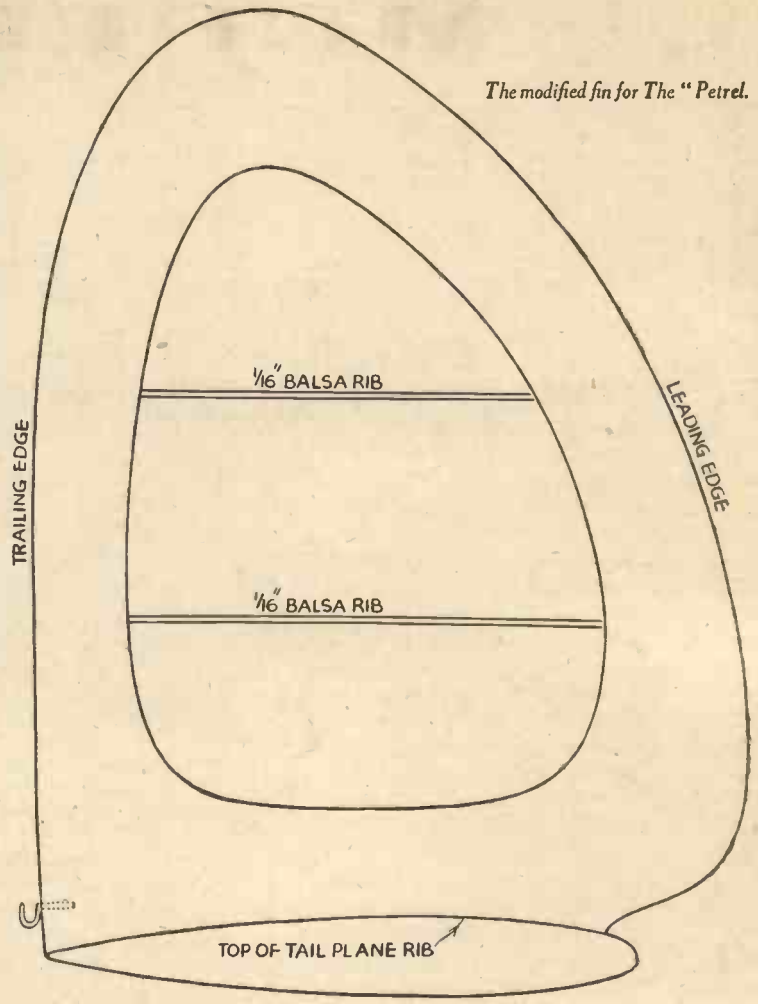
Time Control Switch

IT will be essential to fit a time control switch to the Petrel; the reader may elect to make one as described, or he can fit one of the commercial time control switches such as that marketed by The Model Aircraft Stores of 127*b*, Hankinson Road, Bournemouth. I have tested this switch (it is illustrated on page 571), and find it entirely reliable. The arm at the top enables it to be wound, and it cuts off the ignition at approximately 40 seconds from the fully wound position; by noting the position of the winding arm any duration of motor up to the maximum of 40 seconds can easily be arranged. There is an auxiliary switch at the side of the case containing the mechanism which locks the travelling arm in the permanently "On" position. The switch is very light. As shown, a moving arm travels along a strip and one lead in the battery circuit is broken and the two ends connected to the two leads of the switch.

I have also received from the same firm, and find entirely satisfactory, a pair of their B.B. air wheels, 3¼ in. in diameter, and specially made for small type power models such as the Petrel. These retail at 4*s.* a pair. A special feature is that the pressure remains constant and they will stand up to a considerable amount of hard wear.

New Model Catalogue

I HAVE received from Mr. S. Smith, 44, Legh Street, Lancashire, a copy of his model aircraft and accessories catalogue, which will be sent to any reader for 3*d.* It lists the Selley-Tex kits of flying scale model aircraft, duration models, and all of the materials necessary for building model aircraft including metal fittings.



The modified fin for The "Petrel.

Flying as a Hobby

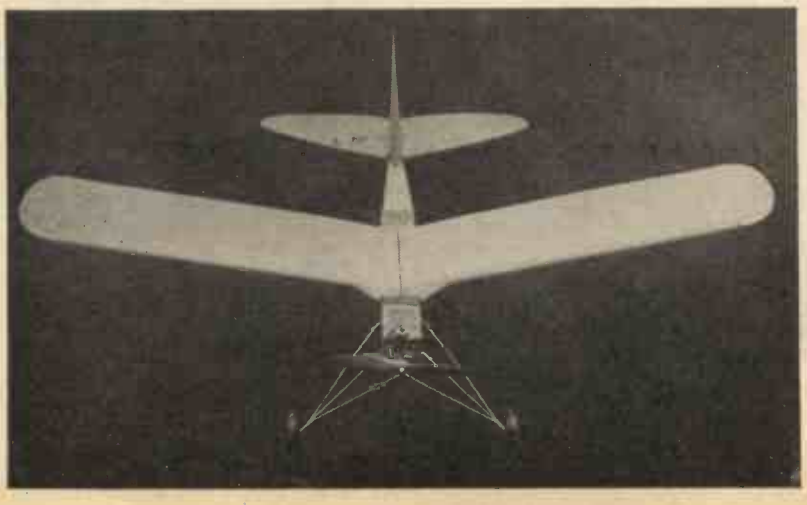
THE increasing popularity of flying as a hobby has created an enormous demand for model aeroplanes of all types and sizes.

The leading stores are meeting this demand with models which fly and models which reflect the spirit of the age and replace the galleon, which is incongruous in the modern home.

One of the most popular flying models is the Frog Mk. IV., which has become famous throughout the world. It is a scale model of a modern fighting aircraft, has an extremely good performance and, as the main parts are instantaneously detachable, it is not easily damaged even in a serious crash.

A cheaper model from the same famous factory is the "Silver Arrow"—an air liner, which follows the same proved methods of construction.

At the other end of the scale is the FROG Hawker Hart Mk. II, an exact scale flying model of the well-known high performance bomber, which sells at two guineas.



The Machine and the Man! The illustration to the left shows Mr. A. T. Fraser's aeroplane, which is fitted with a Comet engine, with which he made the record flight of 16 mins. 25 secs., as reported in these columns last month. The second illustration shows Mr. A. T. Fraser.

THE STORY BEHIND GLASS

THE MECHANICS OF GLASS MAKING

TO those interested in practical mechanics, the manufacture of glass can be a most absorbing subject.

There are as many kinds of glass as there are brands of cheese, and when choosing a type such properties as hardness, heat-transmission, mechanical strength, resistance to scratching and transmission of sound have to be considered.

Glass is made by the fusion of oxides, which are subsequently cooled with sufficient rapidity to prevent the formation of crystals. Sand, which is, of course, the chief constituent of glass, must have a very low iron-oxide content, and it is only in certain districts that this condition is fulfilled.

Glass Sand

Fontainebleau in France, and Hohenbocka in Germany, are both famous for their glass sand. The best sand in England is found at King's Lynn and is used extensively in British glass.

Other substances used in the manufacture of glass include soda, potash, lime, oxides of arsenic, and for colouring matter, silver salts, oxides of iron and copper, and even gold.

Each constituent has its own effect on the properties of the glass. For instance, alumina makes glass specially resistant to the action of water, while soda renders it liable to attack.

The manufacturer, provided with a table of the effects of each constituent, can design his glass with properties suitable for any requirements.

The mixture, known as the "batch," is heated either in small individual pots or in one large tank. It melts at a temperature of about 1,400° C.

Sheet and Plate Glass

Two types of glass are used in window-panes—sheet glass and plate glass. Sheet glass, because of its lower cost, is generally used for ordinary purposes. It can be recognised by the slight distortion it gives to objects when viewed at an acute angle through it. Plate glass gives no such distortions because its sides are mathematically parallel. Its most common uses are in mirrors and car windscreens.

In the making of sheet glass, the molten mass is drawn from the furnace and passed over a roller and through an annealing furnace, as shown in the illustration. The rate of drawing is from about 26 in. to 72 in. per minute, and the process generally goes on continuously, day and night.

In the manufacture of plate glass, the molten batch is transferred from the furnace to a casting-table. It is distributed in front of a massive iron roller which traverses the table from end to end, rolling out the glass into a sheet usually about ½-in. thick. The rolled pane passes down the annealing furnace and is cut into suitable sizes. It is then set in plaster of Paris on a circular grinding table, where it is ground and polished until the surface is perfectly smooth.

Thousands of Years Ago

The art of glass-making is very old. Some ascribe its origin to the Syrians; others ascribe it to the Egyptians, and have unearthed six-thousand-year-old glass beads to prove their point. At any rate, there was a flourishing glass factory at Tell el Amara, in Egypt, as long ago as 1400 B.C.

Despite the immense age of glass, it is only comparatively recently that the use of colourless glass for windows has been developed. The Greeks had no windows in their temples, and much of what light they had came through the doors. Stained glass was used in churches in the Middle Ages, but the private house remained dark and stuffy. Then in 1687 a Frenchman named Perrault invented the casting of plate glass, and the window as we know it to-day began to appear.

The world has been slow to take advantage of the possibilities of glass. The value of sunlight was so little recognised 240 years ago that the British and other governments put taxes on windows. Even to-day many of the buildings in which we live and work contain rooms which are inadequately lit for reading and working.

Insulates Against Heat

Unfortunately, the construction of large windows tends to make a room too cold in the winter and too hot in the summer, for obviously heat will penetrate more quickly through glass than through stone. However, in the place of ordinary colourless panes, a new glass is being used with a co-efficient of heat transmission which is about that of a brick wall. Thermolux, as this glass is known, insulates against heat and cold, so that a room fitted with it has a comfortable tem-

(Top Centre) The laylight of a London store glazed with Thermolux, a new kind of glass which eliminates all shadows, at the same time preventing rooms glazed with it from becoming too hot in summer and too cold in winter. (Below) Showing the use of Thermolux in the new tuberculosis dispensary at Devonport Street, Stepney, E.

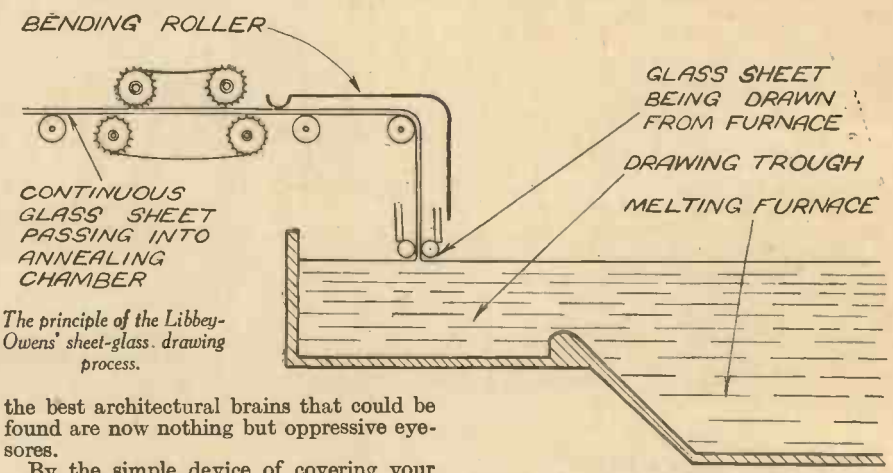
perature throughout the entire year. Thermolux is not transparent, but lets through the maximum of light which can enter a room in such a way that it is perfectly evenly distributed. It also eliminates shadows.

This glass is made like a sandwich, the middle layer being of glass-silk. Glass-silk, an old Venetian invention, is made by the same process as drawn sheet-glass, with the difference that in the latter case the glass is drawn over the rollers moving at less than a hundred yards an hour, whereas glass-silk is drawn on to a drum moving at roughly forty miles an hour. About fifty miles of this thread go to make a square foot of interlayer.

The function of Thermolux is best explained by comparing the interlayer with an ordinary cloud. As soon as a cloud, even of a light kind, passes across the sun, we cease to sense any heat from the sun's rays which, however, in spite of the cloud, are still reaching us in the form of diffused light. This is what happens when a window is glazed with Thermolux glass, which breaks up the light so thoroughly, that it is evenly distributed over the whole room without any shadows.

Architecture of the Future

There is every reason why glass may be used much more extensively in the architecture of the future. Until a few years ago white stone, concrete, and red brick were the main materials used for building. They have one grave disadvantage as surface materials, however. Within a few years of its erection, any building made of them is turned a murky grey by the sulphur fumes and other impurities in the atmospheres of our cities. For this reason many buildings that were once the products of the best architectural brains that could be found are now nothing but oppressive eyesores.



The principle of the Libbey-Owens' sheet-glass drawing process.

By the simple device of covering your building with a layer of glass, white, black or otherwise, you eliminate the danger of decay. Sulphur fumes and other acids in quantities commonly found in the air have very little effect on a glass surface, which can be kept perfectly clean with the minimum of cost and trouble.

At least two buildings in London have already been built along these lines, one of them being the famous black glass building of the *Daily Express* in Fleet Street.

Scientists are even working on the possibility of using glass as a structural material. It is already possible to buy glass bricks, and in America these have been used with success.

100 Halfpennies to the "Royal"

New Decimal Coinage Proposals

A COINAGE based on 100 halfpennies, with a new note to the value of 4*s.* 2*d.*—called a "Royal"—will be the future English system if the proposals drafted by the Decimal Association and just issued receive general approval.

The new coinage would bear similar characteristics to the American and Canadian currencies, the halfpenny corresponding to the cent and the "Royal" to the dollar, with an almost equal value.

"We are convinced that the new system would lead to the greatest benefits, both to internal and external trade, and that such a system could be adopted with the least disturbance of commercial and private life," said Sir Isidore Salmon, M.P., President of the Association.

"The penny is by far the most useful and hard-worked coin in our present system. The £ is a token only, and alters in value daily. A coinage system based on the penny would, therefore, appear the most simple," added Sir Isidore. "But the halfpenny system has a big advantage in that it would need one column less on calculating machines, and the halfpenny itself would not be left as a fraction."

Stress is laid on the fact that the adoption of the halfpenny system would leave the value of every other coin unchanged. It is the changing of values of present coins which would largely account for complications, it is stated. That this would be unnecessary with the halfpenny basis is, therefore, of the utmost significance.

The new proposals are the result of an Empire-wide survey into the question of a universal decimalisation of coinages, and the possibilities of bringing Great Britain and all the Empire into line with the other great Powers.

A Television Exhibition

TO the general public the development of modern television has seemed to have taken place suddenly. It has made its début in an advanced state of perfection, unheralded, it has seemed, by the more usual process of steady development over a period of many years. This is actually far from the truth because the development of high-definition television actually commenced about ten years ago.

