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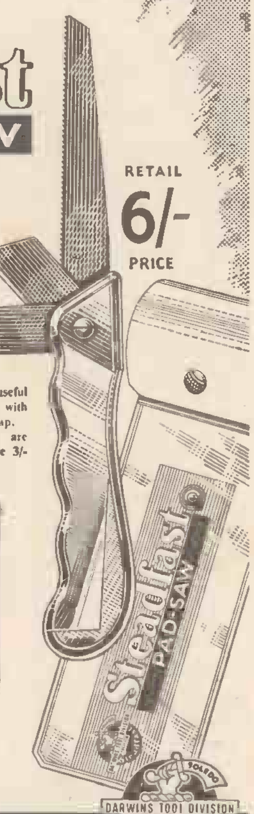

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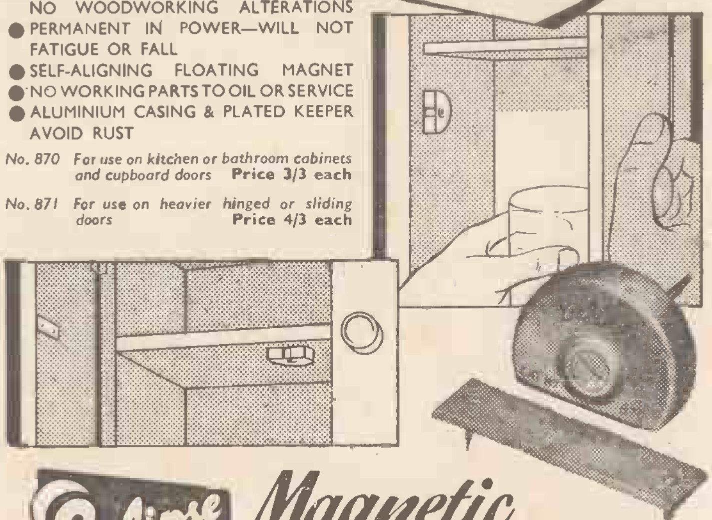

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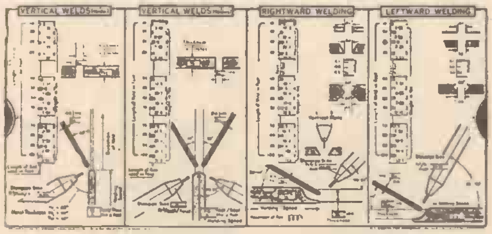

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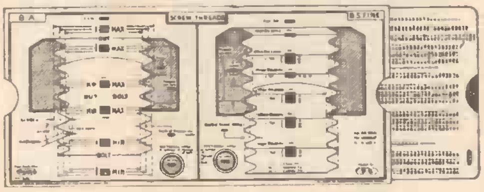

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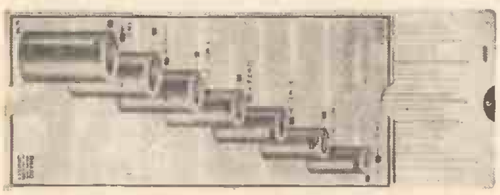

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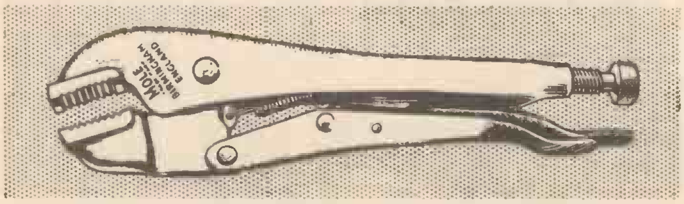

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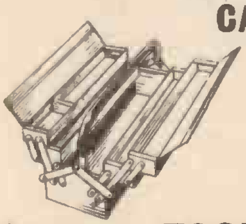

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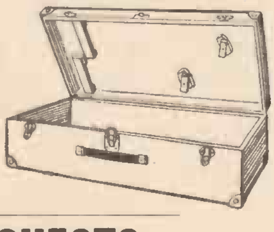

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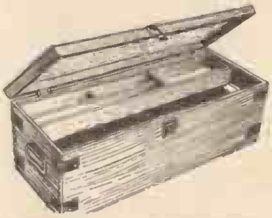

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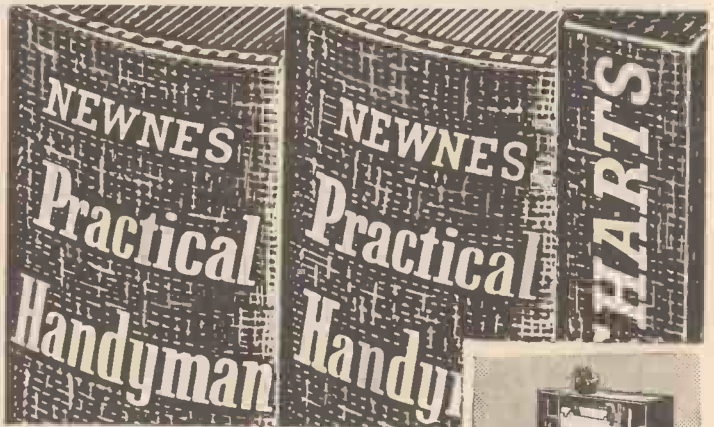

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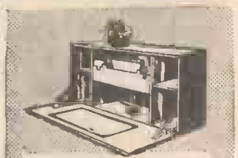

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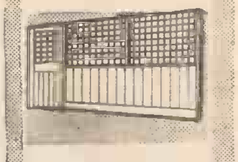

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JUNE, 1960

Vol. XXVII No. 314

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FAIR COMMENT

TUNNEL, BRIDGE OR HOVERCRAFT?

THE idea of a cross-Channel link in the form of a tunnel was first suggested to Napoleon by one of his engineers in 1802 and the matter has been raised occasionally since. Each time, however, it has been dropped for reasons of military inexpediency or lack of finance. Now the Channel Tunnel Study Group has completed its investigations and offered the opinion that the scheme is both financially and technically possible and the tunnel is nearer practical reality than ever before. Elsewhere in this issue we publish an article on the probable form that the tunnel will take and a review of some of the difficulties that the engineers will have to overcome. Apparently only a rail tunnel is considered practicable, the twin problems of finance and tunnel ventilation preventing a road tunnel from being seriously considered.

Britain's huge motoring public are going to be extremely disappointed if the tunnel is for rail traffic only, even if the cost of carrying car and driver by train and tunnel will be less than by air or ferry. It is this disappointment which will cause motorist's to ask if a Channel bridge is not a better proposition.

An outline of the Channel bridge scheme is given on page 405 and our artist's impression makes obvious the advantages an M1 type of highway could offer the motorist whilst also accommodating the rail traveller, the motorcyclist and cyclist. The time saved by not having to wait for trains and while cars are loaded and then unloaded at the other end and the convenience of being able to choose one's route without having to consider boarding the train at some point, would all make the bridge scheme very attractive to motorists. It would have to be a toll bridge of course, and some system of multi-lane ticket offices similar to those in use on the American turnpikes would be necessary. These could be simply operated and should not result in much loss of time. The biggest snag to be overcome would be the British Customs, with its ponderous time consuming procedure. Some method of simplification to bring it into line with that between countries on the mainland of Europe would be required.

We are assured that there are no problems on the technical side which could not be overcome and that a bridge on the lines of the artist's impression on page 405 is completely practicable. We think however that the addition of a windbreak along both sides of the bridge would be necessary to protect traffic from the strong winds which are likely to be encountered in mid-Channel. Whether this would be possible without making a surface so large that the bridge might be in danger of being blown over, is a problem for the engineers. The alternative of having to wait for the wind to drop before crossing the bridge is not attractive.

A bridge would cost more than a tunnel to build and maintain but financial difficulties of this kind are usually overcome once the advantages are apparent.

A third method of transport to be considered is the revolutionary hovercraft. This, of course, if it is developed as planned will offer the advantage of speed, but will still necessitate waiting for the plane's scheduled departure time and waiting while the car is loaded and unloaded at the other end. Much the same advantages and disadvantages are at present experienced by travellers on the car ferry air services already in operation, and although the speed of aircraft can be increased and time can be saved by vertical take off and landing, the fixed departure times and the delay while loading cannot very well be avoided. There are too the additional snags of having to book in advance and the possibility of missing one departure and having to wait for the next.

A further point to be considered with relation to a cross-Channel link is the carriage of goods. Here again the cheapest and most direct service is often by road, which would again indicate a bridge.

In our opinion the Channel bridge is the most attractive proposition, provided that the various engineering snags and financial difficulties can be overcome.

The July 1960, issue will be published on June 30th. Order it now!

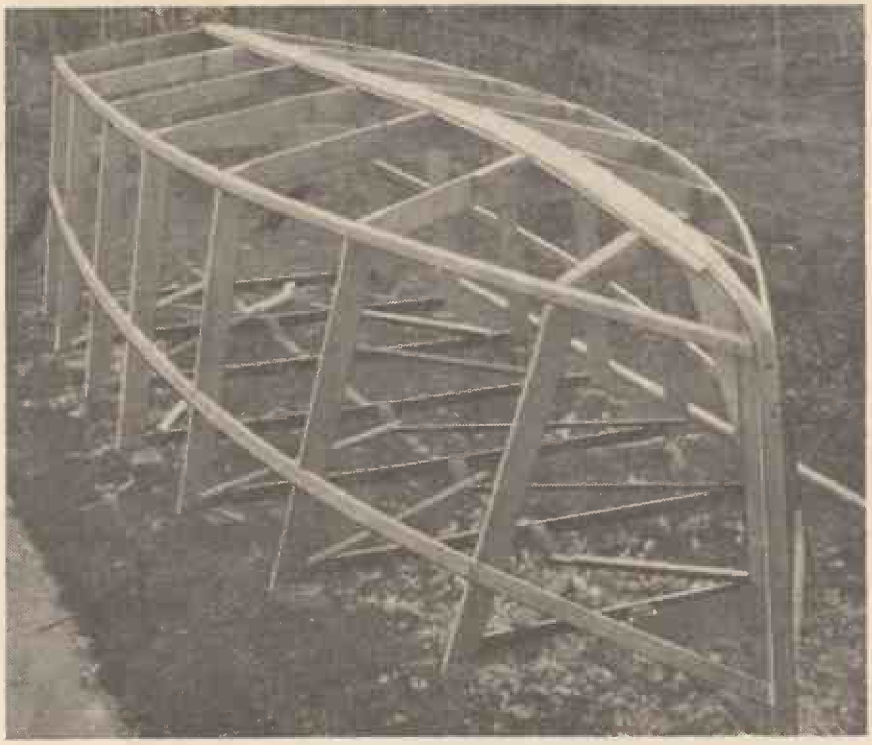
Fig. 9.—The assembled hull.

the stem with two screws and then also put on a cramp to combat the leverage exerted at this point as the keelson is pulled down into place. Be sure to wipe away any surplus glue which may exude from the joints.

On the centre line of the keelson set out the width of the keel. From these lines the keelson must have chamfers planed to run in with the slope of the bottom futtocks. The reader may find it helpful to remove most of these chamfers before the keelson is finally secured in place so that it may be held in a vice. But final planing must be done with the keelson in place.

On each pair of bottom futtocks, each side of the keelson, a water-way must be cut out. These ways should be fairly large as small holes very quickly get stopped up with odd matter which finds its way to the bottom of any boat.

Fitting the Chine and Sheer Battens

These four members are made from some $1\frac{3}{4}$in. × $\frac{3}{4}$in. spruce which should bend round into the correct curvature without resort to steaming. Slots are cut in the frame assemblies as shown last month in Fig. 1. to take these battens.

At the stem the batten is sawn to butt against the stem and is then held in place with $2\frac{1}{2}$in. × No. 10 brass or galvanised c'sk. screws. A little practice is necessary to hold these battens in approximate place against the stem and to saw the correct bevel, therefore it is better not to screw the battens to the frames until a correct fitting has been established,

The P.M. 2-Berth Cabin Cruiser

Part 2.—Finishing off the Framework and cladding with marine plywood

BEFORE the keelson can be fitted a housing must be cut to accommodate it in the lower part of each frame assembly. The method of determining the depth of these housings is illustrated in Fig. 10, which shows how to set out a full-sized template for marking out the housings. The template is made to the shaded area and applied over centre line of frame, adjusting until point x and y coincide with edges of frames. Next mark out points A, B, C and D. Join the points and remove with saw and chisel.

With frames numbers 1, 2 and 3 the housings have a slope towards the stem, and a fair amount of fitting will be necessary to get the keelson to have a proper bearing on the seats of the housings. A G-cramp at each frame will help to hold the keelson down in place. It should be unnecessary to have to steam the keelson in order to get it to take up the correct curvature. Keep a watchful eye that in cramping down, the keelson does not distort the fixing of the frames or pull up the building form.

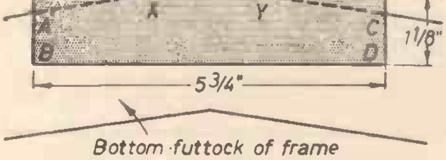

Fig. 10.—Marking out recess for hog in frames.

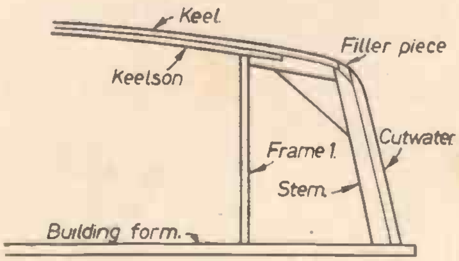

Fig. 11.—The cutwater or false stem.

Fitting the Stem

Remove the keelson from its position on the frames and then proceed to fit the stem assembly on the building form and resting against the bottom futtock of the first frame. A shallow housing in the form will keep the stem from slipping forward at that point. Make sure the lower end of the stem is snug against the frame and make any adjustment that may be necessary. Finally, screw through the frame into the end of the stem with two $2\frac{1}{2}$in. × No. 10 brass or galvanised screws. Be sure that the recess cut on the end of the stem matches the housing cut in the frame. Screw down to the building form the deck end of the stem. A couple of pieces of 2in. × 1in., one each side of the stem and joined to the form will help to keep the stem rigid.

When the stem is secure the keelson may be lowered again and glued and screwed into its final position. Commence by securing at

but to hold the batten in place with cramps.

With the chine battens cramped in place look along the line of the batten to make sure that a smooth curvature is obtained. If there are any irregularities, slight adjustments to the notches may be necessary. It is very important to get a smooth curve at this juncture, even if the notch has to be enlarged a little up or down the side futtock.

Sheer Battens

The sheer battens are also let into notches in the side futtocks of the frames. The positions of these battens can be seen in the frame plans (Fig. 5, last month) and they should have already been marked out on the frames. Here again it is important to get a smooth line to the batten.

Saw the forward ends of the battens at an oblique angle to butt against the stem. The assembly of the hull will now look as in Fig. 9.

Next the bottom and side stringers must


Fig. 12.—Details of the bottom stringer.

be fitted. The former run parallel with the keelson from frame 1 to the transom. The latter fit against the stem and run through to the transom (Fig. 13).

When notching in these members at frames 1, 2 and 3 remember to let in the stringers flush with the rear edges of the frame. Later the protruding pieces at the bow side will have to be planed down during the fairing off procedure.

Close reference to Fig. 9 will show that a bevel has been worked on the top of the stem and that the chine batten runs in with this bevel. The bevel also runs down the entire length of the stem to the sheer batten although this has not been completed in the photograph.

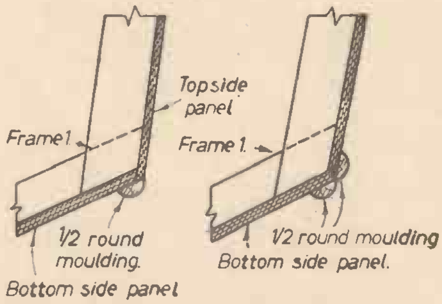

Fig. 14.—*Joint of plywood skin at chines.*

adjustment to the butt joint of the chine and sheer battens may be necessary to run in with these bevels.

An iron smoothing plane and a Surform or Stanley file or plane are the ideal tools for this operation. In fact, this is an almost indispensable tool for the boatbuilder. From time to time the work must be tested with a lath which can be laid across the edges being planed.

The Keel

The keel is a piece of timber 1¾in. × ¾in. finished size. The keel ends 1in. overlapping the joint of the front member of the stem assembly as shown in Fig. 11, and in Fig. 13. This keel is continued up the front of the stem with a false stem or cutwater which is screwed into position after the plywood panels have been glued in position and cleaned off flush with the stem. Thus the front edges of the panels are protected by the cutwater. A small filler piece will be needed to join the cutwater with the keel, shown in Fig. 11.

From frame No. 1 the keel commences to taper in towards the stem to a final width of 1¼in. When this has been worked the keel may be cramped into place and screwed down. Delay glueing and screwing for the time being as it may be helpful to be able to remove the keel during the final fairing off of the frames.

Fairing Off

This process may appear to be rather tedious, but it must be done thoroughly so that the plywood panels bed down evenly on the various other members. The first three frames will require the most work as they have sharply bevelled sides towards the stem.

The side and bottom futtocks must be planed so that their edges run in smoothly with the various longitudinal battens. The bottom edge of the chine battens must be bevelled to run in with the bottom futtock edges (Fig. 14).

The stem must be bevelled so that the front edge is the same as the width of the forward end of the keel (1¼in.). A slight

Fitting the Panels

There are four bottom-side panels and four top-side panels and these are cut from sheets of marine plywood 8ft. × 4ft. The offcuts left over from these panels are used to make the seat tops, etc., at a later stage of construction.

It is advisable to commence with the fitting of one of the forward panels even though these are the most difficult to fix. Large sheets of brown paper are glued together to give enough area to cover one panel. The outline of the required shape is obtained by placing the paper over the frames and rubbing the thumb along the edge of the chine to the stem, up the forward edge of the bevel on the stem, and then along the join between the keel and the keelson to frame 3 and down the edge of that frame. The shape of the panel may then be cut out, but leaving an additional 1½in. beyond the chine line to allow for the subsequent fitting of the top-side panel to this panel.

Note that this bottom side front panel ends at the third frame and provision must be made to strengthen this butt joint with the aft bottom-side panel. To provide extra bearing for this glued joint, additional strips of 1¾in. × ¾in. timber can be glued and screwed to the bottom futtock of the frame. Alternatively, a 3in. strip of the panel plywood can be let in flush into the keelson, chine and bottom stringer thus providing a good bearing for the butt joint of the panels when glued and screwed into position.


Fig. 13.—*Details of the keel assembly.*

First of all cramp the stern end of the panel into place at frame 3 using G-cramps at the keelson and chine. Bend the panel down into position and cramp where possible.

If the builder feels that undue pressure is needed to hold the panel down in place at the stem, the plywood can be made more pliable by the application of rags dipped in boiling water and applied to the outside surface of the plywood. If the timber is thus wetted it must be cramped in place and allowed to dry until next day before being glued in place. When the cramps are removed, the plywood will have taken on a per-


Fig. 15.—*The finished cutwater.*

manent curve to the shape required so that little force is then needed to glue into place.

It is important to get a good fit up to the edge of the keel and a bevel must be planed along the edge of the plywood for this purpose. A small lap-over at the stem can later be planed away when the cutwater is fixed. Keep the lap-over at the chine for the purpose of making the notched joint to the top-side panel as in Fig. 13.

When one is satisfied that there is a good fit, mark with a pencil round on the underside of the panel the shapes of the frames, the keelson, the stem, etc., and then remove the panel for drilling for the securing screws. The screw holes are drilled with a $\frac{9}{64}$in. drill and are spaced 3in. apart. Between frame 1 and the stem and along the stem these holes should be closed in to 1½in. centres. To speed up this work an electric drill is indispensable. The holes should also be countersunk so that the heads of the ¾in. × No. 6 brass countersunk head screws will be below the surface. Subsequently, the holes are stopped.

When all is ready for the final application of the panel, prepare the Aerolite 300 glue, which, being waterproof, is an ideal adhesive for all boat building work. Full instructions for the use of this glue are given with every pack.

The glue is first of all applied liberally to all bearing surfaces of the chine, stem, keelson and frame, etc. The hardener is applied to the areas within the pencil marked outlines on the inside of the plywood panel.

Place the panel in position and first of all hold by one or two screws at widely spaced intervals to ascertain that it is correctly positioned. When all is well, proceed to screw down all round the panel. When the screwing is completed wipe away all surplus glue which may have oozed out of the joints.

The other forward bottom-side panel is fitted next, but it must not be assumed that it is exactly the same pattern as the previous panel and it may be necessary to make a new paper pattern.

When the first panel has been fitted the permanent fixing of the keel should no longer be delayed. It should be liberally glued and then screwed into place with some 2in. × No. 10 galvanised steel screws. Note the termination of the keel in Fig. 11 overlapping by 1in. the joint between the two parts of the stem.

After fixing the two bottom-side forward panels, the fixing of the two aft bottom-side panels will be a much easier task as there is little bending of the plywood. Be sure there is plenty of glue in the butt joint of the after panel with the forward panel.

When the glue has dried out on all four panels the edges of the panels may now be trimmed up flush with the chine battens and the frame of the transom. One important point must be made. From the stem of the first frame the forward bottom-side panels are not trimmed flush but are left overhanging as shown in Fig. 12. Thus the joint between the top-side panels and the bottom-side panels is shown in Fig. 14 for the two positions, fore and aft of frame 1.

Securing the Top-side Panels

The next task is the fitting and fixing of the top-side panels. Commence with the forward panels. It is possible to dispense with the use of a paper pattern for this work. Hold the plywood in place against the side of the boat with a pair of G-cramps and mark the position of the notched joint already mentioned. Saw out the piece required to make a recess for the bottom-side panel and bevel this so that the new edge of the panel will fit snugly against the bottom-side panel overhang. Aft of the notched joint allow a small overlap at the chine for trimming up later. Allow also a small overlap at the stem and along the sheer for subsequent cleaning up.

The join between the fore and aft top-side panels is arranged between frames 3 and 4. As a seating for this join, filler pieces of wood 1¾in. × ¾in. are let in between the battens and another piece is screwed on the inside of the battens to which also the filler pieces are glued and screwed.

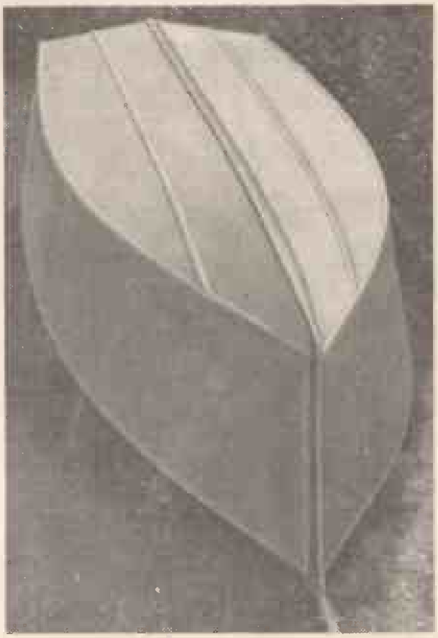

Fig. 16.—The boat ready for turning over.

The Transom Panel

The last part of the skin of the boat is the ¾in. plywood transom panel. This panel is cut to shape approximately and with a liberal application of glue it is then screwed in position. The screws to use are 1½in. × No. 8 countersunk head brass. Often the transom is not painted in the same way as the rest of the hull but is left in natural colour and varnished. If this is done then the heads of the screws are not deeply countersunk but only sufficient to let the heads be pulled in flush with the surface of the transom. No stopping is used. To comply with the best marine practice be sure that all slots in the screw heads are all pointing in the same direction.

The False Stem or Cutwater

From the end of the keel the edges of the plywood skin are planed down flush with the stem. A false stem or cutwater is now fitted to cover the stem and these edges.

As the cutwater may come in for some hard knocks when the boat is in use it is helpful to be able to renew this part without difficulty. Hence, it is not glued in place, but instead a sealing layer of Seelastic is used and the cutwater is screwed in place with some 2in. × No. 10 countersunk head galvanised steel screws. Some holes are drilled with a ⅜in. twist bit to let the screws into the false stem. These holes may be stopped afterwards with dowel rod plugs or other forms of stopping.

Between the lower end of the false stem and the end of the keel is a small space which has now to be filled with a small filler piece, which is worked to the curve of the keelson and to be a snug fit between the keel and the cutwater. It is finally glued and screwed in place with two screws.

It is advisable to leave the filler piece and the lower end of the cutwater a little full, in order that they may be worked up to the final shape when they have been secured in place with their screws (Fig. 15).

The Rubbing Strips

A rubbing strip (Fig. 16) is fitted along the chines and is made from some 1½in. half-round moulding. These strips serve a double purpose because they also serve to seal the joins of the top-side and bottom-side panels. A sealer such as Seelastic is applied under the strips before they are screwed in place. Well countersink the heads of the screws and fill the holes.

To seal the forward part of the panel abutments forward of the point where the notch joint is made in the panels, a shorter strip of moulding may be applied here and not carried right aft.

Additional rubbing strips are screwed to the bottom sides of the cruiser along the line of the battens between chines and keel (Fig. 16).

Guard rails are also required reaching from the transom to frame 5, as this part of the hull is very vulnerable in locks and at moorings. The rail is 26in. in length, 3in. at the transom and tapering down to 1in. at the other extremity. The rails are screwed well to the transom and frames 5 and 6.

Last Stages Before Turning Over

The boat is now ready for turning over (Fig. 16) except for the final finishing off of all surfaces with various grades of glasspaper. All screw holes should be stopped with plastic wood or marine stopping. If the head of a screw seems at all near to the surface take it out and re-countersink the hole.

When the stopping is dry, a final rubbing down will be needed. The skin is now ready for the first priming coat of paint. These priming coats, of which there should be three, should be pink priming well thinned down with turps. A light rubbing down should take place between each coat.

Two undercoats of the appropriate shade should follow. The surface is then ready for the final application of top coat enamel. For this paint work, one is well advised to choose from the wide range of paints specially made for marine use. On the other hand good service has been had from good quality household paint as used for exterior woodwork.

Work on the Boat Turned the Right Way Up

Two persons can now quite easily turn over the boat after all ties have been broken with the building form which has, during construction, been pegged to the ground.

The first step now is to support the keel on a level site and it is quite satisfactory to stand it on the 3in. × 2in. building form which is still secured to the ground. The boat being level longitudinally the procedure now is to support it near the chines at two or three frame positions with blocks and wedges so that it is level traversely.

In order to preserve the interior of the boat from the effects of damp to which it will continually be subjected it is necessary to give the interior two or three coats of clear Cuprinol. At a later stage this can be painted over. Be careful to apply the Cuprinol liberally to the end grain of any timber and down in cracks and crevices which may be found.

Transom Knees

Three knees are used to strengthen the joint between the transom and the keelson and bottom-side battens. The knees also help to cut down vibration in the transom when the motor is running. The knees are cut from some 1¼in. mahogany or oak. Be careful of the direction of the grain and this is shown clearly in Fig. 17.

The fit against the bottom members and the transom must be accurate, and after sawing

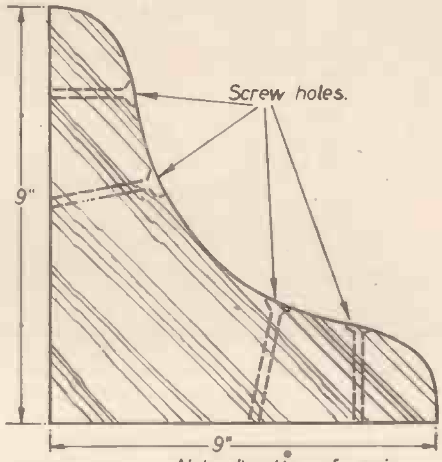

Fig. 17.—The transom knees.

the angle of the knees to a right angle they can be tried in place and fitted by planing the edges with a smoothing plane.

The knees are glued and screwed to the transom and bottom members with some 2in. × No. 10 galvanised steel screws. The screws will have to be recessed into the knees so that the threaded part of the screws protrudes about ½in.-¾in. These holes can be drilled out with a ½in. twist bit first of all and then the hole is followed through with a 3/16in. twist drill.

Whilst doing this work it will be necessary to get inside the boat and whilst it is possible to walk on the panels it is likely that unnecessary strain may be thrown on the joints if this is done, it is therefore advisable to keep on the battens or keel as far as possible.

The Floorboards

The fitting of the floorboards should be the next task, starting with the floor of the cockpit. The flooring is made from 1in. × 6in. floorboards, planed all round. Alternatively, ½in. exterior grade plywood could be used.

The floor must rest on three filler pieces of ¾in. timber cut and secured as shown in Fig. 18. These filler pieces are fitted to frames 4, 5 and 6 and a support of 1¾in. × ¾in. is screwed across the transom, and will need to be in several pieces to fit round the knees.

(*To be continued*)

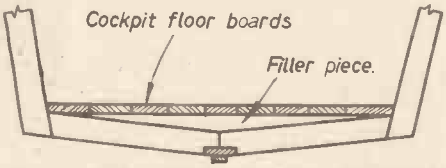

Fig. 18.—Filler pieces supporting the cockpit floor.

THE CHANNEL TUNNEL

To Paris by Rail Soon!

By R. N. Hadden

WORK on the Channel Tunnel will probably begin this year. When completed the tunnel will be one of the engineering wonders of the world comparable with the Suez and Panama canals. Recently a team of engineers and economists prepared a report on the feasibility of the scheme. The report was favourable, and now this has been done, only Government approval will be required to enable the scheme to go ahead.

The Tunnel's History

Before describing the details of the tunnel it is worth taking a quick look at the history of the scheme. The first practical scheme was put forward by a Frenchman in 1856, and although many people were enthusiastic, the British Government of the day were opposed to the idea. For this reason nothing further was done.

Since then there have been several other proposals, not only for tunnels, but also for bridges, causeways, and combinations of the two. Actually, the only proposals which have been at all practical were for tunnels, and so the other schemes will not be described.

At one stage the tunnel scheme progressed as far as having two pilot tunnels drilled for a distance of a mile out from either shore. Although these pilot tunnels were abandoned they did at least prove that the scheme is possible because the leakage of water into them has been nil.

The reason that all the early proposals were abandoned was that the War Office was afraid that if the tunnel was ever captured by an enemy nothing could prevent invasion. While this was probably true at the time, it does not apply now when landings can be made very easily by airborne troops. Also it has been suggested that the power station which will supply electricity for the tunnel trains, should be situated on the English side and should operate at a voltage and frequency not in use in France. This would mean that any enemy wanting to use the tunnel would first of all have to connect up his own supply at the French end, and this would give sufficient time delay to enable it to be flooded.

The Route

So much then for the history and military considerations. The planned route of the tunnel is from behind the Shakespeare cliff, which lies between Folkestone and Dover, to a place between Calais and Boulogne, called Sangatte. The overall length of the tunnel would be about 31 miles. This is somewhat wider than the Channel, but it includes about four miles on either side which would be necessary for the approach tunnels. There are two reasons for choosing this particular point for the tunnel, the first is that it is roughly the narrowest point of the Channel, but the most important consideration is that the geological formations are ideal for drilling.

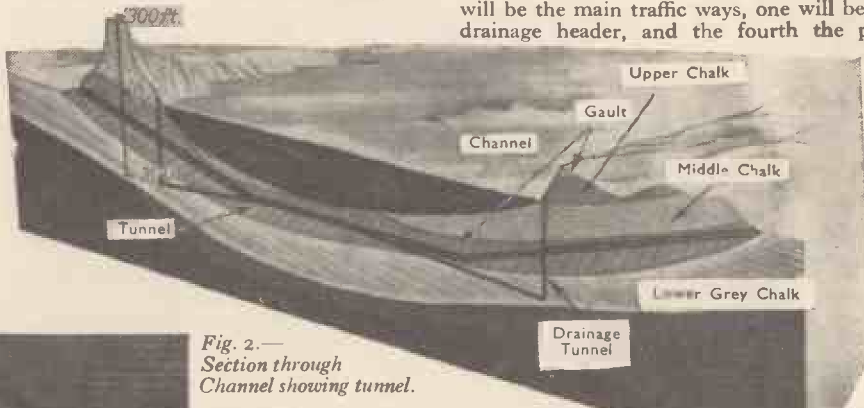

Fig. 2.—Section through Channel showing tunnel.

