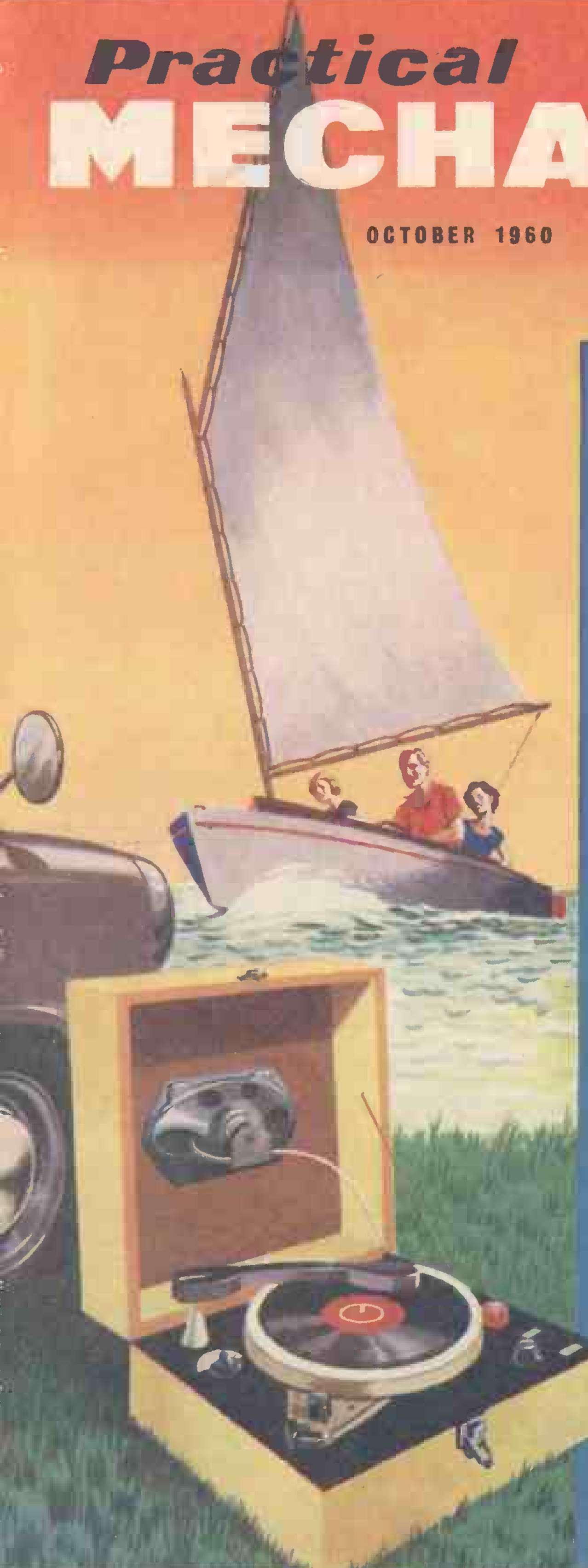
Practical MECHANICS

OCTOBER 1960

1/6



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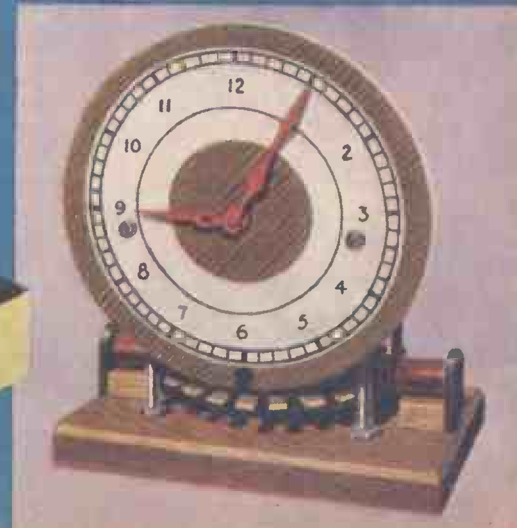
★ BATTERY/MAINS RECORD PLAYER