The technique of television, though related in some respects to that of sound broadcasting, is far more complex, and it would have been both useless and impossible to commence the public broadcasting of high-definition television until its development was properly completed. Research and development, therefore, have been in progress over a number of years, but the final completion and inauguration of a television service has, to the general public, come almost as a surprise.

Partly with a view to demonstrating that television has now emerged from the experimental stage, partly to illustrate the general principles which underlie the modern technique, and partly to foster the widest possible appreciation of television as a home entertainment, a special Exhibition was recently organised by the Science Museum in co-operation with the British Broadcasting Corporation and the leading manufacturers.

The Exhibition incorporated an historic section dealing briefly with early proposals for television, and a number of exhibits described the developments of the past ten years. There was a working demonstration of the low-definition television which was broadcast by the Baird process a few years ago, there were demonstrations on modern cathode-ray receivers supplied by the various manufacturers, and a demonstration of large-screen television by a mechanical-optical process.

In order that these demonstrations could be given when there was no B.B.C. transmission available, a local transmitter was installed which provided programmes from cinema films.

In connection with the Exhibition a handbook has been compiled by Mr. G. R. M. Garratt, M.A. (who has contributed a number of articles to PRACTICAL MECHANICS), assisted by members of the Exhibition Committee. The handbook contains a brief account of early proposals for television, chapters on photo-electricity and light control, the cathode-ray tube and electron cameras, the television transmitter, television receivers, aerials, and a short description of the London Television Station at Alexandra Palace. Copies may be obtained from the publishers, H.M. Stationery Office, price 6*d.* (by post, 7*d.*).

MASTERS OF MECHANICS

No. 23.—The Tragedy of John Kay, of Bury, Inventor of the Fly-Shuttle

ENGLAND during the first quarter of the eighteenth century was a very different nation from what it was at the end of the same century. The "Industrial Revolution," that difficult period of unprecedented change in almost the entire economic system of civilisation, had not yet spread over the face of the land. England still remained rural and agriculture formed, as it had done from the very beginning of things, the stable occupation of our forefathers.

The story of England's Industrial Revolution has often been related. It is a story which is in many ways charged both with gladness and with sorrow. It is undoubtedly true that the economic upheaval which came over England in the middle of the eighteenth century caused an utter disruption in many directions and, owing to the greed and rapacity of certain individuals, resulted in widespread misery. Yet, at the same time, England, as a direct result of the sudden change which had come upon her, rose rapidly to a position of power and wealth which she had never attained before. Standards of living rose, too, and in consequence of the invention of machinery, civilised mankind found itself in the possession of a degree of leisure which it had never experienced before.

Rise of Steam Power

The Industrial Revolution was brought about not by any one individual, or by any single invention, but by many. The rise of steam power, the use of coal as a source of fuel, the progress of invention in the textile, iron, and other trades, the development of transport—all these taking place as they did within the space of a few decades, guided the course of and gave impetus to the drastic economic revolution which so greatly changed the face not only of England but, also, of the entire world.

If, however, any one person might be singled out as having, by his inventive power, unconsciously presided, as it were, over the inception of the Industrial Revolution in England, that individual, in all truth, was John Kay, of Bury, in Lancashire, a poor and humble mechanician, who spent most of his life in wrestling with difficulties and vexations, the majority of which were the direct outcome of his epoch-making invention.

Before the time of Kay, the weaving of fabrics and cloths of all kinds had been a very slow and laborious process. The "warp" or longitudinal threads of the fabric to be woven was first of all prepared on the hand loom, after which the "weft," or crosswise threads of the cloth, was formed by passing the shuttle containing the thread from side to side of the loom by hand.' By this method the warp and the weft threads became interlocked and a woven fabric resulted.

No Progress Made

The above mode of weaving had been practised in all countries from the very dawn of history. The Egyptian mummy-cloths, the fabrics of the earliest Chinese civilisations were all woven by exactly the same laborious process as John Kay learnt as a child on the hillside farms surrounding his native Bury. For thousands of years, mankind had never progressed one iota with its weaving. The Lancashire weaver of the early eighteenth century produced his fabric in exactly the same manner as did the slave of ancient Egypt, and no thoughts of speeding up the process or of making it less laborious ever seem to have occurred to him.

John Kay, of Bury, from an oil painting preserved in his native town.

Little is known of the early life of John Kay, the individual who first speeded up the process of cloth weaving and who, by his invention of the fly-shuttle, gave the lead to other inventors both in the textile and other occupations, and so precipitated the Industrial Revolution. All we know for certain is that he was born on a hillside farm at Park, near Bury, Lancashire, on July 16th, 1704, the posthumous son of one Robert Kay, a Lancashire yeoman and cloth weaver, who had died a few months previously.

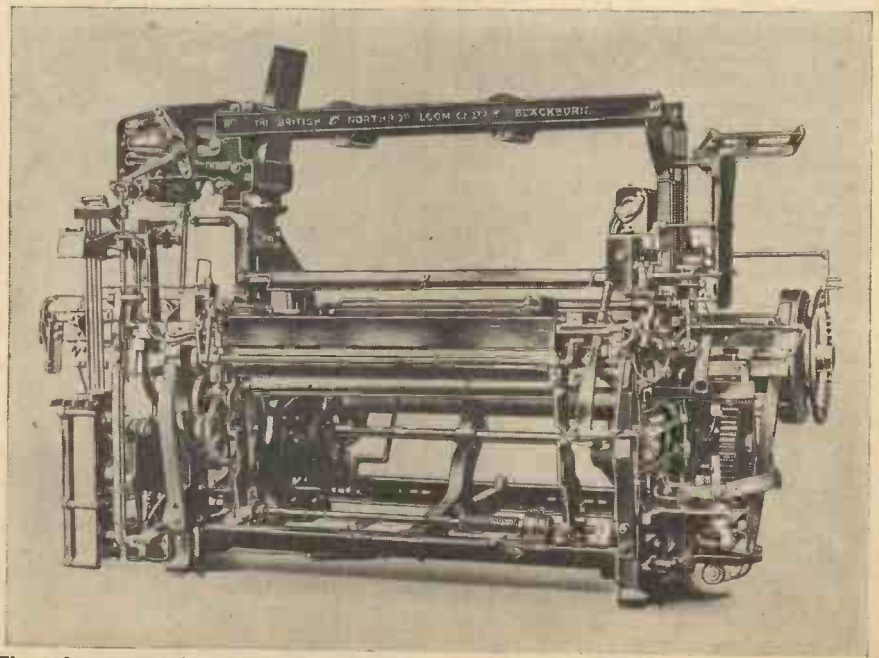
There is a tradition that Kay was educated abroad, but, in truth, there is little probability in this assertion, for, although the Kay family was by no means destitute, it certainly had not the wherewithal to dispatch its youngest member to the Continent for the benefit of his education.

The truth of the matter is that John Kay was reared among the Lancashire hillsides, and that whatever smattering of education he did receive was entirely of the local Lancashire variety. From his earliest youth, Kay, seems to have given much evidence of his inborn mechanical genius. As a boy, he constructed windmills, trains of gears, and other "bits o' things" which actually worked and provided a perpetual source of amazement for his companions and playmates.

Early Years

Kay, during his early years, was, like the majority of other Lancashire children, set to learn the trade of hand-loom weaving. The art was not an easy one to acquire, but there is such a quality as hereditary skill, and it was not long before the youthful Kay was able to turn out woven fabric as fine and as flawless as that of the most experienced weaver.

But Kay's interest was much more in the actual working of his looms than in the cloth which he turned out. One of his earliest inventions, if not, indeed, his very first inventive creation, was a new type of "reed," an appliance used in weaving for separating the threads of the warp in order to permit of the shuttle being passed crosswise between them. Reeds, before Kay's time, had always been fashioned out of thin



The modern version of Kay's "fly-shuttle" invention. An up-to-date high-speed automatic weaving loom.

pieces of cane. Kay, however, succeeded in making reeds out of thin strips of highly polished metal. Such reeds were very durable and, by means of them, fabrics of a finer texture could be woven.

So well received were the metal reeds devised by Kay that he commenced a small business as a reed-maker. Kay's reeds soon became in favour up and down the country and, for a time, the young inventor prospered. His prosperity was further increased by a small legacy left to him by his father which he received when he came of age and, on the strength of his good fortune, he married a local lass, one Ann Holte, on June 29th, 1725.

A "New Engine"

Having in mind the considerable success of his reeds, Kay now turned his attention to improving the traditional method of weaving then in use. How Kay first conceived the idea of his fly-shuttle will, perhaps, never be known. In 1730, when he was twenty-six years of age, he took out a patent for a "new engine" for the purpose of "the making, twisting, and curling mohairs and worsted, and for the twisting and dressing of thread." What this invention was it is difficult to conceive. Kay, however, seems to have paid little attention to it for, three years later—in 1833—we find him taking out his master-patent for the weaving invention which has made his name famous but which, alas, directly brought about the ultimate tragedy of his life.

The above-mentioned patent protected Kay's now historic invention of the fly-shuttle. Kay, instead of being content to construct looms in which the shuttle was passed from side to side by hand, contrived a device by means of which a mechanical hand was made to jerk the shuttle from one side of the loom to the other. The shuttle flew at a great speed in a specially made track or guide across the weaving loom and, in its journey from one side of the loom to the other, it carried the weft-forming thread.

Enormous Advantages

The advantages of Kay's fly-shuttle system of weaving were truly enormous. For one thing, much of the labour inherent in the task of weaving was entirely abolished. The weaver had merely to depress a lever with his foot and the shuttle was mechanically jerked across the loom. Again, under the old system of weaving, the width of the cloth was measured by the degree of stretch of the weaver's arm. The fly-shuttle, however, made it possible to weave fabric in much greater widths, since the mechanically operated fly-shuttle could be passed along greater widths than that represented by the stretch of a weaver's arm. In addition, of course, Kay's invention speeded up the weaving of cloth tremendously. It was, indeed, in every sense an epoch-making invention.

With his invention of the fly-shuttle and the introduction of his sytem of mechanical weaving, however, Kay's former prosperity almost immediately departed and in its place came trials, difficulties, and vexations of very kind.

Almost from the beginning, Kay was looked upon by his fellow weavers as a traitor to their class. His fly-shuttle looms, they contended, by speeding up the production of cloth and by making it possible for one man to turn out as much cloth as that which could be produced by ten weavers working under the old system, held out for them nothing other than the loss of their employment. Kay's invention, instead of being a beneficial one was, in the eyes of the Lancashire weavers, a veritable menance to their existence.

Difficulties Encountered

The same tale obtained in other parts of the country. For a time, Kay worked a number of his looms in the ancient town of Colchester, which was then the seat of a flourishing woollen industry. From Colchester he went to Leeds and in the latter town set up a weaving establishment. At Leeds, he met with another source of difficulty. Master-weavers and large-scale "clothiers," as the cloth manufacturers of the day were called, were not merely content with making copies of Kay's fly-shuttle looms and working such copies for themselves, but when the distracted inventor, in sheer desperation, applied for legal redress in order to protect his invention from such piratical activities, the manufacturers combined together to form "Shuttle Clubs," which were, in reality, associations of master-clothiers formed for no other purpose than to defy Kay and to make good any legal damages which Kay might be awarded against them in defending his patent claims.

From Leeds, Kay next proceeded to his home town—Bury. But here prejudice was strong against him, both on the side of the masters and on that of the men. After a period of residence in Bury, Kay's weaving shop was broken into by an infuriated mob, and the inventor, it is said, only escaped with his life by being wrapped up in a woollen blanket and bundled out of a rear window from which situation he escaped to a place of hiding.

It is true that nearly all the cases of patent infringement which Kay fought in the Courts were decided in his favour. Yet he seldom obtained satisfactory redress for the wrongs which he received from all sides. Thus it was that ultimately, sick at heart with the treatment which had been meted out to him by his fellow countrymen, he left his native town of Bury and, travelling precariously to Dover, embarked for France in a sailing vessel accompanied by his favourite daughter.

Life a Mystery

The life of Kay in France is more or less an entire mystery. The inventor endeavoured to set up his looms somewhere in the neighbourhood of Paris, but either lack of capital or ill-health consequent upon them any disillusionments which he had received brought failure to his efforts. As a last resort, he applied for assistance to the English Consul in Paris. This individual strongly advised him to return to England and to prefer a claim for some monetary reward upon the Government. Kay, it seems, fell in with the Consul's views and sailed again for England. But the reception which he met with at the hands of the British Government was a very cold and official one. His application for assistance was hardly listened to and, after a time, hopelessly crushed in mind, broken in health, and with hardly a penny in the world, the disappointed inventor returned to Paris, in which city he is supposed to have afterwards died in circumstances of the greatest obscurity and poverty and attended only by his devoted daughter, Ann, who afterwards took refuge herself in a nunnery.

Such are the main facts concerning the tragic life-history of Jonn Kay, creator of the textile industry in Britain. There are, of course, many things which we would like to know concerning him, as, for instance, why he was not enabled to return to Bury, his native town, in which locality, the majority of his children were in fairly affluent circumstances. We should also like to know when and where Kay died and where he was buried. Such information, however, appears now to have become for ever undiscoverable.

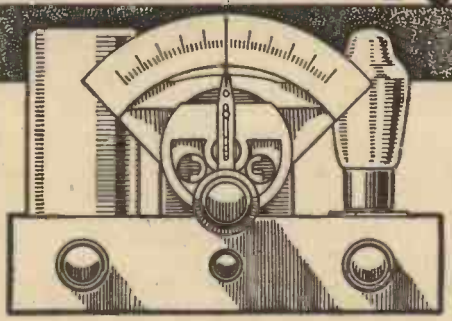
Soon Forgotten

To make the tragedy of Kay complete, the inventor was quickly forgotten in his own town, despite the fact that flourishing industries arose in and around Bury as a direct result of the coming of the fly-shuttle invention. It was, indeed, only in 1903, nearly a hundred and fifty years after the presumed death of the inventor in a foreign land, that the townsmen of Bury decided to erect a memorial in honour of John Kay, England's formerly despised and almost-forgotten mechanical genius.

Fate has a habit of performing tricks of the most grotesque character. In many respects, it may be said that the whole life-of John Kay was governed by Fate in one of her most inexplicable moods. Inventions there have been which have far outweighed that of Kay's in point of spectacularity. Not many single creations of human ingenuity, however, effected so great a change in the trend of civilisation as did the simply-contrived fly-shuttle of John Kay. Yet, as we have seen, Kay suffered a living martyrdom on account of his mechanical genius and even in death he remained for a century or more England's "forgotten inventor."