Fig. 1.—The route of the tunnel.

The map Fig. 1 shows the location of the tunnel, and Fig. 2 shows a typical section along the route. It had long been noticed that the geological formations on both the French and English sides of the Channel were the same, and so it was reasonable to suppose that the same formations would be found under the water. In fact, this has been confirmed by recent survey. Drillings were taken across the Channel and the cores were examined, the drill holes being filled up with concrete. It was found, as had been hoped, that the layer of grey chalk stretched all the way across.

Grey Chalk Bed

The fact that the grey chalk is continuous all the way across is very fortunate, because this is an ideal material to drill a tunnel in. As has been mentioned earlier two pilot tunnels were drilled some years ago. These tunnels were in the grey chalk bed and it has been found that there was no leakage. Another big advantage of drilling in grey chalk is that it is soft, and so blasting will not be necessary. In fact, it is soft enough to be drilled continuously by a giant rotating cutter. Fig. 3 shows how this cutter will operate.

Although this project is always referred to as the Channel Tunnel, there will in fact be four tunnels. Two of these tunnels or tubes will be the main traffic ways, one will be the drainage header, and the fourth the pilot tunnel. The main tubes will each carry traffic in one direction, one North bound, one South bound. Because of ventilation difficulties only electric trains will be able to use the tunnel. Cars requiring transport will be carried on special rail trucks.

The Pilot Tunnel

Although the building of this tunnel would be a tremendous feat of engineering it would not require the use of any techniques which have not been well tried already. The first stage of the construction would be the completion of the pilot tunnel. The accuracy required in drilling this tunnel can well be appreciated when it is considered that it will only be about 10ft. in diameter, and the two halves will have to meet fifteen miles from their starting points. There is no doubt that the engineers will be relieved when the two halves do meet.

When the pilot tunnel has been completed work can be speeded up on the main tunnels

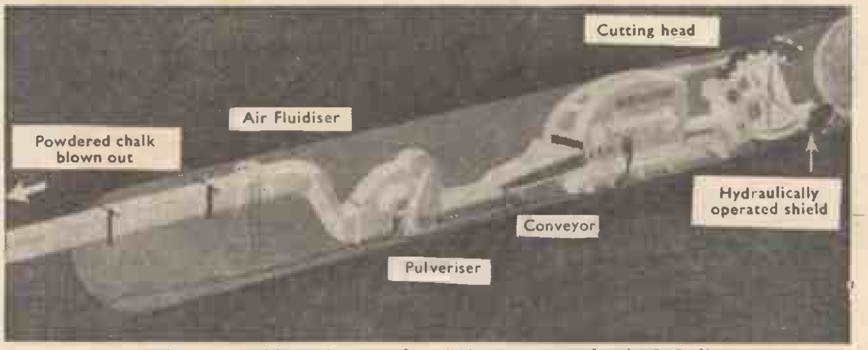

Fig. 3.—Drilling the tunnel and blowing out pulverised chalk.

Fig. 5.—(Right) A section of the tunnel at mid channel.

as drilling can be carried out from intermediate points as well as the ends. Fig. 4 shows a cross-section of the tunnel. As can be appreciated a tremendous amount of spoil will have to be removed from the tunnel as drilling proceeds. Two interesting schemes have been put forward for removing it. In the first scheme it has been proposed that the chalk should be ground up as it is produced and then slurried with water. The chalk-water slurry would then be pumped directly upwards through bore holes to the Channel bed. This proposal is definitely attractive as no further handling would be necessary at the tunnel ends. However there is an element of risk of flooding the tunnel by drilling upwards to the Channel. The second proposal for removing the spoil is similar to the first in that the chalk would be ground up to a fine powder. However, in this case, it would be blown into pipes by air and so to the end of the tunnel. It is probable that this latter scheme would be the best. As most of the tools used at the working face would be air-driven there would be plenty available for blowing the spoil down the pipe.

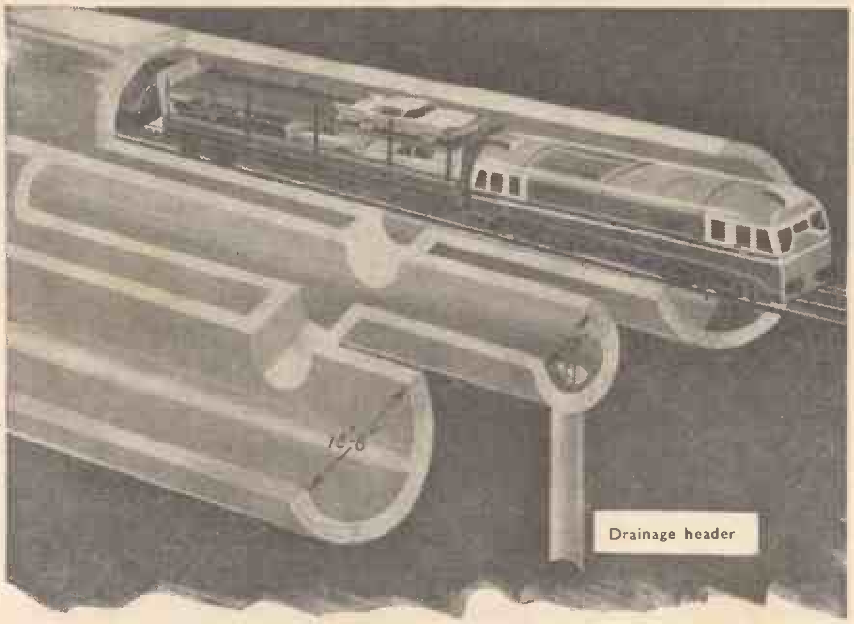

Fig. 4.—A cross-section of the tunnel.

The Lining

As the drilling of the tunnels proceeded they would be lined with steel or concrete sections in much the same way that the London underground railways are lined. The space between the lining and the rough wall of the chalk would be filled with cement grouting. This would ensure that the tunnel would be watertight and very strong.

Drainage Tunnel

In addition to the main tunnels and pilot tunnels a drainage tunnel would have to be drilled. This drainage tunnel is shown in Fig. 2. The drainage tunnel would be required not so much to pump away sea water leaking in, but to remove the condensation which would occur on the cold sides of the tunnel. This tunnel would be 7ft. in diameter and would slope downwards from the centre of the Channel. Fig. 5 shows the tunnel in mid-Channel.

It is not thought that any special method of ventilation would be necessary as the trains would produce no fumes, and the fact that there are two tunnels interconnected would also help. Also the trains running through the tunnels would in themselves produce quite an interchange of air. However, if it was found that some forced ventilation was desirable then it would be a simple matter to blow air down the pilot tunnel.

It may be thought that the pilot tunnel would not be much use once the main tunnels were constructed, or that it would have been better to enlarge it to form one of the main traffic tunnels. However, quite a good case can be made for retaining the pilot tunnel in it's original form. The first reason is that it would greatly facilitate maintenance of the main tunnels. When it is considered that trains will run every ten minutes for 20 hours out of every day, it can be seen how important it will be to get maintenance forces to the required location with the minimum delay. Another advantage is that high voltage cables could be laid to connect the French and English Grid systems. This scheme has already been proposed because the time of peak electricity demand in France is different to that in England. Thus, England could supply France at peak periods and vice versa. It has also been proposed that a fuel gas line should be laid from the natural gas fields in the Sahara to supply the gas boards in this country. If this comes about the gas line could also be laid in the pilot tunnel.

Continental Gauge

The trains using this tunnel would probably be of Continental gauge which is rather broader than the English one. Also, the coaches would be of Continental design. This would mean that the tunnel trains would be suitable for all of Europe. A new line would have to be laid from the tunnel to London, as the larger trains would not fit the existing stations in this country. However, this would not be a disadvantage as it would mean that faster train times could be expected and there would be no delays due to other services.

How much then would this tunnel cost? The latest estimates are that about £109,000,000 would have been spent before it was completed, and that the income from tolls would amount to about £13,000,000 per year. It is suggested that the toll for each person using the tunnel would be 32s. and for a car £4. There is no doubt that when the tunnel is completed traffic across the Channel will increase, and it may well be that it will show a bigger profit than that estimated. It is, therefore, to be hoped that the time when work starts will not be far distant.

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Two Channels

When a stereo record is played there are two distinct channels of sound, each passing from its own wall of the groove, to its own half of the pick-up, its own amplifier and finally its own loudspeaker. Thus for a conversion what will be needed is a second " channel " and a new stereo pick-up cartridge.

The first step in the conversion will be to change the pick-up cartridge, but first consider the purchase of the new cartridge. If the original was of the crystal or ceramic type, then the replacement must be of the stereo-crystal or stereo-ceramic type. This is because the output from bimorphs of crystal or ceramic is very much greater than that from magnetic pick-ups which require amplifiers of a high sensitivity. Acos and Ronnete make excellent stereo crystal cartridges at quite reasonable prices, and these are of the " stereo-mono turnover " type, which have the considerable advantage of being able to play all the old mono records as well as the new stereos (Fig. 2).

The mounting of the cartridge should not present much difficulty since the majority are mounted on universal brackets which will fit almost any type of pick-up arm; certainly all Collaro arms, and most Garrards too. If yours is not of the universal type then care should be taken to see that the bracket on the new cartridge will fit your arm or considerable mounting difficulty might be encountered.

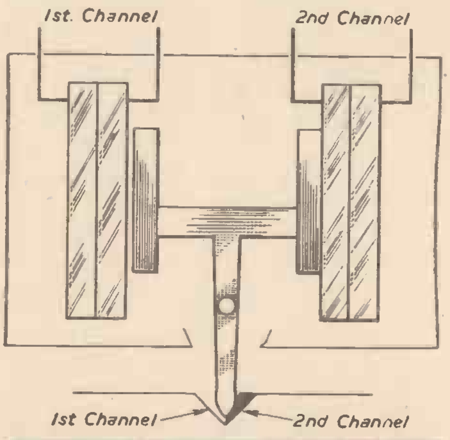


Fig. 1 (*Left*).—*Crystal stereo pick-up cartridge shown diagrammatically.*

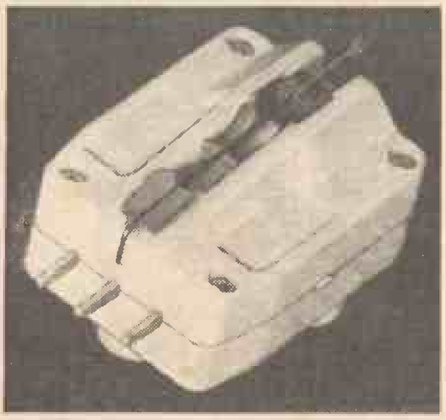
Fig. 3 (*Above*).—*The " Dulci " stereo/monaural preamplifier for use with crystal pick-ups.*

Mounting the Second Lead

When the cartridge has been mounted it will be noticed that there are four output pins instead of the usual two. This is, of course, to carry the extra channel, and it will be necessary to mount a second lead to carry it. When the pick-up swings across the record the pick-up lead is swung clear at the pivot by mechanical means, but when a second is inserted a little difficulty may be met with in clearing the extra lead. There is no standard method of clearance, but normally the problem can be overcome by using a piece of adhesive tape to fix the second lead to the clearance guide of the first. Other than this the reader will have to use his own ingenuity.

There will undoubtedly be instructions with the new cartridge, giving the order in which the connections should be made, but readers are warned against soldering directly to the output pins. There are special slide-on clips for the purpose of making contact, and if the wires are soldered to these then the risk of damaging the cartridge with a hot soldering iron is eliminated.

When the cartridge is mounted the pressure on the stylus will be increased, due to the greater weight of the stereo cartridge, not to mention the added weight of the extra lead. It will therefore be necessary to reduce the weight exerted by the stylus to between 6 and 8 grams. This is done by sticking Mu-Metal to the counter-balance of the pick-up arm.



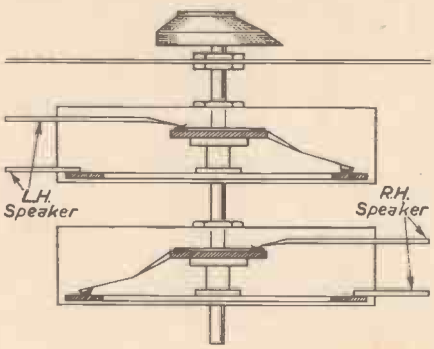


Fig. 2 (*Left*).—*The Acos stereo cartridge.*

Fig. 4 (*Above*).—*The balance control.*

A Second Channel

When the cartridge has been mounted and adjusted some attention can be turned to the provision of a second channel. For this an amplifier of similar power, and a loudspeaker of the same type as the existing one, will be necessary. If, however, there is a radio available with input sockets for pick-ups, then this may be used as the second channel and a

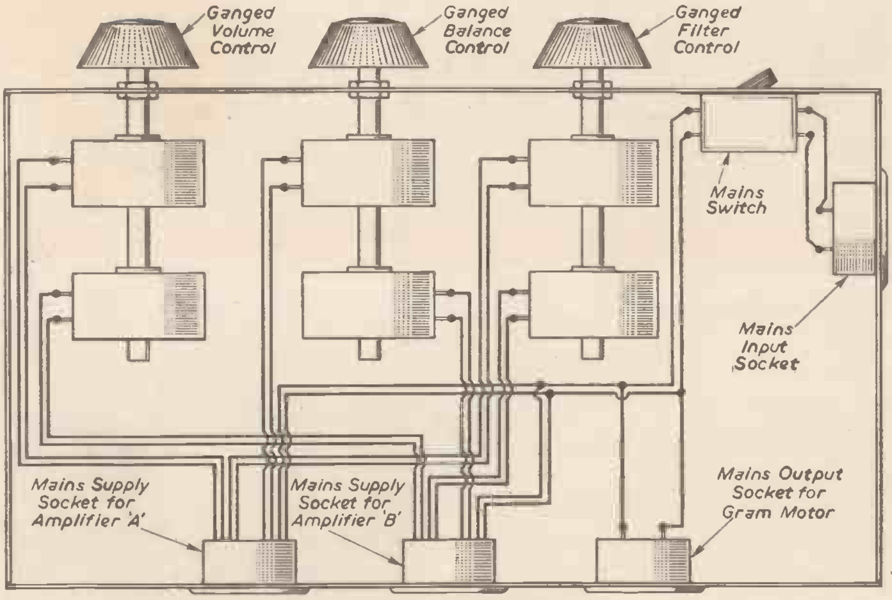


Fig. 5.—The stereo control unit.

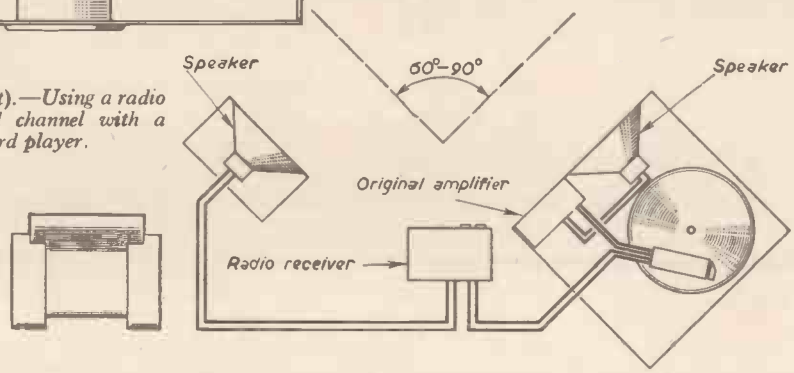
considerable economy effected thereby. Gramophones and amplifier systems used with electronic guitars can also be utilised. If, however, any of the above systems are used, the speaker will have to be removed in order that the lead from the cartridge be kept as short as possible. This is because of the large loss in the power of signals from pick-ups travelling more than a yard or so.

The advantage of buying a new amplifier unit is two-fold. First the power of the original can be exactly duplicated, and therefore (second) " ganged " controls can be used. Before discussing " ganged " or multiple controls. let us consider the " balance " control. This consists of a pair of reversed ganged variable resistors, i.e. a pair of variable resistors operated by one insulated spindle. The connections being so made that when the spindle is rotated the resistance of one will be increasing, whilst that of the other is decreasing. (See Fig. 4.) Therefore if each of the loudspeakers is fed " in series " with one of the resistors, then the volume of one may be increased whilst that of the other is decreased. And this considerably simplifies the job of matching the volume levels of each channel.

Control Unit

If an amplifier of exactly the same type as the original is obtained then a control unit can be made using " ganged " controls, and this also serves to house the balance control.

Fig. 6 (Right).—Using a radio as a second channel with a record player.



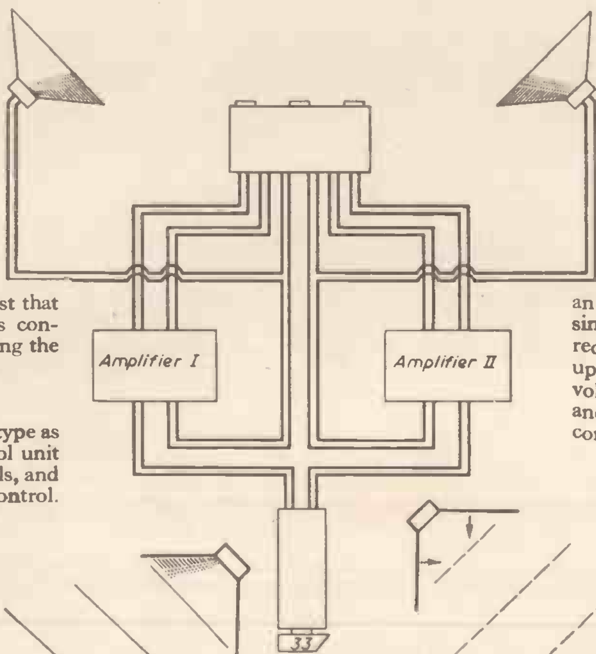


Fig. 7.—The ideal system shown diagrammatically.

An ordinary pre-amplifier chassis is ideal. The unit usually consists of a mains on/off switch, controlling the mains supply to the turntable and both amplifiers, a balance control, and " ganged " pairs of variable resistors controlling treble, bass and volume. The first step will be to remove all controls from both amplifiers (taking care to note the order of connections) and to fit a multi point plug to the amplifiers to take the leads to the control unit. This is not really necessary, since when a control unit is used the amplifiers are usually mounted out of sight inside the gramophone, but when the space is not sufficient, as is often the case with portable grams, then the amplifier and control unit has to be mounted externally, and then, if only for the sake of safety, it becomes necessary to use a multi lead connecting cable. In Fig. 5 only two leads are shown connected to each variable resistor, there are, however, often three, but this is only a minor detail which is mentioned to avoid confusion.

Testing

When the equipment is set up a test will have to be carried out to ascertain whether or not the two channels are " in phase." For the purpose of this test it is preferable to use an ordinary long-playing monaural record, since stereo records can be deceptive. The record should be played and a position taken up as shown in Figs. 6 and 7. At first the volumes will probably be at different levels and this should be corrected using the balance control, or otherwise by altering the volume of

(*Concluded on page 386*)

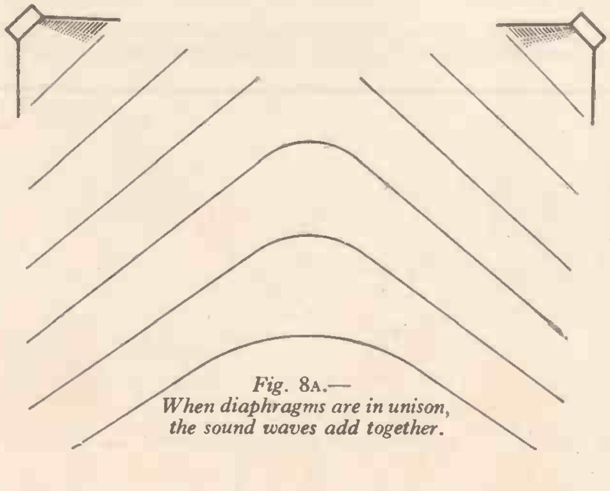


Fig. 8A.—When diaphragms are in unison, the sound waves add together.

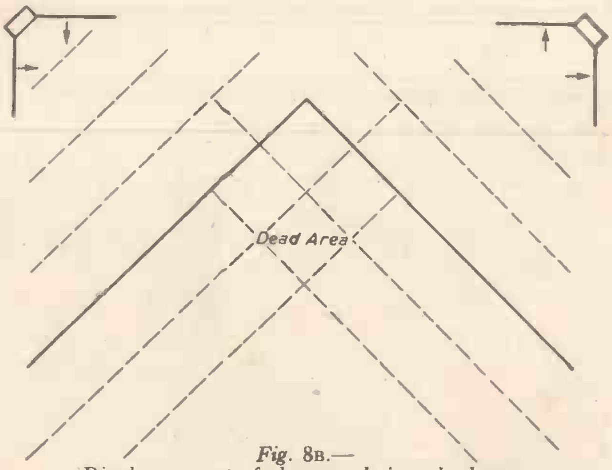
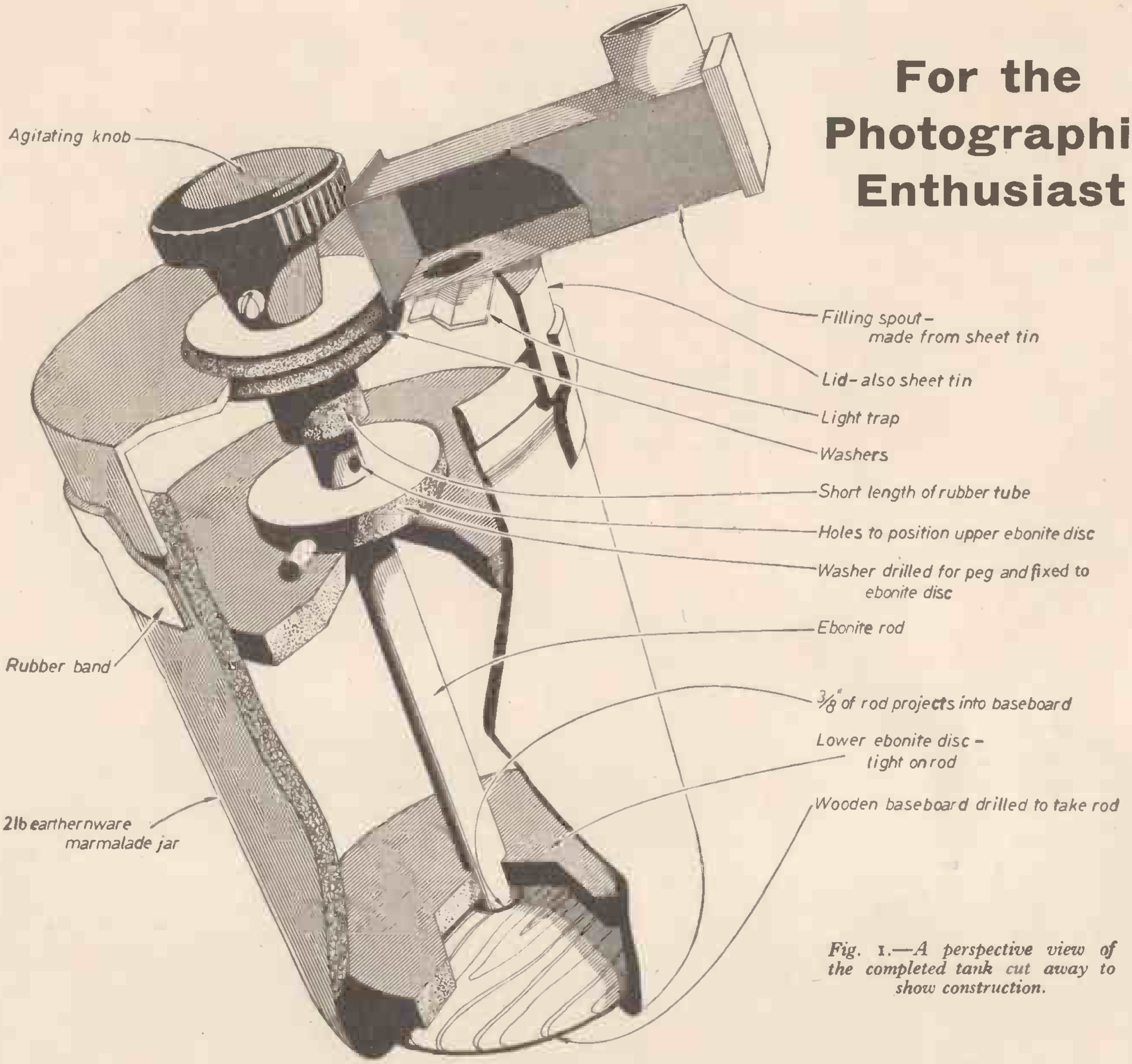


Fig. 8B.—Diaphragms out of phase result in a dead area.



For the Photographic Enthusiast

Fig. 1.—A perspective view of the completed tank cut away to show construction.

A Rollfilm Developing Tank

for size 120, 127 or 116 film, described by Helios

THIS developing tank can quite easily be made mostly from scrap materials and when completed can be used for processing sizes 120, 127 and 116 rollfilms. Dimensions given here are those applying to the writer's tank. They can, if necessary, be modified to suit the reader's requirements or materials available.

The Container

The main component, the container, should be an opaque jar not smaller than 5in. high inside and 3·3in. dia. inside. The writer used a 2lb. earthenware marmalade jar.

From a piece of hardwood ¼in. thick cut a circular disc of such an outside diameter as to be a tight fit in the bottom of the container. In the centre of this disc drill a ⅜in. dia. hole. The hole will form a location for the lower end of the spool centre pillar.

The disc is now fitted tightly into the bottom of the container; take care not to crack the jar when doing this.

Making the Spool

For the manufacture of the spool a piece of ⅜in. dia. ebonite tube or rod is required together with two ebonite discs ¼in. thick and 3⅛in. dia. For the disc material the writer used the control panel from an ancient home-made radio set. If ebonite is not conveniently obtainable hardwood will do. Lacking a piece of genuine ebonite rod or tube an old fountain pen barrel can be made to serve for the centre pillar.

The lower disc of the spool is cut from the ¼in. thick material as shown in Fig. 1. The centre hole must be a tight fit on the centre rod, on to which it is pressed leaving ⅜in. of the rod projecting through.

The upper disc is similar to the lower one except that the centre hole is a *sliding* fit on the rod. Attached to the upper surface of this disc is a smaller disc about 1¼in. dia. also with a sliding fit centre hole. Drilled laterally through the small disc is a ⅛in. hole to take a peg which will locate the disc on the centre rod in a position suitable for the width of film to be processed. The smaller disc is attached to the larger one by a waterproof adhesive.

The assembled spool can be seen in Fig. 1. The locating holes in the centre rod are so spaced that the discs may be adjusted to take 120, 127 or 116 size films. The reader may, of course, adapt the spool to take other sizes.

The Lid

If you are fortunate you may be able to find a metal lid (the type with overlapping edges is required) which will exactly fit the container. Otherwise one will have to be made from sheet metal to the form illustrated.

Drill a ½in. dia. hole where shown. Over this hole is fitted the spout for filling and emptying and beneath it is fitted a small light trap. The filler spout is made of sheet metal and measures 2½in. long × ½in. sq. All joints are soldered and the complete spout is soldered to the lid.

The light trap can be seen soldered in position in Fig. 1. It consists of a piece of sheet metal about 1½in. wide, bent over and so fixed as to cover the hole from the inside while leaving a space for liquid to flow.

A ½in. hole must also be drilled in the exact centre of the lid which must be given two coats of black cellulose paint, inside and out.

(*Concluded on next page*)

A Morse Practice Circuit

By J. B. Dance

WHEN learning morse it is usual to use a small interrupter or "buzzer" operating from a dry battery and working on the same principles as an electric bell. This arrangement may be quite suitable for the early stages of learning morse, but is open to the objection that the note is not a pleasant sound of a single frequency. The sound from a buzzer is harsh and not clear cut. Fig. 1 shows an extremely simple circuit which gives a note of an adjustable frequency and which can easily be constructed by an enthusiastic schoolboy. The only power supplies required are a 9- or 18V. grid bias battery and, if a valve with a 2V. heater is used, an ordinary small 2V. accumulator. If it is used by a youngster there is therefore no possible chance of him getting even the slightest shock.

A valve designed to work from a 1·5V. dry battery is especially convenient, as one cell of the grid bias battery used to supply the anode can also be used to supply the heater as shown in Fig. 1. Almost any small general purpose triode is suitable. Alternatively a small pentode may be used if the screen grid is connected to the anode and the suppressor grid to the cathode. The 1T4 is a suitable miniature pentode which has a B7G base and a heater requiring only 0·05A. at 1·4V.

The Layout

Possibly the simplest arrangement—and one which can be constructed very quickly—is the use of a "breadboard" layout in which the components are screwed to a piece of wood. The valve can then conveniently be one of the old type of British 4-pin valves which were used in pre-war battery receivers. The 2V. heater supply should be obtained from a small accumulator.

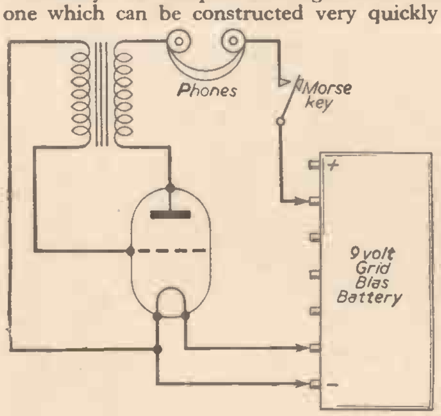


Fig. 1.—The circuit.

The transformer may be one of the components designed for coupling audio frequency amplifier stages. A transformer with a ratio of 3:1 to 5:1 is suitable. If the circuit does not work at first the connections to either the primary or the secondary winding of the transformer should be reversed.

The frequency of the note heard in the 'phones varies with the voltage supplied by the battery to the anode circuit and also with the heater voltage. It is easy to find a tapping on the battery which gives a note of frequency between 1Kc/s and 2Kc/s which is very suitable for morse. The note is clear and musical and the morse is very clear cut.

List of Components

- 1 Morse Key.
- 1 General purpose triode (almost any kind will do). (e.g. PM2HL).
- 1 Audio transformer (about 3:1 or 5:1).
- 1 Valveholder.
- 1 Pair headphones, high resistance.
- 1 Grid bias battery, 9V or 18V.

If a 2V valve is used, one small 2V accumulator will also be required.

A Rollfilm Developing Tank — *concluded*

The filler spout should be painted inside before attaching to the lid.

The Agitating Device

Means have to be provided for rotating the spool within the container during processing. This is achieved by the assembly shown fitted into the centre of the lid.

The knob was removed from an old radio control and the washers should be of fibre or ebonite 1¼in. in dia. The rod should be a piece of the same diameter material as that from which the spool centre rod was made. A hole is drilled through the rod immediately under the lid and a peg passed through to secure it in position. The short piece of rubber hose should be arranged to project just far enough below the lid so as to engage with the top of the spool centre rod when the lid is in position. Turning the knob will then cause the spool to rotate in the solution. Agitation in the other direction can be effected by gently rocking the container.

A 1in. wide rubber band—cut from an old car inner tube — should be placed around the container and overlapping the edge of the lid flange. The completed tank can be seen in Fig. 2.

Films are intended to be loaded into the tank in conjunction with an apron. This consists of a length of cellulose acetate material of the same width as the film to be processed. The edges of the apron have small indentations to keep film and apron from being completely in contact. Aprons are not easy to make but may be purchased cheaply in various sizes.

Fig. 2.—A photograph of the completed tank.

Before using the tank for the first time fill it with water to just above the top disc of the spool, then empty the water into a measuring glass. Make a note of the quantity—it will be the amount of solution to be poured in after the tank is loaded.

As a precaution the tank should be used only in subdued light. This should make for no complications since processing is not usually carried out in broad sunlight.