★ 14 FT. FAMILY SAILING CANOE

★ SKELETON SYNCHRO-CLOCK



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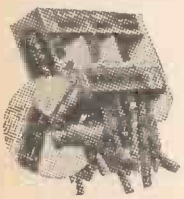

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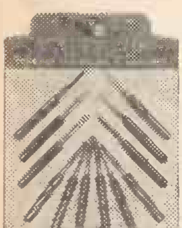

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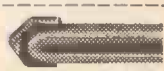

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CONTENTS

CONTRIBUTIONS
The Editor will be pleased to consider articles of a practical nature suitable for publication in "Practical Mechanics." Such articles should be written on one side of the paper only, and should include the name and address of the sender. Whilst the Editor does not hold himself responsible for manuscripts, every effort will be made to return them if a stamped and addressed envelope is enclosed. All correspondence intended for the Editor should be addressed: The Editor, "Practical Mechanics," George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2.

FAIR COMMENT

PROGRESS OF THE AIR CAR

THE Saunders Roe Hovercraft has been in the news a great deal during the past few months and deservedly because it may well be the prototype of a whole new era of transport. The Hovercraft, however, it not the only air car in the world; there are a number of them in America and in fact two are being put on the market by an American firm. Many other firms are making experimental models utilising differing methods of producing the air pad and different ideas for producing forward motion and direction control. In fact the air car has captured public imagination so much that a number of home handymen have built their own, ranging in size from models a few inches in diameter to craft large enough to carry their builder's weight.

Rapidly increasing popularity, however, does not mean that the air car is now firmly established. There are a number of serious problems to be overcome before the craft can realise even a fraction of its potential. The most serious problem of all is to find some means of enabling the vehicle to vary its height so that it can fly over obstacles in its path—things like fences, hedges, buildings and small hills. At the present time the maximum height of air cars is about 12in. and most of them are forced to operate at a height considerably less. Experiments have been made in adding a flange to the base to contain the air cushion and enable the car to fly at a higher level. This, of course serves to increase the height of the actual vehicle, but the bottom of the flange is still the same distance from the ground. The answer may lie in using flexible materials for the flange. A basic theory of air car design seems to have emerged which relates the height it can fly to the area of the base, but there would seem to be no answer to the problem here. A car with a base large enough to allow it to clear fences, would be far too large to use the narrow roads in this country. It is possible to increase the height at which the car can fly by using a much larger power unit, but this adds both to the initial outlay and to running costs.

Another serious problem at the moment is that of increasing the speed sufficiently to allow the craft to compete with existing forms of transportation. At present none of the air cars has travelled much in excess of 30-40 m.p.h.

A problem which has been the subject of a great deal of experiment and one which is possibly well on the way to being solved, is that of steering. Some of the smaller cars have been steered quite successfully by the pilot altering the position of his body while others use the principle of controlling the air flow in various parts of a peripheral jet. This tilts the car and introduces horizontal thrust. The Saunders-Roe Hovercraft has a different system. Here some of the air from the propeller is channelled through horizontal openings and used to provide thrust in the direction required.

A further development in the U.S., the experimental "Levacar," might have a better chance of solving all these problems. This vehicle is designed to run on a high pressure narrow strip of air which keeps it just above a guide rail. The problem of surmounting obstacles in the vehicle's path is immediately overcome and the car is confidently expected to reach speeds in the region of 300 m.p.h.

All the air cars at present being developed are still very much in the experimental stages and it is by no means certain that all the problems associated with this new form of travel will be overcome, but if the optimistic forecasts of the firms concerned with their development can be taken as an indication of their confidence, then the air car should have a bright future indeed.

The November, 1960 issue will be published on Oct. 28th. Order it now!