The PRACTICAL MECHANICS

WIRELESS EXPERIMENTER



OUTDOOR RADIO

HELPFUL HINTS FOR THOSE WHO WISH TO ENJOY OUTDOOR RECEPTION, EITHER BY EMPLOYING THE ORDINARY SET OR BY USING A PORTABLE.

IF the hot, sunny weather of June continues throughout the later summer months there should be a real boom in outdoor radio.

Although it is not always essential to have a portable receiver to enjoy outdoor wireless reception, that type of set is certainly to be preferred, if only on account of its compactness and light weight. Besides, receivers of this type are designed to operate from a self-contained or simple "throw-out" aerial, whereas if an ordinary "fixed" receiver is employed it often becomes necessary to erect an aerial on the picnic site. On the other hand, if it is not proposed to take any great advantage of outdoor reception, it might be considered that the expense of a completely new and additional set will not be justified; it must not be forgotten, however, that a portable receiver has other advantages than those applying when it is used out of doors. For example, it is invaluable when reception is desired in alternative rooms of the house.

The choice of the best type of portable receiver depends principally upon the kind of reception required. Generally, it is sufficient to be able to ensure good reception of the two nearest medium-wave transmitters and of Droitwich, in which case a three-valve receiver having one H.F. and one L.F. stage is sufficient. If reliable and good loudspeaker reception of a greater number of programmes is desired it is usually necessary either to employ four valves or to make provision for attaching makeshift external aerial and earth leads to the set. In those cases where it is merely wished to listen to weather reports, news bulletins, and generally to "keep in touch with civilisation" when on tour, a two-valver using sensitive headphones such as may be obtained from Ericsson Telephones Ltd., is adequate.

Using the "Home" Set Out of Doors

As the question of making a self-contained portable will be fully dealt with in the next issue it will be sufficient here to consider the methods of improvising a "fixed" receiver for outdoor use, and of improving the results to be obtained from a portable set of average pattern. Dealing with the improvisation of an ordinary receiver, the first point to consider is whether it will be wished merely to use the set in the garden, near to the house, or whether the set will be carried to more remote parts in the car—the average set cannot normally be carried satisfactorily by any other means. If garden reception only is wanted it will in most cases be found better to extend the loudspeaker leads and to use a remote control switch than to move the set and erect an aerial near to it. The former method, is of course, essential where a mains receiver is concerned, and the method of connecting the Bulgin remote-control switch is as shown in Fig. 2.

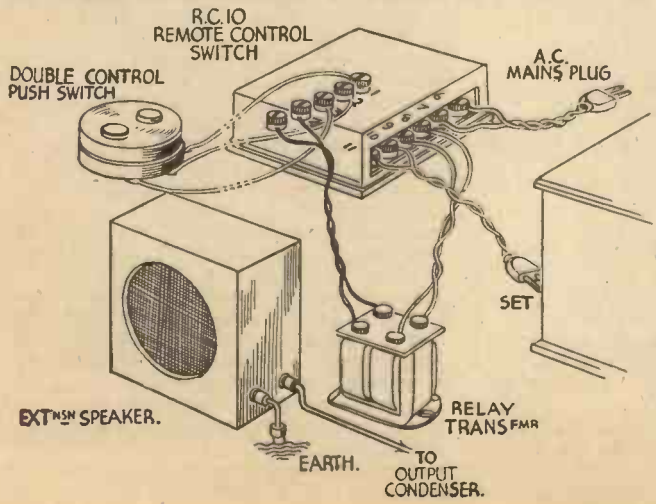


Fig. 2.—This shows the method of using an extension speaker and Bulgin remote-control switch with a mains receiver, which is left inside the house.

Makeshift Aerial and Earth

When the set is to be moved bodily it will generally be found that a length of insulated wire, with a weight tied to the end, slung over a convenient tree or tied to the roof of the summer-house will suffice for the aerial. A length up to 50 ft. or so is to be preferred where it can suitably be arranged, but selectivity might be adversely affected by using a longer piece of wire. The earth connection can be made to a proper earth tube or to a length of copper, brass or iron pipe which can easily be pressed into the ground. When the receiver is used near to the car, a satisfactory and simple alternative is to make the earth connection to the chassis. This can be done by tying a length of bare wire to a bright part such as a bumper or the radiator cap or mascot.

When using a sensitive type of receiver, such as a modern superhet, it will be found that the elevated aerial can be replaced by an earth lead attached to the aerial terminal; this will act as combined aerial and earth, and often provides better reception than that obtained when using a short and inefficient aerial. Where a band-pass circuit is used for tuning the first stage it will often be found worth while to dispense with one of the tuning circuits in the interest of greater sensitivity—selectivity will be amply good when using a small improvised aerial system. All that is necessary is to connect the aerial (or earth lead used as aerial) to one of the terminals marked A, B, and C in Fig. 3, the connection being made through a ·001-mfd. pre-set condenser. The three alternative connections can be tried so as to find which is most suitable.

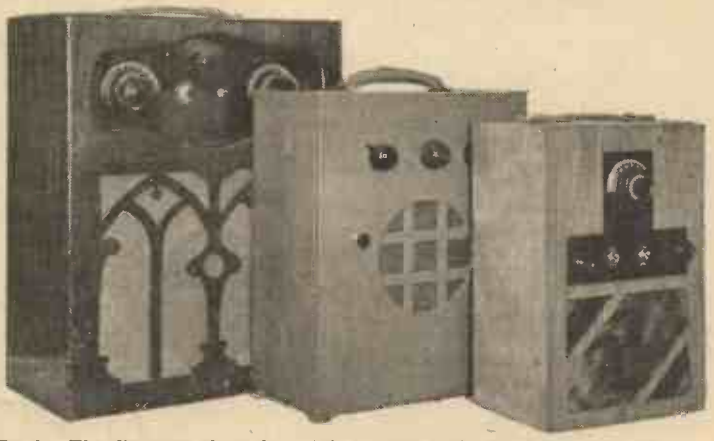


Fig. 1.—This illustration shows three of the portables produced in our laboratories.

Power Supply from Car Battery

In order to reduce the weight of the portable outfit it might be considered desirable, when using the receiver with the car, to eliminate the normal accumulator, taking the L.T. current from the car battery. This can be done easily enough by making connection to the negative lug of the car battery and to the first bus-bar inter-cell connector, as shown in Fig. 4. Connection to the bus-bar can be made either

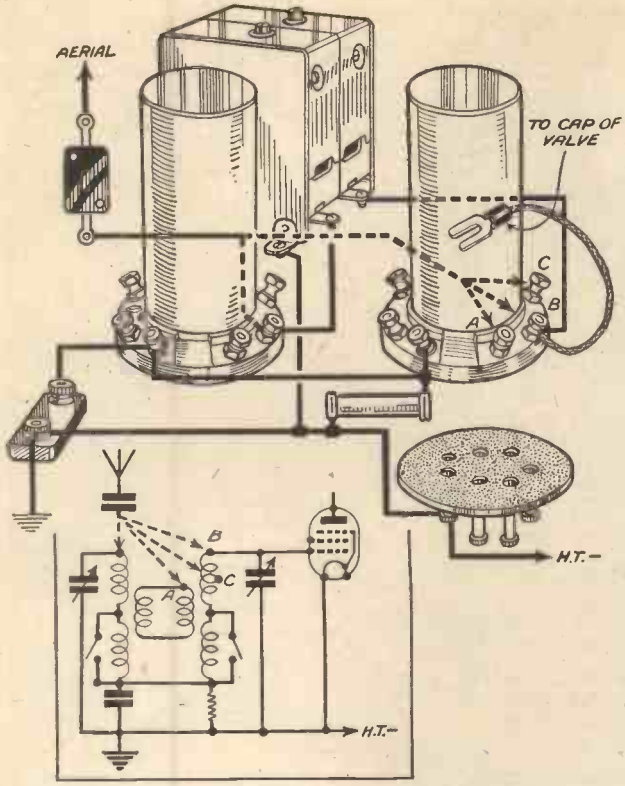


Fig. 3.—The first tuning circuit of the band-pass filter can be cut out of circuit by connecting the aerial to terminal A, B, or C. This provides increased sensitivity when using a short improvised aerial.

by binding the bared end of a piece of wire round it—after scraping it bright—or a more permanent job can be made by tapping the lead connector and screwing a terminal into it. In the majority of cases the current drain will be so small as to be negligible, so there will be no danger of exhausting the battery.

High-tension also can be drawn from the car battery, if desired, by using a rotary converter. This is a rather expensive device—costing £6 or so complete with filter unit—but it can easily be fitted to the under-side of the floor-boards, and can be used at a later date for a complete home-made car-radio installation. Units are available for various outputs, the lowest being about 180 volts at 30 mA.; they can be had for either 6- or 12-volt operation.

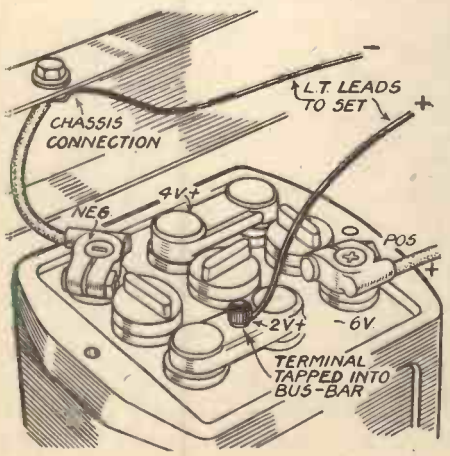


Fig. 4.—The car battery can be used for L.T. by making connection to the negative lug and the first inter-cell bus bar.

Making a Frame Aerial

Those who propose to use a fixed type of receiver as a portable in conjunction with a frame aerial can make the latter fairly easily as shown in Fig. 5 by using four slotted ebonite corner brackets screwed to a sheet of ply-wood. The supports are formed by making a number of saw cuts in strips of ¼-in. ebonite measuring about 3 in. by ½ in. If the slots are about ¼ in. apart, seven can easily be accommodated, so that the medium-wave section can be placed in three of them, the long-wave section being in the remainder. An aerial of this kind is not, theoretically, efficient, but is satisfactory for the purpose in question. Both windings should be in the same direction, and be connected in series, an on-off switch being used to short-circuit the long-wave winding. Suitable wire for the medium-wave section is 24-gauge d.c.c., whilst 28- or 30-gauge d.c.c. wire can be used for the long-wave section. The number of turns required depends, naturally, upon the size of the frame, but can easily be determined by allowing 75 ft. for the medium-wave portion and 210 ft. for long waves. In Fig. 5 a ·0005 mfd. bakelite-dielectric variable condenser is shown mounted on the ply-wood support, along with the wave-change

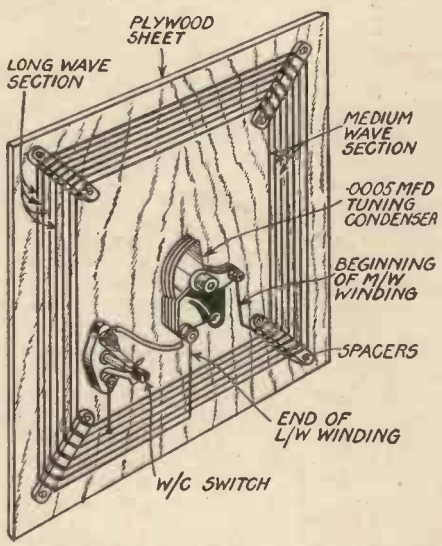


Fig. 5.—Constructional details of an easily-made frame aerial complete with tuning condenser and wave-change switch.

switch, and this arrangement is very convenient. The two leads from the frame assembly must be connected in place of the leads from the existing coil, which are joined to the grid of the first valve and earth (or variable-mu bias supply); the connections in a typical set are shown in Fig. 6. It will be evident that the two coil leads must be disconnected, and that the coil can be removed if desired.

The slight objection to this arrangement is that both the tuning condenser in the set and the new ·0005 mfd. one have to be operated together, but this is often the case with a "pukka" portable. Another important point is that the frame must be rotated until it points to the station to be received in order to obtain maximum signal strength. This simply means that after a signal has been tuned in, the frame should be turned until full strength is obtained. The same applies to a portable receiver with built-in frame, of course.

The range of reception of any portable with self-contained frame aerial can be extended by adding aerial and earth connections, and provision for this is made on nearly all modern portable receivers.

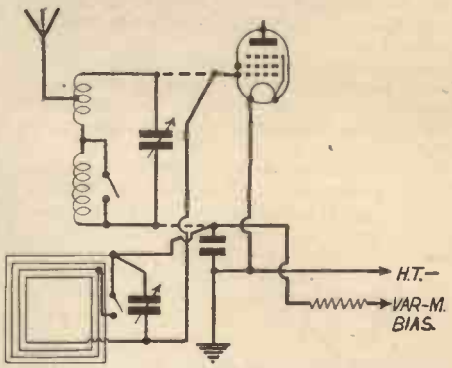


Fig. 6.—Showing how the frame-aerial assembly can be used to replace the aerial-tuning circuit in a typical receiver with a variable-mu H.F. stage.

THE 'SIMPLAT' RECORDING SYSTEM

READERS who are interested in home-recording should obtain a copy of the new booklet issued by the V.G. Manufacturing Co., Ltd., of Gorst Road, Park Royal, London, N.W.10. This booklet costs 6*d*. and describes in very full detail the "Simplat" system of home-recording. It utilises a glass blank upon which is deposited a special medium. This is intended to be cut by means of a special saphite needle supplied by the makers, and immediately after recording the blank may be played back by means of an ordinary steel needle. In order to lengthen the life of the record and to provide better quality, it is recommended that it be wiped with a special processing fluid (supplied in two separate bottles at 5*s*. the set), and one of these hardens the surface, whilst the other polishes it. The records are then almost as durable as the standard commercial disc. Various sizes of blank may be obtained up to 16 in. diameter, and to provide the correct spiral track a special recording apparatus should be employed. The Simplat recording tracker and sound-head is a very efficient piece of apparatus and is illustrated in the booklet. It is driven through a synchronous motor providing constant speed and complete freedom from vibration and will give a good cut even under the heaviest load likely to be imposed by the amateur recorder. The amateur may record wireless programmes for replaying at some future date, or may make records of himself or friends with the aid of a suitable microphone and the ordinary wireless amplifier.

The EMPIRE'S WINGS

"Ensign," the new air liner of Imperial Airways.

By J. R. Ashwell-Cooke

IN these days of hectic Royal Air Force expansion, the achievements of civil aviation are apt to pass by unobserved. Yet, in fact, there has never been a period in the short but spectacular history of air transport when so many almost revolutionary changes were in progress.