Conversion to Stereo—

(*Concluded from page 384*)

one of the channels until it is at the same level as the other. When this is done, to a listener sitting in the optimum position, the sound should appear to come from a point directly in front of him and between the two speakers. If, however, this is still not the case after further adjustment, then the system is almost certainly "out of phase." The phase of a system will depend upon which order the electrical signals are fed to the loudspeaker. Fig. 8A shows that when both diaphragms move forward at the same time the high pressure parts of the sound wave produced add together. But when one moves forward and the other moves back, then high and low pressure areas will coincide and cancel each other out. (See Fig. 8B.) The result is a "dead" area where there is little or no sound. To rephase the speakers *one* of the connections will have to be reversed. This can be done at either the "output to speaker" sockets on the amplifier or at the taps on *one* of the speakers. It should be realised that two reversals will simply serve to re-dephase the system.

When this test is completed and the optimum listening position has been decided upon, the system will be ready to play stereophonic records.

Suggestions

Firstly about the second speaker housing. The definition of a speaker cabinet is not "just a box." Speaker enclosures are designed by acoustic experts, and if it is decided to build an enclosure it is always advisable to work to a plan, and to use the right enclosure for the speaker.

Finally a word about mounting levels. A common mistake made by stereo enthusiasts is in either mounting the speakers up on a picture rail, or simply placing them on the floor. Far better mount them at ear level, remembering that one is usually sitting, and not standing, when listening.

The author wishes to acknowledge the kind assistance of the E.M.I. Company in compiling this article.

Where is it ?

By O. B. Stones

HERE is a fascinating money-maker which appeals to young and old alike. It is easy and cheap to make, topical at all times, and can be used indoors or out of doors.

As will be seen from the photograph Fig. 1, it consists of a large map of England and Wales on which county boundaries are marked; one hundred and forty towns, unnamed, are represented by steel studs. The customer pays a small sum and draws a card on which is written the name of one of the towns. He is then asked to place the magnetic wandering lead on the stud he thinks occupies the position of that town on the map If the choice is correct the bulb lights up and the customer may choose any one of many small prizes exhibited on a table, or may be given a small money prize. The operator has his own wandering magnet and a set of steel studs each of which bears the name of one of the towns studded on the map; these are arranged on the operator's panel in alphabetical order. After the customer has placed his magnet in position the operator puts his magnet on the town drawn and the circuit is completed if the customer's choice is correct.

A suitable map is available from "Geographia" Ltd., 68 Fleet Street, London, E.C.4. It is black and white and shows only the coastal outline and the county boundaries, no names whatever. It costs 3s. 6d., postage and packing included. Ask for their No. 6 map. It measures 30in. × 40in. which, with a 1in. flat-round moulding, brings the overall size to 32in. × 42in. The board carrying the map is sloped slightly and is mounted on legs which brings the height to just over 6ft. This is well within reach of the average person and ensures the apparatus being visible from a distance.

Fig. 1.—The game erected and ready for customers.

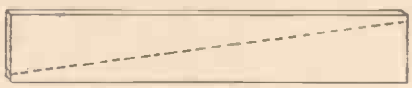


Fig. 2.—How both sloping sides may be cut from one board 3ft. 6in. × 3in. × 1in.

Fig. 3.—Rear of map board with back removed to show guide tags bearing names of towns.

Peg-board has been used to carry the map but plain hardboard may be substituted if desired. The latter gives much more scope for accurately placing the studs but necessitates drilling 140 holes.

Mounting the Map

Having bought the peg-board or hardboard the map must be mounted on the face side. Pockets of air and creases must be avoided at all costs and the finished job present an absolutely smooth surface. The adhesive must be weatherproof. Use a strong but thin glue, and apply it to the back of the map; *not* to the hardboard. With a clean cloth press down from the centre outwards, raising the map when necessary to even out any bubbles or creases. If it can be left on a flat table under pressure so much the better. Since a piece of plain hardboard 40in. × 32in. will be required later on for the back, it is a good plan to use this to cover the map (smooth side downwards) and apply as many weights as possible all over it. When thoroughly dry, apply two coats of copal varnish but before doing this paint the seas medium blue; water colour paint used sparingly is ideal.

The board should now be mounted at the sides on two pieces of 1in. wood 6¾in. wide at the base and tapering to 1in. at the top. Fig. 2 shows how these two pieces may be cut from one board 3ft. 6in. × 8in. × 1in. Two cross struts of 1in. × 1in., each about 30in. long, are screwed at the back of the board horizontally at the top and the bottom. Now paint the flat-round moulding and the outside of the side pieces bright red after having applied an undercoat. Fix the moulding around the edges of the map, mitring the corners. Mount the bottom on a 12in. wide length of

⅜in. plywood. The overhang is later required to carry the operator's box and panel, so it is a good thing to fix it now and thus let it hold the unit steady.

The studs are steel cheese-headed 2 BA bolts ½in. long, with one nut and two washers to each. Approximately two gross of bolts and nuts and four gross of washers will be needed. The magnets are " Eclipse " button magnets No. 821A and have a height of ⅜in., a diameter of ½in. and a central hole 11/64in. dia. These are fastened to flexible leads of suitable length with brass bolts and nuts or small wireless terminals. The light is a miniature screw-in 4½V. one, mounted in a batten holder which is fastened to the front of the map (somewhere between the Isle of Man and the Isle of Anglesey) and a fixed anchor-stud placed near it to accommodate the magnet when not in use. It will probably be necessary to reverse the terminals on the batten holder so that they protrude at the back of the board; this makes for a neater wiring job. The operator's lead should be about 4ft. long.

Selecting Towns

Before studding can be commenced it is necessary to decide what towns are going to be used, and this will depend largely on whether peg-board or hardboard has been used as a mount for the map. There are plenty of towns with quite familiar names which the average person knows, or thinks he knows, are in certain counties, but which are quite difficult to position correctly. A list is given in col. 3 of the towns chosen by the author.

Stud Fixing

To facilitate wiring, the author attached small cards under each stud with the names of the towns on them (Fig. 3). This indication is essential as it is extremely awkward to follow the studs from the front of the board to the back with accuracy. If the making of these small cards is thought tedious, the whole of the back of the board may be painted matt white and the town name written above each stud as it is inserted. If plain hardboard has been used it will be necessary to drill holes where studs are to be placed. Put one washer and a nut loosely on each stud as it is inserted; this will prevent them falling out when the board is manoeuvred on the bench.

The next operation is to fix the backleg stays as these form the sides of the box, of which the lid is the operator's panel. The box thus formed, which has no back, is 2in. deep and runs the full length of the board. The lid of the box is essentially of peg-board and is 5in. wide. Figs. 4 and 5 show the leg stay and front and lid of box. The outside of this lid—the smooth side of the peg-board—should be given two coats of matt white

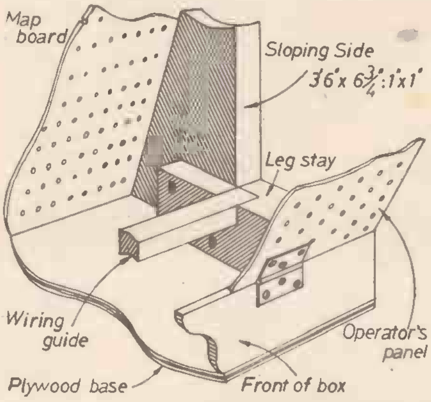


Fig. 4.—The leg stay also form side of box and support for plywood base.

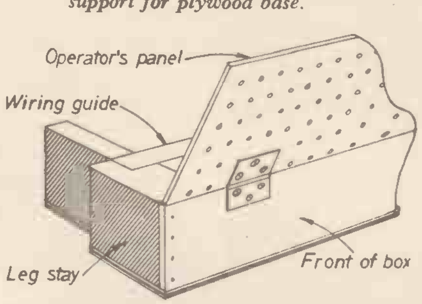


Fig. 5.—Part of box and operator's panel. No studs are shown in the pegboard.

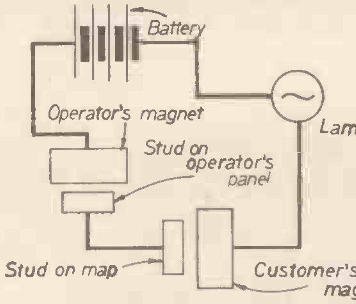


Fig. 6.—The electrical circuit.

paint and, when dry, the names of the 140 towns written above the studs in alphabetical order downwards. Each of the four rows will have 35 studs. Write the names in Indian ink and give two coats of copal varnish when dry. The studs may now be fitted, threading on one washer and one nut loosely to each stud. Before commencing the wiring, a 1in. × 1in. wood batten is fixed across the back of the box as a wiring guide; it is clearly shown in Figs. 4 and 5. Let it in to the leg stays so that it is flush with them; it is later used for anchoring the wires between the map board and the operator's panel. Note that the wires run *underneath* the guide and are thus totally enclosed when the back is screwed on.

Wiring

Plastic-covered single bell wire (about 26 gauge) is used for connecting the studs on the map to the appropriate ones on the panel. About 150 yards will be required, and there are several ex-Govt. surplus dealers who have 100ft. coils of this wire at 2s. 6d. per coil. Cut the wire only as required, and it is best to proceed as follows: Bare one end for about 1¼in. and twist it into a loop which will just fall over the stud without gripping it; this can be done quickly and neatly by using a round awl as a template. Select the lowest town on the map and work upwards from left to right. Say, for example, the lowest town is Padstow: remove the nut from the Padstow stud on the map, place the bared loop over the stud, add one more washer and the nut, and tighten up. Note here that it is by far the better plan to tighten up by means of the stud

Chosen Towns in order of Counties:

Cornwall—Newquay, St. Agnes, Padstow, Helston	4
Devon—Dartmouth, Salcombe, Newton Abbot, Okehampton	4
Somerset—Dunster, Chard, Keynsham, Glastonbury	4
Dorset—Portland, Blandford	2
Wiltshire—Salisbury, Warminster, Melksham	3
Gloucester—Gloucester Cirencester, Cheltenham	3
Hampshire—Ringwood, Aldershot, Basingstoke, Winchester, Cowes (I.o.W.)	5
Sussex—Eastbourne, Chichester, Rye, Horsham, Arundel	5
Surrey—Sutton, Woking, Godalming	3
Kent—Dover, Rochester, Gillingham, Lydd, Tunbridge Wells	5
Berkshire—Sandhurst, Wantage	2
Oxfordshire—Burford, Banbury	2
Buckingham—Slough, Marlow, Chesham	3
Hertfordshire—Hertford, Stevenage	2
Essex—Epping, Harlow, Saffron Walden, Clacton	4
Bedfordshire—Bedford, Ampthill	2
Cambridge—Wisbech, Cambridge, Ely	3
Suffolk—Ipswich, Bury St. Edmunds, Mildenhall, Beccles	4
Norfolk—Norwich, King's Lynn Mundesley, Swaffham	4
Huntingdon—Kimbolton	1
Northants—Northampton Kettering, Oundle	3
Warwicks—Birmingham, Warwick, Stratford-on-Avon, Rugby	4
Worcester—Kidderminster, Droitwich	2
Rutland—Oakham	1
Leicester—Melton Mowbray, Lutterworth, Loughborough, Market Harboro'	4
Lincolnshire—Lincoln, Grantham, Spalding, Boston, Cleethorpes	5
Nottinghamshire—Retford Mansfield	2
Staffordshire—Stoke-on-Trent, Newcastle-under-Lyme, Walsall, Wolverhampton	4
Derbyshire—Matlock, Chesterfield, Glossop	3
Salop—Shrewsbury, Market Drayton, Wellington	3
Cheshire—Chester, Macclesfield, Crewe	3
Lancashire—Liverpool, Manchester, Blackburn, Preston, Oldham	5
Yorkshire—Hull, Leeds, Bradford, Harrogate, York, Filey, Middlesbrough, Sheffield	8
Co. Durham—Stockton-on-Tees, Bishop Auckland, Darlington, Jarrow	4
Westmorland—Appleby, Ambleside	2
Cumberland—Carlisle, Penrith, Workington	3
Northumberland—Haltwhistle, Hexham, Alnwick	3
Monmouth—Newport	1
Flint—Rhyl	1
Denbigh—Colwyn Bay	1
Caernarvon—Pwllheli	1
Merioneth—Barmouth	1
Carmarthen—Llanelly	1
Pembroke—Fishguard, Tenby	2
Glamorgan—Cardiff, Barry, Swansea, Aberdare	4
Cardigan—Cardigan	1
Radnor—Llandrindod Wells	1
Anglesey—Holyhead	1
Isle of Man—Peel	1
	140

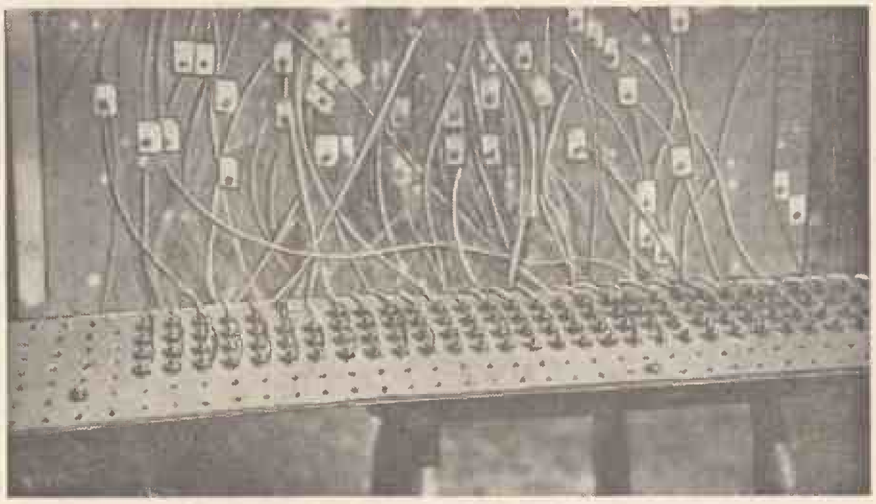


Fig. 7.—Close up view of underside of operator's panel.

head at the front of the map, holding the nut at the back steady with the hand; if the nut itself is turned it tends to take the washer with it and thus carry round the wire. Now open the lid of the box so that it lies roughly horizontal and support it in this position with a block of wood. Run the wire down by the shortest route to a position on the wiring guide directly opposite to the Padstow stud on the operator's panel, run a further length to the stud itself, and cut after allowing another 4-5in. Bare the end as before, make the loop, pass the wire *under* the wiring guide, remove the nut, thread on the loop, add a washer, and tighten up—also by turning the stud *not* the nut.

Check Connections

It is a good plan at this stage to complete the electric circuit so that connections can be checked now and again as made. The battery is an "Ever Ready" No. 126 which is $4\frac{1}{2}$V. and fitted with two terminals. Fig. 6 is a theoretical diagram of the circuit from which it will be seen that the customer's wandering lead is connected to one side of the lamp holder and that the other lamp connection runs direct to the battery. This latter should be placed in the extreme right of the box.

The other lead, to the operator's magnet, is threaded through one of the spare holes in the panel and is knotted on each side of the peg-board so that an accidental pull on the wire will not strain or break the connection. Do not be tempted to utilise a transformer; the introduction of alternating current will destroy the power of the magnets.

Rewiring Errors

Proceed with the wiring, working up the map, until all the towns are correctly connected up. You will no doubt find, as the author did, that a wrong connection now and again comes to light, a stud on the panel being already wired up when it should not be. In these cases trace the leads very carefully to the towns on the map and re-wire on the panel, checking up by completing the circuit and watching if the bulb lights. This fact is mentioned because as the wiring gets well under way the multiplicity of criss-crossing wires is quite difficult to follow and mistakes are easily made. If, when correcting such a fault, it is found that the wire is now on the short side (since it will have to be shifted to another stud on the panel possibly far from the original) cut a fresh length of wire and discard the old; all the wires must be of sufficient length to allow them to be neatly bunched at right-angles from the panel studs to the wiring guide to which they should be led and, when there are four of them, tied with thin cotton-covered wire or fine twine. They should also be tied at the back edge of the box lid (when open) by threading a length of wire through the peg-board holes, looping it around the four stud wires, re-threading through the same holes, and continuing to the next and so-on. Fig. 7 shows how these wires are led neatly along each set of four studs to the wiring guide; after they leave the underside of the guide they are, of course, out of control as regards neatness but this is unavoidable since the wire is not thick enough to retain right-angled bends even were they attempted. Anyway, such precision wiring is entirely unnecessary.

The Legs

These may now be cut and fixed. They consist of four pieces each 3ft. 6in. × 2in. × 1in. rounded at the top and cut to the necessary bevel at the bottom so that they rest firmly on the ground. If they are set at an angle of 15 deg. as shown in Fig. 8 it will be found that they spread to approximately 2ft. They should be painted a brilliant blue.

Preparing the Cards

A set of cards for the customers to draw from will be required and the author used plain visiting cards measuring 3in. × $1\frac{3}{4}$in. which are obtainable at any good stationery shop. They will stand reasonable handling, are thick enough to resist bending, and are easy to write on. Use Indian ink for writing the names of the towns; about $\frac{1}{4}$in. letters for the shorter names will show up boldly, and the longer names, or those involving two lines, can be $\frac{3}{16}$in. deep. It is advisable to make a box to hold these cards and Fig. 9 illustrates a suitable one. It is made to hang on the left side of the map by means of a glass-plate and a short strip of $\frac{1}{4}$in. square wood to keep it upright. Note that the bottom slopes away from the front; this is to ensure the cards do not fall forward and it also makes for easier removal one at a time.

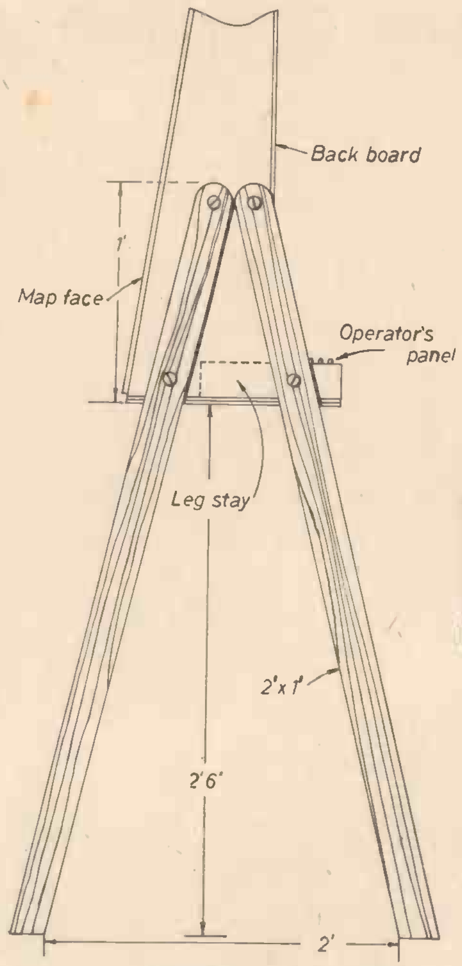


Fig. 8.—The position of the legs which are at 15 deg. to vertical.

Operator's Hints

All the cards, face downwards, are placed in the left-hand partition and, as drawn, go in the right-hand partition face upwards. This ensures that all the cards are in turn drawn, and it also prevents easier-found towns being replaced by the customer with a view of locating them next time!

For a similar reason it is advisable to let the customer place his magnet on what he thinks is the town he has drawn *before* the operator puts his stud on the appropriate stud on his panel. This will prevent any misunderstanding such as "the customer wasn't ready" or "hadn't really decided where the town was" although he had placed his magnet in position.

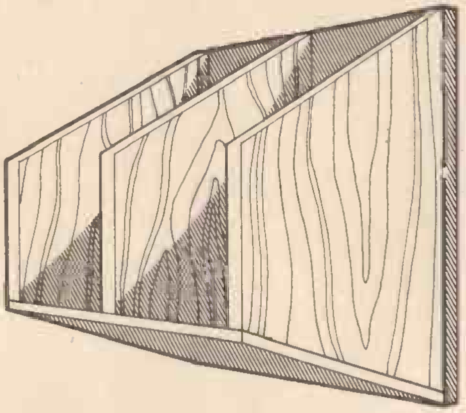


Fig. 9.—The card box. Note that the bottom slopes towards the rear.

As mentioned previously, a back of hard-board to cover the wiring should be fitted. This is screwed on with not more than, say, four screws each side and three at the top—none at the bottom since the edge of the back merely rests on the wiring guide. Quick access to the wiring might well be necessary if a disconnection takes place.

The advertising matter or attractive wording "Where Is It?" "Do You Know Your England?" or any similar wording is on hard-board painted matt white, written in 2in. block lettering in bright red, and the whole given two coats of copal varnish. As will be seen, the smaller sign is bolted to the map front, while the larger sign is secured to the top by means of a 1in. × 1in. batten.

The National Do-It-Yourself Journal

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and many other interesting features

A TODDLER'S ROCKING CHAIR

Fig. 1.—The chair in use.

Cutting List
Rockers: 2 pieces ramin 2ft. 3in. × 3in. × ¾in.
Legs: 4 pieces deal 7in. × ¾in. × 1¼in.
Handle: 1 piece deal 16in. × ¾in. × 1¼in.
Handle support: 1 piece deal 6in. × ¾in. × 1¼in.
Spacing bars: 2 pieces deal 8½in. × ¾in. × 1¼in.
Seat frame: 2 pieces deal 10in. × ¾in. × ¾in.
Seat frame: 2 pieces deal 8 in. × ¾in. × ¾in.
Seat supports: 2 pieces deal 12in. × ¾in. × 1⅜in.
Seat supports: 1 piece dowel 6in. long × ⅜in. dia.
Seat: 1 piece hardwood 11in. × 9½in. × ¾in.
Also required are screws, glue, sandpaper, paint, etc.

ANY child from about one year old to three or four will enjoy playing with this chair, which, if built as shown in the drawings is completely safe. Fig. 1 shows the chair in use.

The Rockers

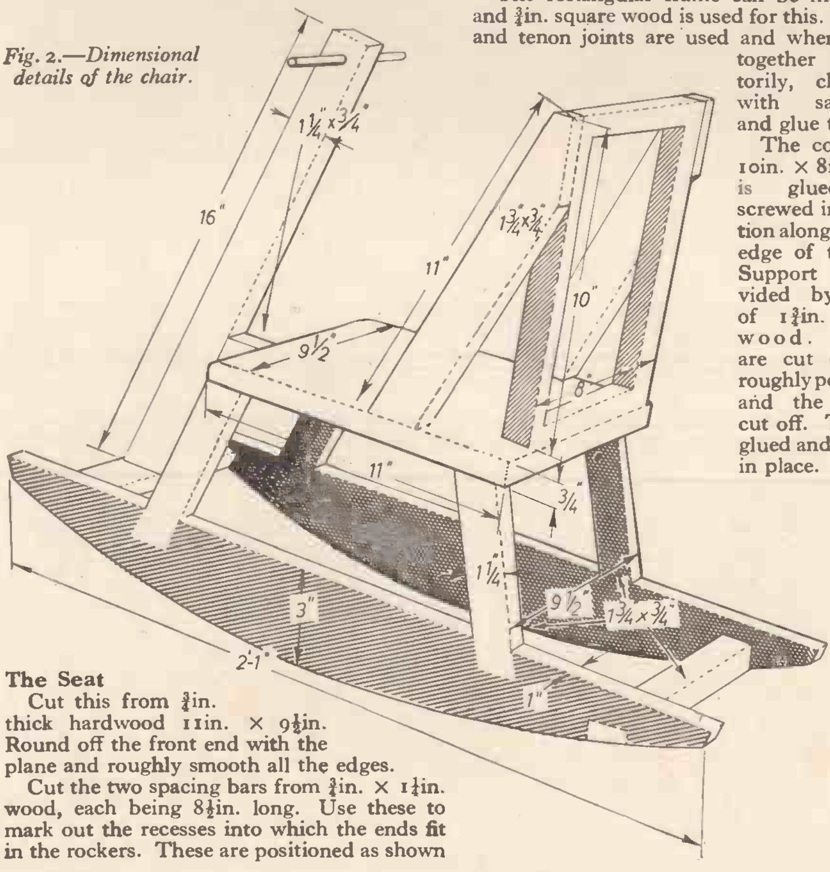
Draw the curve on to a piece of cardboard first by drawing a long centreline on the bench, placing the cardboard at right angles to it at one end. Tie a pencil on one end of a piece of string and pin the other end on the centre-line. Using this as a pivot point draw the curve on the cardboard. Cut out the outline of the curve and then using this as a template transfer it to the two pieces of 2ft. 3in. × 3in. × ½in. ramin from which the rockers are to be cut. Cut the pieces roughly to shape with a saw, then clamp them together in the vice and finish shaping them with a spokeshave or a small plane. Cut an inch off each end, trim with a rasp and sandpaper so that the complete length is 2ft. 1in.

Mark out the position of the notches for the legs, but do not cut them yet.

Cut out the legs a little longer than the 6½in. required, squaring off one end of each. Offer these squared up ends to the notches marked out in the rockers and if necessary modify these to ensure a tight joint. Next cut out the notches, using a saw and chisel.

Glue the legs into position. Casco was found satisfactory in the prototype. When these have set, clamp the two rockers together and saw the tops of the legs 4½in. above the top of the rockers and parallel to it.

Fig. 2.—Dimensional details of the chair.



The Seat

Cut this from ¾in. thick hardwood 11in. × 9½in. Round off the front end with the plane and roughly smooth all the edges.

Cut the two spacing bars from ¾in. × 1¼in. wood, each being 8½in. long. Use these to mark out the recesses into which the ends fit in the rockers. These are positioned as shown in Fig. 2.

The two rockers, their spacing bars and the seat can all be screwed together dry, dismantled again, sandpapered smooth, then finally glued into position and the screws replaced.

The Backrest

The rectangular frame can be made first and ¾in. square wood is used for this. Mortise and tenon joints are used and when all fits together satisfactorily, clean up with sandpaper and glue together.

The completed 10in. × 8in. frame is glued and screwed into position along the back edge of the seat. Support is provided by pieces of 1⅜in. × ¾in. wood. These are cut oversize, roughly positioned and the surplus cut off. They are glued and screwed in place.

The Handle

A 16in. length of ¾in. × 1¼in. wood is butt jointed on to the front spacing bar and glued and screwed into place. Support is provided by a 6in. length of the same material, with one end cut at an angle to suit, glued and screwed under the seat.

A ⅜in. hole is drilled 1in. from the top of the 16in. length and a 6in. length of ⅜in. wood dowel glued in to form handgrips.

This completes construction and it only

Make it for Your Child

By C. J. Jay

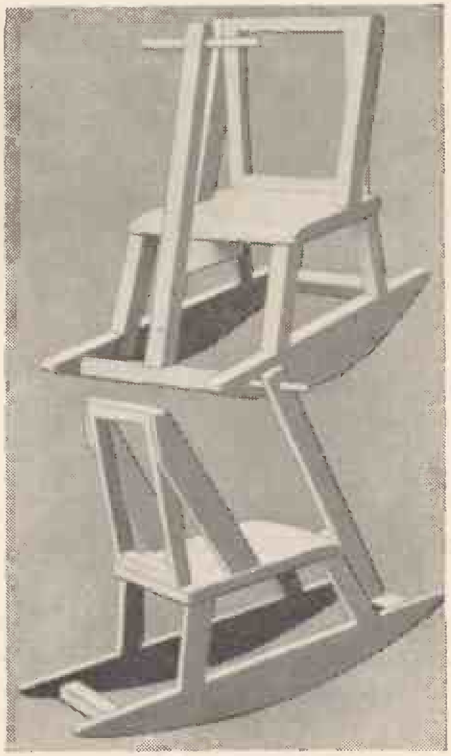
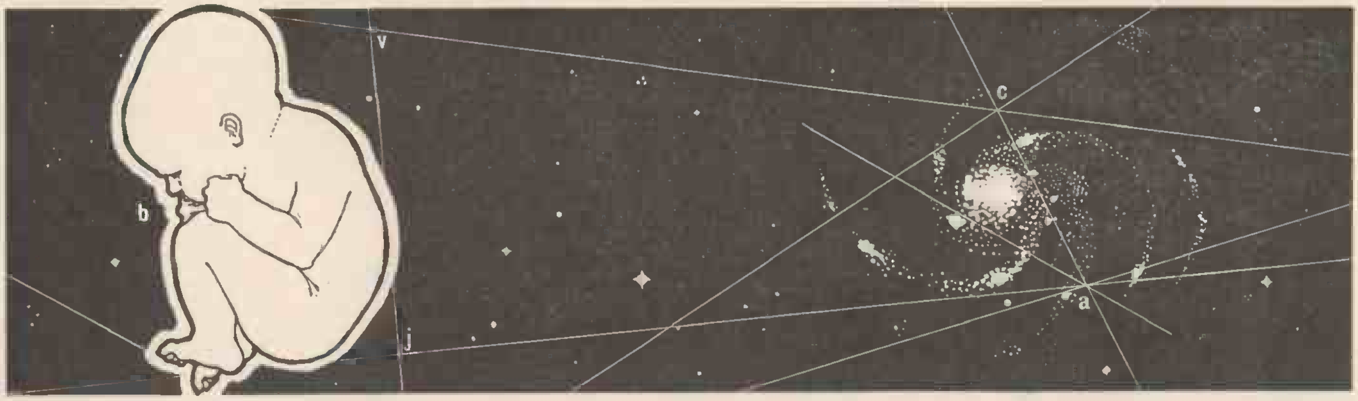


Fig. 3.—Two views of the completed chair.

remains to sandpaper smooth, apply primer and one coat of undercoat and top coat in some bright colour. Fig. 3 shows two views of the finished chair.

As shown, the rocker is completely safe and almost impossible to turn over. A greater amount of "rock" could be provided by giving the rockers a deeper curve, but the safety factor would be proportionately lowered.

PLANETS and UNIVERSAL LIFE



Part 2 • Universal Life

By William Ellwood

IN our quest for sentient life from that found on Earth, it is probable that we may have to probe well beyond the Solar System—although there is a chance of finding reasoning beings on Mars and on one or more large satellites of the major planets.

Last month we established that there must be innumerable planetary systems throughout our Milky Way Galaxy and its millions of galactic neighbours. In this discussion we shall consider sentient life forms as they have emerged or will emerge on planetary families of stars far removed in distance but not quality from our star, the Sun.

Unrealistic Speculations

Much has been said in recent years which suggests that sensible beings on other planets will be vastly different from Earthlings. Multi-eyed, multi-limbed monsters each weighing many tons; meditative vegetables with a penchant for the calculus; microscopic organisms capable of reasoning, planning and acting on a macroscopic scale; and creatures so basically different from humans in a physical sense that they are impervious to extremes of temperature. These and hundreds of similar ideas are but the outcome of illogical speculation. A moderate knowledge of organic chemistry and biology quickly dispels such hypotheses as near impossibilities.

It is indeed surprising that certain views expressed at a recent space conference in Nice tended to lend credence to the probable existence of such extremely alien beings. Reasoning creatures as large as elephants and others possessing both animal and vegetable characteristics were postulated.

Little attention is shown towards the fact that whilst in the *lowest* forms of animal and plant life there can be a transference or interchange of physical traits—in the *higher* manifestations of animal life the possibility of a similar transference verges on the absurd.

Exobiology

This relatively new science, exobiology, is a branch of astronautical study which deals with the physical and physio-mental aspects of reasoning beings on planets other than the Earth. Such a science must perforce have a fundamental similarity to terrestrial biology as will now be indicated.

The Basis of Life

Wherever the carbon element is found in abundance we find the *first* imperative requisite for the manifestation of life. It is not our present concern to understand why carbon is unique compared with the other elements. The fact remains that no other element is comparable with carbon in its capacity to form the complex molecules which in turn aggregate to form organic structures—the very matrices in which sensitive and reasoning life resides.

The green plants on which all animal forms ultimately depend for their sustenance, in their turn rely on the Sun's radiation to provide them with energy. By the process of photosynthesis plants build up carbohydrates from the carbon dioxide which they absorb. In this process oxygen is released.

In the case of nearly all living creatures, their varied activities demand a constant supply of energy which is realised by the oxidisation of carbon. This combustive process naturally requires the presence of oxygen. This element therefore constitutes the *second* imperative requirement for animal and reasoning life forms.

The *third* major essential for the manifestation of sensitive life is that of water, present either in liquid form or as water vapour. Over 75 per cent. of the human body is constituted of water in solution, or combined with tissue colloids were it exists in the bound state. The vital part played by water in the structure and functioning of the body cannot be overestimated.