B1

B2

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PRACTICAL MECHANICS 3 IN 1 CONSTRUCTIONAL PLANS

14 ft SAILING CANOE

THE P.M. RECORD PLAYERS

COMPACT SKELETON SYNCHRO-CLOCK

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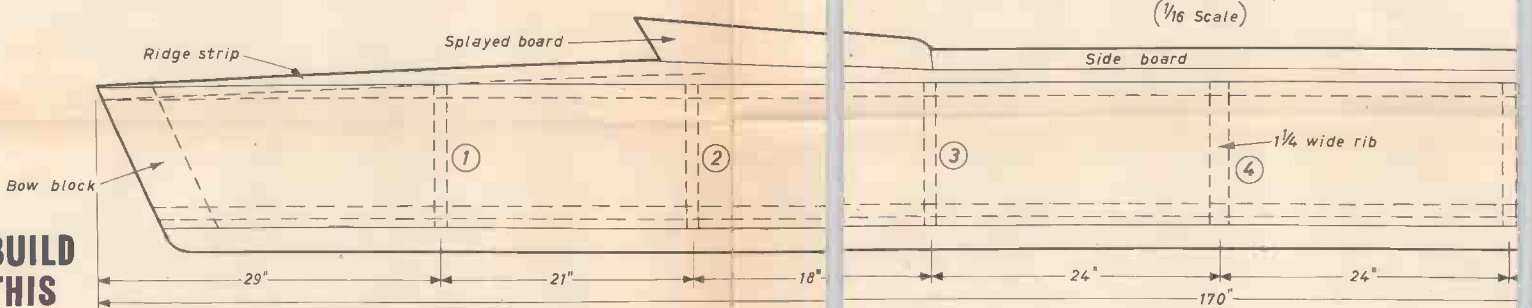
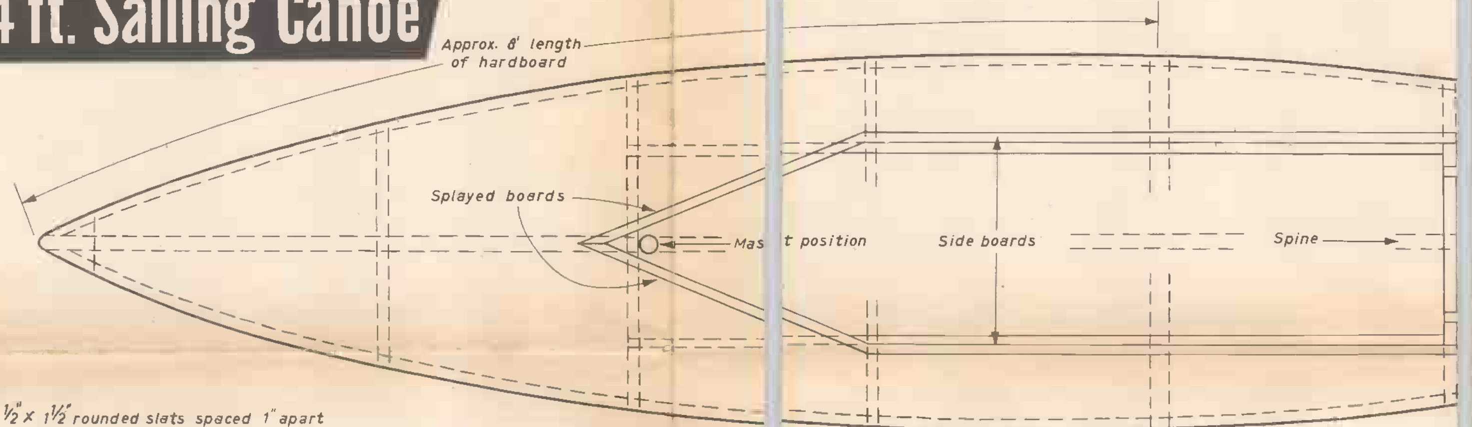
FIG 10 HARDBOARD COV
(view of underside

Ribs
(1/16 Scale)