As an example, consider for a moment what is happening on the most important section of the national air transport system, namely the Empire air routes. Within the next six months the entire network of services to India, Australia, Egypt, and South Africa will have been completely reorganised. Briefly, the speeds of these services are to be doubled, pay loads are to be trebled, and the frequency of services is to be greatly increased.

The principal reason for this vast reorganisation is the decision by the Government that in future all first-class mail to and from all parts of the Empire is to be carried by air without extra charge. This evolutionary decision has in fact raised British air transport from a luxury industry to an essential public utility service, and at this stage it is almost impossible to anticipate its far-reaching effects. Based on present experience it means that no less than three million letters will be transported each week along the Empire's twenty-seven thousand miles of air routes, and even this figure is expected to grow by leaps and bounds over a short period, when the benefits of air mail become more generally appreciated.

New Traffic

In consequence of this decision, Imperial Airways Ltd., the company entrusted with the transport of His Majesty's Empire air mail, had to take very drastic steps to provide the aircraft and organisation necessary for the handling of this new traffic, and to cater for the consequent increase in speed and efficiency. No comparable problem had arisen before in the history of air transport. Investigations commenced to find the solution first revealed the interesting fact that several aircraft manufacturers were ready and willing to design and build machines of at least twice the size of anything previously attempted, and expressed the view that they expected few problems to arise which were outside the normal routine adopted for the production of any new type. Further inquiries indicated that substantial ultimate economies were likely to result if flying boats were adopted in preference to land planes. Finally an order was placed with Short Bros., of Rochester, for twenty-eight flying boats, each with a total all up weight of almost 20 tons, or nearly twice the size of anything previously attempted.

The plane assembly of an "Ensign" class air liner.

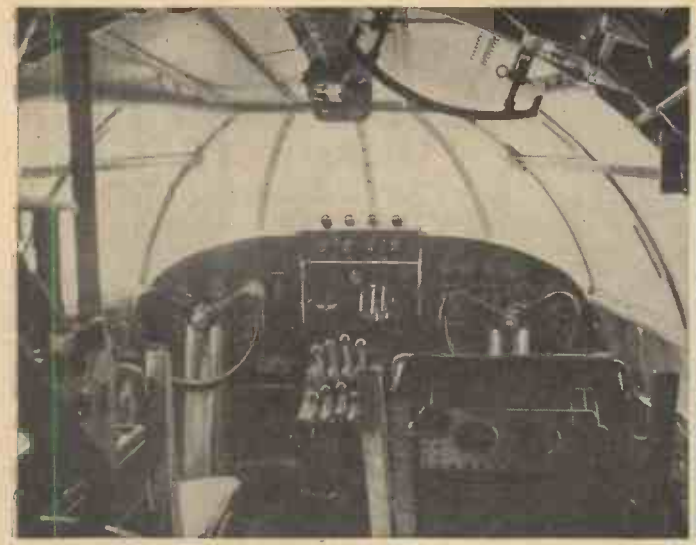
This projected "air fleet" meant the planning of a new route which would enable coastal bays, inland lakes, and rivers to be substituted for aerodromes. At the same time it was decided to operate land planes as well as flying boats over certain sections of the route, where the latter could not operate with complete freedom or where land machines were likely to prove of special value to local mail services. For this purpose a further contract was placed with the Sir W. G. Armstrong Whitworth Aircraft Co., Ltd., for twelve 20-ton monoplane air liners.

Ground Organisation

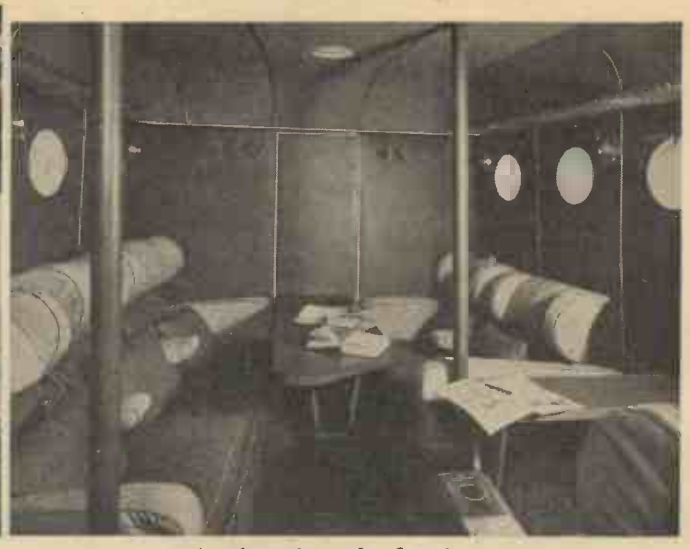
Once the aircraft had been ordered, it became necessary to lay down the necessary ground organisation. Marine bases had to be selected, hangars and slipways built, wireless stations and radio beacons erected, and finally the necessary personnel had to be engaged and trained in their new duties. To-day, after many months' preparation, the whole scheme is gradually coming into operation as the aircraft become available, and it is possible for us to examine them.

The Empire flying boats which form the backbone of the whole project are now in steady production, twelve having been delivered within the past six months. They are all built to a definite pattern and standard in order to facilitate not only constructional, but also operational work. All the machines of this type will be cantilever high-wing monoplanes fitted with wing-tip floats. It is difficult to convey a true impression of their huge size without some visual comparison, and therefore I shall utilise for this purpose the typical London omnibus. The span is 114 ft., or slightly more than fourteen omnibuses placed side by side. The overall length is 88½ ft., or three and a half omnibuses placed end to end, and the height on a beaching chassis is just under 30 ft., or one and a quarter times higher than a double-decker bus.

When fully loaded, each boat weighs rather more than 18 tons, of which up to 5 tons is available for passengers, mail, and



The bridge of the Imperial Airways Empire flying boat "Canopus."



A smoking cabin inside a flying boat.

freight, excluding the fuel necessary for a normal stage flight. The total engine power is 3,700 h.p., made up of four Bristol "Pegasus" engines mounted in the wing, and each fitted with the latest type of variable pitch airscrew. Thus equipped the machine has a top speed of 200 miles per hour, though in practice the machines will cruise at about 170 miles per hour.

Inside the Fuselage

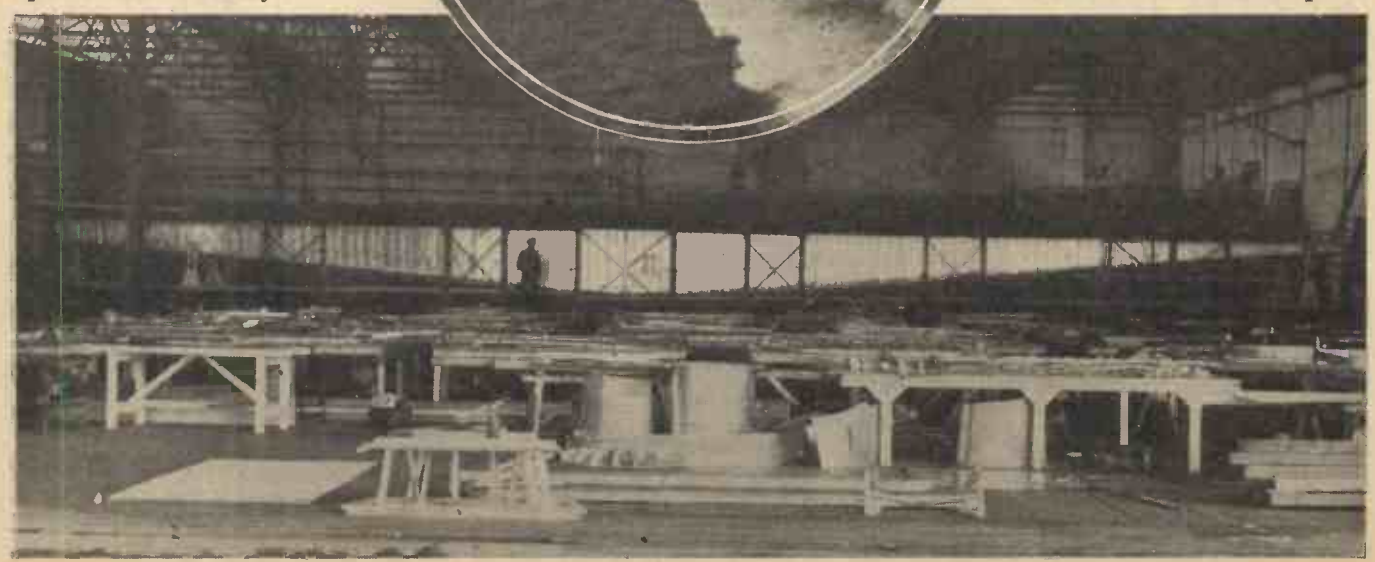
Inside the fuselage there is a complete break away from convention, in that the accommodation is arranged on two decks, the first time that any such design has been utilised on a regular passenger service. On the upper deck the complete navigating and operational crew are housed, including a ship's clerk, whose duty it is to check mails, luggage, and freight during the flight.

The lower deck is devoted solely to passengers and their equipment. It contains four saloons, the forward saloon being set apart for smokers. Really luxurious seating is provided for twenty-four passengers, together with a promenade deck, lavatories, and a model kitchen. The main freight compartment is located in the tail, but there is also a substantial mail compartment on the upper deck. As it is proposed at a later date to operate these machines on a twenty-four-hour schedule, special provision has been made for night travel, and a special hold is provided to store sixteen sleeping berths, together with all necessary bedding and equipment. The whole of the passenger accommodation is very effectively soundproofed and attractively decorated. In an article of this nature it is almost impossible to convey a truthful impression of the spacious luxury of the Empire flying boat, but it can be said without question that these aircraft set an entirely new standard of comfort for air travel.

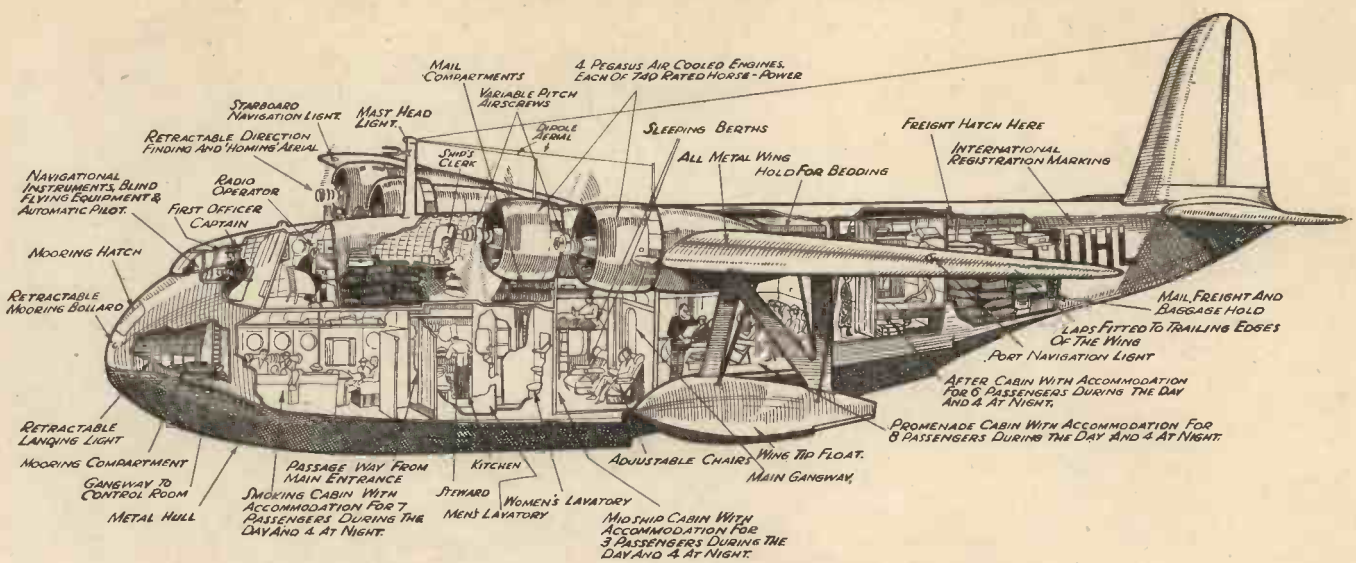
Twelve Machines

The fleet of land planes which is to work in conjunction with the Empire flying boats is still under construction at Hamble, near Southampton, but the first of these twelve machines has now reached a stage where it is possible to judge practically everything except its performance in the air, and if there is any truth in the old adage "that if an aeroplane looks right, it is right," then this machine should have an astonishing performance.

Like the Empire flying boats the "Ensign" class of land planes are high-wing all-metal cantilever monoplanes, fitted with four engines. In this case the total horse-power



(Top centre) Flying boat "Canopus" taking off. (Below) The main spar of an "Ensign" class air liner. Its length is 127 ft.



This illustration shows representatively the vast strides which have been made in aircraft construction.

available is slightly less, the total being 3,400, supplied by four Armstrong Siddeley "Tiger IX" supercharged engines built into the leading edge of the wing, and fitted with controllable-pitch airscrews. According to the manufacturers' estimated performance figures the machine will have a top speed of over 200 miles per hour, and will be able to maintain its height on two engines only in case of emergency.

The principal feature of the design is the wing construction, in which the entire wing, which is tapered in plan form and thickness, is built up around a single rectangular box spar of light corrugated sheet metal. The fuselage is a conventional oval monocoque structure covered in duralumin, and flush riveted to reduce skin friction.

The undercarriage, despite the fact that it is the largest in the world, is retractable. Hydraulically operated, the back leg folds to enable the wheels to travel backwards and upwards into the engine fairings behind the main plane spar. As each of the two single wheels is fitted with a tyre over 6 ft. in diameter and 2 ft. wide, it is not surprising that this section of the machine provided the designers with the greatest problems.

Layout and Equipment

The interior layout and equipment of this machine is similar to the Empire flying boat, except that accommodation is provided for forty-two passengers, each of whom is provided with a table, reading lamp, and a personally controlled ventilator. This last item is independent of the main ventilation and heating system, in which clean air is drawn in around a steam heater operated from the engine exhausts and subsequently circulated through all the passenger saloons, thus affording a constant supply of air untainted by engine fumes and delivered at an equable temperature.

In addition to the passenger saloons, there are two separate lavatories, a kitchen, a bar, mail and freight holds, and an office for the ship's clerk.