The presence of other elements in various combinations is important for the full manifestation of higher forms of life, but if carbon or carbon dioxide, free oxygen and water are present; the prospects for such manifestations are bright.

Uniformity of Creation

As the emergence of animal and sentient life is primarily governed by the conditions outlined, life forms elsewhere in the Universe cannot to any great extent differ chemically from the varieties existing on Earth. They will be subject to similar survival ranges of heat and cold and their modes of nutrition must bear comparison to those we are aware of.

The conditions for life manifestation on Earth must be repeated a thousand million-fold throughout the Universe, for the distribution of elements is remarkably unbiased. No element is found in the Sun which is not found in the Solar planets—and conversely so. More important still: no element has yet been found in the Sun which is absent in its innumerable starry neighbours—and again, conversely so!

This strongly infers that stellar evolution anywhere (with planets as inevitable side-products) must occur in similar sequence. Stars and their planets emerge and ultimately die, but for a glorious cosmic moment sentient

Star cloud in the region of Sagittarius. Photographed on the 48in. Schmidt telescope.

life bursts forth and gazes wonderingly on its environment.

For animals and sentient beings to survive they must obtain organic matter to feed the body and provide fuel for energy release. Their search of this organic food substance is possible only if they are capable of moving from place to place. Very low forms of animal life and virtually all forms of plant life are capable of garnering their food from their immediate surroundings—their demands are few and their development is correspondingly limited. *When we discover sentient life on other planets, it will be in the form of motile beings.*

Bilateral Symmetry

It is logical and expedient for motile creatures to evolve along symmetrical lines. Simply put, bilateral symmetry of a living body means that its right side is virtually a mirror of its left side. To achieve smooth and direct progress the motivating limbs must be of the same length and equally positioned relative to the centre line of the body. It is therefore to be anticipated that *sentient beings on other worlds will have balanced forms similar to ourselves.*

The Erect Posture

The erect posture of the body adopted by sensitive and sentient forms is an instinctive acknowledgement of the laws of perspective. As the eye-level is raised, these forms become aware of an increased horizon both in width and depth. The erect posture may also be associated with increased mental activity due to fear, hunger or sheer curiosity, viz., the rearing of a frightened horse, the attacking attitude of the snake, the preparatory rearing of the bear, the begging dog, and the permanent semi-erectness of high mammals like the chimpanzee and gorilla which stems from a widening awareness and curiosity. The permanent fully erect posture of sentient beings such as ourselves is easily understood, for we find that by using our bodily length to gain the maximum height, we thereby gain a greater knowledge and therefore greater control of our environment. *This must apply to reasoning beings anywhere in the Universe. They will literally proceed in an upright manner.*

From these three essential characteristics mobility, bilateral symmetry and erectness—of intelligent life forms we can expect to find a basic likeness existing between ourselves and our counterparts on other planets.

They will also possess similar senses to our own for they will, like us, live within a planetary atmosphere. Light from their parent star will be diffused within it, and sound will be transmitted by it; thus encouraging the development of sight and hearing organs. Similar promptings will bring forth the other bodily senses we know of.

Detail Differences

There will of course be numerous differences in physical detail between ourselves and beings on other planets. They may have larger or smaller eyes, different teeth, more or fewer fingers, webbed or toeless feet, unsurrounded smelling and hearing apertures, completely hairless bodies, different skin tissue and pigmentation . . . and so on *ad infinitum.*

Stature

The greatest physical difference which we can expect with considerable certainty is that of height.

Professor H. Massey has been quoted as saying that the size of other planetary beings can be estimated once we know the size of the relevant planet. This estimate is based on the gravitational attraction of the planet. On a large planet the beings would be small, but on a smaller planet than Earth they could be considerably taller than us.

This opinion is acceptable, but it must be qualified by a consideration of the density of the planet. A planet of high density could restrict the average height of its inhabitants just as surely as could a planet of much greater mass but lower density. This is obvious when we remember that gravity varies according to the inverse square—the further the surface of a planet is from its centre of gravity, the less will be the force of gravity acting at that surface. A local example of the variation of g is that existing between polar and equatorial positions on the Earth. (Equatorial dia: 7926·50 miles. Polar dia.: 7900·02 miles.) This results in the weight of an object being slightly more at the poles than it would be on the equator.

Considering the range of planets which may evolve atmospheres amicable to life (for atmospheric content is governed to a large extent by planetary mass), it may reasonably be assumed that extra-terrestrial beings will vary between 2ft. and 12ft. in height. A corresponding variation in weight may be expected.

Mentality of Planetary Beings

The foregoing analysis encourages us to believe that our brothers throughout the Universe will in physical form strongly resemble ourselves. On the other hand there can be immense differences in mental evolution. The purposive drive which is inherent in the mental arrangement of highly developed beings, seeks to dominate and transcend its physical surroundings. This mental striving could readily lead the beings of other planets along lanes of scientific discovery which we have utterly neglected or missed entirely.

The harnessing of cosmic, gravitational and stellar energy may well be commonplace on other planets, much in the same manner as we use electrical and atomic energy on Earth. Some peoples of the Universe it may be contemplated, have for aeons past achieved space flight and now roam the Milky Way Galaxy as casual and unafraid as we venture over the seas and through our native atmosphere.

If in time alone, a planet is far more mature than the Earth, we may expect a corresponding maturity in mental outlook relevant to its inhabitants. We may visualise and hope that such conditions of tolerance and consideration may prevail in the future on our own planet. In the acceptance of a Creator and in the various branches of medical science we can confidently expect a bond to exist between ourselves and our Universal friends; for the Creator is essential to the Great Plan of existence, and the welfare of human bodies which we can be certain are of similar construction throughout the Universe, will be maintained by comparably similar means.

Mechanical Luggage Loading

A UNIQUE feature of the new P. & O. liner *Canberra* launched recently, is its built-in luggage handling equipment. Not only does this avoid the nuisance of waiting while luggage is unloaded before going ashore, but unsightly derricks are avoided. A model of this equipment was on view at the recent "Mechanical Handling Exhibition."

New Coal Cutter

THE fearsome device shown in the photograph below is not a Medieval torture instrument but is the latest improvement in coal cutting machinery. The fabricated drum is designed to replace the standard cutting drum of the Anderton Shearer Loader. The drum consists of a number of pockets on the periphery of which pick boxes are mounted. Two rows of pick boxes are provided at the face side of the drum to give a close pick sequence on the four inches nearest to the coalface. The rest of the drum has a special semi-helical pick lacing and the drum is cut away between these helical rows of picks to form pockets; these pockets allow large coal to pass freely round the drum and also prevent recirculation.

Robinson shearer drum.

Flame cutting Stone

A FIRM in America has harnessed a jet flame to a small manual torch and this handy tool, using a flame only 4in. long, it is thought, will in time replace many of the time honoured chipping methods of stone masons. The harder stones, such as sandstone, granite, quartzite, syenite and taconite are cut best by this new process and jobs formerly considered either impossible or uneconomical can now be carried out.

Drilling for Oil in the North Sea

SEISMIC exploration is being carried out on the deeper strata under the North Sea off the coast of Holland to establish sites on which three drillings will be made. Drilling will be carried out from the £500,000 mobile underwater oil-drilling platform "Triton" recently completed on the Tyne. The 115ft. × 80ft. platform will be equipped with modern direct-current diesel-electric drilling rig and a helicopter landing deck.

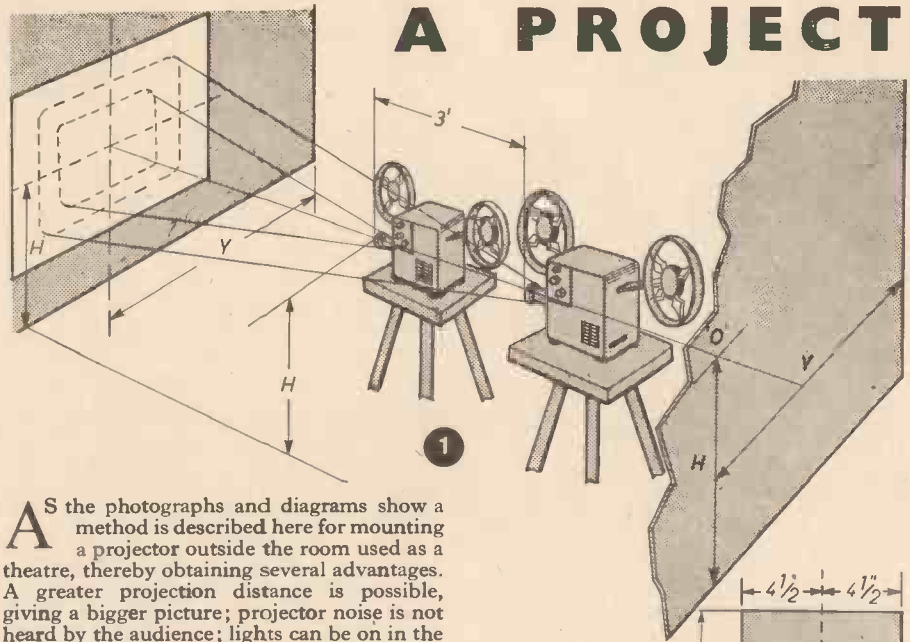
Aid to Precision Machining

THE Plus-Gas Co. Ltd., of 1-11 Hay Hill, London, W.1 are producing a fluid, the main constituent of which is a high grade oil of exceptionally low surface tension. This allows it to penetrate intergranular crevices in the surfaces of metals being machined and also to establish a permanent film of fluid between tool and workpiece throughout the operation. A clean cutting action is thus assured while build up on the edge of the cutting tool is greatly reduced. A film of oil remains on the finished workpiece protecting it from rust. The fluid is non-acid and non-corrosive.

A PROJECTION PORT

When Not in Use it Becomes a Wall Light.

By Thos. Brown



AS the photographs and diagrams show a method is described here for mounting a projector outside the room used as a theatre, thereby obtaining several advantages. A greater projection distance is possible, giving a bigger picture; projector noise is not heard by the audience; lights can be on in the projection room, which is a great advantage when operating a tape recorder synchronised with the projector; finally control over the audience lighting is facilitated.

Estimating Projector Distance

The first essential is to position the screen where it will be normally used and at the desired height, then set up the projector at the correct height with the base parallel to the floor so that the picture is central on the screen. Make a note of the width of the projected picture. Now move the projector 3ft. nearer the screen and measure the new width of picture. The difference in picture width per yard of projection distance can now be used to determine the projection distance to give a picture the full width of the screen. Also make a note of the height from floor to centre of projection lens.

From the centre of the screen width make a mark Y on the wall for the position of the projection port and then fix the position by marking the height from floor to centre of lens H. " O " in Fig. 1 denotes the position. Complete the marking out on the wall as shown in Fig. 2a.

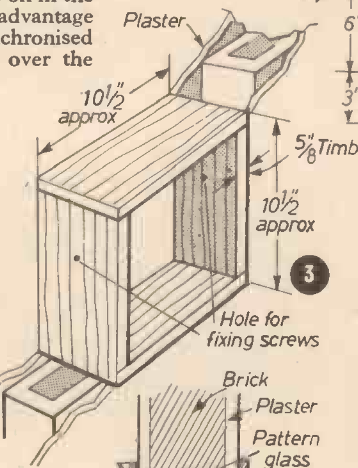
Construction

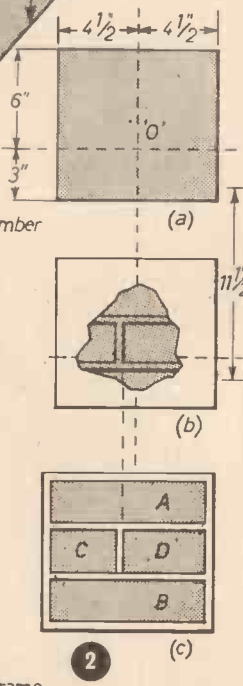
Start by removing plaster at the centre of the square until a vertical and horizontal joint is found in the brickwork (b). Using the centre lines of the brick joints, re-mark the 9in. × 9in. square in the nearest possible position to the original marking out. Remove plaster to expose brickwork as shown in Fig. 2c. Bricks A and B can be knocked out (from other side of the wall) when the bond has been chipped out. Bricks C and D should then be cut with a coarse hacksaw blade. Although time consuming, this method gives the best result and is quite successful. The resulting opening will be approximately 10½in. square.

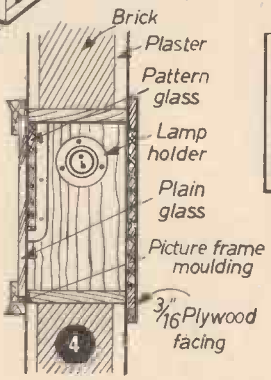
Wall Port Lining

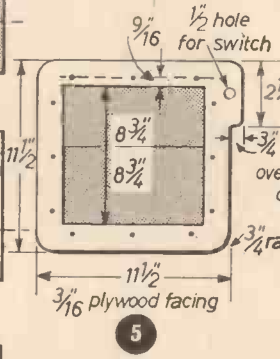
It is now necessary to make a wooden box to fit the opening with a depth to suit the wall thickness (approx. 5¾in.) as shown in Fig. 3. A wall mounting lampholder should be fitted

(Concluded on page 402)









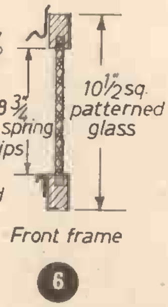


Fig. 1.—Positioning the projection port and screen.

Fig. 2.—(a) marking out the wall; (b) removing plaster; (c) exposed brickwork.

Fig. 3.—Wall port lining.

Fig. 4.—Section through wall port.

Fig. 5.—The plywood facing on the projector side.

Fig. 6.—The front frame to carry the patterned glass.

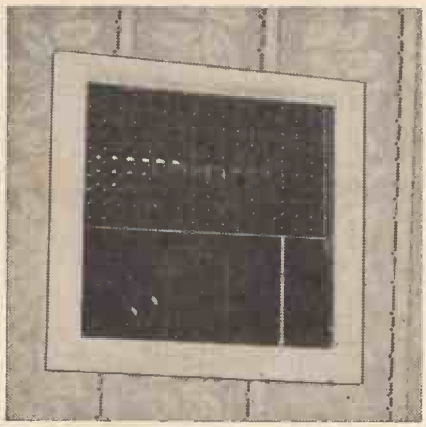


Fig. 7.—The screen side of the port.

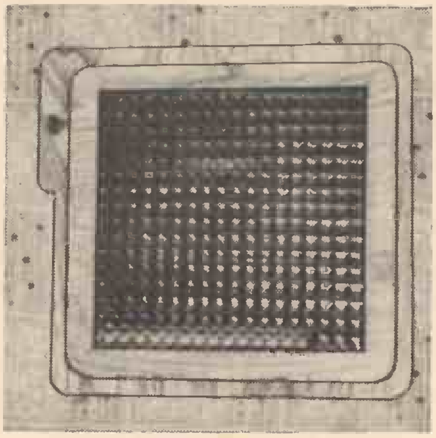


Fig. 8.—The projector side of the port with patterned glass in place.

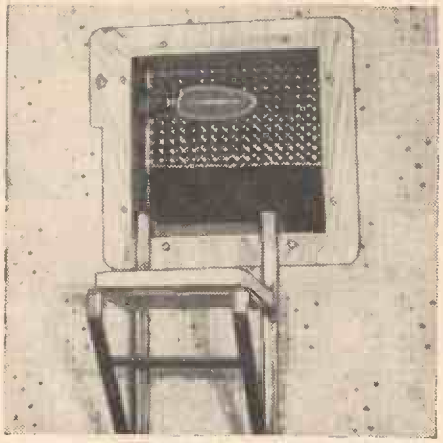
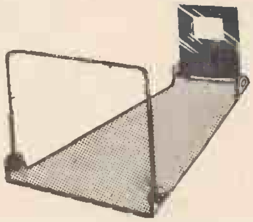


Fig. 9.—The projector side complete with stand.

Widen your box camera's scope by adding a

Wire Frame Finder



described here by "Helios"

MANY amateur photographers possess an ancient box camera, similar in pattern to the old No. 2 Brownie, which they are loth to part with for one reason or another, not the least being the opinion held by many users that the lenses fitted to the "black boxes" are superior to their modern counterparts.

The great disadvantage of the old-fashioned models, however, is the very small and indistinct type of reflecting finder which necessitates the holding of the hand around the viewing window and which cannot be used to observe the expression on the face of a subject —a serious disadvantage usually resulting in rapid upward and downward movements of the photographer's head as he endeavours to watch both sitter and finder at the same time.

It is quite a simple job to fit up on such cameras a wire frame eye level finder which will greatly increase the scope of the instrument.

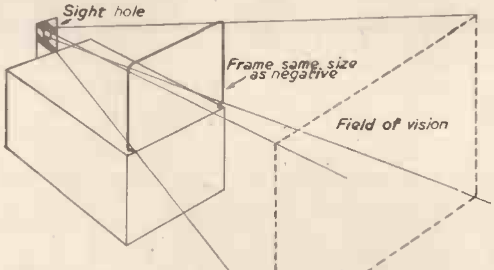


Fig. 1.—Principle of wire frame view finder.

The Principle

The principle of all wire frame finders is as follows. If we erect exactly over the lens a frame of the same size as the negative produced by the camera, and erect over the film position a sight hole perpendicular to the centre point of the framework, then the view (observed through the sight hole) enclosed by the frame will correspond to the picture projected by the lens. This is illustrated in Fig. 1. It will be seen from this diagram and Fig. 2 that if the wire frame is placed further back, it can be made smaller but will have to be raised above the level of the camera side otherwise the view will be obstructed. The centre of the sight hole must always be at a distance from the side of the camera equal to half the width of the negative. A smaller frame has certain advantages of relative inconspicuousness and lack of bulk but is more liable to errors in use. It is always advisable when fitting direct viewfinders (or any other type for that matter) to check the result by fixing a piece of ground glass in the film position temporarily and comparing the view projected thereon with that seen through the finder.

Bearing in mind the relative dimensions and fitting requirements given in principle above, a wire frame finder can be constructed in this manner. The actual dimensions of the parts will have to be worked out for the particular camera for which the device is required.

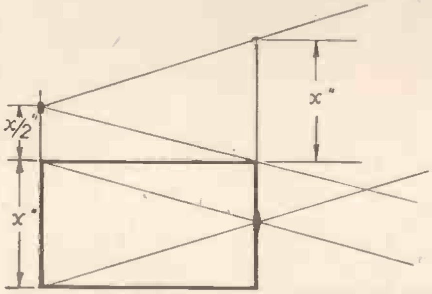


Fig. 2.—Dimensions of the wire frame related to the camera.

The Base

The base (Fig. 3) is made of sheet iron rather heavier in gauge than that used for ordinary "tins." The dimension between centres of the 7/64in. dia. holes should be equal to the focal length of the camera lens in one direction and equal to picture height in the other. The base can be cut out from a sheet of metal with tinsnips. Bending up the four lugs gives the shape shown in Figs. 3 and 4.

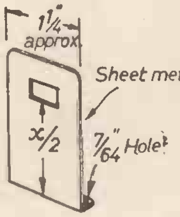


Fig. 5.—The sheet-metal sighting piece.

The viewing frame (Fig. 4) is made from a piece of 1/16in. thick iron wire, bent and fixed to the base as shown inset. Two 6 BA screws and nuts, with locknuts, are used for fixing so that the frame is not completely rigid but can be folded flat to the base when not in use.

The sighting piece (Fig. 5) is made of sheet iron and is to be capable of pivoting on the lugs at the smaller end of the base in a similar manner to the viewing frame. The centre of the sight hole must, as mentioned before, be opposite the centre of the viewing frame. The hole itself should be about 3/8in. × 1/4in. and can be cut out by drilling, followed by the use of a small ward file.

Mounting the Finder

The completed finder is shown in Fig. 4. Methods of fixing the gadget to the camera depend upon the ideas of the constructor. Perhaps the best way is to use two 6 BA screws through holes drilled in the side of the camera, with nuts inside. There is usually sufficient space internally between camera body and film carrier to allow for this being done. For those who do not care to drill holes through their cameras another way is to include in the finder base, extra lugs to bend over the side of the camera for locating purposes, the finder being held in position by elastic bands.

The finder may with advantage be given a coat of matt black paint before fixing to the camera.

Now is the time to make this attachment for your camera so that this year's holiday snap-shots can benefit from it.

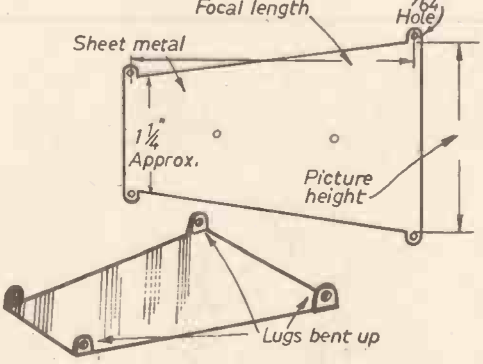


Fig. 3.—Details of the base.

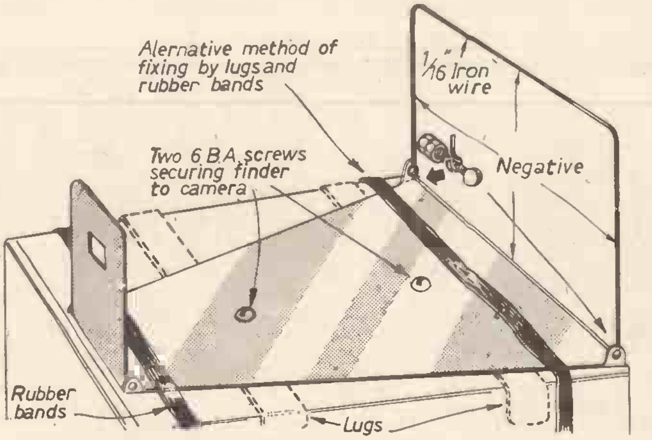


Fig. 4.—The assembled finder.

The Thermionic Converter

A new device for generating electricity directly from heat

By D. S. FRASER

ONE of the world's great needs is an efficient, inexpensive device that will convert heat directly into electricity, eliminating the need for costly generating equipment. Such a device could reduce power-production costs which could be a vital aid in meeting the unprecedented world-wide increase in power requirements.

Improvements from this type of development, particularly in high-fuel-cost areas seeking industrialisation, might include more stable economies, higher living standards and expanded commerce.

Direct Conversion Devices

Recognising the benefits that lower-priced, plentiful power would provide, scientists in the United States have developed several promising direct-conversion devices. They are simple, silent, have no moving parts and are inexpensive to build, operate and service.

Some will be ready for small-scale use within the next year or so. Eventually, after further development, direct-conversion may simplify the production methods for large-scale power plants.

Four of the devices, now in an advanced stage of development, have shown thermal efficiency ranging from 10 to 12 per cent. The maximum expected efficiency would be more than 30 per cent, which compares favourably with the 40 per cent efficiency of present-day turbine-generators. The difference in efficiency rates would be offset by the financial savings inherent in direct heat-to-electricity production.

One of the new devices, known as a thermionic converter, has been developed by the General Electric Research Laboratory, in Schenectady. This new method takes advantage of the fact that electrons can be " boiled out " of a hot metal surface and used to produce electric current directly. The process takes place in a tube of gas containing two electrodes that are maintained at high but widely different temperatures. When the heat is applied to one of the electrodes, it emits electrons, which are collected by the adjacent cooler electrode, producing a stream of electric current.

The design—and the materials used in the converter—smooth the path of electrons and remove barriers that in the past made such a device uneconomical because most of the energy dissipated before it could become usable power.

The Inventor

This type of thermionic converter was invented by Dr. Volney C. Wilson, a 47-year old physicist at General Electric. He was director of instrumentation and control during the construction of the first atomic reactor in 1941 and 1942. He has done, since, important work on the use of the neutron diffraction spectrometer as a research tool.

(*Left*) *A recently discovered ceramic material being prepared by a special furnace.*

(*Above*) *A pile of ceramic powder used to produce the small pellets shown.*

In a simplified explanation of his thermionic converter, Dr. Wilson said that when heat boils electrons out of a metal surface it is analogous to lifting water to the top of a hill. " If we let the water flow down the hill, it can do work—run a water wheel, for instance—but only if we can provide the water with a smooth uninterrupted path down the hill. The thermionic converter essentially smooths the path of electrons from a hot electrode to a cooler one, and removes barriers which in the past have absorbed the energy before it could do useful work in an electric circuit."

The Thermocouple

Most previous methods of converting heat directly into electricity, without rotating machinery, have been based on the thermocouple, a device long used by scientists for measurement and control functions.

One difference between the thermionic converter and the thermocouple is that the metals of the former are separated by a gas at very low pressure. There is an electrical flow between the electrodes, but there is less flow of heat than through a metal. Thus the electrodes can be at different temperatures, and the efficiency is greatly increased.

An ordinary flat iron converts electricity into heat with 100 per cent efficiency. Man's attempts to perform direct conversions in the other direction—from heat to electricity—are now beginning to achieve efficiencies which are interesting.

Indirect conversion is the basis for most of the modern electric power industry. Heat produces steam that spins a turbine—that drives a generator—that produces electricity. Modern steam turbine generators operating in this way have efficiencies of about 40 per cent.

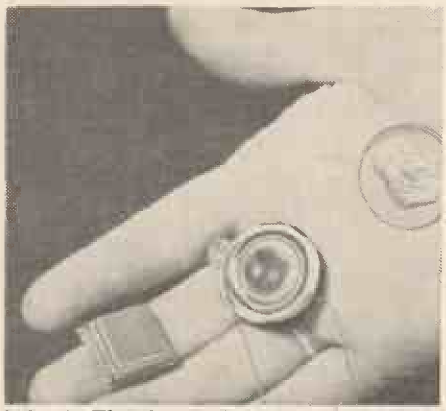
Thermo-Electron Engine

Another type of converter, developed at the Massachusetts Institute of Technology, is the thermo-electron engine which also uses electrons instead of steam for production of electricity. It operates on the principle that if two metal plates, one of them hot and the other cold, are placed side by side, inside a vacuum tube, electrons jump from the hot plate to the cold plate and produce electricity.

On the basis of its efficiency, the thermo-electron engine might compete with small generators now in use, many of which have low operating efficiencies. This device is silent, small and lightweight; has no moving parts, requires little supervision and is virtually maintenance-free.

A device that utilises a thermo-electric ceramic material, known as a mixed valence oxide, instead of metal has been developed by Westinghouse Electric Corporation. When heat is applied to one end of a pellet of the ceramic material, electricity flows off the cool end of the pellet.

(*Above*) *Electricity produced without the use of generating equipment operates the light bulb held by Dr. Volney C. Wilson.*



(*Above*) *The thermionic converter* (*centre*) *is used by the General Electric Company in the U.S. to produce electricity directly from the nuclear energy (gamma radiations) given off by a small strip of radioactive gold.*

The ceramic material, which can operate at a temperature of 3,000 deg. F., is being used in the designing of an atomic reactor. Heat from the reactor's nuclear fuel will be converted by the ceramic directly into electricity—simply, silently and without moving parts of any kind. Among the many advantages of this type of reactor will be its simplicity of design, construction and opera-

(*Concluded on page* 406)

THE MECHA

Details of Steering

By
Arth
W. J.
Ord-H

Steering Pylon

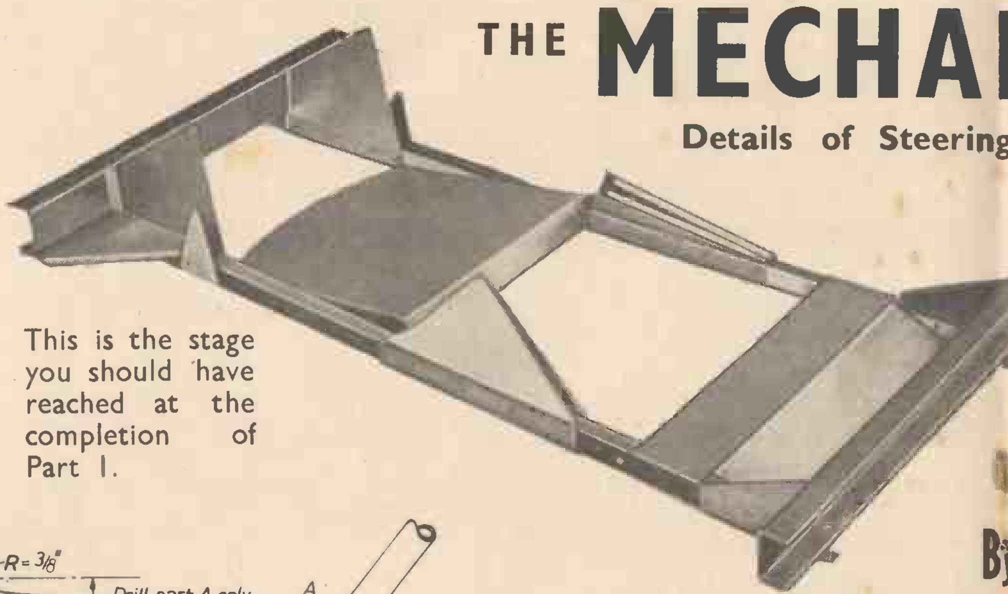
THE pylon supports are next formed from 18 gauge mild steel sheet. These are detailed in Figs. 10 and 11. The holes in the inner support through which the pylon bolts pass are drilled on assembly.

The pylon struts are of 1in. tubing. The gauge is not too important, although 18 or 20 is the thinnest which should be used, otherwise the bolts will crush the tube.

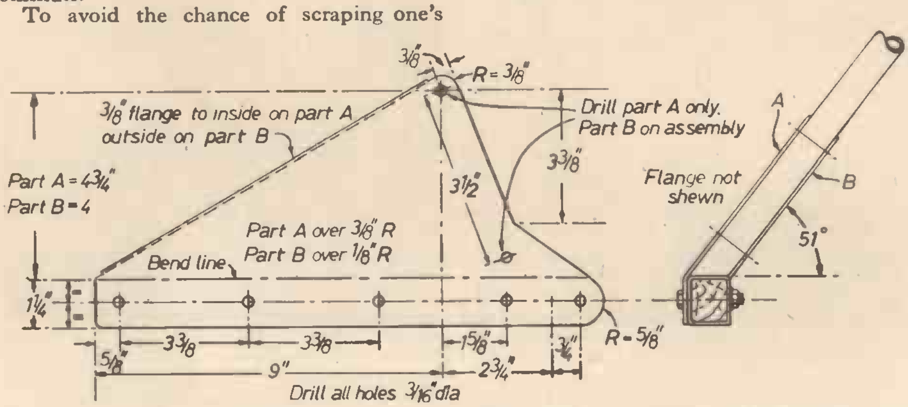
The pylon tubes are inserted between the supports and clamped in position whilst the two top trunnion plates are made up. Mark the position of the holes in these on the pylon tubes, remove them, drill the holes and bolt on the trunnion plates. The complete inverted "V" pylon assembly (Fig. 12) is replaced between the side supports and the holes drilled through. Make quite sure that the centre of the pylon is in line with the centre of the kart. The pylon may now be bolted in place using 2 BA pan-head bolts and stiffnuts.

To avoid the chance of scraping one's thighs on the protruding rear edges of the side supports, dress the metal down to the tube as shown in Fig. 13.

The bearing for the forward end of the steering column is a simple plain bearing as



This is the stage you should have reached at the completion of Part 1.



Figs. 10 and 11.—Two views of the pylon support. Make two pairs (handed) from 18G. M.S.P. The inside flange is dressed down on assembly to the chassis.

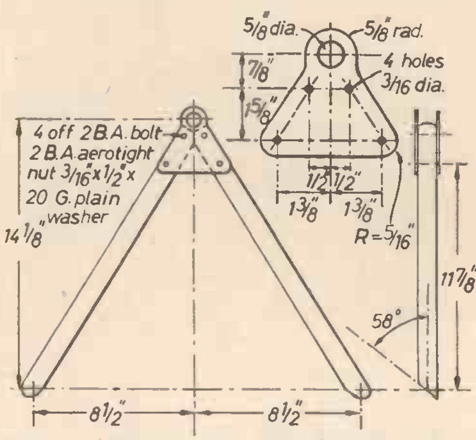


Fig. 12.—Steering pylon made from 1in. O.D. × 20G M.S. tube. Also bearing plate, two of which should be made from 16G M.S.P.