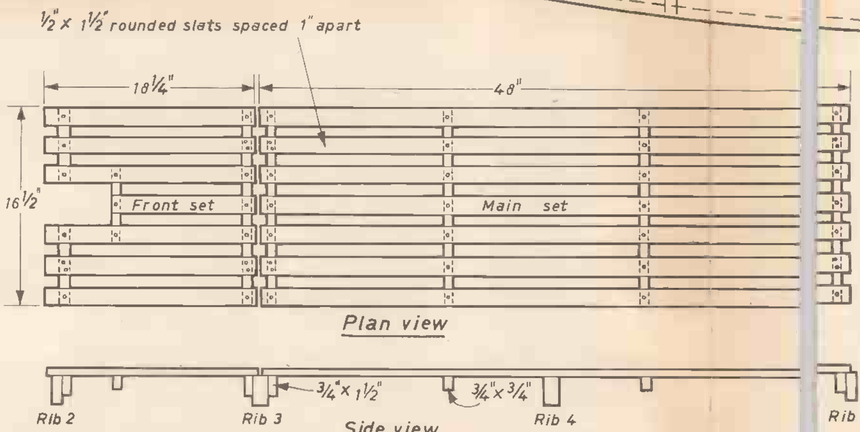
BUILD THIS 14 ft. Sailing Canoe



Side view



Plan view



Plan view

Side view

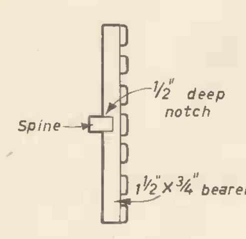


FIG 3 SEAT SLATTING (1/8 Scale)

FIG 8 STEERING (1/6 Scale)

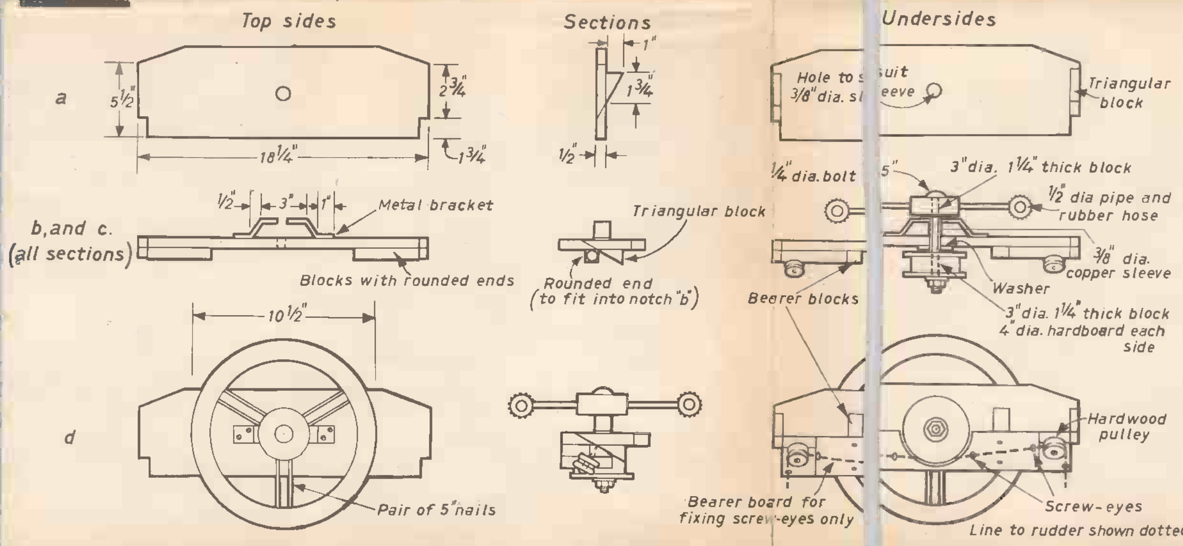
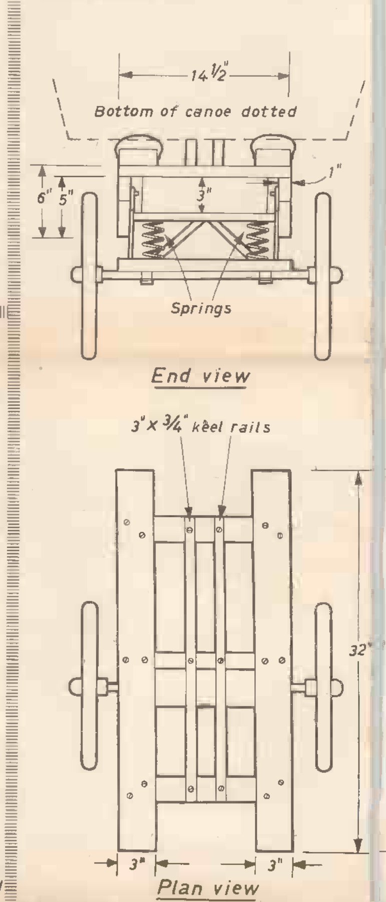