No longer are the pilots expected to sit in a half-open and draughty cockpit. In both these new types the pilot, first officer, and wireless operator are accommodated in a comfortably fitted "control room" in the extreme nose of the machine. Here the equipment, in addition to the customary side-by-side dual control columns and parallel-motion rudder bars, includes an automatic pilot of the latest type, short and long wave radio transmitter and receiver, and full direction-finding apparatus. The first of these machines should be flying within the next six weeks, and its performance seems likely to break all records for aircraft of similar size.

From the above descriptions it will be seen that no stone has been left unturned in the effort to ensure the success of the greatest air transport project yet conceived, the equipment is impressive, but no less impressive than the schedules laid down for the commencement of the services. According to present plans it is intended to reduce the journey to India from five to two and a half days, and to operate it five times a week in each direction. Singapore and Cape Town will be only a four and a half days' journey as compared to the present eight days, and Australia will have a twice weekly service, taking seven days instead of the present twelve and a half days. Meanwhile the fastest ship takes thirty-one and a half days for the same journey. In the words of its sponsors, "this scheme aims to abolish the famous overseas 'mail-day'," and seems certain to succeed.

Rhodium Plating—Some Practical Notes on a New Art

THE introduction of rhodium as a plating metal is of very recent date, yet, owing to the excellent results obtained by the process, rhodium plating has achieved a well-deserved popularity for decorative purposes.

Rhodium is a member of the platinum group of metals. It is, of course, a rare and an expensive metal, but, fortunately, only a small quantity of a rhodium salt is required for plating purposes and, after the rhodium plating bath has once been set up, its actual running costs are very low.

A White Metal

Rhodium is almost invariably plated on silver-plate or on sterling silver articles. The metal is nearly as white as silver and is practically indistinguishable from the latter. Rhodium is an absolutely untarnishable metal so that a rhodium-plated article will, unlike a silver or a silver-plated object, remain bright indefinitely.

An effective rhodium plating bath may be made up according to the following formula:

Rhodium sulphate . .	·25 gram.
Ammonium sulphate (Pure)	8 grams.
Sulphuric acid (Conc.) .	16 grams.
Water	250 ccs.

This bath should be used at a temperature of 50° C. The anode should comprise a carbon rod, or, better still, a thin strip of platinum, whilst the cathode consists of the silver or silver-plated article which is to be rhodium plated.

Current Density

A small battery of 2 volts should be used with the bath, the "current density" (i.e. the measurement of the current passing through a given area of cathode surface) being about 60–70 amps. per square foot of surface to be plated. Thus it will be seen that a fairly heavy current at low voltage is required.

The current should be passed for from 20 to 30 seconds. This will give a very close-grained deposit of metallic rhodium on the silver article, after which the latter should be withdrawn from the bath, carefully drained, well-washed and finally dried and subjected to a light polishing.

The rhodium-containing electrolyte must be contained in a porcelain, glass or enamelled vessel and not in a metallic one. Rhodium sulphate is, of course, an expensive salt, costing some five or six shillings per quarter gram. It may be obtained from most dealers in fine and laboratory chemicals as, for instance, Messrs. Johnson Matthay & Co., Hatton Garden, London, E.C., or from Harrington Bros., Ltd., London, E.C.1.

Untarnishable

Thodium should not be plated on base metals such as iron or copper, since a film of rhodium on the surface of such metals sets up an electrolytic action resulting in the gradual loosening of the deposited rhodium. For permanently preserving the white, lustrous appearance of silver and silver-plated articles, rhodium plating has much to recommend it, for, once deposited on such objects, the silvery white film of metallic rhodium is untarnishable and unalterable.

OUR BRITISH YACHT CHALLENGERS

By W. J. BASSETT-LOWKE, M.I.Loco.E.

SCALE MODELS OF THE FAMOUS *ENDEAVOURS*

NEVER in the history of the America's Cup has a British yacht stood a more sporting chance of winning back this most elusive trophy. As I write these words, *Endeavour I* and *Endeavour II*, the two famous challenger yachts, are crossing the Atlantic for this contest, which will be the centre spot of the Coronation Yachting Season.

A decision as to which yacht will be the actual challenger will be reached after the trial races off Rhode Island, but this contest may be considered to have done more towards the improvement of large racing yachts in every aspect, than any other yacht racing, and the experience gained in details and equipment is to the great benefit of the cruising yachts of the future.

All-steel Construction

Mr. Charles Nicholson has created in the lovely all-steel *Endeavour II* a marvel of efficiency. The measurements of Mr. T. O. M. Sopwith's latest challenger are a secret, but her approximate dimension are as follows: From bow tip to the extreme counter she is 132 ft., her draught is 15 ft. and she registers 164 tons. Her unique steel mast, which in general construction is like a bamboo tree, is 65 ft. high, her cross-trees and standing rigging are of steel tubes and rods, and her great white mainsail is made of 120 pieces of specially tested sail-cloth.

Both yachts are equipped with centre-boards of steel plate, which can be raised and lowered through a slot in the lead keel. They are fitted with specially designed capstans for working the running rigging and sails, and a number of instruments are fitted such as tension meters for the rigging, wind-speed indicators, speed logs, etc. The large number of capstans on the yachts eases the manual labour, so that even when racing all out, the crews can keep them well in hand. The only difficulty is to keep aboard when a yacht is heeling at a dangerous angle, because there is only a low foot rail between them and the sea.

Raced Last Season

Endeavour II was raced last season in the J Class in England, but the general conditions were not conducive to a thorough testing. Her performance was generally very satisfactory however, and it is the majority's opinion that she is a faster yacht than *Endeavour I*, particularly in moderate winds. She is all steel except her rudder which is of mahogany, and her decks of yellow pine. The accommodation provided on her is similar to other yachts of her class, including a number of staterooms, two bathrooms, a large saloon and Officers' and Crews' quarters. She is also equipped with electric light.

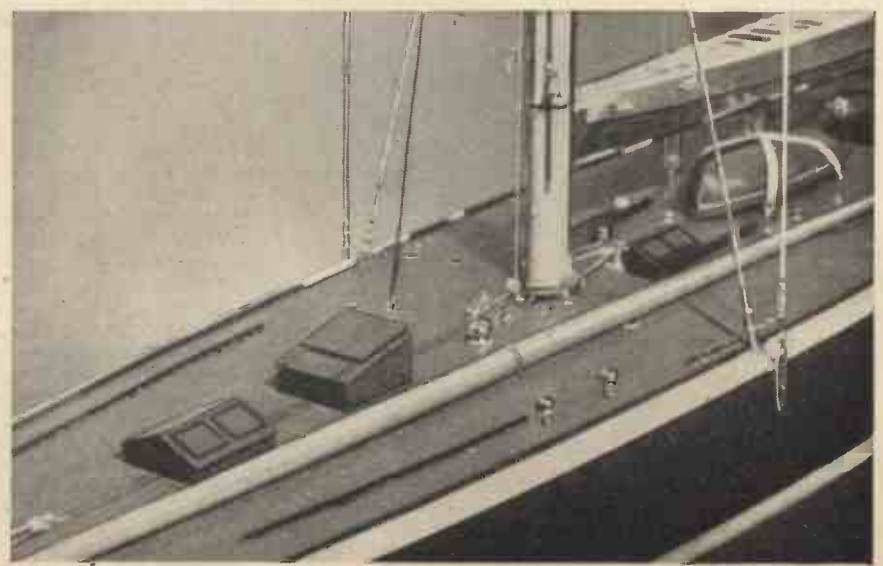
Port side view of the completed model of "Endeavour II."

The conditions for the Cup Races call for certain requirements, such as a large ice box, and the fitting of normal living comforts for the owner and crew on board.

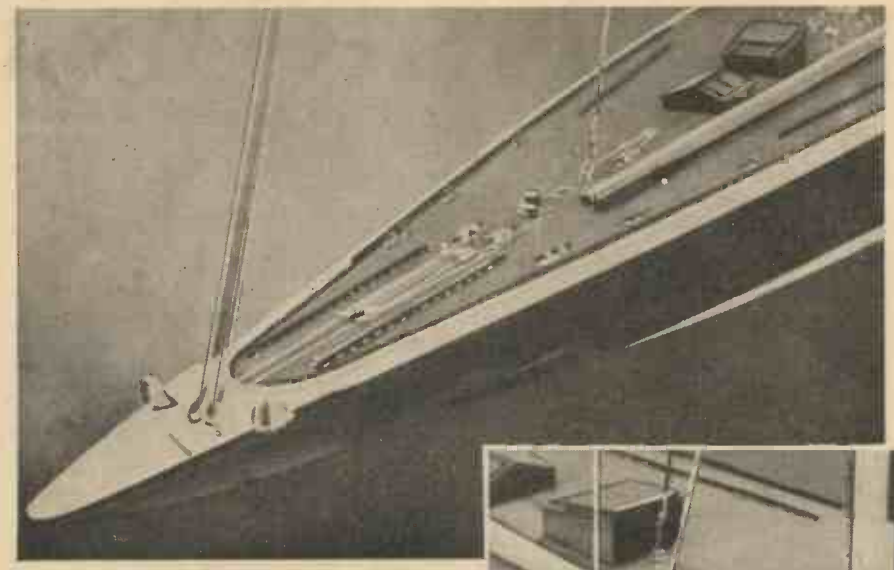
Under the present-day rules for this contest, the yachts are constructed to Lloyd's Class, but weight of masts is limited, and there are a number of clauses whereby both the challenger and the defender are bound to be generally similar yachts; and it is due to this that the present contests are fairer and the yachts generally more equal, than in the history of the past races for America's Cup. Apart from the actual design of the yachts, their general handling, helmsmanship and sail trimming are of immense importance, and have been developed to a very high technique.

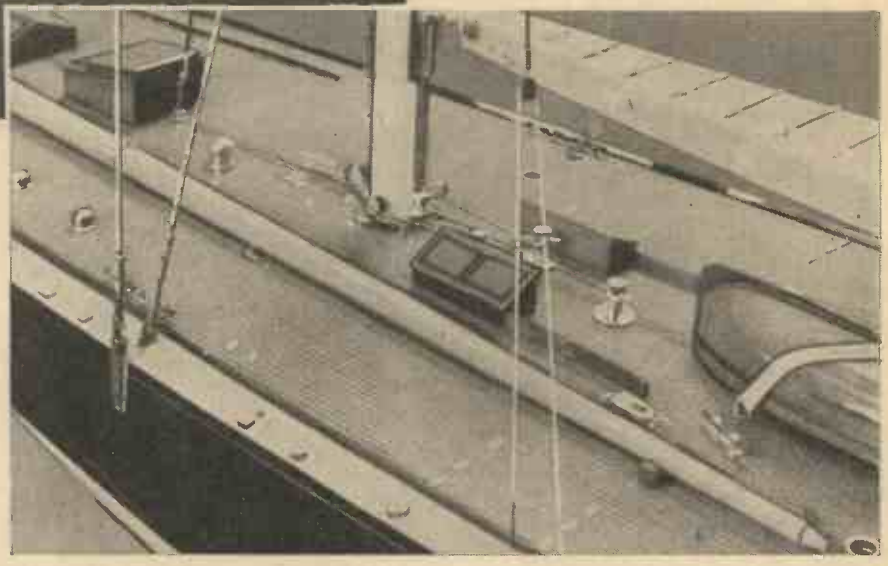
Three Models

The illustrations on these pages are of models, whose hulls were made at Gosport (where the real yachts were built) and finished off and rigged at the Northampton shipyard of Bassett-Lowke Ltd. There are three models in all, one of *Endeavour I*, made for the New York Yacht Club, and two of the new challenger, *Endeavour II*. One of these goes to the owner, Mr. T. O. M. Sopwith and the other is being exhibited in the British Government Pavilion of the



The heel of the mast taken from the forward side showing the spinnaker in chocks on the deck.





Top left : The bow of "Endeavour II" showing the accurate deck detail. (Above) Amidships at the heel of the mast from aft.

Paris International Exhibition. They were all built to the same scale of $\frac{3}{8}$ in. to the foot, which makes them about 4 ft. long with masts 5 ft. high. *Endeavour I* has finer lines than *Endeavour II*, and the mast of the "first" is round while the "second" is in an oval section. A particular feature of all three models is the peculiar triangular-shaped boom. The hulls are of kauri pine with mahogany king plank, and the yachts are very similar, with the exception of sundry small difference such as the fact that the *Endeavour II* has a white stringer plate, and the *I* has extended chain plates.

The hulls were sent from Gosport and Bassett-Lowke craftsmen worked on them for a month, completing the deck work, cabin skylights, rigging the masts and adding the hundreds of special small fittings, all of which were silver-plated and gave an exquisite finish to the model, which will no doubt be admired in their various "homes," particularly the one which has gone to Paris, where it will be an important item among the other examples of "modern progress" which will be shown in model form.

"Electric Wiring Diagrams," by W. Perren Maycock, M.I.E.E. 155 pp. 258 illustrations. Published by Sir Isaac Pitman & Sons, Ltd. Price 5/-.

THE Second Edition of this interesting handbook deals with circuit connections for supply mains, distribution boards, transformers, lamps, signs, heaters, motors, bells, fire alarms, private generating plant and many other phases of electric wiring. It includes a table of British Standard Electric symbols used in wiring diagrams and many practical diagrams which will be found of great value to those who are engaged in electrical engineering. The book is an invaluable reference guide to the practicing electrician as well as an interesting handbook for the student.

"Patents for Inventions," by Reginald Haddan, F.C.I.P.A. 92 pp. Published by Sir Isaac Pitman & Sons, Ltd. Price 3/6.

THE method of obtaining protection for an invention which may arise as a result of the study of a hobby or as a result of intensive research on a particular subject is often misunderstood by the layman. The result is that the values of the invention are lost to the inventor, or he fails to make sufficient capital out of the invention. The difficulties of a patent office search to ascertain anticipation and the other intricacies of obtaining a valid and worth-while patent are fully discussed in this interesting little book, which should be in the hands of every mechanic and handy-man. The various chapters explain the nature and validity of patents, the value of patents, methods of obtaining provisional and full protection, title and specifications, searches and their object, maintenance of patent, stamp duties and many other details.

"Profitable Photography," by William Stewart. 106 pp. 21 illustrations. Published by Sir Isaac Pitman & Sons, Ltd. Price 2/6.

EVERY user of a camera has felt at some time or another that he would like to be able to turn his hobby to profitable use. The usual haphazard snapshot cannot usually be sold for publication, but with a little care it is possible to take snaps which, whilst fulfilling the usual personal requirements, will also have a commercial value, and this little book explains the various points which have to be considered in using the camera for this purpose. The 11 chapters of the book explain the Photopress terms ; Posing subject ; the News Picture ; Gaslight photography ; Story and article illustrating ; the Unlimited Field of Advertising ; Markets for photography, etc. A chapter is devoted to a description of the illustrations appearing in the book.