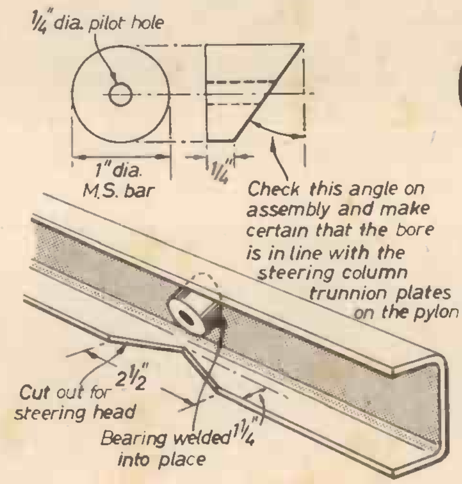


Fig. 14 (Right).—The forward steering column bearing, which is large enough to permit a phosphor-bronze bush to be pressed in.

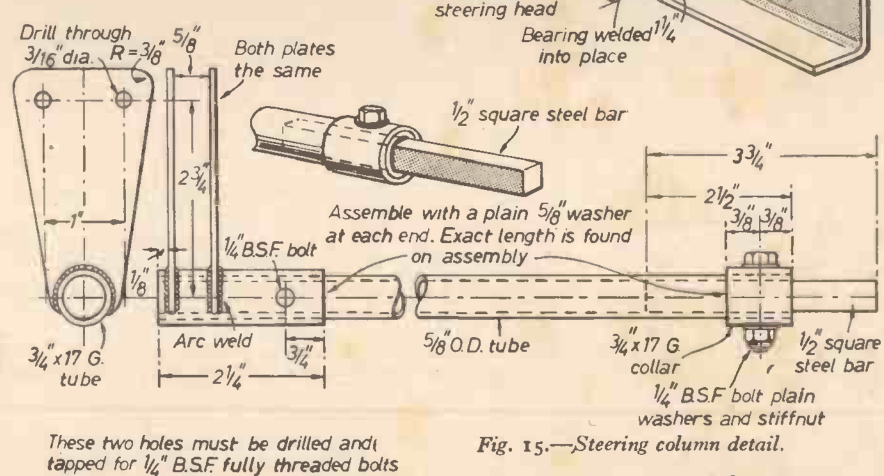


Fig. 15.—Steering column detail.

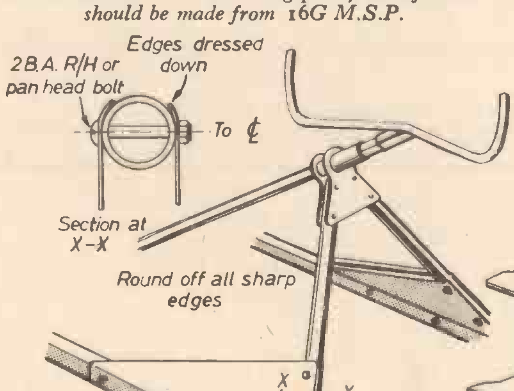


Fig. 13.—Dress down the edges of the pylon supports to avoid sharp edges.

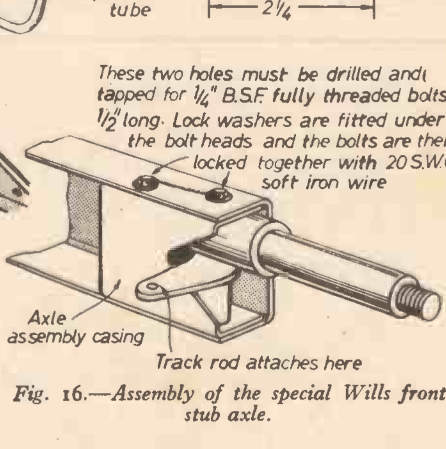


Fig. 16.—Assembly of the special Wills front stub axle.

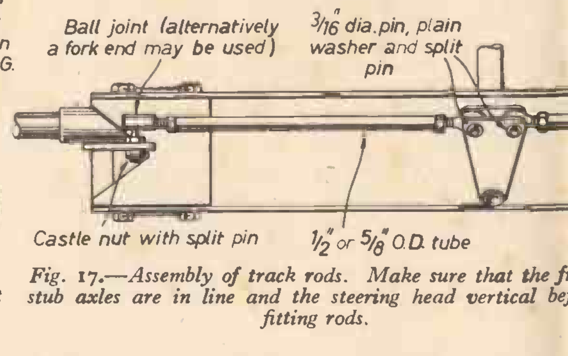


Fig. 17.—Assembly of track rods. Make sure that the f stub axles are in line and the steering head vertical be fitting rods.

NIKART ...PART 2

g Assembly, Stub Axles, Seat and Fenders

shown in Fig. 14. Alternatively, the constructor could enlarge the housing and press in a self-aligning ball race if he so desired.

The location of the front steering bearing is scribed on the front channel cross-member and drilled through ¼in. in dia. The bearing housing is also drilled ¼in. dia. located over the scribed centre-mark and arc-welded into place. It is then reamed out to the correct size, namely ⅝in. dia. A small " V " must be cut from the lower flange of the front cross member to provide clearance for the steering gear. This is shown in Fig. 14.

Steering Column

The steering column is made from a length of ⅝in. o.d. 18 or 20 gauge mild steel tube. The top end of this has a small retaining collar and a square shank to carry the handlebars. Both collar and shank are retained by one ¼in. B.S.F. bolt.

The lower end of the steering column carries the track-rod lever which is attached with one ¼in. B.S.F. bolt. Details of the steering column and assembly are given in Fig. 15.

Front Stub Axles

The front stub axle assemblies are standard parts available from H. A. Wills Limited. These are made to take a ¾in. bore hub. The correct method of assembling them to the chassis is shown in Fig. 16. These cost £2 3s. 8d. the pair, comprising one left and one right assembly.

These assemblies are not bushed. This is because the king-pins are so designed that wear is minimised. Also, the introduction of bearings or bushes would result in a more costly item. Whilst a kart must be a practical and sound engineering job equipped to perform its task, there is little object in exceeding the requirements thereby resulting in a much more costly piece of machinery.

These axles come complete and ready for bolting to the front beams.

The track rods are made of ½in. or ⅝in. o.d. tubing for rigidity. The wheel end is a ¼in. ball-and-socket assembly. This is a standard motor part which is available from most garages and spares stockists. The shank dia. of the ball end should not be less than ¼in.

The steering column end is a self-centring ball joint. This again is a standard motor part or, alternatively, the constructor may use aircraft surplus rod ends. A $\frac{3}{16}$in. dia. pin is used here in double shear. The detail and assembly are shown in Fig. 17.

The handlebars assembly is a standard part available from Messrs. H. A. Wills Limited. The handlebars may either be chromed or plastic dipped. Small turned wood plugs are fitted in the tube ends and rubber grips fitted.

Seat

Now make the seat-back bow (Fig. 18). This is of 1in. o.d. mild steel tubing, preferably of 17 gauge. Draw out full size the shape of this on a table-top and start by forming the top, central bend. The tube may be bent with the aid of a blow-torch or, failing that, the

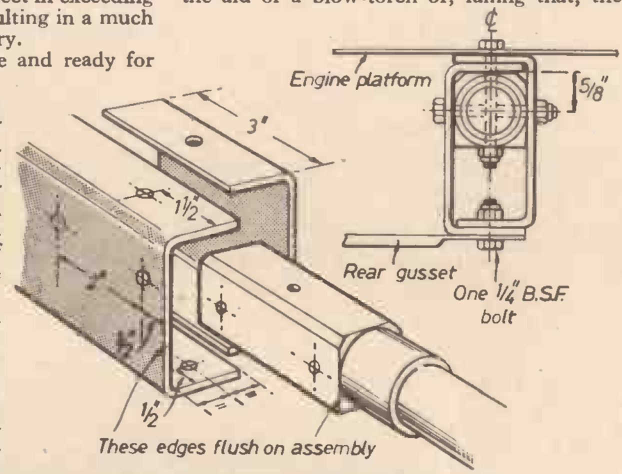


Fig. 20.—Assembly of the Wills rear axle.

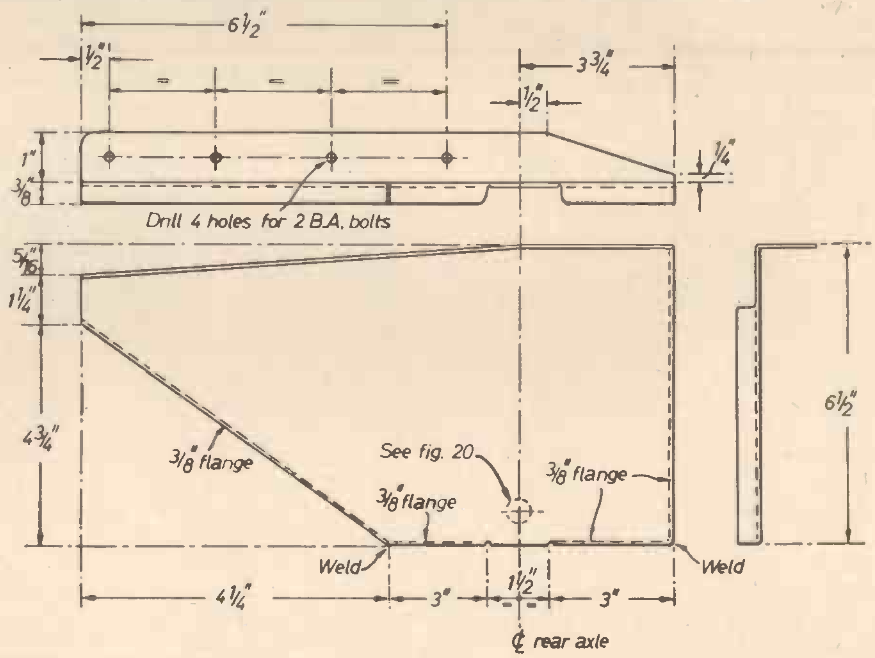


Fig. 21 (Right.)—Engine mounting table. Make two (handed) of 16G M.S. and fit parallel to longerons.

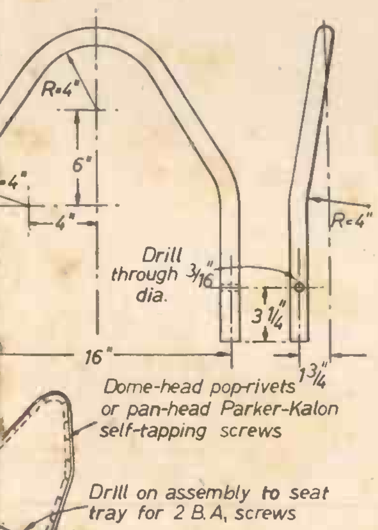


Fig. 18 (Left).—Seat hoop of 1in. O.D. × 18 or 20G steel tube. Seat back is 16G aluminium sheet pop riveted to the frame. Leave 2½in. extra along bottom for attaching to seat tray with 2 B.A. screws. Trim to shape on assembly.

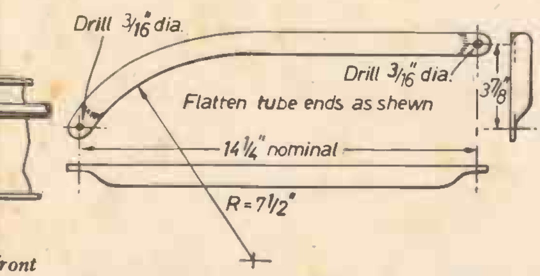


Fig. 19.—The safety rail. Two (handed) should be made from ¾in. O.D. tube 18 or 20G.

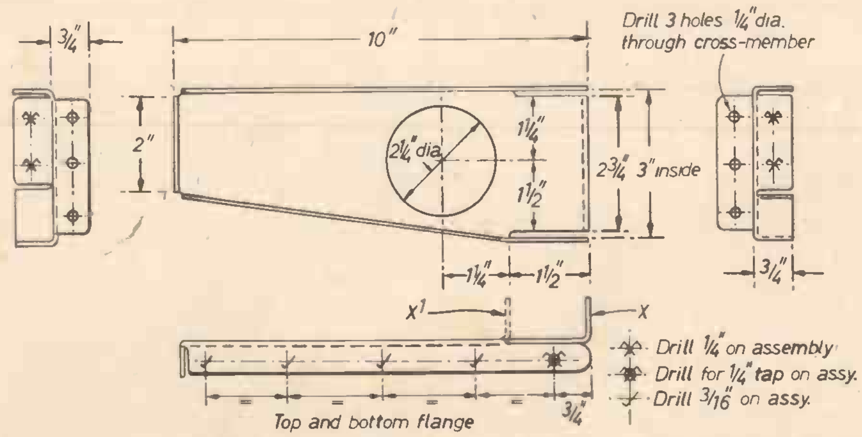


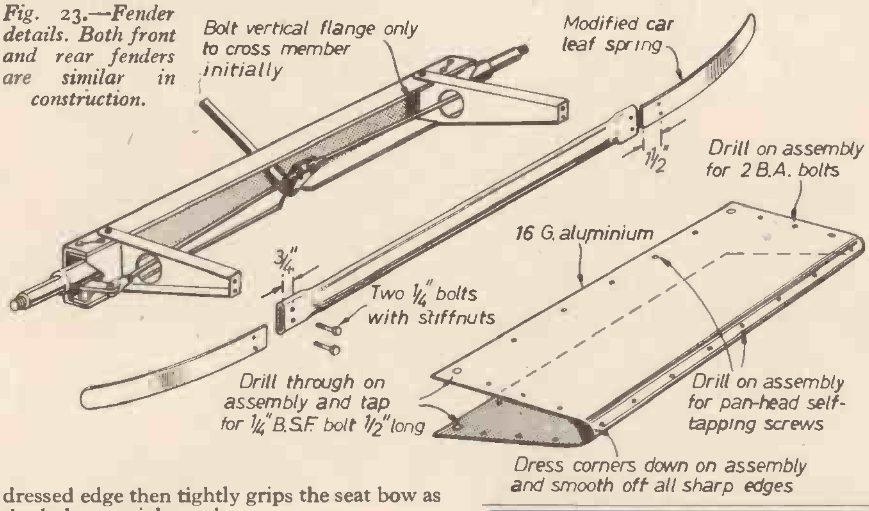
Fig. 22.—Fender support brackets. Make up two handed pairs in 14G. M.S. On the rear brackets the vertical flange X is made as marked X¹ and picks up on one bolt of the rear stub axle only. The 2¼in. ϕ holes are also deleted for the rear pair.

local plumber will be happy to oblige with his tube-bending machine.

Insert the seat bow between the side gussets and clamp it into place whilst the holes are drilled through.

As before, once the seat-bow is bolted in, dress down the edges of the side gussets. A somewhat better finish is achieved by dressing down the forward edge of the side gussets before fitting them to the longerons. The dressed edge then tightly grips the seat bow as the bolts are tightened.

Fig. 23.—Fender details. Both front and rear fenders are similar in construction.



The actual seat back is of 20 gauge mild steel sheet or 16 gauge aluminium. This is designed to act as a firewall and is a mandatory design requirement. Note that the top of the seat bow is bent back to enable the curved back to fit in neatly. The back itself is attached to the bow with domed-head pop-rivets or pan-head Parker-Kalon self-tapping screws. The lower end of the seat back is cut flush with the bottom of the seat flange and then drilled to take five 2 BA pan-head screws with stiffnuts, evenly spaced.

To dismantle the kart for packing, the seat-back can be completely removed by removing these five screws and the three 2 BA bolts each side, allowing the complete back to be slid out.

Before fitting the seat back, paint the seat back bow. This is particularly important if the seat back is to be made of light alloy as otherwise electrolytic corrosion will set in between the dissimilar metals.

Next make up and fit the two safety side rails. These are of ⅞in. tubing. Electrical conduit is quite suitable for these, although if proper tubing is used, they may be chromium-plated to add to the appearance. Fig. 19 details these.

Rear Axles

The rear axles are next fitted. These again are standard parts costing £2 2s. 6d. the pair from H. A. Wills Limited.

The method of attachment is shown in Fig. 20. The short channel-sections may be cut from the same material as the rear channel itself. The two horizontal bolts pass through the holes provided in the axles. One additional ¼in. hole is drilled down through the engine mounting table (shown in Fig. 21), through both channel top flanges and down through the axles for a ¼in. B.S.F. bolt.

As this kart may also be fitted with two engines if desired, both stub axle and side-gusset assemblies are similar, although handed. The details of the engine mounting platforms are shown in Fig. 21.

These platforms are drilled to take the engine later on.

Fenders

To protect the steering gear and also to provide a protection for the front and rear of the kart, fenders are provided. These also act as "overriders" in the event of two karts colliding. The wheel diameter is such that, even if one kart should override another, it is extremely unlikely that the kart would overturn.

The fenders each comprise two support brackets, a forward tube and a "stressed skin" covering. The ends of these tubes are flattened to take short car leaf springs.

The support brackets are each made from 14 gauge mild steel sheet and are bolted to the channel members. Fig. 22 illustrates the method of attachment. Note that the flanges face outwards. The track rods are so arranged that they pass through the clearance holes in the front pair.

For the actual fender, 1½in. dia. tubing is used. The true lengths of the fender tubes are 30in. for the front and 28in. for the rear. The last two inches of each end of both tubes are flattened to provide a ½in. wide slot to take the leaf spring. Austin 7 springs, available from any garage, are best for the job. The ends are softened for drilling and the spring slightly reshaped to provide about two inches clearance between the spring and the crown of the tyre. The spring is inserted in the end of the tube and then drilled for two ¼in. dia. bolts which pass also through the fender support brackets. Remove the springs and retemper them.

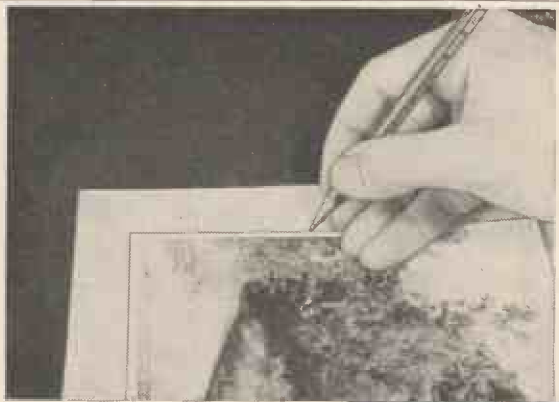
A sheet of 16 gauge aluminium is next cut and bent to fit around the fender. It is bolted to the flanges of the fender support brackets. Parker-Kalon pan-head self-tapping screws are used to attach the top and bottom aft edges to the front and rear cross members.

When drilling the holes for Parker-Kalon screws, the pilot hole must be of the correct diameter otherwise the screws will work loose in service.

Next month's issue will contain the instalment dealing with the assembly of the drive sprockets, the brakes and the installation of the engine.

PRINT MOUNTING

By A. E. BENSUSAN



USE rubber gum specially prepared for mounting photographs. Ordinary rubber cement is rarely satisfactory.

First, lay the print in its correct position on the mount, and draw around it using a finely pointed pencil held at an angle so that the point actually contacts the mount just inside the edge of the print (top photograph). In this way, the lines will be hidden after the print has been mounted. Squeeze a little gum on to the centre of the print and work it out to the edges with a spatula or a strip of card (centre photograph). Lay the print aside and apply gum to the marked area of the mount in just the same way. Keep the coatings as thin as possible, consistent with even coverage. Gum on the face of the print will rub off with a fingertip when it is dry.

Leave the coatings to dry partially, this takes about 10 minutes, and then place the print in position and rub down with a wad of cotton wool (bottom photograph). Place under a weight.

THE AUTOMATIC HOUSE

PART 4

TIME-DELAY SWITCHES

Some more thermal delay and time delay devices. Described by E. V. King

A Non-latching Thermal Delay Switching Device

FIG. 24 shows the layout and Fig. 25 the circuit adopted. Where non-latching relays are used current is required to energise one or both of them all the time the lamp circuit is on. This is a slight disadvantage but no latching device is required and the unit may be mounted any way up found convenient.

The relays are shown mounted by small brackets fitted at the end opposite to the armature, these brackets are screwed to the base under the relays and are not visible (Fig. 30). Spare contacts have been removed, but this is not necessary. Two n/o contacts are required on one relay and one n/c on the other.

The Annakin 1768 delay switch may be used, but a better one is Annakin 2041. The base code was given last month in Fig. 17. Any other make of heating switch may be used. R2 may be any value up to about 40 Ω.

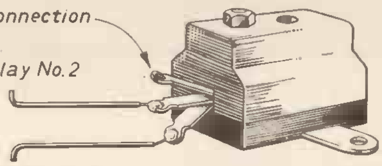


Fig. 23.—Using the Bulgin S586 flasher as a delay switch.

Operation

The unit is wired up in the same way as Fig. 15, connections 5 and 6 being omitted.

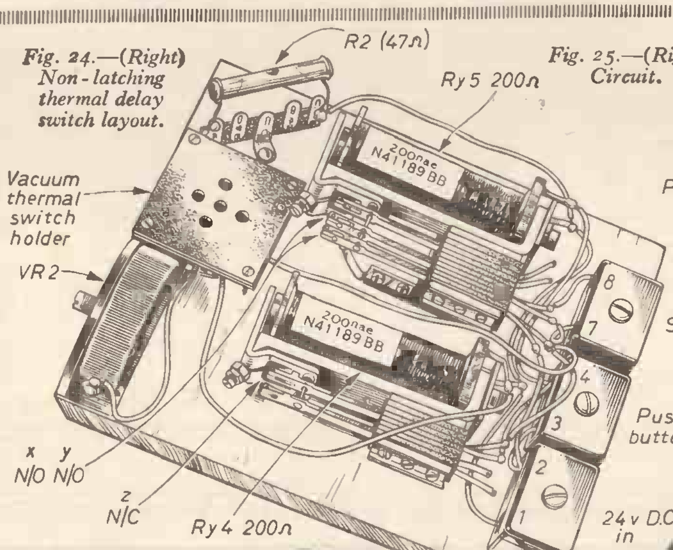
Pressure on the bell push energises Ry5. Contacts y close switching on the light. Contacts x also close and a circuit through the normally closed z contacts keeps Ry5 energised although the bell push is released. At the same time the circuit through the heater chain Vr2, R2 and thermal heater is operative. Slowly the bi-metal bends and eventually h and g contacts touch; Ry4 is energised. This causes points z to open and the current energising Ry5 is interrupted. Points x and y thus open to normal. The light goes out and the cycle is ready to commence again on depression of the push button.

A Thermal Delay Switching Device Using an Xmas Tree Flasher Lamp

It is possible to use a thermostat which opens on heating. Such a device is an integral part of Xmas tree flasher lamps rated at 0·3A. 20V. The layout is shown in Fig. 29. This is by no means critical and the unit may be mounted any way up and boxed as previously mentioned. The circuit is shown in Fig. 27 and a variable resistance may be fitted to give adjustable delay, it should have a resistance of about 50 Ω and be rated at 5 watts. A fixed resistance may be fitted if desired. The flasher lamps vary, but with a full 24V. most of them give about 6 sec. delay, this may be increased up to about a minute with the resistor in series with the heater. The device is shown completed in Fig. 28.

It is also possible to use a Bulgin Flasher Switch Type S586 if a resistance of 48 Ω,

Fig. 24.—(Right) Non-latching thermal delay switch layout.



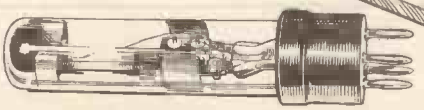
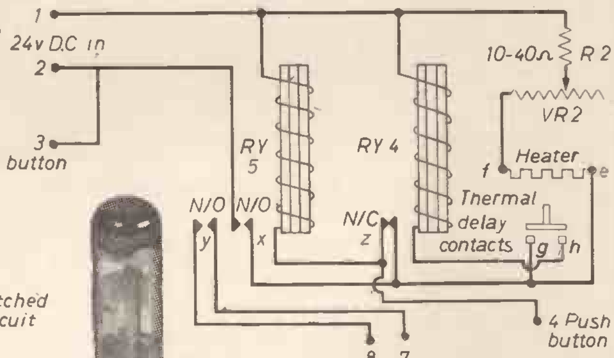
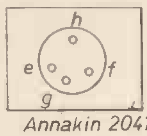


Fig. 25.—(Right) Circuit.





Annakin 2041 (AP 54103) Base code

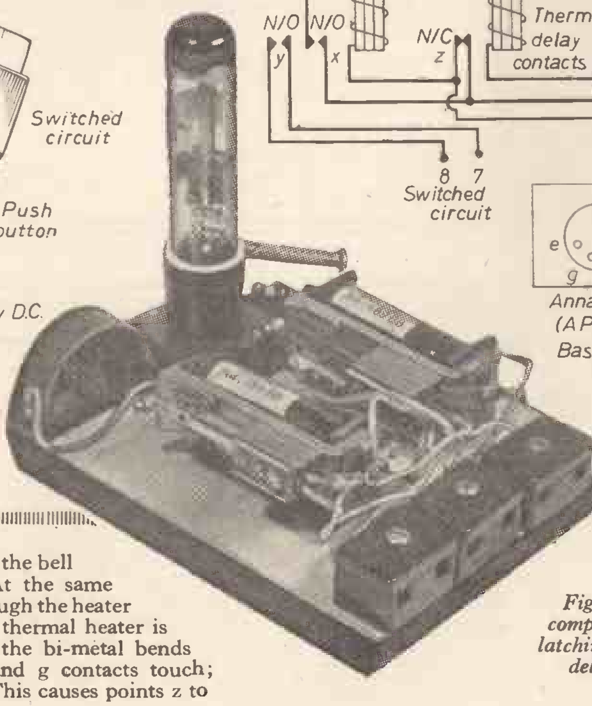


Fig. 26.—The completed non-latching thermal delay switch.

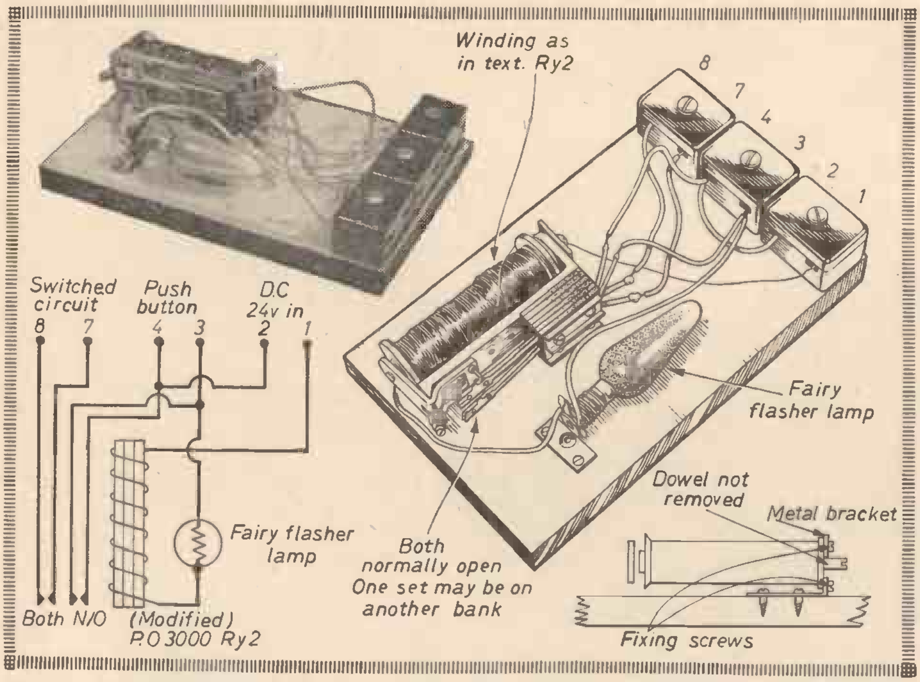


Fig. 28 (*Top*).—*Completed thermal switch using Xmas tree flasher lamp.*
Fig. 27.—*Circuit using fairy lamp flasher.*

Fig. 29 (*Top*).—*Layout of thermal delay switch using Xmas tree flasher lamp.*
Fig. 30.—*Alternative method of mounting P.O. 3000 relay.*

5W. rating, is fitted in series with the heater. The switch is shown in Fig. 23 together with wiring instructions. The life of the switch will be much longer than an Xmas tree lamp and is adjustable within limits of 1 to 5 sec. Rather greater adjustment is obtainable from flasher lamps by the series resistor method.

Operation

The external wiring is exactly as in the previous two units. When the push-button is depressed, the armature of Ry2 is pulled down and both sets of points close. One set is across the bell push thus keeping the armature pulled in, but only as long as the lamp remains alight and is passing current. When the lamp circuit is broken relay returns to normal.

The relay requires a very small resistance or the lamp will be unduly dimmed, probably P.O 3,000 relays are available with about 5 Ω resistance, but those of 200 Ω are very cheap and the author took one of these, removed the coil and cut away the windings. The metal core was wrapped in Sellotape and 200 turns of 26g enamelled wire wound on. The lot was then bound with tape. This relay dims the light very little and pulls in very strongly on the 0·3A. passed by the lamp.

Time Delay Units

Various time delay devices are available surplus and from control gear manufacturers. Most of these are known as process timers and are not made for operation by push-button at a remote place. Most surplus timers are made for use on 24V. and are not insulated for 240V. Two were tried out with no trouble from breakdowns. In case of trouble always carefully earth the casing using a good thick copper wire and use small fuses in the mains system.

Time Delay Switch 5C/2123

This is obtainable at 12s. 6d. from Messrs. Whistons. Refer to Fig. 31. Terminals 1 and 2 go to the 24V. supply *via* a push-button at any convenient point. The switched circuit, such as a passage light, is taken from 4 and 5 (in the other diagrams these terminals correspond with 7 and 8). Faraday wax, sealing wax or other insulating material must be used over the terminal block.

On pressing the push a loud click is heard from the unit and a clockwork mechanism is wound up in a fraction of a second. The lights come on and the device clicks quietly away for about 30 or 40 sec. when it stops and terminals 4 and 5 become open circuit and the light goes out.

When using this unit, which is designed for all 24V. operation it is advisable to earth one side of the 24V. D.C. supply.

Time Delay Switch 27N/56

This unit is a fine geared escapement wound by pressure on the knob shown in Fig. 32. 24V. D.C. is applied to an electro-magnet *via* a relay which is an integral part of the unit. It is possible to have a switched-on delay of about 7 sec. or 22 sec. No current is consumed when the unit is normal.

The original use of this unit is unknown and parts of it are not required. Remove front and back covers of the unit. Remove the push-button by undoing screws around the retaining boss. Remove the unit by cutting the wires to terminals and undoing three retaining screws visible when the back cover is removed. Cut away all the fine "fabric" covered wires going to contacts g, i, and h in Fig. 32. Remove *all* other wires except the yellow one already connected to the large electro magnet shown on the right, the yellow wire from this magnet to contact e of the bottom relay, and the red wire connected to contact f of the same relay.

Rewire as follows: For approximately 7 sec. "on" after pressing. Switch wires will be connected to c and d contacts of the upper bank of relays, these will be connected via terminals 1 and 4. For approximately 22 sec. delay, wire switch leads to g and i of the tiny changeover relay in the centre of the unit. Very fine flexible wire is required for this or the relay will not operate. If extra terminals are added, both delays may be made to work, one operating a lamp of 7 sec. and the other another lamp for 22 sec. In both cases wire yellow magnet lead to No. 2, and red "f" contact lead to No. 3 terminal.

The remarks about earthing and insulation apply to this unit and should be noted. This 27N/56 unit is available from the Midland Instrument Company for 5s. We believe Messrs. Arthur Sallis (Radio Control) Ltd., can supply the same unit.

Commercial Delay Units

Sauter Controls Ltd., manufacture a special switch for this purpose and is known as MP6, it will carry a load of up to 6A. if necessary. The period may be from 1½ to 3 min. and the operation may be prolonged if reset before the light goes off.