FIG 9 THE CANOE TROLL



End view

Plan view

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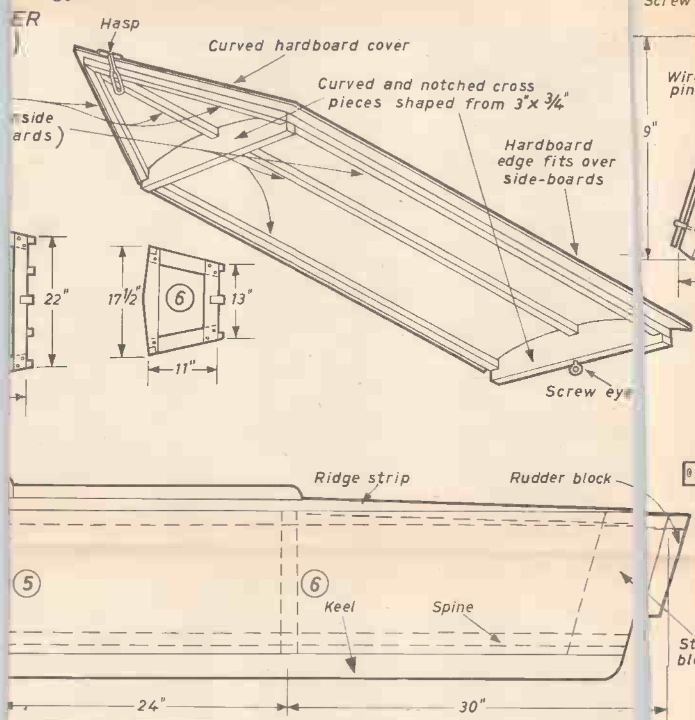
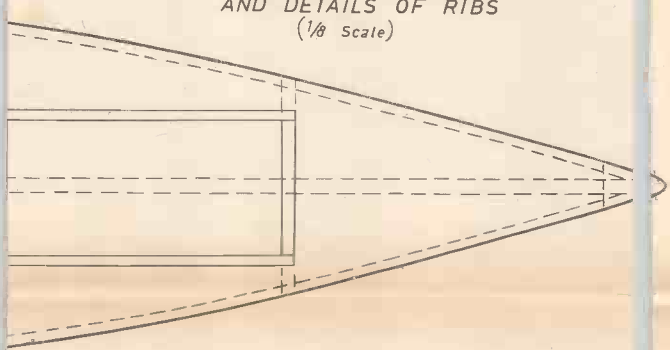
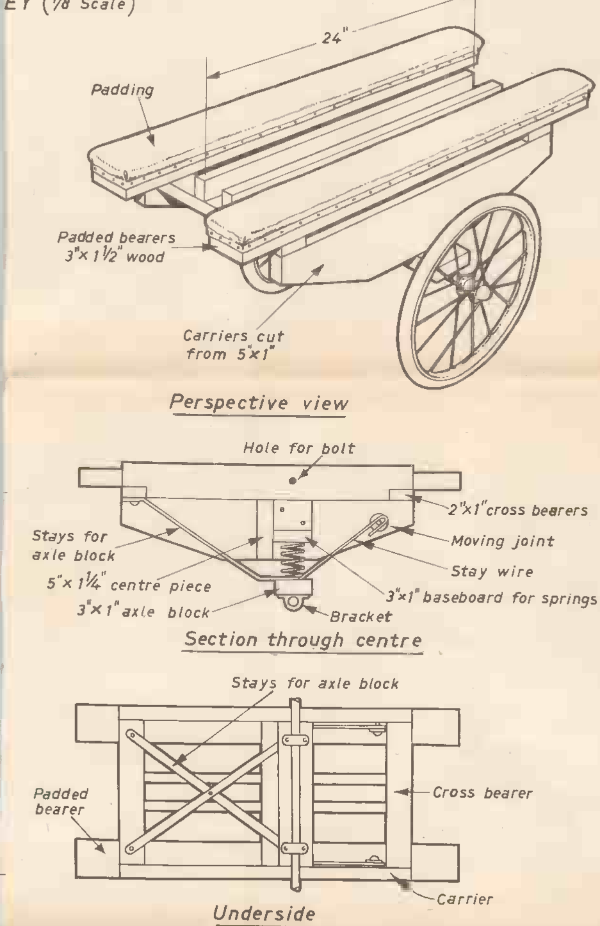