NEW EXHIBITION BUILDING

EARLS Court Limited commissioned Mr. McKnight Kauffer to design a symbol for their great Exhibition Building now nearing completion. This mark has now been registered.

Asked why he chose a knight on horseback as the basis of his design, Mr. McKnight Kauffer said, "I have tried to produce a symbol which would carry on the Earls Court tradition of spectacle and sport."

He described his design as "a link with the past and a challenge to the future."

"Earls Court," he said, "came into prominence with Buffalo Bill's equestrian entertainments, and although its future might see the eclipse of the horse, the romantic element would always be present. .

NOTES ON PETROL-DRIVEN MODEL AEROPLANES

By C. E. B.

A New Monthly Feature

This model aeroplane which has a 6 ft. wing span is powered by a Baby Cyclone engine of ⅛th h.p. Its estimated flying speed is 35–40 m.p.h.

General

IN this series of monthly notes on petrol model aeroplane construction, I hope to assist the newcomer to petrol models, in general hints on design and also in constructional methods and detail work.

Now is the time, during the summer, to produce the model that will be flying next summer.

Set the design down on paper now, and take the late summer evenings for leisurely construction, after which the test flights can be carried out, and any small modifications required can be incorporated.

This month I hope you will compete for the New International Trophy I have presented to the Society of Model Aeronautical Engineers for annual competition.

The rules are being kept simple so that all types of petrol models of any design or size up to 15-ft. span can enter.

Provided the model is reliable and stable, and is not prone to damage, it has an excellent chance of winning. The beginner, therefore, should enter.

The S.M.A.E. have already published the rules, and in the meantime I can assure those interested that they can start construction now, and if they keep to a simple stable model with some device that will control the duration of flight to within reasonable limits, it will fit the rules, for it is the good flying type of model we are out to encourage.

I sincerely hope this trophy will draw a large number of entries, for the idea behind the trophy is to encourage *all types* of petrol models that will fly, and not to limit constructors to design only one type of model as has to be done in most of the competitions for rubber driven models.

It is my hope that the entry will be large and comprehensive, and produce many and varied designs which will all add to the general interest, value, and fun of the game.

The First Model

I always like to see a newcomer to petrol start off with a very simple model with rectangular fuselage, a high wing of cantilever construction, and with a simple but effective undercarriage.

This type of model is much more likely to give encouraging results than the complicated scale type of model. Gain experience on the simple high-wing model first, then try a simple biplane and follow that with a simple low-wing model.

After that set about the more beautiful monocoque or scale affair, and suitably modify the design to produce effective flying results from the experience you have gained on the more simple models.

And yet one often sees the reverse procedure adopted, followed by failure.

I cannot too strongly advise patience and the simple beginning. I have built all types, including two flying boats and two autogiros, but am a firm believer in the simple model for excellence of flying.

Wing Loadings

Some readers may remember my old "Blue Dragon" high-wing monoplane which still holds the British R.O.G. record. This old model is now four years old and has been flown by many types of engine.

Its most recent exploit was with a little 6-c.c. "Baby Cyclone" engine.

OUR FREE ADVICE BUREAU

The attention of the reader is directed to the Revised Rules of our Query Service, as detailed on page 541.

I was particularly interested to see what this engine would do with such a heavy and large model. With the "Cyclone" fitted the outfit weighed 6¾ lb.

The model has an 8-ft. span wing designed for high lift and slow flying.

The test was all the more interesting, as on the day I first took the model out there was another model on the aerodrome also fitted with a "Cyclone" engine, but with a considerably less wing area and a fast wing section. This model only weighed 4½ lb.

The day was dead calm and rather damp and foggy, therefore difficult going for a small engine in a large and heavy model.

If you have not had much experience with petrol models, I expect you will feel that the lighter model did the successful flying.

Actually this was not so. Let us examine the reason. The ancient, oil-sodden and dope-weighted old "Blue Dragon," built extra heavy forward for larger engines, after a few adjustments to thrust line to suit the smaller engine, carried out from 10 to 15 flights during the afternoon at a low altitude, circling around the aerodrome in steady but leisurely fashion, its little engine humming raucously away, whilst the lighter model failed to get going in the still damp air. Why was this ?

The explanation is very simple, but should be remembered by the man who is seeking after knowledge when designing his first model.

On the "Blue Dragon," *the wing loading and flying speed suited the propeller pitch, and the propeller pitch enabled the little engine to produce maximum revolutions to produce its best power.*

The "Blue Dragon," although far heavier, has a light wing loading, that is to say, the span and chord present a large wing surface in relation to the weight, whereas the other model, although much lighter in itself, has a small wing to carry its load. The wing loading was therefore heavier, and as the pitch of the propellers were the same on both engines (7½ in.) the smaller model had too fine a pitch to fly at the fast speed that

he *high-wing loading and fast-wing section* produced. I will explain propeller pitch and its effects another time, as it makes all the difference between a good and a poor model.

If the pitch had been greater on the smaller but faster model, it would have flown. But if the pitch had been greater, the very small engine would probably not have driven the propeller at a sufficient speed to gain its maximum power.

The answer then is, of course, to produce a model with a light wing loading and with a slow-flying section, and thus a slow-flying model for these little engines. The result will be most gratifying, for there is nothing nicer to see than a slow flying petrol model that flies steadily and safely, and a low-powered model if correctly designed excels at this.

In America a "Baby Cyclone" engine has flown a 15-ft. span model! Of course this model is built light, but nevertheless it is comparatively heavy and has a lot of head resistance due to size. If the wing loading is kept light, a great deal of weight can be carried on a very little power if the owner is content to assist the model into the air by a push R.O.G. or by hand launching. Keep

At High Altitudes

I have recently constructed a smaller sized model for the 6-c.c. "Cyclone" engine that can give high-altitude flying. The weight is much less, and the wing loading is also light. The wing span is 5 ft. 8 in., with a constant chord of 11½ in. and with a thick section. The weight of the model is 4½ lb., and it is very robust, as I do not like repair work and our climate is very strange.

Fig. 1 shows the model on the ground and gives a good general impression. It will be noticed that a monocoque fuselage is fitted. This might prove rather difficult to construct for the beginner, but the main dimensions, angles of incidence and fittings would form a valuable clue for any one designing a first model, but keeping to a rectangular fuselage. I therefore propose to give some of these main details in my next month's notes, and also to explain propeller pitch and the vital importance of fitting the correct pitch to suit the speed of the model.

Summary

From this article let us remember to keep the wing loading light and the model

Fig. 1.—The writer's 6-c.c. model which has a 5 ft. 8 in. span and a monocoque fuselage.

wing loadings from between 8 oz. per square foot to 15 oz. The smaller the engine the nearer the 8 oz. it should be.

Suitable Sizes of Model that 6-c.c. will Fly at Medium Altitudes

For practical purposes in England, I have come to the conclusion that the 6-c.c. engine of good power output will fly at *medium altitudes* a model like the "Blue Dragon" with a wing of 8-ft. span and 16-in. chord at the root with a taper to 10-in. chord about 10 in. from the tips. A thick section and slight undercamber helps towards slow speed. A newly built "Blue Dragon" would weigh about 6 lb. all on with a "Cyclone" engine, and yet be very robust for the English climate. As already explained, my old model has collected extra weight from dope, old oil and stouter nose for larger engines.

For those who use the 10-c.c. "Brown Junior" engine with its extra power, the "Blue Dragon" measurements are ideal for high-altitude flying, and I have used this engine a lot in the model, although there is a great fascination in the lower altitude aerodrome flying with the smaller "Cyclone" engine.

simple. If one takes a full-sized design as a pattern, the wing loading will almost invariably be too high, as the full-sized machine is meant to travel fast, and therefore has a high wing loading.

After I have discussed the main points in design and construction, and as the model flying season will soon be in full swing, I hope to give some useful hints and tips that will help to give you trouble-free engine running.

Accessories

I try out all sorts of accessories for information and amusement, and will pass on from time to time what I think may be of interest and use.

There are two useful types of wheel that I have recently tried, and both are of British manufacture. The first is the "M.S." airwheel, produced by The Model Shop, Newcastle-upon-Tyne. The wheels are inflated by a simple valve and have robust tyres that give a reasonable weight. I have found the 4½-in. diam. wheels excellent.

Another airwheel that is also very effective is the "B. & B." airwheel produced by the Model Aircraft Stores, Bournemouth. This wheel has the merit of low cost.

Around the Trade

News from Manufacturers

Beck's "Home Laboratory" Competition

A. N. BECK & SONS, 60, High Street, Stoke Newington, London, N.16, have recently organised a "Home Laboratory" competition which should appeal to readers interested in chemistry.

All you have to do is to write a short essay on "Chemistry Experiments at Home" not exceeding 500 words in length, treating the subject in any way you wish. You may stick to plain facts or you may draw upon your imagination. There are a number of prizes the first being a set of apparatus and chemicals, value £5 5*s*., second prize a chemistry set, value £2 2*s*., and third prize a chemistry set, value £1 1*s*. Fifty consolation prizes will also be awarded. If you desire to enter, *your entry must be accompanied by an order*, otherwise it will not be accepted. The closing date is August 31st, 1937.

Model Shipbuilding

MESSRS. E. GRAY & SON, LTD., 18-20, Clerkenwell Road, London, E.C.1, have recently issued new and enlarged editions of their lists of "Designs for Sailing Ships" and "Designs for Steam and Motor Ships, Liners, Warships, Racing Yachts and Motor Boats." Each booklet contains a list of designs (blue-prints, etc.), with a selection of books available for the use of model shipbuilders. They cost 6*d*. each, post free, from the above address.

"Slipknot" Rubber Tape

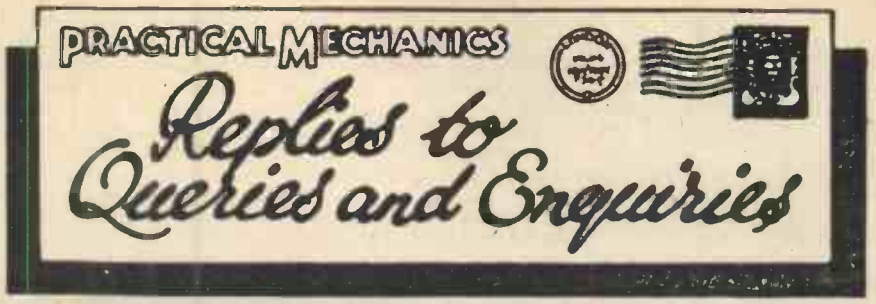
WE have recently received from Rotunda Ltd., Denton, Manchester, a sample coil of an exceedingly novel and very useful rubber tape which they manufacture, known as "Slipknot" Rubber Splicing Compound Tape.

It is a rubber insulating tape of high voltage resistance and is suitable for many ingenious purposes. When it is lapped under ordinary tension (after first removing the red protective interleaving), the layers mould into a solid piece of rubber without the aid of heat or vulcanisation.

The retail price works out about 9d. per 4-oz. coil and 1*s*. 3*d*. per 8-oz. coil of ¾ in. width. Wider widths in larger coils can be supplied if required.

Coloured Cement

"COLORCRETE" is a Portland cement with the addition of permanent standardised colour which is supplied by G. & T. Earle, Ltd., Wilmington, Hull. The addition of this colouring matter does not affect the cement adversely. It is supplied ready for mixing with the aggregate and water. The cost of rapid hardening "Colorcrete" either buff or red, is 5*s*. per cwt. and is delivered in non-returnable paper bags. There is also a range of more delicately coloured cements sold under the name of "Colorcrete" (not rapid hardening); the cost of these is somewhat higher, and prices will be quoted on application to the above firm.



A stamped addressed envelope, three penny stamps, and the query coupon from the current issue, which appears on page 591, must be enclosed with every letter containing a query. Every query and drawing which is sent must bear the name and address of the sender. Send your queries to the Editor, PRACTICAL MECHANICS, Geo. Newnes Ltd., Tower House, Southampton Street, Strand, London, W.C.2.

SOFTENING PARCHMENT

"COULD you please advise me as to a method of softening parchment so as to be able to mould it into a very shallow dish of approximately 10 in. to 12 in. diameter and about 6 in. deep?

"After this shape has been attained, I should want the parchment to retain its colour and qualities as before softening. I have tried a solution of water, gelatine, sulphur, and linseed oil, but these do not seem to be very satisfactory.

"Would you also please advise me of the name of a firm where I can obtain paper which is printed to imitate veneer woods?" (E. J. W., Chelsea.)

(1) PARCHMENT can be softened by steeping in very hot water or a hot one per cent. solution of caustic soda. Oils have no action in softening parchment which, if genuine, is an animal skin and is thus only influenced by heat or by alkaline agents.

(2) You can obtain wallpapers printed to imitate veneers from Wallpaper Manufacturers, Ltd., King's House, King Street, West, Manchester.

PLASTICS

(1) I am deeply interested in a bi-product of ammonia, which can be poured into a mould, and when set, resembles glass. This glass is very flexible indeed and can be bent into a complete semi-circle with reasonable ease. When in sheets, it is extraordinarily clear, and if it is stood on between two pieces of wood, it will bend considerably. (This information was obtained from a scientific film in a news theatre.)

(*a*) "Could you tell me whether this material is armour plate glass or whether it is a certain kind of celluloid?

(*b*) "Is this glass manufactured in a laboratory, and if so could you possibly tell me the ingredients?

(2) "I am trying to make a liquid or paste which, when set into a mould, can be used over and over again, will be hard, with a very slight flexibility, will not be brittle, will stand a good knocking about, will stand screws (and nails), and can be joined by pushing a pin into the substance.

"If there is such a substance, could you please tell me if it can be made in a laboratory without much difficulty, and if so could you tell me how and what chemicals to use?" (A. H., Manchester.)

(1) THE material you refer to is a synthetic plastic product now manufactured commercially by Imperial Chemical Industries, Ltd., from whom you may obtain full particulars. The Head Office of I.C.I. is Millbank, London, S.W.1. There is also a branch of this concern in Manchester.

(2) We doubt whether there exists a material possessing the somewhat exacting properties which you demand. One of the new synthetic plastics would suit your needs the best, but these cannot be produced in a home laboratory and, moreover, they necessitate the employment of special presses for their moulding. Particulars of many of these plastic materials may be obtained from I.C.I. (mentioned above) and, also, from Afcom, Ltd., 32, Victoria Street, London, S.W.1. A thick solution of glue to which has been added a small quantity of formaldehyde might, by careful heating, becomes so insoluble that it could be moulded into the articles you require.