Messrs. Londex Ltd. also manufacture a special switch known as SST and is similar to the above Sauter unit, with metal contacts it will carry up to 3A. and can be set *before* purchase to any interval between ½ min. and 6 min. in 1 min. steps.

Full details are supplied with these units, but basically the external systems are those already described as far as wiring is concerned. Naturally they do not use the 24V. system, but work entirely at mains voltage.

(*To be continued*)

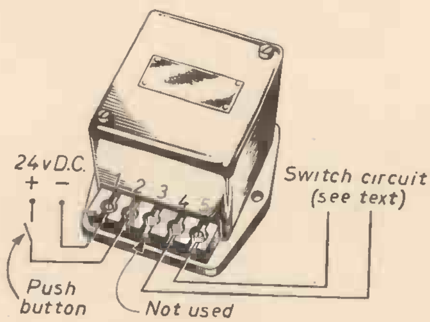


Fig. 31.—*Time delay switch* 5C/2123 *and method of wiring.*

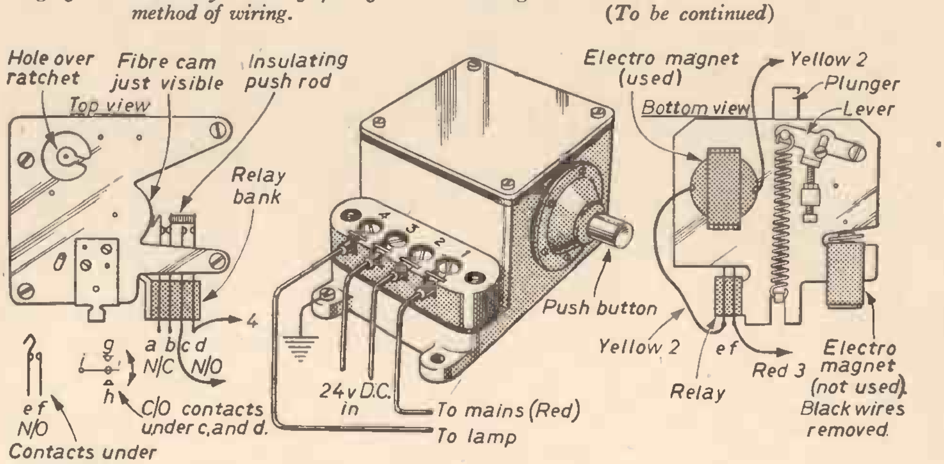
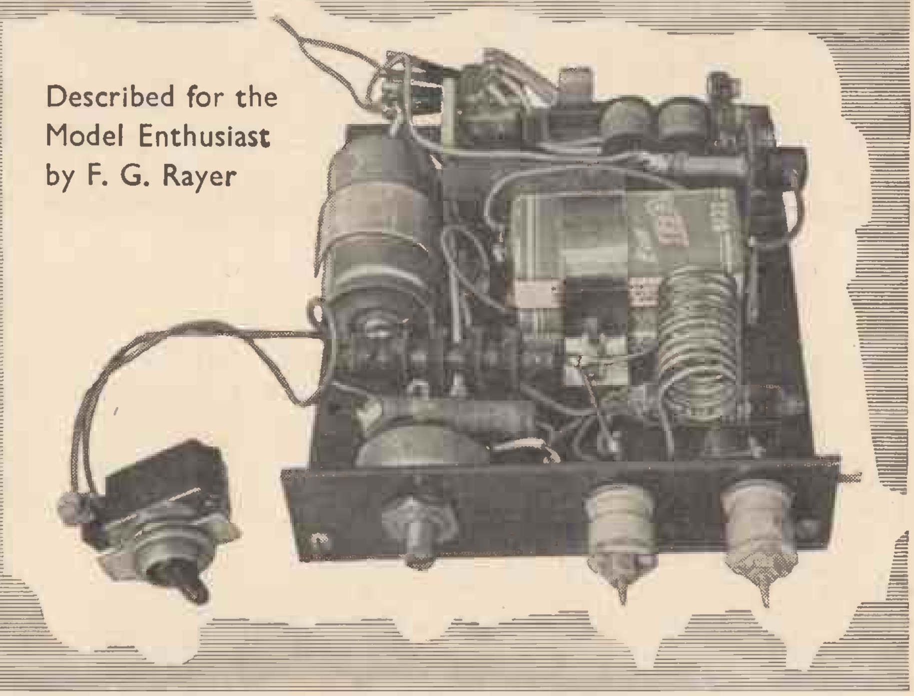


Fig. 32.—*On the left are the working parts, in the centre the* 24V. *time delay switch (Ref.* 27N/56) *and right and left the cover removed.*

A One Valve Receiver for Radio Control

Described for the Model Enthusiast by F. G. Rayer



WITH many models except those of rather small size the receiver, batteries and relay can be accommodated in a single unit. When this is possible, it is more convenient than having these items separate, and interconnected with flexible leads. The unit described here consists of a one-valve receiver, with 45V. H.T. and $1\frac{1}{2}$V. filament supply, mounted with batteries and relay on a 4in. × 5in. Paxolin panel. The complete unit is approximately $1\frac{1}{2}$in. deep, and can thus be easily placed inside a low superstructure on the model. The main on/off switch is separate, so that it can be fitted to the model in an easy operating position.

The circuit is shown in Fig. 2, and is for a gas-filled XFG1 triode. Regeneration and quenching are controlled by the damping of the aerial, which is adjustable by means of the 30pF aerial condenser, in conjunction with the 30KΩ potentiometer. The aerial circuit is intended for a self-supporting rod, tube or wire between about 9in. and 18in. length. This type of aerial is usually very easily arranged and is not out of place with small models. With a 12in. aerial, range is up to about 100 yd., which is ample for boats on normal ponds. It is possible to increase this considerably, if needed, as described later.

Trimmer Mounting

The panel is $\frac{1}{16}$in. or $\frac{1}{8}$in. Paxolin, and a strip of similar material 4in. × 1in. is attached by means of two small brackets, as in Fig. 1, to carry the trimmers and potentiometer. Three holes are necessary for each trimmer, for centre leg and outer tags. The tags are then bent outwards, to hold the trimmers in position.

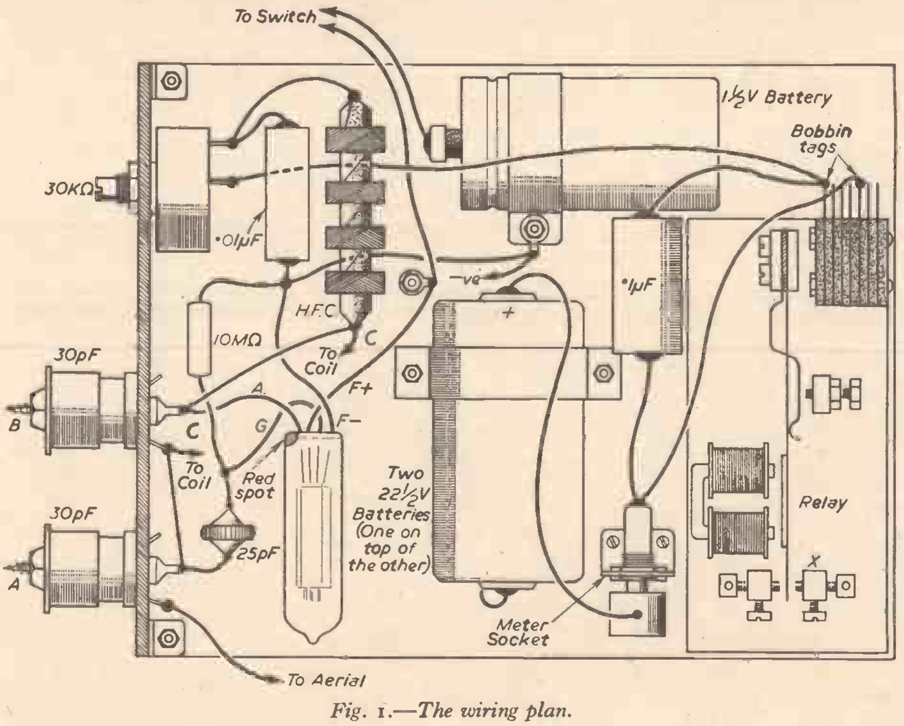


Fig. 1.—The wiring plan.

All connections are shown in Fig. 1, the points marked C going to the ends of the tuning coil. The red spot denotes the anode wire of the valve. Thin insulating sleeving should be placed over the valve leads and other connections. A small bolt serves to anchor the switch lead (filament positive) and valve connection. No mounting is necessary for the valve, unless the model is subjected to much vibration. If so, the valve can be secured by elastic passing down through small holes in the panel.

The coil is wound from 16 s.w.g. or other fairly stout wire, and is self supporting. A length of the wire is drawn straight, and about eleven turns are wound tightly on an object just under $\frac{1}{2}$in. dia. When this object is removed, the coil should spring out to about $\frac{1}{2}$in. internal diameter, as in Fig. 3. It is then stretched until it occupies about $1\frac{1}{4}$in. length, and the ends are bent so that there are *ten* turns in the actual coil itself. It is then soldered in as shown in Figs. 1 and 3.

A coil of different diameter, wire gauge, or number of turns will do, provided it can be tuned to the transmitter frequency. Stray capacity of the H.F. choke and aerial will to some extent influence the frequency covered, but a coil wound as described will usually allow 27 Mc/s to be reached with the 30pF trimmer at around half capacity.

Batteries and Meter

The $1\frac{1}{2}$V. L.T. cell is held by a metal clip forming the negative connection. The positive connection, to switch, is soldered to the brass cap of the cell. Dimensions allow a cell from type 1839 battery to be accommodated; a higher voltage must on no account be used.

The H.T. supply is obtained from two B122, $22\frac{1}{2}$V. batteries, connected in series as shown in Fig. 4. Connections are soldered as this is easy and gives reliable working. L.T. consumption is approximately 50mA, and H.T. consumption $1\frac{1}{2}$mA, so these batteries will have a good working life.

A meter must be included in the H.T. circuit, when adjusting the receiver. To facilitate this, a plug from H.T. positive is inserted in a socket as shown in Figs. 1 and 4. The meter leads are equipped with a similar plug and socket, so that the meter may be brought into use as shown in Fig. 4. When adjustments are finished, the battery plug is inserted in the socket as in Fig. 1, and the meter removed. Care should be taken that the plug, etc. does not come into contact with other parts or connections, when the meter is in use.

The Relay

This item must be of the sensitive type intended for model control. Some relays, such as the Siemens twin-coil 3,400 ohm models, may have separate tags for each bobbin. In this case the tags are so connected that the two windings are in series. The effect of reversing connections to one pair of tags should be tried because the relay will only be as sensitive as possible when the windings are so connected that opposite magnetic poles arise at the ends of the cores near the armature. This can easily be checked by wiring relay 30KΩ potentiometer, and 22½V battery in series with the meter, and slowly adjusting the potentiometer from its maximum resistance until the relay closes. Connections to one pair of tags should then be reversed, and the test repeated. The correct method of connection will be that where the relay closes with the least current.

This test is not required with single coil relays, or relays in which both bobbins are permanently wired in series. In use, the relay is normally held down, and is released when the transmitter is keyed. Connections to the model will thus need to be from armature to the contact marked "X" in Fig. 1.

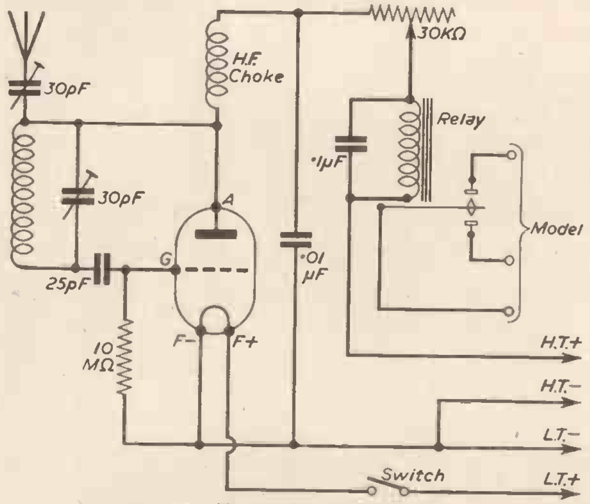


Fig. 2.—The receiver unit circuit.

Strong, regular operation of the relay will be very easy at short range, because the anode current change of the valve is large. But for maximum range much more careful adjustment is necessary. For high sensitivity, the armature must be very near the magnets, and both contact screws so adjusted that only a very small armature movement is necessary. Armature tension is so set that the valve anode current only *just* holds the relay down, with the transmitter switched off.

Quench and Tuning

Short range working, up to perhaps 50 yd. or so, can easily be arranged. Longer range will then become possible as adjustments are more carefully made.

The aerial should be wired to the receiver, because changes to this will modify adjustment. The output from the transmitter should be much reduced, if this is in the same room during initial tests. This can be done by removing the aerial and also reducing the H.T. voltage used with the transmitter.

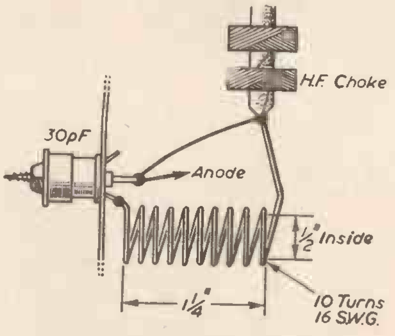


Fig. 3.—How the coil is wired.

The transmitter is switched on, and checked for frequency in the usual way. The 30KΩ receiver potentiometer is then turned to maximum resistance, and a 2mA or similar meter plugged in. The receiver is switched on, and trimmer "B" is rotated until a sharp dip is found in anode current, as shown by the meter. Correct tuning is the point at which anode current falls to the lowest value. If the transmitter is switched off, anode current should rise again to its normal value.

For moderate range the 30K Ω potentiometer can be adjusted until anode current is about 1mA, with transmitter off. This will permit adequate sensitivity for normal conditions. For greater range, the control can be set so that anode current is about 1·5mA. Exceeding this will much reduce valve life.

Trimmer "A" controls aerial damping, and thus oscillation. Closing this very far will cause anode current to rise, so the 30K potentiometer will have to be readjusted. Adjustment of "A" makes slight retuning with "B" necessary. Having "A" near minimum possible setting will reduce range somewhat.

The amplitude of oscillation can also be modified by changing the inductive/capacity ratio of the tuned circuit. This is done by compressing or drawing out the turns of the coil, and retuning with "B" to resonance with the transmitter. The 10MΩ grid leak may also be returned to H.T. positive, instead of L.T. negative. However, these adjustments are only required when the best possible range is required, and operation should then be obtained up to a distance of at least 500 yd.

The unit is suitable for operation in conjunction with a very low power transmitter, such as a single valve with low H.T. voltage. In such circumstances, great range will of course by impossible, but reliable control can be achieved up to sufficient distance for a boat on a small pond.

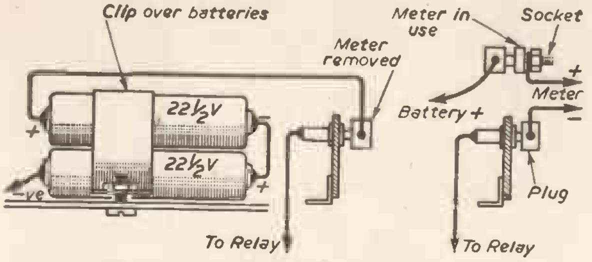


Fig. 4.—H.T. and meter plug and socket.

A PROJECTION PORT

Concluded from Page 393

on one side of the box 2½in. from the top and wired before the box is fitted into position.

Frames

On the screen side a picture frame moulding is used to secure a piece of plain glass 9⅝in. square and a piece of patterned glass 9¼in. long × 5in. deep is secured by clips inside the box at the top so as to hide the lamp, see Fig. 4.

On the projection side a $\frac{3}{16}$in. plywood facing is screwed, having provision to carry a double pole switch (See Fig. 5); this latter was chosen to facilitate wiring. If a channel is cut in the plaster for the supply lead, it is advisable to have a metal protection over the cable before replastering.

Finally make a frame to carry a sheet of patterned glass 9¼in., square with provision for spring clips to hold it in position when the projector is not being used (see Fig. 6). Figs. 7, 8 and 9 show three views of the author's projection port, and Fig. 10 shows it in use.

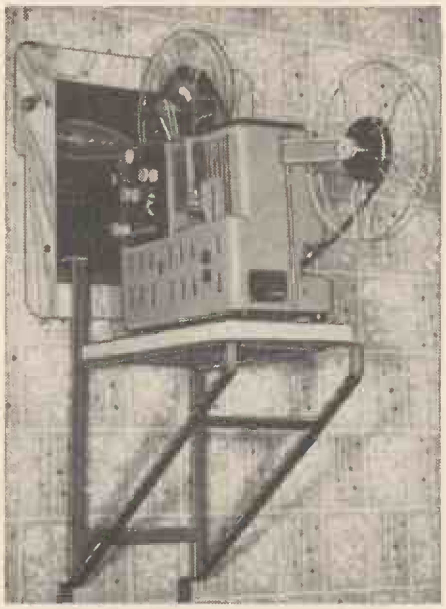


Fig. 10.—The projection port in use.

PUZZLE CORNER

The Two Cricketers

So far through the season two cricketers, A and B, each have an identical bowling average of 28 wickets for 60 runs. Then, for the remainder of the season A's average is only 1 for 27, but B's is 4 for 36. Who has the best average at the end of the season?

Answer

Neither! The following sums prove this:

A.	B.
28 for 60	28 for 60
1 for 27	4 for 36
29 for 87 = 1 for 3	32 for 96 = 1 for 3

Building the 'Luton Minor'

Part 10 Deals with Propeller and Engine, Registration and Covering

Fitting the Propeller

IT is advisable to run the engine at this stage in the presence of the inspector in order to ascertain that no portion of the airframe vibrates excessively or in such a manner that, for example, a cable is made to chafe a rib.

Start by putting a gallon of oil in the engine. The grade of oil should be Aeroshell 100 or equivalent. Remove the sparking plug blanks.

The propeller normally fitted is a wooden, two-bladed one. Known as a Z.5931, it has a diameter of 5ft. and a pitch of 2·9ft. The direction of rotation, viewed from the front, is anti-clockwise.

By hand, turn the engine over until the impulse starter on the port magneto is heard to give a loud and distinctive click. This will be produced on every second revolution of the crankshaft. If there is no click, the starter may be jammed. It is easily freed by *lightly* tapping it with the haft of a hammer or a screwdriver handle.

Having found exactly which position of the hub produces the impulse, remove the nuts and washers from the six propeller attachment bolts on the engine hub and take off the circular bearing plate.

Set the propeller on the hub so that the impulse occurs with the propeller in approximately the horizontal position (Fig. 71).

It will be found that the propeller bolts tend to push back behind the hub back-plate. They can easily be worked forward with a thin spanner or screwdriver but the engine must not be turned until all the bolts are drawn forward, the bearing plate fitted and the washers and nuts in place. This is because the heads of the bolts, protruding too far behind the hub back-plate, will foul the bracing webs on the front of the crankcase. These are easily broken with the leverage which it is possible to exert inadvertently by turning the propeller.

Tighten the propeller nuts just sufficiently to prevent the bolts turning. Now tighten up half a turn on opposite bolts around the hub, thereby evenly clamping the propeller to its hub (Fig. 72).

Stand a trestle or a box in such a manner that the tip of the lowermost blade of the propeller just touches it. Turn the propeller through 180 deg. and repeat for the other blade. By adjusting the tension of the hub bolts, set the propeller so that there is not more than $\frac{1}{16}$in. difference between the blades measured against a fixed point (Fig. 73). The operation is called "tracking the propeller" and it is vital to do this whenever the propeller nuts are tightened or the propeller refitted. Failure to check this could result in serious engine vibration and damage. Lock all the hub nuts with split-pins.

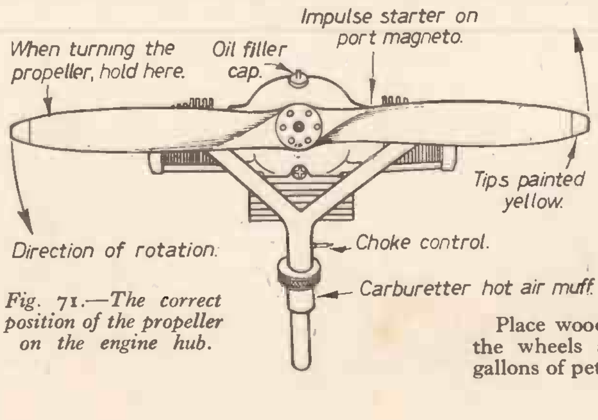


Fig. 71.—The correct position of the propeller on the engine hub.

Turn the propeller about fifty revolutions to circulate the engine oil. It should be possible to register a low reading on the oil pressure gauge in this manner.

The sparking-plugs approved for the J.99 J.A.P. engine are Lodge N.14 type which are fitted with two solid copper ring washers and a shrinkage washer each. Set the plug gaps to 0·018in. before fitting them.

The plug leads are connected as shown in Fig. 74.

Running the Engine

Stand the aeroplane in an open space facing into the wind and preferably on grass or concrete. See that there are no loose stones or pebbles which might be sucked up into the propeller. Get a competent assistant to sit in the cockpit and make sure that he understands which way the throttle works (fully back for closed) and the operation of the switches (*up* for on). As there is no fabric on the tail, enabling the elevators to be used to keep the tail down, a second assistant should stand by the leading edge of the tailplane to prevent the tail rising. Failure to observe these precautions could result in the aircraft tipping up on its nose when the engine is running, breaking the propeller, possibly damaging the cowlings and carburetter and probably seriously damaging the engine.

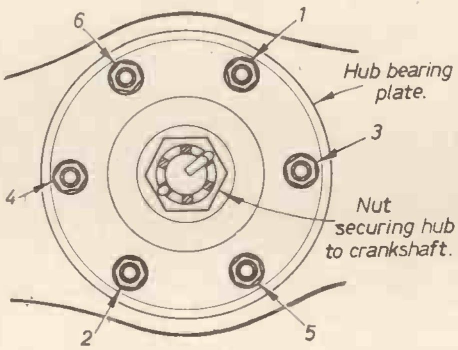


Fig. 72.—The correct sequence of tensioning the airscrew hub nuts.

Place wooden blocks or bricks in front of the wheels as chocks and put about two gallons of petrol in the fuel tank. The correct grade of fuel to use is 73 octane (unleaded). If motor spirit is used, use the ordinary cheap mixture as some of the better petrols contain lead which is injurious to the cylinder heads. It is not advisable to operate continually on neat motor petrol except in an emergency.

Check that the ignition switches are off. Turn on the petrol cock under the tank. Pull out the choke control. Turn the propeller over in an anti-clockwise direction (the direction of engine rotation) six times with the

Material Selection

SOME constructors have asked what they should do with lengths of prepared spruce containing small flaws. The presence of large knots, holes, splits of resin-pockets renders that part of the timber unsuitable for use. If, however, it is possible to cut so as to miss such flaws, this is in order. It is very difficult to obtain absolutely perfect timber although the constructor must naturally obtain the best he can. Planned cutting ensures that timber with slight blemishes need not be discarded although, when in doubt, ask or discard.

Rib stock should be examined for imperfections, the best lengths used for the capstrips and any slightly defective lengths cut, the useless portion discarded, and the remainder used for the short rib bracing members.

The more highly stressed parts of the aircraft demand the best possible timber. The spar flanges, for example, must be absolutely free from defect, the most important faces being the upper one of the top flange and the lower one of the bottom flange, these faces being the most highly stressed. The solid tailplane spars have their maximum bending stresses in the top and bottom edges. This means that the importance of perfect material is greatest near the top and bottom and least at the centre where the stresses decrease appreciably. From this explanation, it will also be apparent that scarf joints in spar flanges must be avoided if possible. Should any primary structural members require scarfing, the constructor should approach Phoenix Aircraft Ltd., for advice beforehand.

Plywood, likewise, often contains minor defects which can be cut out with careful marking-out. The spar webs must be of absolutely perfect material and scarf-joints made very carefully.

Complete kits of selected timber and plywood are available from Phoenix Aircraft Ltd., together with synthetic-resin glue, brass brads and all other materials and sundries.

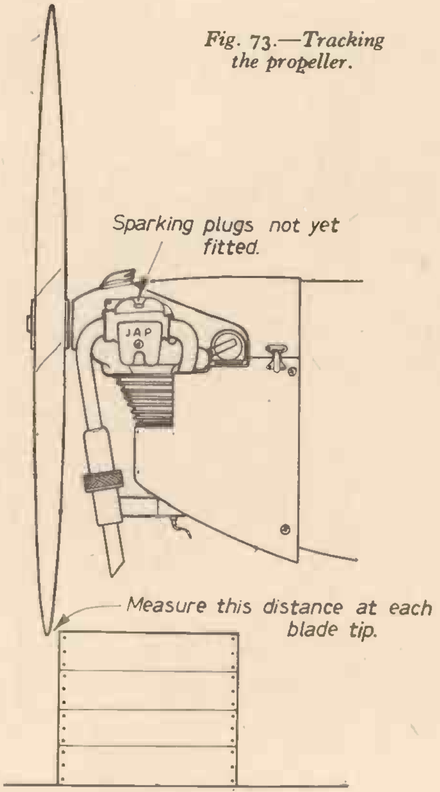


Fig. 73.—Tracking the propeller.

throttle closed. Always treat the propeller with respect for, if the switches are incorrectly wired, or there should be a fault in the earthing, the engine might start suddenly.

Set the switches to "on" (*contact*) and open the throttle about $\frac{3}{8}$in. on the pilot's lever (*throttle set.*) Turn the propeller briskly over the compression whereupon the engine should start. A small amount of "throttle-pumping" (moving the ever backwards and forwards an inch or so) may be needed to get the engine to run smoothly. Complete information on engine starting, failure to start, etc., is given in the Luton Minor Pilot's Handling Notes available from Phoenix Aircraft Ltd.

Caution! Stand clear of the propeller. When the engine is running, the propeller is almost invisible. Cultivate the habit of walking round the nose of the aircraft in a wide arc. If it is necessary to stand close behind the propeller during the running, keep one hand firmly on a strut, move slowly and think before each action. It pays!

Almost as soon as the engine starts, the oil pressure should rise rapidly. If this does not happen, stop the engine immediately and locate the source of the trouble, which might be a leaking union. Let the engine warm up for five minutes or so at 700 r.p.m. Carefully push in the choke control by hand and continue running for about ten minutes. Close the throttle and switch off. *After* switching off, open the throttle fully until the propeller stops, then return it to the closed position.

Remove the top cowling and look for oil leaks. The J.A.P. is normally a very clean engine and any oil seepage can be traced to weeping pressure line joints or, in extreme cases, a faulty gasket between the rear cover and the crankcase. A small quantity of oil may seep past the seals on the magneto drive gearbox after prolonged running, but this is unavoidable.

If all is correct, refit the cowling and re-start the engine. After four or five minutes at idling r.p.m., open the throttle smoothly to 1,600 r.p.m. There are certain inherent flat spots in the J.A.P. engine which only manifest themselves on the ground. Pass through these smoothly and quickly.

Switch off the port magneto switch and note the drop in r.p.m. on the tachometer. Switch on again and repeat on the other magneto switch. The drop should be not more than 50 r.p.m. Now gradually open the throttle fully. The tachometer should show a speed between 2,100 and 2,200 r.p.m. Do not run the motor at full throttle for longer than a few minutes. Ease back to about 1,800 r.p.m.

During the time the engine is running, the assistant must remain in the cockpit. Check over the airframe to see that all is well and then close the throttle, allow the engine to idle at 700 r.p.m. for a minute or so to cool off, and then stop the motor.

The inspecting engineer will now express his views on the aeroplane and may ask for certain small items to be attended to which are necessary.

Registration

At this point, the aeroplane must be registered with the Ministry of Aviation. This step may be taken earlier if required, but the actual registration mark must be known before painting the aircraft.

Write to the Secretary (A.R.G.1), Ministry of Aviation, Berkeley Square House, London, W.1, and request Form C.A.1. Complete this and return it to the Ministry together with the fee of thirty shillings. You will then be issued with a "G-A . . ." registration which will identify your aircraft so long as it is in existence.

Dismantling the Aircraft

Before fabric-covering and painting, remove the wings, the engine, the tail-unit and the undercarriage. It will be necessary to drain out the engine oil before removing the motor. Never lift the engine by the exhaust pipe or the carburetter.

Materials for Finishing

The tools and materials needed for fabric-covering and finishing are a 10in. or 12in. double-ended sail needle, a pair of pinking shears, a soft-lead pencil (2B), a 12in. ruler and a sewing machine.

The fabric used is either DTD 343 madapolam or DTD 575 light aircraft mercedised cotton. The whole aircraft can be covered with madapolam but, for durability, it is recommended that the DTD 575 be used. If it is desired to cover the plywood fuselage, then madapolam only is suitable for this.

Fabric is available in nominal widths of 52in. and is bought by the yard. An approximate purchasing estimate is as follows: Each wing = 12yd.; tailplane elevators and rudder = 9yd.; fuselage (decking only) = 3yd.; fuselage (complete) = 12yd.

Serrated-edge tape, made of the same grade of fabric, is available in various widths and the constructor will need one 150yd. roll of $2\frac{1}{4}$in. wide and about 30yd. of 3in. wide tape. He will also need 100 yd. of 1in. wide cotton webbing tape.

A ball of W.30 linen thread and a block of beeswax complete the fabric requirements.

The materials for doping are as follows: 5 gal. of red oxide tautening dope (add about three more if the fuselage is to be covered with madapolam); 1 gal. aluminium sealer undercoat, 1 gal. cellulose filler (for use on fuselage whether fabric-covered or not); one tin cellulose stopper (used on fuselage); 1 gal. each of second finishing colour and primary finishing colour. These last two should be of the high-gloss type with nitro-varnish added. Additionally, about 3 to 5 gal. of cellulose anti-chill thinners will be needed.

For rubbing down, a dozen sheets of medium (120 or 180) grade wet-or-dry abrasive paper will be wanted together with half a dozen sheets of fine (220) and a few sheets of very fine (320) grade.

A word on equipment. If at all possible, use a proper spray gun with a compressor which will give—and maintain—about 60 p.s.i. pressure. Equipment which does not provide such pressure, demands the use of an excessive amount of thinners. On the finishing coats in particular, the thinners content should be as low as possible (with reservations described later), it being better to increase spray pressure to aid atomisation. If a vacuum cleaner spray kit has to be used, do not expect such a good finish unless you are prepared to take additional time and spend much longer rubbing down and polishing.

First coats of red dope must be brushed and the constructor should obtain some good new paint brushes. It is well worth the extra few shillings to get the best rather than spoil the finish with loose hairs. Two brushes 2in. or 3in. wide and two 1in. wide are ideal.

Covering the Rudder

Sandpaper the edges of the rib capstrips and spars to remove sharp edges. Run the hands over all edges and surfaces which will be in contact with the fabric to check for roughness, lumps or hard glue and protruding

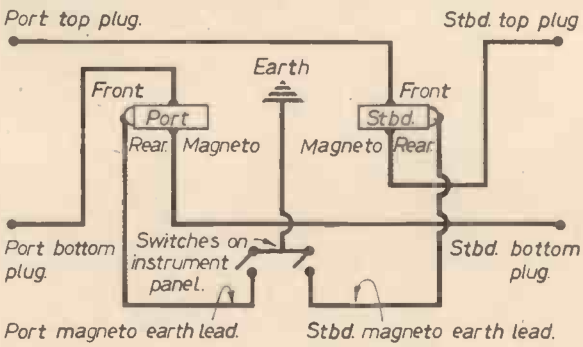


Fig. 74.—Wiring diagram for plug leads and ignition switches.