FIG 1

SETTING OUT DIMENSIONS AND DETAILS OF RIBS (1/8 Scale)



EY (1/8 Scale)



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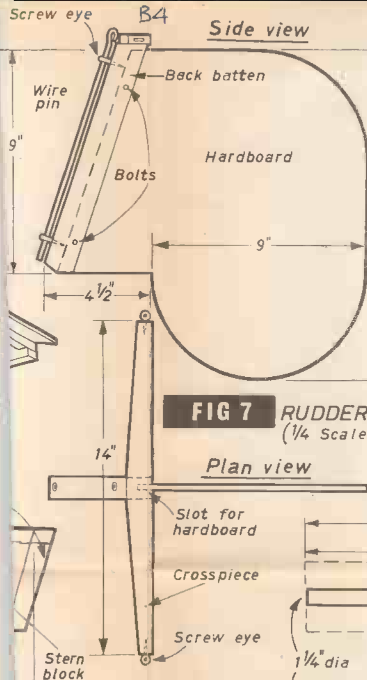


FIG 7 RUDDER (1/4 Scale)

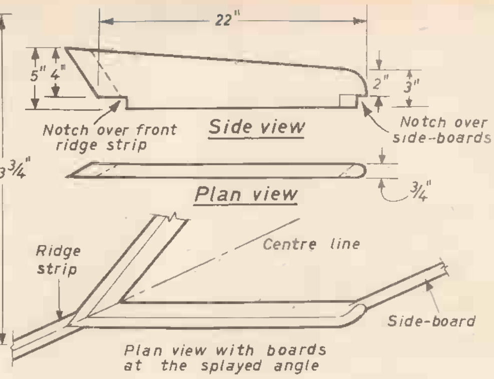


FIG 2 SPLAYED BOARDS TO CANOE OPENING (1/8 Scale)

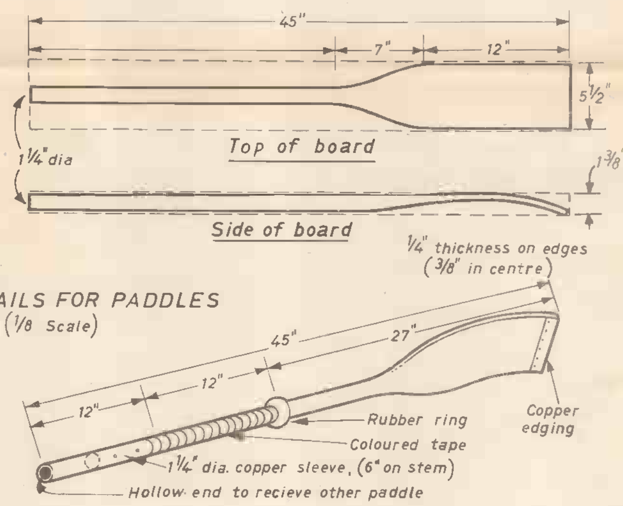


FIG 5 DETAILS FOR PADDLES (1/8 Scale)