A CANVAS FLOAT

"I WISH to build a canvas and ply float (completely covered and water tight) to carry 160 lb. before becoming submerged. Every endeavour will be made to make same as light as possible.

"Will you kindly give me dimensions (about 6 ft. long), or some simple formula to obtain cubic air space per lb. lift." (R. H. D., N.W.1.)

A FLOAT to support a weight of 160 lb. and having a maximum length of 6 ft. would be 12 in. wide and 7½ in. deep for the central 4 ft. of the body if the ends are to be tapered off each end for 1 ft. You do not state whether the float is to be stationary or whether it is to be propelled in some manner through the water, in which case it would obviously be pointed at each end and for which this calculation allows. The dimensions also allow for the approximate weight which the materials are calculated to weigh. The float fully laden to the specified weight should float with the top slightly clear of the water.

If, however, the float is to be propelled at any speed it would be advisable to relieve it of some of its draught by increasing the length to eight feet. Such a float having less draught and more length would require less effort to propel than the former with full draught.

PROPELLER FOR SPEEDBOAT —

"I HAVE a boat 8 ft. long by 4 ft. beam and the bottom is veed into the bows, gently tapering off until it is flat at the stern. In it I have installed a 250 cc. Villiers two-stroke engine and geared it down, by means of two sprockets and a chain, to about 1½-1, and I have a universal joint in the propeller shaft. Could you tell me what size of propeller would give the best all round results (dia. and pitch), and what speed it should turn, also how fast will the boat go?" (F. S., Surrey.)

AS you are restricted to 5 in. between the shaft and the bottom of boat, you cannot use a propeller greater than 9 in. and even this is cutting matters rather fine, but since you have geared your engine down to 1½ to 1 you can use a three-bladed propeller 9-in.

diameter and 9-in. pitch. With your engine developing, say 2,500 r.p.m., you will get a propeller speed of approximately 1,466 r.p.m., which should give your boat a speed of about 8 m.p.h. It must be remembered that your hull is designed on speedboat lines, and is therefore meant to plane and to be propelled by a high-power engine. Your inquiry states that you have a universal joint in the propeller shaft. Have you fitted a thrust bearing between it and the propeller to take the forward thrust when under way? If not, this should be done as the load on a universal joint at approaching 1,500 r.p.m. will cause undue wear, and vibration.

AN IMPROVED TOY BALLOON

WILL you please advise me as to whether the device, a sketch of which I enclose herewith, is patentable. If it is, will you please give me an idea of the charge which a patents agent would make for filing a provisional specification to cover it, and also a list of firms who might be interested in it. If the device is not patentable, could you suggest any means by which I might exploit it?" (C. W., Surrey.)

THE improved toy balloon is novel, and forms fit subject matter for protection by letters patent. You are advised to file an application for patent with a provisional specification, which will give you protection for about 12 months, during which time you should be able to ascertain if the invention is likely to be commercially successful. The usual inclusive charge of a chartered patent agent for filing an application for patent with a provisional specification for a simple invention is £4 4*s*. The following firms might possibly be interested in the invention: Balloon Publicity Ltd., 37, Harrow place, Houndsditch, E.1; Lewis Knight Ltd., 53, Bunhill Row, E.C.1; A. Siebert & Co., Ltd., 6, Fann Street, Aldersgate, E.C.1. You are advised not to submit your invention to any firms until after you have protected it.

A SPARKING-PLUG SPANNER

"I ENCLOSE a sketch of a sparking-plug spanner which I have made. Some plug spanners listed by well-known toolmakers cannot be used without difficulty on most car engines of to-day owing to distributor, dynamo, and other components being mounted on the cylinder head. This type of spanner can be used with ease, and will fit the two sizes of plugs most commonly used to-day. Would you please tell me if this might be of any commercial value and advise me where to communicate for protection by letters patent." (F. L., Dorset.)

THE improved sparking-plug spanner is thought to be novel, and forms fit subject matter for protection by patent.

If the invention is properly marketed, it should have a distinct commercial value. You are advised to file an application for patent with a provisional specification, which will give you protection for about 12 months, during which time it should be possible to ascertain the commercial possibilities of the invention, before having to incur any great expense.

A CAMERA LENS HOOD

"WILL you please advise me whether the enclosed idea is a suitable subject to patent. Should you advise me to take any further action, I should be grateful for any information that you can give or recommend as to methods of procedure, as I know very little about this." (W. T., Sussex.)

THE improved camera lens hood is thought to be novel and forms fit subject matter for protection by letters patent. You can apply for a patent either with a provisional specification or a complete specification. In the former case, protection is obtained at the least expense for about 12 months, and if a full patent is desired a complete specification must be filed within the 12 months. The official search for novelty of an invention is only made after the filing of the complete specification.

It would probably be advisable for you to apply for a patent with a provisional specification, as during the 12 months you should be able to ascertain if the invention is likely to be a commercial success, or obtain assistance in financing it. You are advised to obtain professional assistance in applying for your patent.

MAKING FIREWORKS

"1. WHAT are the proportions (by weight) necessary when mixing the explosive mixture required for 'bangers'? I am led to understand that the proportions, by volume, are as follows: chlorate of potash, 20 parts; wood charcoal (powder), 9 parts; sulphur, 7 parts.

"2. How can I make other well-known types of fireworks—Snow-storms, rockets, jumping crackers, and spinning wheels, etc., and where can I obtain supplies?

"3. Also, can you tell me how I might obtain correct mixtures? I have no chemical balance." (R. W., Sheffield.)

1. THE proportions *by weight* which you state of potassium chlorate, charcoal and sulphur, will give an efficient detonating mixture particularly when the mixture is tightly rammed down. You should, however, bear in mind the fact that the grinding or rubbing together of mixtures containing potassium chlorate is an exceedingly dangerous operation, since such mixtures are liable to explode at any moment.

2. Rockets, crackers, spinning wheels all contain a fairly rapid-burning gunpowder, of which the following formula is a typical one:

Wood charcoal . . .	2 parts.
Saltpetre	4 parts.
Wood flour (fine sawdust)	0.5 part.
Flowers of sulphur . .	1.5 parts.

The above powder may be "coloured" by admixing with it small quantities of copper sulphate, stronium nitrate, barium nitrate or sodium nitrate. These will give, blue, red, green and orange fires respectively All the above chemicals can be obtained from any firm of laboratory suppliers, as, for instance, Messrs. Reynolds & Branson, Leeds, or from The British Drughouses, Ltd. London, N.1.

3. Correct mixtures of the above materials may be obtained by working out the "parts" of each ingredient in spoonfuls. If, for instance, the gunpowder mixture above quoted is measured out in spoonfuls instead of "parts" it will serve quite well. There is, indeed, in actual practice little difference in these mixtures between "parts by volume" and "parts by weight."

FROSTED GLASS

"I WOULD be greatly obliged if you could inform me of the ingredients required to make the solution which one puts on glass to obtain a 'frosted' effect such as is shown on the small piece enclosed." (S. M., Manchester.)

"FROSTED" effects on glass, such as that on the small piece of glass submitted, are nowadays obtained by painting over the glass with a special lacquer containing a trace of a suitable dye. A simple method of preparing such lacquers is by dissolving a quantity of *Abrac Ester Gum* (procurable from Messrs. A. Boake, Roberts & Co., Ltd., Carpenters Road, Stratford, London, E.15) in acetone or white spirit and by colouring the solution with a trace of acetone- or spirit-soluble dye. It is quite possible that Messrs. Boake, Roberts & Co. may be able to supply a ready-made lacquer for the above purpose.

FOLDING OUTBOARD BOAT

"I HAVE studied your design for a Folding Outboard Boat, in the current 'P.M.' with very great interest; also the £15 Speedboat, described last year.

I am eagerly awaiting the next issue for further details. In the meantime, perhaps you will advise me on the following:

1. "Is there any objection to increasing the length to, say, 12 ft., and the beam to 3 ft. 8 in.?

"2. Why use plywood? I am given to understand that this is an unsuitable material for boat-building.

"3. Would not Lloyd board be more suitable? (and, of course, more expensive?). What would be a suitable thickness? What is the price per sq. ft.? Is Lloyd board British-made?

"4. As an alternative, could one use a small mast and sail, in place of the motor? A very simple type is desired." (K. H., Yorks.)

1. THE length may be increased, also beam.

2. Plyboard is specified mainly because it can be obtained anywhere. If the edges are well painted or varnished the wood will stand up quite well.

3. We see no reason to substitute Lloyd board and do not think you will gain anything.

4. A small mast and sail is not to be advised and it certainly would not take the place of a motor. Before a sail could be used with all-round good results, a centre-board would have to be fitted and that is quite out of the question in the case of this boat.

"I WISH to construct a folding boat as described in May 'Practical Mechanics,' but with certain modifications, and would be glad of your advice.

"I should like to use 'Masonite' tempered Prestwood, for the sides and bottom, as this only weighs 12 oz. per sq. ft. (¼ in. thick) or 18 oz. if ⅜ in. thick. Also, as it is obtainable in sheets 12 ft. long, would it be all right to increase the other proportions by the same amount? (⅓th).

"Further, as the sheets are 4 ft. wide, and I intend to carry that boat on top of my car, could not the centre seam in the bottom of the boat be done away with, and the bottom made in one piece?" (D. O., N.W.9.)

IT is questionable whether the material you contemplate using would have the necessary rigidity to be a success, for it must be remembered that there are no fixed frames in the boat, we advise you to keep to ¾-in. plyboard. The bottom could, of course, be made in one piece if you don't want to fold it.

The dimensions may be increased provided again there is sufficient rigidity in the material.

AN EXPERIMENT IN CHEMISTRY

"COULD you please give me some advice on the following:

1. A weighed quantity of sulphur is burnt in oxygen to form sulphur dioxide, which is dissolved in hydrogen peroxide to form sulphuric acid. Can this be used to find the weight of sulphur in sulphuric acid not assuming the formula of sulphuric acid? If so, how can the experiment be performed?

2. How much does an air pump cost working from the mains, and where are they obtainable?" (E. T. B., Northants.)

1. THE experiment you mention cannot be performed quantitatively because, although hydrogen peroxide has the property of converting sulphurous acid into sulphuric acid, the conversion is not carried out to finality and side-reactions proceed at the same time. Also, sulphuric acid itself (above certain concentrations) decomposes hydrogen peroxide, liberating ozonised oxygen.

2. By "air pump" we presume you refer to a vacuum pump capable of removing air from enclosed spaces. These are expensive articles. The cheapest rotary pump costs about £7 and this is really only suitable for hand operation. A serviceable pump operated by a mains-driven motor would cost anything up to £50, and even more. However, an enquiry to either Messrs. Reavell & Co., Ltd., Ranelagh Works, Ipswich, or Messrs. Philip Harris & Co. (1913), Ltd., Birmingham, would bring you precise details and prices of any type of vacuum pump you specially desired.

ELECTRO-PLATED PLASTICS

WE have received the following letter, *à propos* our recent paragraph under the above title.

A managing director of a company which until recently was engaged in working the above process, makes the following comment on the paragraph headed "Electro-Plated Plastics," under "This Month in the World of Science and Inventions," which appeared in our issue dated June, 1937:

"The process of electro deposition of metal on non-metallic surfaces has been known and practised for many years, under the name of 'Kupronizing' in the case of copper, on plaster and wood, etc.

"The depositing of copper as a base for subsequent nickel and chrome plating on Bakelite and similar plastic mouldings relies on the fact that the surface of the moulding must first be 'metalized' by treating with graphite or spraying with bronze powder in a weak solution of cellulose lacquer, or some similar means. The disadvantage of this process is that the adhesion of the film of metal is very poor, being so slight that, unless there are many curves on the article plated, it is inclined to lift away when polished, or even before the polishing has been carried out.

"Another difficulty in connection with the process is to obtain a satisfactory Electrical contact in order that the metal may 'grow' right over the article.

"Although mouldings of certain types have been successfully plated, the percentage of scrapped parts is very high."

IMPORTANT!!

In future a charge of 3d. will be made for queries sent in by readers. See page 541 for details. A stamped addressed envelope and the Query Coupon cut from the current issue must also be enclosed.

FREE SERVICE FOR READERS

READERS requiring information concerning goods or services advertised in *PRACTICAL MECHANICS* should give names of Advertisers from whom particulars are desired. Any number of names may be included and we will obtain for you catalogues, lists and any other information you may be wanting. THERE IS NO CHARGE FOR THIS SERVICE.

Readers desiring particulars from a number of Advertisers will, by this method, save time and postage. Halfpenny stamp only is required if your envelope is left unsealed. If any advertiser stipulates that stamps or postal orders are necessary before samples or catalogues are sent, please enclose the necessary amount with your instructions. You are cordially invited to make full use of this service.

Post this to

ADVERT. SERVICE DEPT.,
PRACTICAL MECHANICS,
TOWER HOUSE, SOUTHAMPTON STREET, STRAND, W.C.2

Please obtain and send to me particulars from the Advertisers in your July issue whose names I give on list attached.

Advertiser	Page No.	Information Required

Attach sheet of paper, with particulars, and your name and address (written in **BLOCK** *letters) with date, to this announcement.*

BUY, EXCHANGE OR SELL

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.

CANOES

BOAT AND CANOE. Home Constructor Kits from 25/-. Completed craft from 45/-. List stamp; Trade also.—POUNCY "Meta-craft" (P) Ltd., CHRISTCHURCH.

CINEMATOGRAPHY

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.

ELECTRICAL

£18, LIGHTING AND CHARGING PLANT complete 100 volts. Worth double. Crowther, 125 Hazelbury Road, Edmonton, London.

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.

SUPER A.C. MOTORS. Brand New, ⅛ 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.

ENGINES

ARIEL V TWIN COMB. Ideal unit, complete for conversion to Four-Wheeler. Any trial, £3 10s. cash. Mason, Grove Farm, High Road, Chadwell Heath, Essex.

JUBILEE WORM DRIVE HOSE CLIPS

The long-life clip with the ever-tight grip

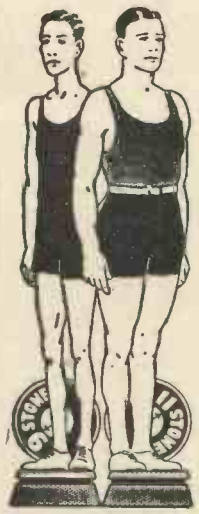
The Best Known

For Radiator Joints Air, Oil, and Water Hose Joints.

Large sizes stop squeaking brakes.