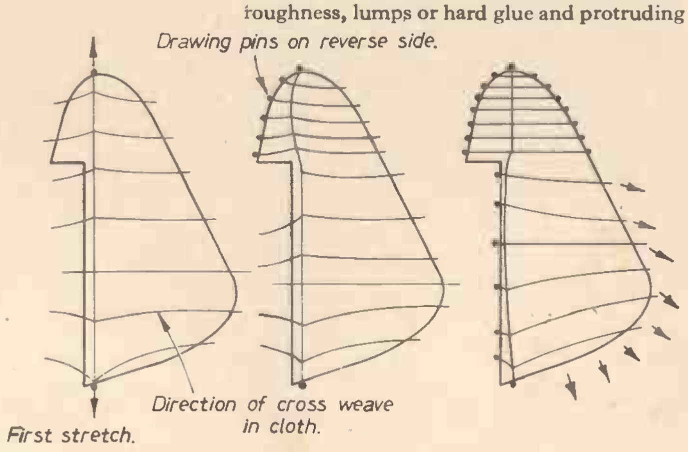


Fig. 75.—Stages in fabric covering the rudder. Notice how the fabric weave is kept straight.

brads. See that there are no staples left in the structure unless they are of stainless steel.

Try to keep the weave of the fabric square, i.e. the threads should run vertically and horizontally, not diagonally. Also try to keep the threads straight by even tension in the cloth.

Cut a piece of fabric large enough to cover one side of the rudder. Lay the rudder on top of it and, using drawing-pins, fold the cloth over the edge member and pin it to the side which is uppermost. Start at the top of the rudder, then stretch the fabric just sufficiently to produce light longitudinal ripples each side from the top to the bottom where the fabric is again folded over the edge and pinned. Now pin the fabric from the top down to the end of the leading-edge bow. With practice, the right degree of stretch can be achieved so that when the trailing-edge fabric is tautened for pinning, the vertical weave remains straight. The illustration shows the manner in which the top of the rudder is covered. This is possibly the hardest portion of the aircraft to cover, and the sequence should be followed closely. Avoid excessive tension in the cloth—it is only necessary to stretch it gently.

When the rudder top is covered, pin down the front of the spar to the bottom, then pin from the middle of the trailing-edge round to the bottom. The correct angle of tension can easily be found by experiment. It is likely that odd wrinkles may appear here and there, but the removal and repositioning of the pins will smooth them out.

Take a 1in. brush and a tin of red dope and carefully dope the fabric to the edge members. Do not allow the dope to trickle or drip on to the bare fabric now or at any time. Such drips will make almost immovable blemishes in the finish which will be most unsightly. It is very easy to allow dope to drip down to the inside of the fabric from the back edge whilst putting on the first side of fabric, so be cautious. If dope does get on to the fabric in this manner, rub it well in with the fingers, dispersing it as much as possible.

When the fabric has been doped to the edge members and allowed to dry, remove the drawing pins and, with a sharp knife, trim the cloth overlap to the full width of the edge member, this remaining flap being doped down thoroughly with about three coats of dope. Allow it to dry well before starting the other side.

The second side is covered in precisely the same manner except that this time the

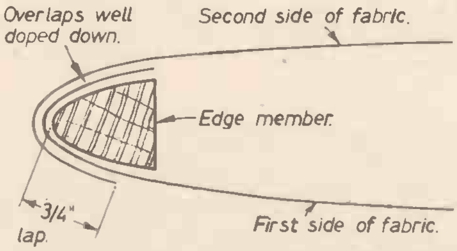


Fig. 76.—Section showing how the fabric is overlapped and fixed at the edge member.

drawing-pins pass through the first fabric flap into the member (Fig. 76). Once more dope the edge down and, when set, remove the pins. This time, however, the surplus fabric is cut back to about ¾in. from the edge all the way round and doped down. Well dope the edge and allow to dry.

The first two coats should be thickly applied by brush and worked well into the fabric. Work one rib bay at a time with a wide brush and use a stippling action, first from side to side and then up and down.

The fabric will go very soft and spongy and may well remain this way after the first coat has dried. There is no cause for alarm, however, as the second coat (applied after stitching) will immediately tighten up the cloth on drying. When later covering other parts of the aircraft, it will be found that in certain cases the fabric softens enough to allow it to come into contact with part of the underlying structure not normally touched by the fabric. There may be a tendency for the fabric to stick to such places during drying. Where there is a likelihood of this happening, gently hook the fabric up at intervals with a bent pin during drying. The pin holes will vanish with the second coat. Another point to watch is that when the fabric does touch the underlying structure, the dope brush will leave a streak of dope against the obstruction. This will set as a hard ridge in the finish even though the cloth no longer fouls the structure. Take care to avoid this if you want a good finish.

After the first coat has been applied, the cloth is ready to be stitched to the structure. There are two schools of thought here; one being that stitching should be done before doping is done, and the other that a coat of dope should be applied first. This latter principle is best adopted by the amateur since any faulty tensioning of the cloth, which might result in the sheet creeping, will not result in wrinkles round the stitching or, in extreme cases, actual bending of the ribs beneath.

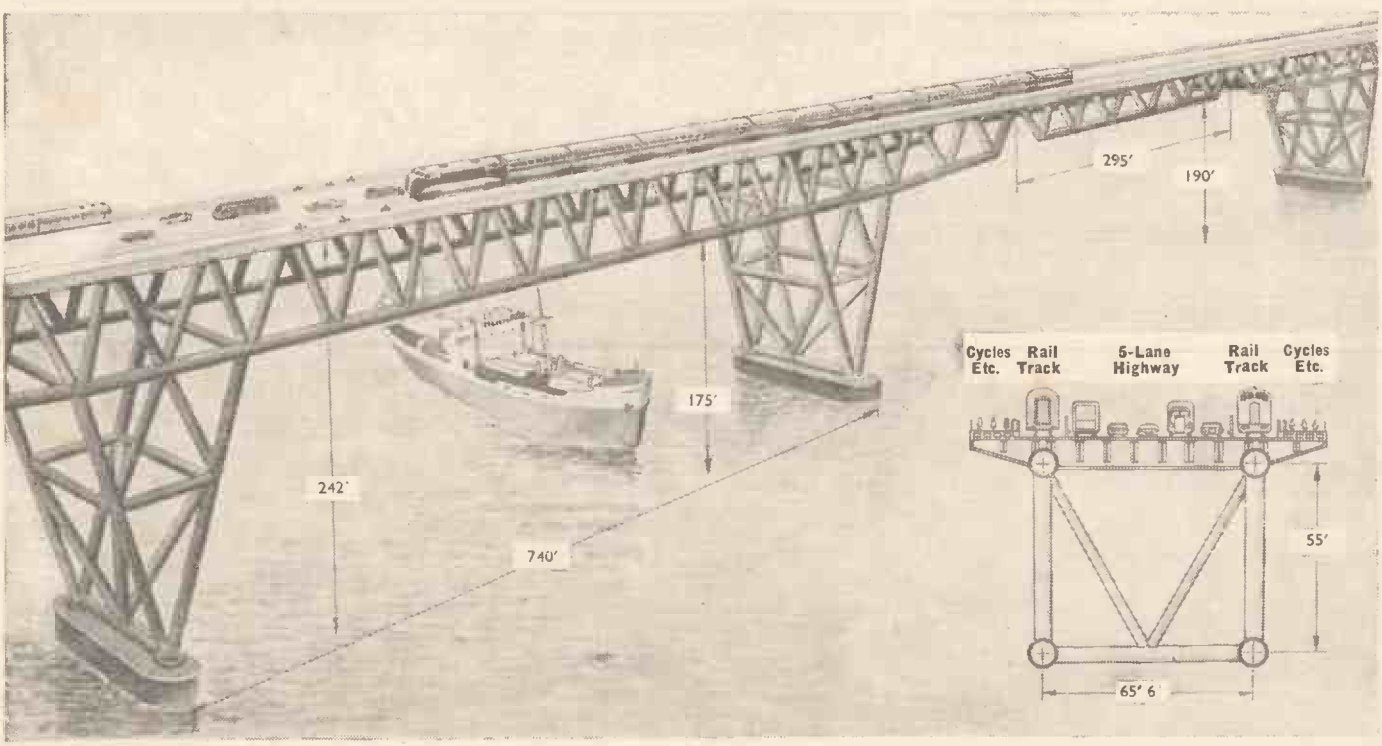
A word of warning. Cellulose dopes and thinners are highly inflammable. Never try to accelerate drying with a naked light or red-element heater and never dope in a room with an open fire. Should heat acceleration be required, infra-red " black heaters " may be used or, on small areas, an ordinary electric light lamp and shade supported a foot or so from the surface to be dried will suffice.

In the next article, stitching, doping, final inspection and flying will be dealt with together with a materials list.

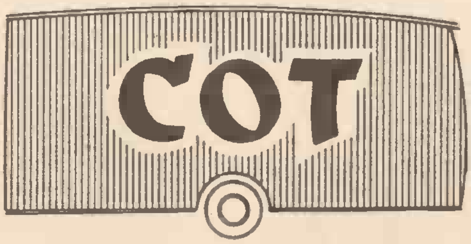
(To be continued)

The Latest Scheme for
A CHANNEL BRIDGE
It Can Be Done!

THE idea of a channel tunnel has barely been proved a practical proposition; now it has been followed by another proposal this time for a channel bridge. Several very large engineering firms are backing this idea. It would be expensive, costing something in the region of £200 million but look at the artist's impression below to see what it would offer. The 21-mile long bridge would have twin railway tracks and a five-lane 49ft. wide motor highway with special 13ft. tracks for cyclists and motorcyclists. The height would be 242ft. and the span between pier centres 740 ft. except for two wider navigation openings. At high water there would be a minimum headroom of 170ft. Over 40 of the 142 piers would be at a depth of 130 to 165ft.



A CARAVAN COT



by Griff Kendall

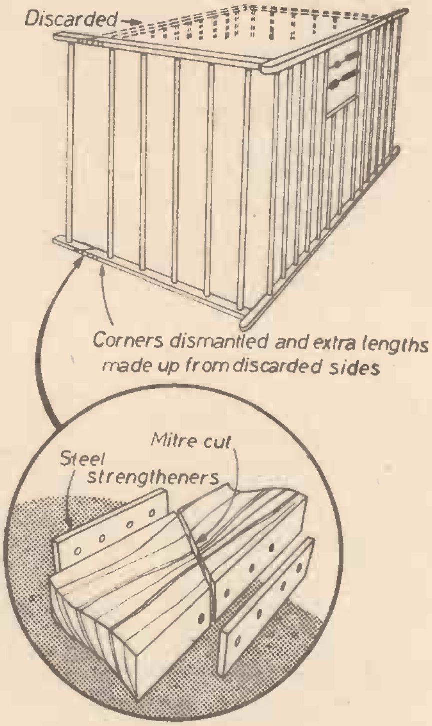
MANY people today are making their homes in caravans and many more, particularly those with young children, choose this form of accommodation for their holidays. There is no room even in the largest caravan for the conventional cot and the simple solution is to convert one of the fitted bunks by adding a rail to it. The cot can then serve the dual role of sleeping accommodation and playpen.

Anyone who is sufficiently proficient in carpentry could make the rail complete, but the author found it easier to obtain an old playpen. This consisted of four lengths of rail. The hinges were unscrewed to provide two long and two short lengths.

One long and one short length were to be hinged together again, but before this was done, the length of these two pieces was made up to what was required by using pieces of the other two sides of the playpen, as shown in the sketch.

The method of jointing is shown inset. Cut the end of one of the pieces of railing (top and bottom) to approximately 30 deg. Lay these ends over the piece of rail to be joined to it and use the ends to mark off exactly the same angle. When this has been cut, glue the two pieces together using a good wood glue. Finally, secure into position with metal plates as shown.

Hinge the front and end together and use hooks and eyes to secure to the caravan walls. The rails are then easily removable for cleaning the bunk and making it. The rails rest on the wooden part of the bunk and not on the mattress.



(Right) How the pieces are cut and jointed.

(Below) The completed cot.

The Thermionic Converter

(Concluded from page 395)

tion; its high efficiency and its small size. Ceramics are inherently stable and chemically inactive, even at very high temperatures. They can be heated indefinitely in the air with an open flame without deterioration; they do not require chemical preparation to an extreme degree of ultrapurity; their use raises no technological problem of high-vacuum operation, complex electric or electronic apparatus, or the like.

" Fuel Cell "

Another development produces electricity by a completely different method—chemical reaction. It is the result of research by Allis-Chalmers Manufacturing Company. Known as a "fuel cell," this device is simple, operates independently of any source of heat, and can be constructed in any desired size.

The entire process takes place in a metal box containing a number of one-volt cells, each made of two metal electrodes coated with a catalyst. The electrodes are separated by an electrolytic solution. When hydrogen and oxygen gases are fed into the box, a chemical reaction occurs which frees electrons in the electrodes, producing electricity.

Upon completion of research, this device is expected to be a valuable source of electric power for many purposes—to operate electric lights and household electrical appliances, to provide emergency or supplemental power for industry and hospitals and to manufacture aluminium which is produced through electrolytic reduction.

Although a lot of research work must still be done before these various developments can be actually utilised commercially, they represent great milestones in the continuing effort to simplify conversion of energy into usable form.

Their potential and the developers' hopes for the future are very high. Commercial use of these " converters," the goal of continuing research, may reduce electrical-production costs, vital to world-wide advances in industrialisation, increased economic stability, commerce and living standards.

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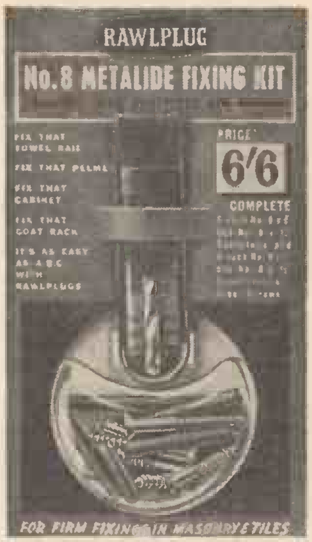

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Six each No. 8 × ¾" and No. 8 × 1½" Rawlplugs.
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6/6
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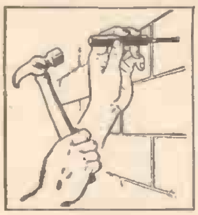

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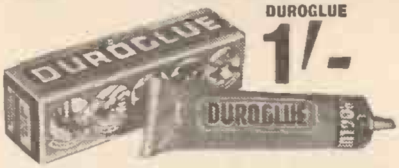

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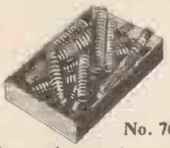

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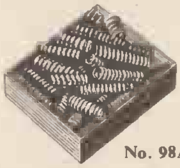

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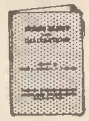

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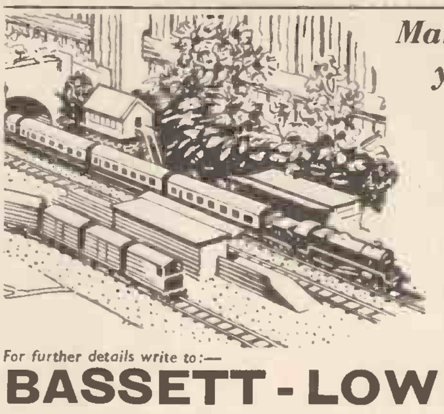

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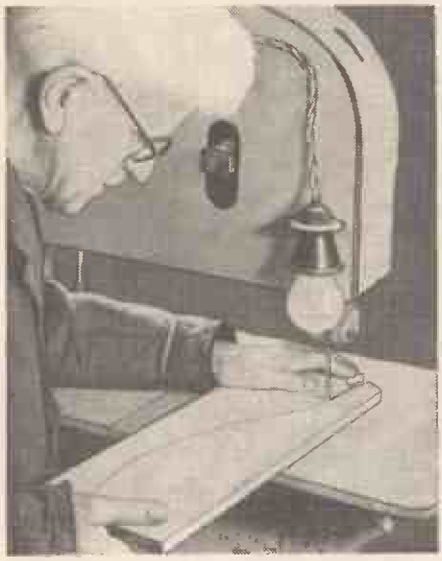
Jameson Erroll describes the construction of a 4-wheel

BANDSAW for wood or metal

Concluded from the May issue

Part 2 describes mounting, the motor board, the table, safety guards and accessories.



The Author using his bandsaw.

THE frame is sturdy enough to allow the machine to stand upright but it is rather narrow in proportion to its height and width and would require stabilising to withstand vibration. Whether or not it is to have its own motor, it could well be mounted on a suitable board, say about 12 in. wide, and this board could be clamped to the bench when the machine is in use.

If the machine is to stand alone, however, three 3in. × 2in. legs should be added as shown in Figs. 1 and 6, and use can be made of them to support a board on which the motor might well stand. The two legs attached to the back of the machine should splay outwards and both they and the single leg on the front should be bevelled for about 5in. to throw them away from the back and front and thus spread them well before they reach the floor. Fig. 7 furnishes detail of this. Note that the bottoms of the legs should be cut off at an angle so that they rest squarely on the floor.

The length of the legs will vary slightly according to the person who will work the machine normally, particularly if he be very tall or rather short. For the average man they can be 23in. long of which approximately 5in. is above the bottom of the frame of the machine. A reliable figure on which to work is that the table height should be in the region of 3ft. 6in. from floor level. The two back legs are screwed and/or bolted to the plywood back and rear braces if they cross the line of the bevelled portion of the legs. The front one is screwed to the filling block as shown in Figs. 1 and 2. Use stout, long screws that penetrate deep into the framework.

If the machine is not constructed for metal cutting, increase the length of the legs.

The Motor Board

Much depends on the shape, height and length of the motor. Although the board may be low enough to house the height of the motor, it may not, at that point, be deep enough to prevent the back of the motor fouling the front centre leg. Another point to bear in mind is that the 2in. pulley on the motor must be in vertical alignment with the 10in. loose pulley and the 3in. motor pulley must line up with the 5in. fixed pulley. The nearer the floor the motor board is placed the larger it can be and, consequently, offer more scope for positioning the motor.

While on this subject it may be well to mention the method employed to decide the sizes of the two belts required to drive the machine at either high or low speed. The formula is: Half the sum of the diameters of the two pulleys concerned multiplied by Pi. and added to twice the distance the centres are apart will give the length of the belt.

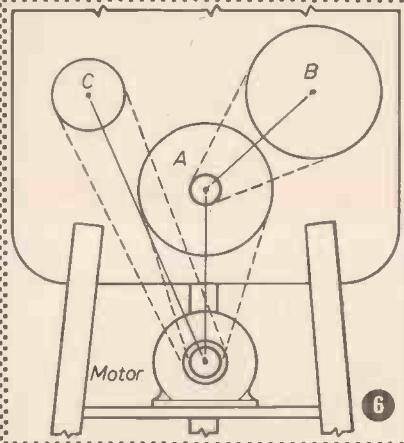
Two examples from Fig. 6 explain this:—

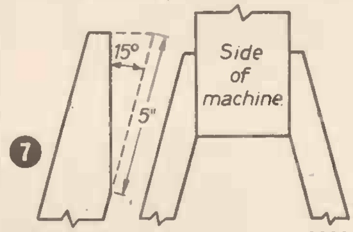
$$\frac{10\text{in.} + 2\text{in.}}{2} = \frac{6 \times 22}{7} = 19\text{in.} + (13 \times 2) = 45\text{in.}$$ To nearest inch.

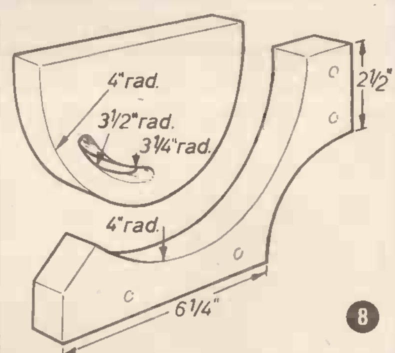
$$\frac{5\text{in.} + 3\text{in.}}{2} = \frac{4 \times 22}{7} = 13\text{in.} + (22 \times 2) = 57\text{in.}$$ To nearest inch.

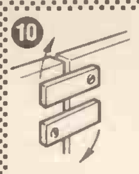
Equally, of course, if the two pulley sizes are known and you have a belt of known length, it is possible to work out the distance apart the centre of the two pulleys should be in order to make use of the belt. In fact, any one measurement can be found if the others are known.

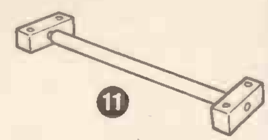
Once the best height has been decided upon, it is a simple matter to measure the size the board should be in order, not only to be supported by the legs, but also to lend them support and thus obviate a tendency to splay outwards because of the weight of the machine. Notches should be cut in the board to receive the legs. Short blocks of 1in. × 1in. hardwood are screwed to the legs to support the board, and the board screwed down on to them to give lateral aid.

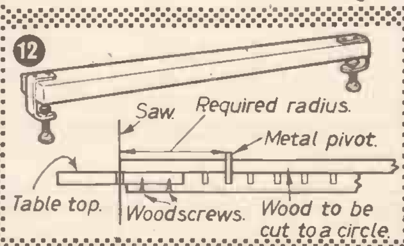












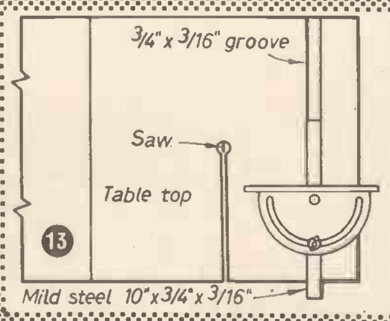


Fig. 6.—Pulley arrangement. At A are 2in. and 10in. loose pulleys; B is a 10in. pulley; C is a 5in. pulley. Pulley A and the motor are at 13in. centres. A and B are at 10½in. centres and the motor and C are at 22in. centres. Therefore Vee belt from small pulley A to large pulley B should be 40in.; belt from large pulley A to 2in. pulley on motor 45in.; and belt from C to 3in. pulley on motor 57in.

Fig. 7.—Angle for legs.

Fig. 8.—Trunnions.

Fig. 10.—Underside of the front edge of saw table showing saw kerf supported by two swivelled metal bars.

Fig. 11.—Lower thrust wheel.

Fig. 12.—Adjustable fence for straight cutting, and (below) accessory for cutting true circles or arcs.

Fig. 13.—Mitre gauge for various uses.

The Table

This consists of a piece of ½in. plywood 24in. long and 14in. wide. It is cut to make one piece 10in. × 14in. (the fixed part of the table) and one piece 14in. square for that part of the table which will tilt. The shorter piece is firmly screwed towards the back of the throat to the 1in. × ¾in. batten, and is supported near the front of the machine by a suitable piece of 1in. wood screwed to the brace carrying the two lower bandwheels. This may be cut wider at the top than at the bottom, so that it offers maximum support to the table without fouling either of the bandwheels.

The saw is now removed and the tilting portion of the table placed in position temporarily and marked where the saw will need to pass through it. This point will be found to approximate the centre but can be arrived at accurately by the use of a square in conjunction with the saw guide holder. Now bore a ⅜in. hole with the point as centre and, from the front of the table towards the hole mark off a right-angled line and cut through to the hole with a handsaw. This saw kerf will, when the table is in position, enable the bandsaw blade to be removed. It should be found that, having cut the line with a handsaw, the kerf is wide enough to pass the bandsaw without interference. If this is not the case, owing perhaps to the use of a fine panel saw, the kerf must be widened until the bandsaw passes safely and smoothly through it.

To give stability to the front edge of the tilting table, two metal bars are screwed near the face edge on the underside as shown in Fig. 10. These are swivelled aside when it is necessary to remove the blade.

A lower thrust wheel can be added under the table to give additional support to the blade but is not essential. Fig. 11 shows that used by the author. Two metal blocks about 2in. × ½in. × ½in. have a ¼in. silver steel rod about 3in. long running through them, this rod being a press fit. On this rod runs a length of metal tube which revolves freely on it. The two blocks are screwed to the underside of the table centrally with the saw kerf and in such a position that, when not in use, the back of the bandsaw just clears the roller.

The table is tilted and supported by a single trunnion cut from 1in. hardwood. Figs. 8 and 9 illustrate clearly the two pieces which may be cut from a piece about 10in. long and 5½in. wide. The greatest care must be taken in cutting the semi-circle for on its accuracy depends the smooth action necessary to operate the table successfully. It is reasonably easy to cut with a jigsaw but a lot more difficult to cut by hand with a coping saw. Nevertheless, if the job is not hurried, a very neat, square job can result. The cut should, of course, be evened up and smoothed with a file and glasspaper. The segment in the top portion of the trunnion in which a fixed ¼in. bolt will engage should be marked out with care, the bulk of the material removed with several $\frac{3}{16}$in. drillings, and finally smoothed with a thin rasp and glasspaper.

With the table in the flat position, and temporarily clamped down, the top trunnion is placed in position against the outside of the plywood back with its centre point exactly in line with the saw; cramp it for the moment and then screw down into it from the top of the table, using three 1½in. No. 8 c'sk. screws. Remove the cramp and place the lower part of the trunnion tightly against the upper part letting the mitred part—which will protrude from the side—line up with the bevelled edge in the side framing. The cut-out quarter-circle lower right will be found to give ample clearance for the 5in. pulley wheel. Screw into position and, with the table still cramped down, drill a ¼in. hole through the plywood from the back, using the lower end of the segment as a guide. Now pass a 2in. × ¼in. bolt through the hole (from the inside) and through the segment and fix with a substantial steel washer and flynut. Remove the cramp, and the table should glide smoothly over the trunnion and lock at any desired angle. In order to support the front of the table when tilted to 45 deg., a widening piece may be added to the edge of the 4in. × ⅜in. board the top of which is already bevelled. This can be clearly seen in Fig. 1.

Safety Guards

It now remains to cover in the whole of the mechanism except the short length of saw in use, and this is accomplished by the introduction of three hardboard doors. The top one is 12in. wide, the bottom one 18in. wide, and the third—which is very small—encloses the short space left between the two bandwheels on the left side at the end of the throat. After rounding the corners to match up with the

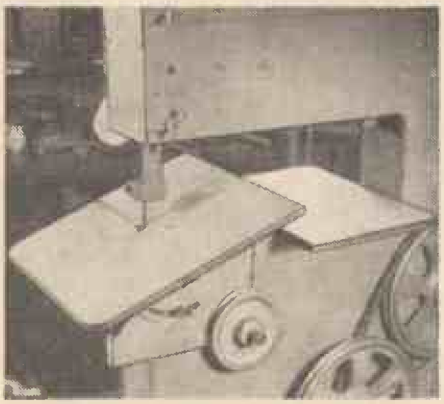


Fig. 9.—A view of the table tilted.

frame, hang the top door by a pair of hinges from the top of the machine so that it opens forward and upwards and automatically rests on the top frame. The wider board—the lower door—is hinged to the bottom of the machine, opens forward and downwards, and comes to rest against the single front leg. The

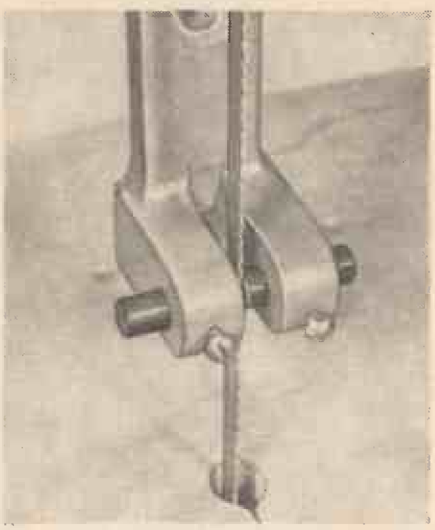


Fig. 14.—A close-up of the blade guide and table hole.

fact that this lower door does not quite reach the underside of the table does not matter—it is only an inch or so short and saves buying a 2ft. wide hardboard. The slightly exposed portion of the saw is virtually out of reach unless one deliberately seeks it. The little side door is about 7⅝in. high and 3in. wide and is hinged to another piece of hardboard also 7⅝in. high and about 7in. wide; this latter piece is pinned to the upright brace and the block " B " (Fig. 2) to even-up the surface.

Any form of fastening may be used to keep the doors closed provided it combines efficiency with ease of removal.

Tensioning the saw calls for a little instruction to the uninitiated. Too much tension may cause the saw to break when running at speed, and too little allows unnecessary " slack " which will cause the saw to wander from true vertical. In general, a wide saw needs more tension than a narrow one but it is a matter of experience. Test by pressing the blade between the wheels with the finger —the saw should " give " just a little. If in doubt err on the tight side.

While on the subject of safety the following should be noted:

- Always close the doors when running the machine.
- Set the saw guide holder as close to the work as possible consistent with ability to see the cutting line clearly.
- Keep the saws sharp and do not exert undue pressure.
- Whenever possible avoid backing out of a cut; it is dangerous since it tends to pull the saw off the bandwheels. It can also result in a broken blade.
- Don't work in loose clothing; button your coat, tuck in your tie, and roll up your sleeves.
- *Take particular care to see that both driving belts are not connected to the motor at the same time.* Remove the one not required to be used.

Power and Speed

A ¼ h.p. motor will successfully carry out all work likely to be undertaken. If, however, really heavy jobs are expected, e.g. continuous sawing through 4in. thick hardwood, then install a ½ h.p. motor.

Bandsaw speed is based on linear measurement, i.e. the rate at which any particular tooth passes a given point in feet per minute. From 2,000 f.p.m. is normal, the higher speeds applying to large saws. The machine being described is calculated to pass 2,100 f.p.m. for wood, using a 3in. pulley on the motor and a 5in. pulley on the bandwheel; for metal it is rated at 138 f.p.m. using a 2in. pulley on the motor to a 10in. loose pulley then again a 2in. loose pulley (on the same shaft) to a 10in. fixed pulley on the other bandwheel. The speed of the motor is 1,425 r.p.m.

Additional Accessories

While, as has already been mentioned, the bandsaw is not intended for straight cutting, it can be so used for many small jobs and will perform in a satisfactory manner if the work be fed along an adjustable fence such as that shown in Fig. 12.

Circle Gauge

Accurate circles, or parts of them, may be cut with the aid of the lower device shown in the same figure. This device can be of any reasonable length and have borings at various distances. It is screwed to the underside of the table—at right-angles to the saw and away from the throat—and ¼in. holes bored as needed, according to the radius of the circle or arc to be cut. A short length of ¼in. steel is inserted in the hole allowing ⅛in. to ¼in. to protrude above it. The centre of the wood to be cut is bored with a similar hole and placed over the steel rod. As the saw cuts, the wood is rotated and a perfect circle results.

Mitre Fence

For accurately cutting right-angles or mitres an adjustable mitre fence can be made and a groove cut in the table top along which it can slide. Fig. 13 illustrates this accessory which may also serve for use with a circular saw.

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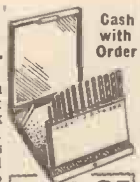

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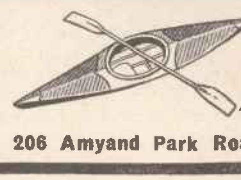

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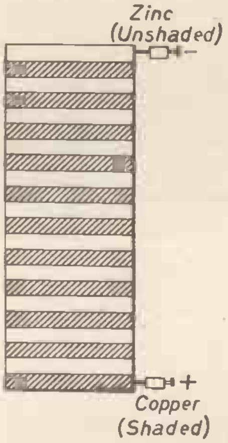
LETTERS to the EDITOR

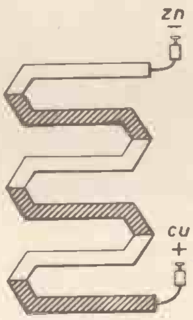
The Editor does not necessarily agree with the views of his Correspondents

New (?) Sources of Electricity

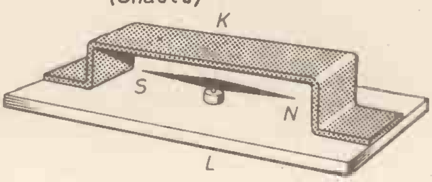
SIR,—In the March issue under the title "New Sources of Electricity," you mention the thermo-couple. As the principle of this seems to be fairly old perhaps some readers might be interested in the following extracts from a paper on the subject by Lt. B. A. Fiske, U.S. Navy, published about 1890:

Galvani while preparing frogs' legs to demonstrate the action of passing a current of electricity through them found that the legs kicked without the generator in action at all. He eventually found that if he touched the nerve with one piece of metal and the corresponding muscle with another piece, while at the same time touching the other ends of the metals together, the legs kicked. He believed

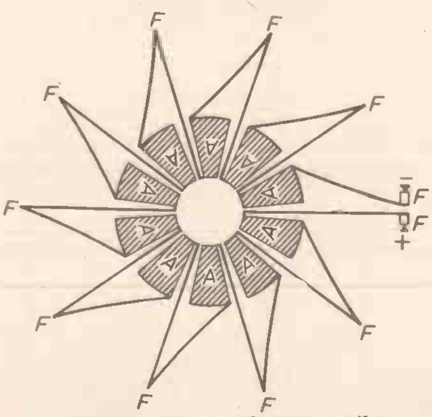




(Left) Volta's pile. (Above) Thermo-Voltaic pile.



(Above) Seebeck's apparatus.



(Above) Clamond's thermo-pile.

this was due to electricity in the frog's legs.

Volta, however, believed the current was due to the contact of the metals and proved his theory by inventing "Volta's Pile" (see illustration). This consisted of discs of zinc and copper in contact, each pair separated from the next by a disc of damp flannel or blotter, there being a disc of zinc at one end and a disc of copper at the other end of the completed pile. Later the Thermo Voltaic Pile (see sketch) was invented; this consisted of bars of copper and zinc arranged as shown, the junctions on one side being heated.

Seebeck's Apparatus (see sketch) consisted of a bent piece of copper (K) resting on a piece of bismuth (L) and heated at one junction. The passage of a current was shown by the deflection of the magnetic needle (S-N).

Clamond's Thermo-Pile (see sketch) consisted of blocks of alloy (A) to which were fastened iron sheets (F), bent as shown. These extended considerably so as to radiate the heat, thus keeping the outer junction cool; the inner junctions formed a central flue. One of these piles was claimed to produce sufficient electricity to maintain a light of considerable power.—F. Cosgrove (Co. Dublin).

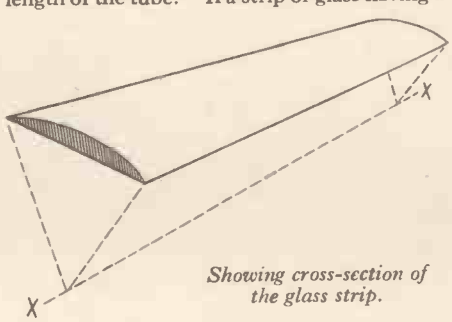
The Luton Minor

SIR,—The photograph below depicts the fuselage of a Luton Minor, built to the instructions which have appeared in PRACTICAL MECHANICS, being removed from the attic workshop of one of our amateur constructors! This particular constructor only began work three months ago.—A. W. J. G. ORD-HUME, Phoenix Aircraft Ltd., Cranleigh, Surrey.

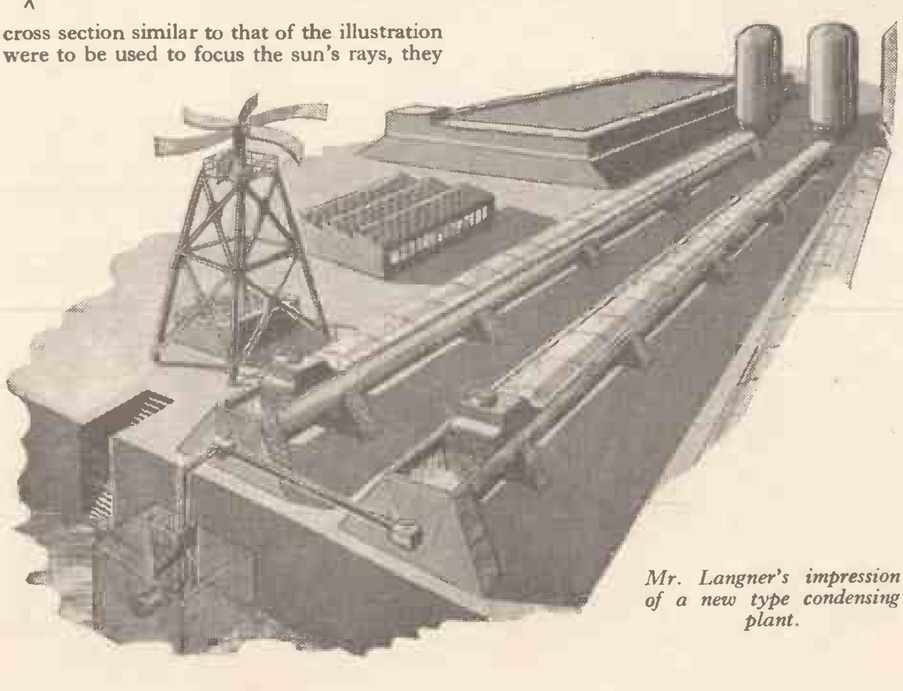
The fuselage of a Luton Minor being removed from an attic.

NOVEL CONDENSING PLANT

SIR,—If the sun were to be viewed through a solid glass tube, its image would appear elongated, in fact, along the whole length of the tube. If a strip of glass having a cross section similar to that of the illustration were to be used to focus the sun's rays, they would be concentrated on a continuous line along its length. A large condensing plant using this principle could be of immense use in hot, dry regions. Using the glass lengths would be a cheaper proposition than the conventional circular-type magnifying glass. The illustration shows such a unit. Power for the pumps, fans and cleaning tackle is provided by a wind rotor. Sea water is pumped into the long troughs and the vapour obtained is blown along their lengths to the condensers at the far end, and from there to the reservoir. The salt deposits could be periodically removed by a form of moving plate, having the same profile as the trough, hauled by winches situated in the fan units.—K. E. LANGNER (Ramsgate).



Showing cross-section of the glass strip.



Mr. Langner's impression of a new type condensing plant.

TRADE NOTES

A REVIEW OF NEW TOOLS, EQUIPMENT, ETC.

WOLF "JUBILEE" POWER TOOLS KIT

TO celebrate their 60th anniversary year Wolf Electric Tools Ltd. are marketing a special power tool kit—the "Jubilee".

The complete Wolf "Jubilee" power tool kit.

The new kit includes the "Jubilee" ¼in. electric drill, jig saw attachment for fine cutting in metal, wood, plastic, etc., rotary paint and varnish remover, six assorted sanding discs, rubber backing disc and arbor, 3in. grinding wheel, 3in. calico buff, 3in. scratch wire brush, arbor assembly, paint mixer and stick of polishing compound. The "Jubilee" Kit retails at a special low price of £8 19s. 6d. and is available from most tool merchants.

The makers emphasise that, in spite of the reduced price, quality has not been sacrificed and the kit is covered by their usual guarantee. In addition to being of interest to the householder, the kit should appeal to the modelmaker, particularly as a jig saw attachment is included.

"THE ENGINEER" BUYERS GUIDE

THE 1960 edition of "The Engineer" Buyers Guide costs 7s. 6d., plus 1s. 9d. postage, and is obtainable from "The Engineer," 28 Essex Street, Strand, London, W.C.2. The Buyers Guide Section of 768 pages contains over 34,750 entries arranged under approximately 2,650 classified headings with 1,600 cross references to help the user find what he wants. The addresses and other details of the firms whose entries appear there are given in the address section. The titles of other sections are: Forthcoming Engineering and Industrial Exhibitions; Associations, Institutions and Societies connected with the Engineering Industry, and Trade Names, etc.

SCREWDRIVER INFORMATION

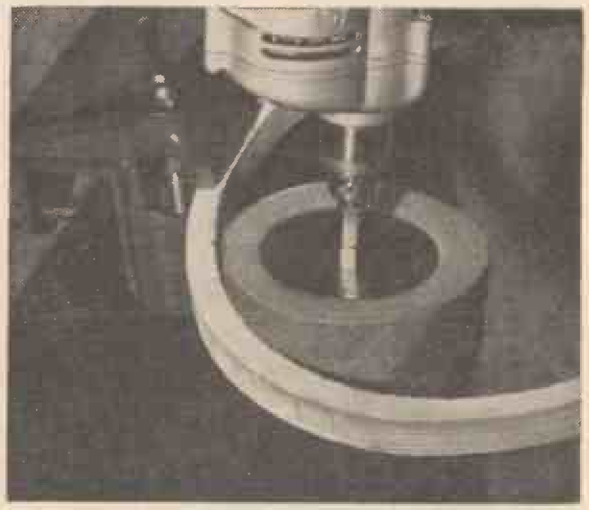
FROM Messrs. Stanley, the well-known firm of tool manufacterers comes news of two leaflets dealing with the subject of screwdrivers. One deals with the choice, use and care of screwdrivers for the general user. The other is for the industrial user and deals with the range of Stanley Phillips screwdrivers and bits, with notes on their correct and economical use. Enquiries should be made to the Home Sales Dept., Stanley Works (G.B.) Ltd., Rutland Road, Sheffield. 3.

A. T. SALLIS CATALOGUE

FOR the price of 2s., plus 6d. postage and package, A. T. Sallis, of 93 North Road, Brighton, Sussex, supply a well illustrated catalogue of their range of Government surplus electrical and radio equipment. Possession of this catalogue will save readers much fruitless searching for special ex-Government items.

NEW TYPE SANDERS

THESE sanders are of completely new design and the manufacturers think that in time they will supersede the disc type. One of the big advantages is that they can be used on most materials, including wood, metals, plastics, etc., and inside curves or outside ones can be sanded with ease. Another advantage is that rubbing down can be done in line with the grain. All the abrasive is cutting at uniform speed and the flexible head makes it virtually impossible to gouge or cut in. The attachment will fit any electric drill. The manufacturers are Super Tools, 67 Victoria Road, Scarborough, and the sanders come in 4½in. and 6in. dia. sizes and cost 14s. 6d. and 19s. 6d. respectively.



The Super Sander in use.

THE "QUICKDRAW"
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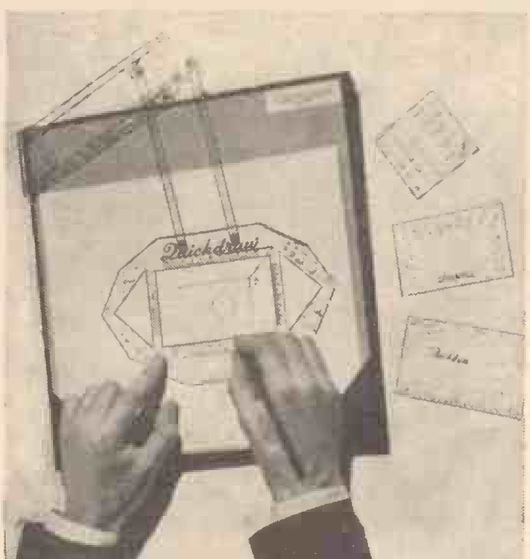
THE Quickdraw is an ingenious device which provides an invaluable aid to the production of drawings and sketches, either for the professional or amateur. It needs no accessories beyond pencil and paper and enables a person with little or no experience to draw and make plans, sketches and other outlines rapidly and accurately to scale. It consists of a transparent template to produce the principal angles, triangles and rectangles. It is calibrated in inohes and millimetres and the scaling is in $\frac{1}{16}$in., ⅛in. and $\frac{1}{10}$in. It will also produce circles from ⅛in. to 1in. in diameter or sections thereof, and these are slightly larger than indicated to allow for pencil point. By placing a ruler against any edge hatching can be neatly and quickly undertaken by the set of nine holes on the left. An ems (pica) scale is on the left-hand column. The pantograph can be removed and fitted on any suitable board.

The folder is 14 in. square and covered with leather cloth. The base is $\frac{5}{16}$in. thick and serves as a drawing board. Corners and one drawing pin hold the paper in position. The cost of the Quickdraw is 75s. and it is a product of The Quickdraw Co. Ltd., of 127 Gunnersbury Avenue, London, W.3.



The "Quickdraw" drawing device in use.

"HUMBROL" CHROMATE PRIMER

THE Humber Oil Co. Ltd, of Marfleet, Hull, has just announced a new product which will have particular interest for modellers who work in metal. To ensure the best possible adhesion of the paint finish it is desirable to use a primer on the metal prior to painting, and the new "Humbrol" Chromate Primer is particularly intended for preparing all metal surfaces, especially those subjected to heat, such as boilers and pipes in model locos, ships, etc. Possibility of discolouring or deterioration is minimised and rusting prevented. This product is easy to apply and flows on smoothly. It is packed in handy tins priced at 2s. each.

SOLDERING INFORMATION

PERDECK Solder Products Ltd., Abbey Mills, Waltham Abbey, Essex, have added a new Technical Information Sheet on the subject of special purpose soldering fluids to their existing series. For a copy of this new sheet and any of the others in the series readers should write to the above address.

CASCO CASEIN GLUES

WE regret that under the heading "Your Queries Answered" in our March issue we gave the incorrect address for Leicester, Lovell & Co. Ltd. Their correct address is St. Christopher's Works, North Baddesley, Southampton. They are the manufacturers of the well-known Casco Casein glues.

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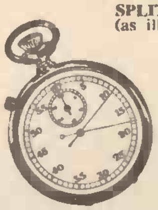

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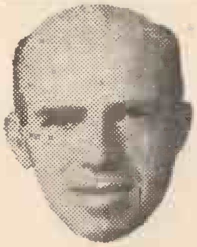

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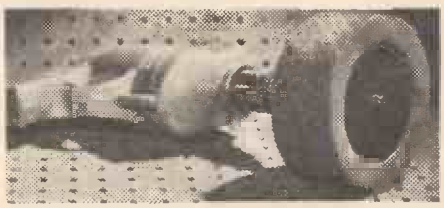

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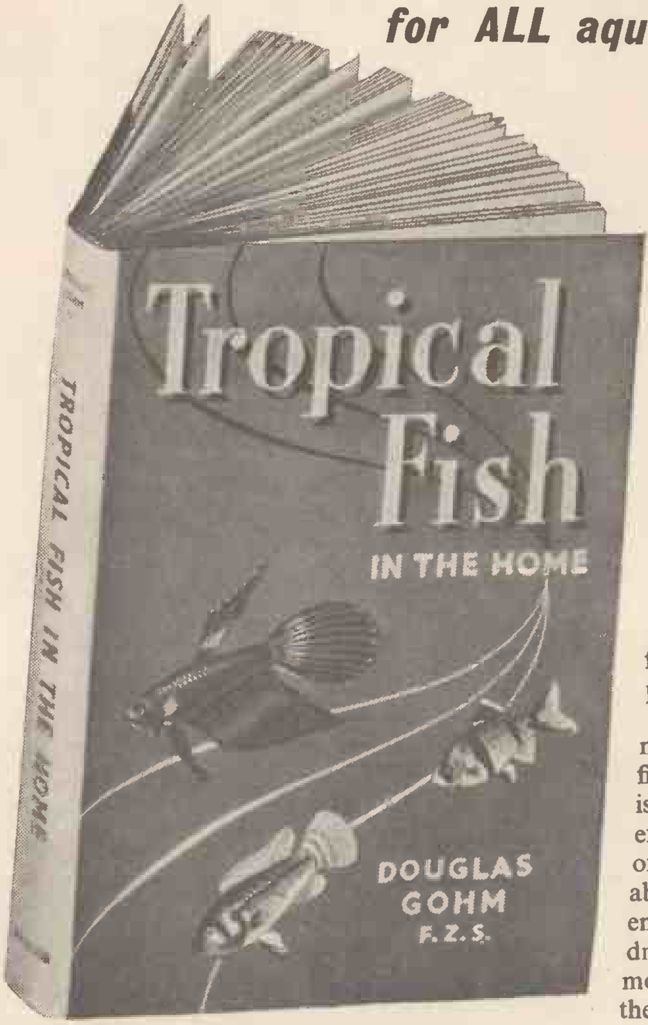

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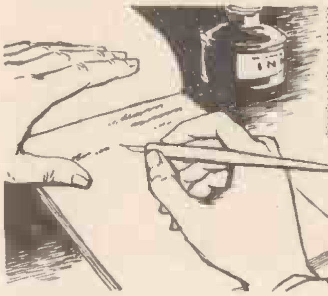
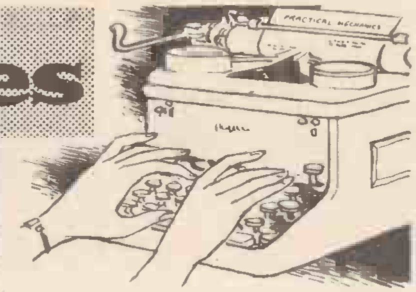


Your Queries Answered



Water Hammer

COULD you explain what causes a tap from the domestic water supply to vibrate violently on being turned off?—S. E. Palmer (Kent).

YOUR trouble is a case of true water-hammer, and is caused by the pressure of water not being sufficient to first lift the valve jumper and then keep it open, this causes the jumper and washer to vibrate at some point in its movement.

We suggest that you try experimenting with the stop tap on the main. First reduce the flow until only the minimum quantity required flows at the kitchen tap, then gradually open the stop-tap until the noise stops; if there are two stop-taps on the main, try variations on both of them. Also, take out the jumper from the tap and fit a spare washer on the top side of the spindle. A hot water washer here will not require renewal so often.

Veining Plaster

I SHOULD like some information about a material which when added to plaster produces a veined effect like marble, also a substance which makes plaster look like alabaster. Can you tell me what these ingredients are?—W. G. Quinn (N. Ireland).

ALMOST any of the earth colours (obtainable from a decorators' suppliers or drysalter) can be mixed with plaster of paris; if several small portions of treated plaster are stirred very gently into the main mix just before it is poured, a marbled effect results. The translucent alabaster effect is obtained either by dipping the moulding in hot paraffin wax and polishing with a soft cloth when cold, or by painting with a solution of white shellac in equal parts of chloroform and ether (white french polish).

Plastic Sealing for Documents

I WONDER if you could supply me with information regarding the plastic sealing of small documents? American magazines often carry advertisements of machines to do this type of work, but I have not seen any details of these machines in British publications.—C. W. Fearnside (Hastings).

THIS is quite a simple process and needs no elaborate machine. Polythene sheeting is the material used and the edges are seamed together by heat from a mildly hot domestic iron or soldering iron.

Place your document on a firm, smooth wooden board and cut out the polythene sheet to appropriate size. Place one of the cut sheets under the document and the other piece on top of the document. Hold the top sheet of polythene firmly to the document and board by means of a "straight edge" of truly planed wood. Then run your hot iron along the edge of the two pieces of polythene sheeting, using the straight edge as a guide. The two sheets will then adhere firmly one to the other. Repeat this operation to the other three sides.

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Our Panel of Experts will answer your Query only if you comply with the rules given below

A stamped addressed envelope, a sixpenny crossed postal order, and the query coupon from the current issue which appears on the inside of back cover, must be enclosed with every letter containing a query. Every query and drawing which is sent must bear the name and address of the reader. Send your queries to the Editor, PRACTICAL MECHANICS, Geo. Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2.

Frosted Glass Effect

I HAVE a room with a very large window which I wish to convert into a bathroom. Please tell me how to "frost" this window to prevent people seeing in but not obstructing light.—E. H. Kerridge (Essex).

IN order to obtain the frosted glass effect, it would be necessary to remove the sheet from the window frame and lay it flat in order that it could be either (a) treated with a chemical such as mild hydrofloric acid which has the power of etching glass or alternatively (b) by using a fine carborundum powder such as valve grinding paste and another piece of glass as a rubber. This is used in the manner of an ordinary sandpaper block, the surface of the glass being rubbed until the desired effect is obtained. Both of these require the glass to be laid flat, for in the former instance it would not be wise to allow acid to drain down and come into contact with other materials and in the grinding process some pressure is required in order to get the carborundum to bite into the glass.

An alternative to these methods would be to use a flat white paint stippled on to the inside surface of the glass. This is quite commonly carried out in order to make transparent glass opaque and although renewal is necessary from time to time, it is quite a simple matter to strip off the paint with a paint stripper and re-coat the surface. The stippling method has the merit of achieving a more uniform coverage.

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Cleaning Sump Oil

PLEASE tell me how to clean used sump oil for burning purposes?—L. Hodgson (York).

THE chief object of the cleaning of used oil is to remove solid or semi-solid particles of such size as would fail to pass through the burner nozzles. As practically all such solids are heavier than the oil in which they may be found, the most simple solution is the use of a settling tank. This merely involves the provision of a receptacle, the taller the better, in which the oil is retained before being passed to the burner.

With the passing of time and depending upon the amount of impurities in the oil, these impurities will settle to the bottom of such a receptacle and provision should be made for their removal from time to time. They will of course not be thin enough to drain off by themselves and when the time comes, a scoop may be necessary to remove them.

At the same time it should be borne in mind that it is only the lower layers which, in time, will pack fairly hard and the upper layers of this sludge could easily be disturbed and re-mixed by turbulence such as that which might result at the outlet of the fresh delivery pipe. Such an inlet pipe should therefore be arranged if possible to discharge down the side of the tank and the supply to the burner should be taken from the opposite side of the tank from the supply. Perhaps the ideal arrangement is to have two tanks one of which could be used at a time, the idle one allowing settling to occur before use.

Electrical Trick

AT an electrical exhibition recently I saw a demonstrator hold a 100 watt lamp in his hand and with no visible connections made it light. Can you please explain this?—John McGeever (N. Ireland).

FROM your description of the equipment it would appear that the lamp was lit by electromagnetic or electrostatic induction. We have not seen the demonstration but suggest that this may have been effected on one of the following lines.

It is possible that a high-frequency A.C. magnetic field can be passed between two poles. If a coil is placed in this field voltage will be induced in the coil which could possibly be used to light a lamp. The higher the frequency and the strength of the magnetic field the greater the induced effect. Possibly a coil could be connected to the lamp.

Alternatively a high frequency alternating electric field may be passed between two faces at high voltage. Two parallel metal plates could be connected to the lamp filament. With the plane of the plates in line with the electric field no voltage would be induced between the plates, but with the plane of the plates at right angles to the electric field, voltage would be induced between the plates which might be sufficient to light a lamp. We should, however, expect that rather large apparatus would be required to produce the effects with a 100W. lamp.

Shutter Speed Check

I BELIEVE a method of checking camera shutter speeds (compur) exists by photographing a television picture and then counting the number of lines of the image. Could you please explain this method?—E. W. Hudson (Middx.).

THE calculation $\frac{405 \times 25}{N}$ will give the shutter speed, where N is the number of lines which can be counted. The screen should be adjusted for good brightness and contrast, and sharply focused, shots being taken in a dark room. With ample development, a moderately fast pan film will suffice for f/2.8. Faster films can be used for smaller apertures. Ignore lines of reduced brilliance caused by the after-glow. An average of several shots should be made, and the exact results will depend to some extent upon aperture, especially at brief exposure times, because the opening and closing of the blades is not instantaneous.

Treating Chair Seats

I HAVE some dining chairs which are covered with leather cloth or similar material which sticks to cushions and clothes when sat on, owing to bodily heat.

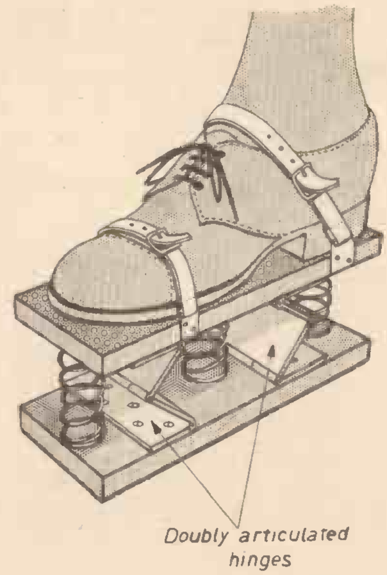
Can you give me any method by which it can be cured? I wish to avoid having them recovered unless really necessary. —B. R. Davids (Mon).

THE trouble concerning your chair seats is due to treatment with a coating which is not capable of hardening off during its drying process. It is as if the surface had been painted with a paint or varnish containing an insufficient amount of dryer. The only hope of a remedy which we can offer is that you remove the surface coating inch by inch, either by actual scraping with a sharp blade, or by vigorous rubbing with hot paraffin. Either of these methods will remove the sticky, non-drying coating. The underlying fabric work should then be treated judiciously with any good wax furniture polish and finally rubbed up normally to a dull sheen.

Jumping Jacks

I WOULD like to make a pair of "Jumping Jacks" for my son, but am bothered about the type of springs to use, as ordinary coil springs cause a wobble from side to side when standing on them, which can be dangerous.—W. R. Wright (Lancs).

PARALLELISM of movement, up and down, would be secured with a bent broad flat spring, but the objection to it is that, although there is no lateral swaying, practically all the movement vertically comes at one end, either front or back, according to how the spring is put on. We would suggest that spiral springs should be used, and to compel the inside and the outside to move parallel



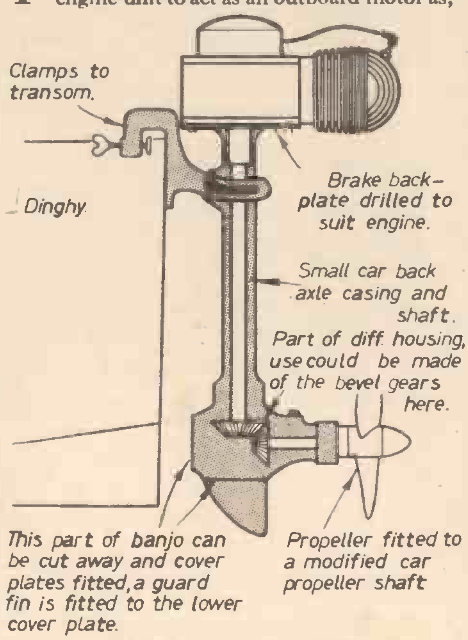
Suggested design for Jumping Jacks.

there should be a pair of doubly articulated hinges, one at the front and one at the back. Possibly these four hinges would have to be made specially from steel plate and with pivot pins through them of about $\frac{1}{16}$in. dia. This is the only suggestion we can offer. It should be borne in mind that the success of the scheme will depend upon the cross stiffness of the hinges, which will depend upon the stiffness of the plate and the accuracy with which they are made. We should like to mention that until one becomes used to "Jumping Jacks" they may be rather dangerous.

Engine Conversion to Outboard

I AM thinking of converting a small two-stroke engine (scooter or motor-cycle) into an outboard engine for a small dinghy. Could you please advise me on the details of conversion?—P. Taylor (Dundee).

IT is not an easy matter to adapt an existing engine unit to act as an outboard motor as,



Layout for the conversion.

will be seen from the illustration of the layout required. The drive from the engine has to be extended by a shaft to a newel drive to the propeller. This drive is usually enclosed in an aluminium casting, bolted to the crankcase of the engine, and the casting in its turn being secured to the transom of the boat by a pair of clamps. The problem for the practical mechanic is to contrive a watertight casing to enclose the newel drive and propeller shaft.

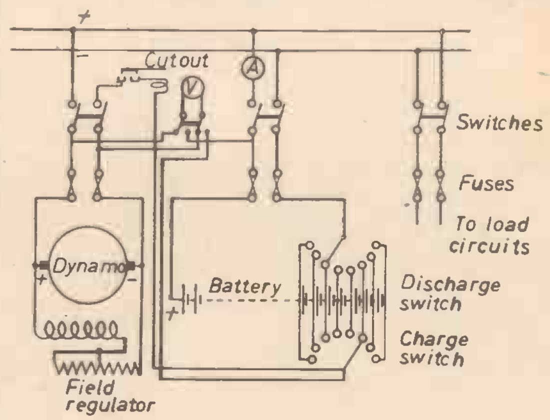
Changing from Dynamo to Batteries

I HAVE a 110V. D.C. lighting set at present directly driven, that is, the light comes direct from the dynamo with no batteries.

I am now thinking of installing 45a.h. batteries. Please give me a wiring diagram and tell me how I could control the rate of charge. At present the Amperage varies with the number of lights I have on.

The dynamo was originally a comp. wound 3h.p. 110V. motor.—J. K. Sinclair (N.I.).

WE presume that it is your intention to use the dynamo as a shunt machine, with the series field windings disconnected and that you may wish to charge the battery at the same time that current is being taken



Circuit details.

from the battery. In order to charge the battery fully we advise about 2·6 or 2·7V. per cell so that, if the battery has 55 cells the voltage of the dynamo should be raised to about 145 volts or more. This could be done by altering the pulley ratio to drive the dynamo at about one third higher speed than at present. It will then be necessary to connect a resistor in the shunt field circuit to limit the field current to the present value in order to avoid overheating of these windings.

This field circuit resistor should be of the variable type so that it can be used to regulate the charging current by controlling the dynamo voltage. An automatic cut-out should be connected between the dynamo and battery. A small two-way switch should be used with the voltmeter so that it can be connected to either the dynamo or the battery, as required. Two tapping switches having about eight contact studs each, should be connected to the end cells of the battery as shown in the diagram. The discharge switch is used to regulate the voltage applied to the load circuits as the battery becomes discharged The charging switch is used to cut the end cells out of circuit as they become fully charged, which will normally occur before the rest of the battery is fully charged.

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100 ,,	2½in.	MC/FR	12/6
200 ,,	2½in.	MC/FR	12/6
5 Amperes	2in.	MC/FS	27/6
15 ,,	2in.	MC/FR	10/6
25 ,, D.C.	2½in.	MI/FR	7/6
30-0-30 ,,	2in.	MC/FR	15/6
50-0-50 ,,	2in.	MC/FS	12/6
10 Volts	2in.	MCR/FS	25/-
50 ,,	3½in.	MC/FS	45/-
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METER RECTIFIERS, 250 μA., 1 M.A., 5 M.A., F.W. bridge, 8/6, post 6d.
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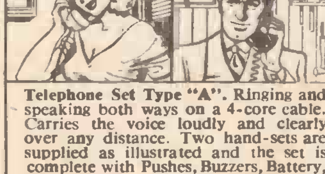

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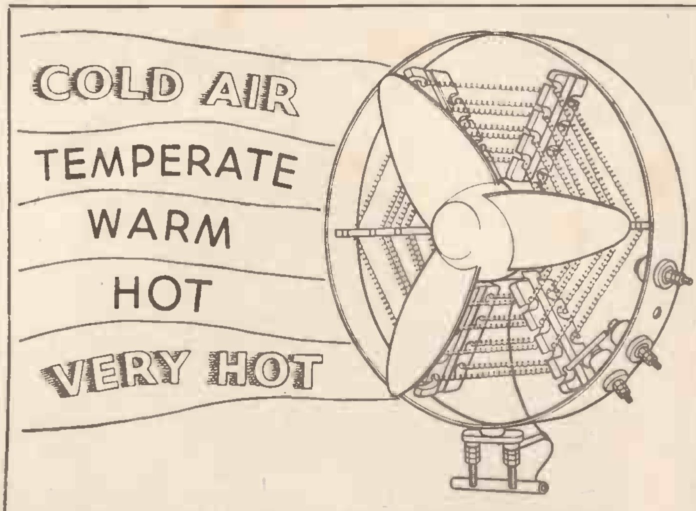

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A compact Mains Blower Unit all ready for fitting into your own casing or ducting Enabling you to construct: Clothes Drying Cabinets, Forced Draught Convector Heaters, Fan Cooling for Warm Weather, Greenhouse Heaters and Ventilators; all at a fraction of the cost of manufactured equivalents.

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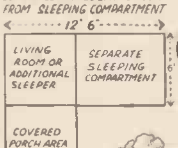

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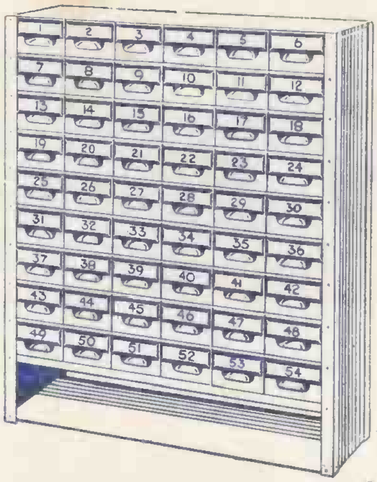

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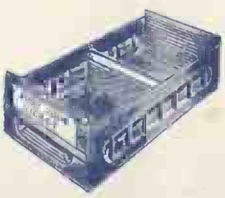

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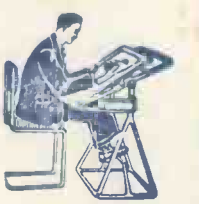

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