Stocked by all Garages and Accessory Dealers.

L. ROBINSON & CO., 25 London Chambers, GILLINGHAM, KENT.



Don't let* SKINNINESS *deprive you of your Summer Enjoyments!

No longer need you be embarrassed by skinniness or thinness and deprive yourself of Summer bathing. VALITONE BONBONS, Dr. Gallinger's prescription, the new improved, safe method of putting firm flesh on thin, scraggy people, will soon solve your problem. Valitone has helped thousands of Men and Women to become well-developed, attractive and popular. These tasty Bonbons will soon increase your weight from 10 to 30 lb., enrich your blood, aid digestion, and restore nervous energy. You will no longer be tired and sickly looking, in a few weeks your former skinny looks will be replaced by a beautiful, healthy appearance.

If you really wish to increase your weight, stamina, and nerve force, send 4/- for large box to :—

THE VALITONE Co. (V.12), 45, Hatton Garden, London, E.C.1

THE WEBLEY SERVICE AIR RIFLE MkII

NO LICENSE REQUIRED TO PURCHASE

WRITE FOR DESCRIPTIVE FOLDER

Rooks, Rabbits, Rats, Sparrows and similar vermin can be destroyed by this extremely accurate and powerful Air Rifle

Ideal for Target Practice.

CALIBRE 22 or 177 *With Leafsight and Peepsight*

WEBLEY & SCOTT Ld. 106 WEAMAN STREET, BIRMINGHAM, 4

The 'ADEPT' Bench Hand Shaper

Length of stroke of ram, 3½ ins.; Length of cross travel of slide, 3 ins.; Size of Table, 4½ ins. x 4 ins.; Rise and fall of Table, 2 ins.; Vertical feed of tool slide, 1¼ ins.; Maximum distance between tool and table, 3 ins.; Weight, 18 lb. Also the 'Adept' No. 2 B.H. Shaper, 6½-in. stroke. Price £6 - 9 - 6.

Manufactured by

F. W. PORTASS

SELLERS STREET, SHEFFIELD.

MAKE MORE MONEY

£3 to £6 weekly can be earned at home in a wonderful business of your own. No matter where you live you can commence to make money in your spare or whole time. No risk, canvassing or experience required. A wonderful opportunity for anyone wishing to add pounds to their income. Particulars stamp.

BALLARD, York House, 12 Hambrook Rd., LONDON, S.E.25

BLUSHING

FREE to all sufferers, particulars of a proved home treatment that quickly removes all embarrassment, and permanently cures blushing and flushing of the face and neck. Enclose stamp to pay postage to Mr. M. Temple (Specialist), "Palace House," 128 Shaftesbury Avenue (2nd Floor), London, W.1. (*Est.* 35 *years.*)

OUR ADVICE BUREAU

COUPON

This coupon is available until July 31st, 1937, and must be attached to all letters containing queries, together with 3 penny stamps. A stamped addressed envelope must also be enclosed.

PRACTICAL MECHANICS, JULY, 1937.

FORMULAS

START THIS PROFITABLE manufacturing business, making modern recognised specialities, from World's best Formulæ!! Investment small, profits TREMENDOUS. Lists, catalogue 4½d.—" TECHNOCRAFT," 41 Longford Place, Manchester 14.

LITERATURE

7,500 AMERICAN Mechanics' Magazines, 4/- Dozen. Books bought.—G. A. Final, 15 Nashleigh Hill, Chesham.

THE TECHNICAL PRESS LTD.—Publishers o Scientific, Technical and Industrial Books.

SLIDE RULE AND HOW TO USE IT. By C. Hoare. With a Slide Rule in tuck of cover. 110 pp. Net 4/-.

DECORATOR'S AND RENOVATOR'S ASSISTANT. Six hundred Recipes and Processes of Practical Utility in the Home. 170 pp. Net 2/6.

WATCH REPAIRING, CLEANING, AND ADJUSTING. By F. J. Garrard. A Practical Handbook dealing with the Materials and Tools used, 224 pp. illustrated. Net 5/-.—5 Ave Maria Lane. London, E.C.4.

MICROSCOPY

MICROSCOPIC OBJECTS—unmounted prepared. Assorted packet 2/-. MOUNTED SLIDES STOCKED.—LENG, 183 MANCHESTER DRIVE, LEIGH-ON-SEA.

MISCELLANEOUS

AVAN PROPELLERS. Cheapest and best for elastic or petrol. Guaranteed accurate. Lowest prices. Trade or Private. Full particulars from: AVAN, 3 Potters Cottages, Sherrard Road, Leicester.

RAILWAY—CYCLE—ELECTRICAL. Send for free list.—Kirby, 606–608 Washwood Heath, Birmingham.

A 20-TON STOCK of surplus Instruments, Magnet, Resistance, etc., Wire. Low prices. London Electric Firm, Croydon.

GRAMOPHONE

ATTACHMENTS for Radio, electric motors 30/-, Pick-ups 9/6, Portable Gramophones 15/-, spring motors 4/6, dozen 36/-, pedestal Anexagram £5, Soundboxes, Tonearms, Horns, Cabinets, needles, gears, springs, accessories cheapest. Violins, Accordions.

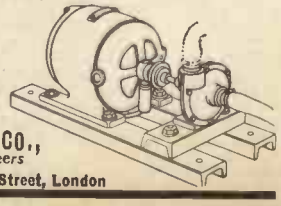
Trade supplied. Catalogues free. Established 1903

REGENT FITTINGS COMPANY, 289D—120, Old Street, London, E.C.1.

LESDIX ELECTRIC **WATER PUMPS**

For Fountains, Water Gardens and Aquariums. No water mains needed. Use your pool water. *The Bijou Lesdix Electric Pump* runs for 20 hours for a unit. Throws jets 6 ft. and only costs 67/6. Bronze Pump, Enclosed Motor.

67/6 COMPLETE



LESLIE DIXON & CO., *Electrical Engineers*

218, Upper Thames Street, London

BUY, EXCHANGE OR SELL

MODELS

EVERYTHING FOR electrical rewinds and repairs. Screws, nuts, and washers for model engineers. Lists free.—Lumen Electric Co., Litherland, Liverpool, 21.

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

MODEL ENGINES

ENGINES. Small power. Build BUTLER'S ¼-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.

MONEY-MAKING OPPORTUNITIES

MONEY-MAKING OPPORTUNITIES constantly occurring; highly recommended; particulars free. Send postage.—Messrs. Green, 17 Church Lane, Hull.

INFORMATION where to buy anything!! English and Foreign Wholesalers and Manufacturers. Lists, literature, catalogue, of money-making propositions, ideas, etc., All for 1/-. MAKE MONEY from old drained Motor Oil, full instructions 1/-.—"TECHNOCRAFT," 41 Longford Place, Manchester 14.

MONEY-MAKING BOOKS

LEARN "HYPNOTISM," 25 LONG LESSONS 2/6d. "VENTRILOQUISM" nine dialogues 1/3d. "1,000 PRICELESS TRADE SECRETS" 2/-. "150 ways of making a living" and interesting literature 1/6d. "MANUSCRIPTS" of Illusion secrets, professional apparatus, "SECOND-SIGHT" Acts, for sale. Lists, book catalogue, 2d. stamp.—"TECHNOCRAFT," 41 Longford Place, Manchester 14.

MUSICAL INSTRUMENTS

BAND GUIDE. Hints on the Bugle, Drum, Flute, Staff Parade formation, etc. Free, post paid.—Potter's (Manufacturers), West Street, London, W.C.2.

PATENTS

REGINALD W. BARKER & CO. (Established 1886), 56 Ludgate Hill, London, E.C.4.—Patent and Trade Mark Booklets Gratis.

PHOTOGRAPHY

"PANTOGRAPHS" make large accurate drawings from small photographs, printed drawings, etc., easily. 1/-.—Below.

POSTCARD PHOTOGRAPHIC ENLARGEMENTS, 6 for 9d. Send film.—Cooke, 33 Hawthorn Road, Levenshulme, Manchester.

£500 worth good, cheap Photo Materials, Films, Plates, Cards, Papers, Chemicals, Catalogue and 4 Samples Free.—Hackett's Works, July Road, Liverpool 6.

DON'T TAKE RISKS. Good developers mean good results. Our reliable stock developers keep twelve months after mixing. Satisfaction certain to amateurs and professionals. Best developer ever put on the market. Makes two pints strong developer. 6d. each, 6 for 2/3, 12 for 4/-. Post free.—Hackett's Works, July Road, Liverpool 6.

PHOTOGRAPHIC MATERIALS. Films, plates, papers, postcards, mounts, chemicals, &c. Superb quality. Economically priced. Factory fresh always. Money-saving lists free.—"KIMBER'S," 105 Queens Road, Brighton.

"HOME LABORATORY" COMPETITION

Beck's offer you a great chance of winning a valuable prize. All you have to do is to write not more than 500 words on the subject of:

"Chemistry Experiments at Home"

First prize is a £5 5s. 0d. Chemistry Set, second a £2 2s. 0d. Chemistry Set, and third a £1 1s. 0d. Chemistry Set. In addition there are fifty Consolation Prizes. The Competition finishes on August 31st. Names of prizewinners will be announced in October issue.

Send for Free Competition Folder containing full particulars to

BECK (Competition Dept. A), 60 High St., Stoke Newington, London, N.16

FREE To Cyclists

THE YEARS MOST INTERESTING BOOKLET ON VARIABLE GEARING

Send for it right away

CYCLO GEAR COMPANY LTD POTTERS HILL · BIRMINGHAM 6

Be a MAN *that Women* ADMIRE

Stebbing Pupil Collins

Now YOU can be the kind of MANLY MAN that women admire. Take up my world-famous 4-in-1 Course for building Body, Brain, Nerves and Will, practise my new advanced methods for 80 days; if by that time you have not gained Robust Health, doubled physical and mental Strength, 10-25 ins. more muscle and 12-28 lbs. in weight—I WILL REFUND YOUR MONEY IN FULL. Thousands of testimonials, seen by leading Editors. The one complete all-round MAN-MAKING System. Complete Course 5/-, or send 2/6 now and 2/9 when satisfied. Sent privately under plain cover.—**Lionel Stebbing, Stebbing Institute, 28 [MP-5], Dean Road, London, N.W.2.**

INVENTORS

VALUABLE GUIDE

General Advice Free. POST FREE 6d.

CHATWIN & CO. Est. 1880

Regd., Patent, Design and Trade Mark Agents for all countries.

253 (D) Gray's Inn Road, London, W.C.1

NERVOUSNESS

Every sufferer from "nerves" should read my interesting book describing an inexpensive treatment for Weak nerves, Depression, Morbid Fears, Insomnia, Self-Consciousness, Blushing and similar nervous disorders; sent privately free of charge.

HENRY J. RIVERS (Dept. K.D.7), 40 Lamb's Conduit Street, London, W.C.1

BUILD and FLY your own AEROPLANE The "SAFETY FIRST" Luton MINOR.

Aero Engine "Sprite," 25 h.p., 30-80 m.p.h. Set Blue-prints £5 Full set Materials, Wheels, Blue-prints, etc., £40. Semi-manufactured Set £75. Ready to fly away, prices from £180 to £200

LUTON AIRCRAFT Ltd., Phœnix Works Gerrards Cross.

SITUATIONS VACANT

VACANCIES OCCUR for thirty men aged 18-23 in the Post Office Eng. Dept. Experience is not required, but applicants must be willing to study technical subjects. Commencing pay £3 13s., rising to £7 per week and upwards, with pension. For full particulars apply B.I.E.T. (Dept. 579), 17 Stratford Place, W.1.

GET A BETTER JOB! Learn book-keeping, salesmanship, hotel book-keeping, journalism, etc., at lowest fees; prospectus free.—London School of Commerce (Dept. P.M.2), 116 High Holborn, W.C.1.

FREE—1937 GUIDE. New edition of our 1937 Engineering Guide explains how all the best jobs are secured, and shows how such money-making qualifications as A.M.I.C.E., A.M.I.E.E., A.M.I.Mech.E., etc., are obtained. Numerous "Higher Pay" courses in Electrical, Wireless, Aero, Auto., etc. Branches of this newly recovered industry are fully explained in this publication, which is FREE on request to National Institute of Engineering (Dept. 5), Staple Inn Buildings, W.C.1.

WIRELESS & TELEVISION

Marconi's and other Employers require hundreds of trained men.

We train students for **ALL BRANCHES OF RADIO** at our Residential Colleges in Southampton and Colwyn Bay, and **GUARANTEE APPOINTMENTS.**

LICENSED BY POSTMASTER GENERAL—RECOMMENDED BY MARCONI'S.

WRITE FOR FREE PROSPECTUS:

THE WIRELESS COLLEGE, COLWYN BAY,

or The Wireless College, Calmore, Southampton.

London Office, 4 WINTON AVENUE, N.11

TOOLS

GRAYSON'S Glass-boring Outfits and Tube. Cutters avoid risk.—Below.

DRILLS, Taps, Dies, Files, Chisels and Punches. Best quality at keenest prices.—Grayson & Company, 300 Campo Lane, Sheffield.

MYFORD 3½ & 3½ in. LATHES. See our new 3½-in. Longbed Model. Unequalled for Value. Complete range of specially designed Accessories. Write for Lists, or ask your local Tool Merchant.—Myford Engineering Co., Neville Works, Beeston, Notts.

BRAND NEW, power tools of quality. 10" Bandsaws, 54/-; Jigsaws, 21/-; Planing Machines, 80/-; Bench Drills, 22/6; Sanders, 17/6; Circular Saws from 25/-; 3" B.G.S.S.S.C. Toolroom Lathes, £5 10s. 0d. Electric Drills, Grinders, Spray Plants, Guns, Air Compressors, etc.—JOHN P. STEEL, Clyde Street Mills, Bingley.

BRAND NEW 1" Precision Micrometers. Latest type with positive lock 12/6 each.—JOHN P. STEEL, Bingley.

PLEASE SEND for copy of our clearance list.—QUEEN'S ENGINEERING, 60 Queen's Road, London, S.W.8.

WATCHMAKING

WATCH AND CLOCK REPAIRS. Everything for the watch, clock and model maker. Large stock of watches, clocks, and clock movements, etc. Wholesale prices. List 3d.—Blakiston & Co., Ainsdale, Southport.

WOODWORK

CABINET HARDWOODS, Oak, Mahogany, Ash, Whitewood, Ply-woods, etc. Lowest Prices. Send Cutting lists. Planing free. Speciality Prime Jap Oak, all thicknesses.—Wilfred Parr & Co., March Works, Lancaster Road, Leytonstone, E.11.