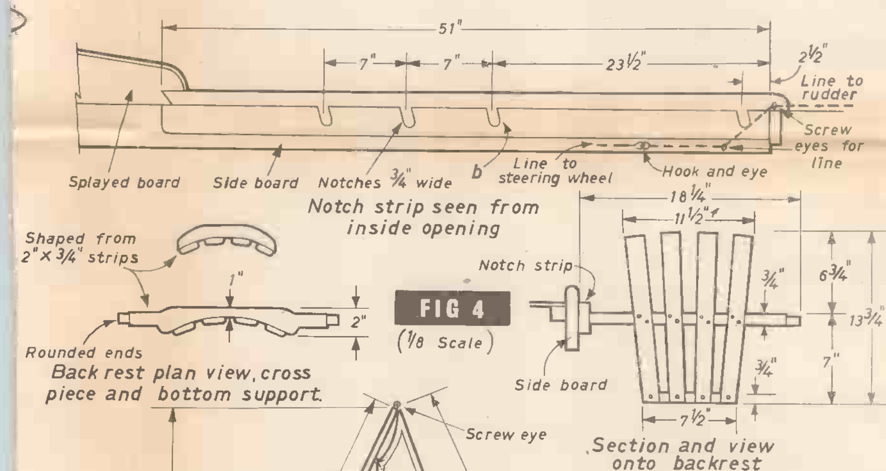


FIG 4 (1/8 Scale)

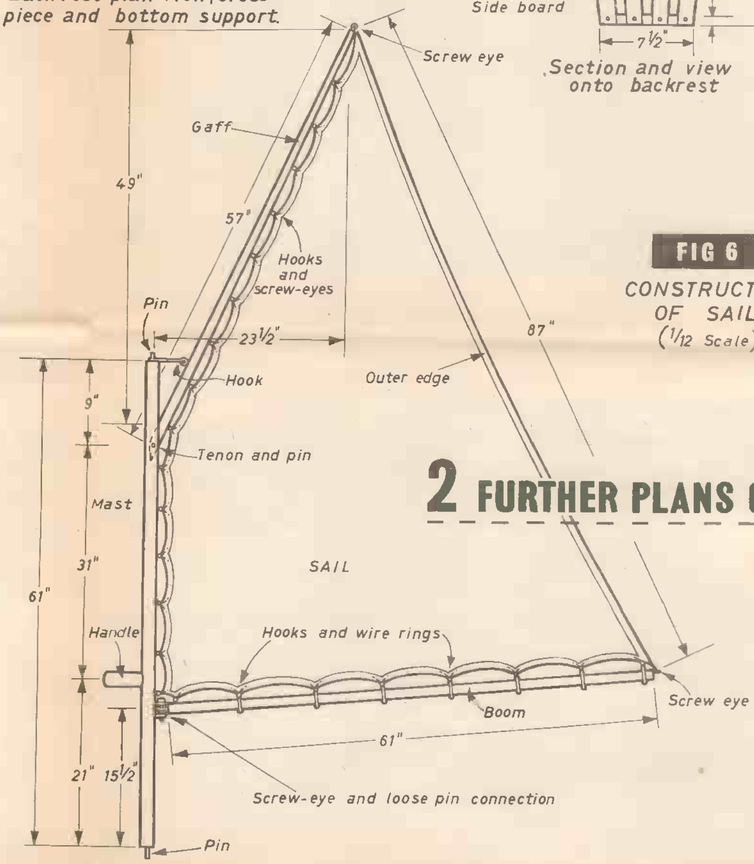


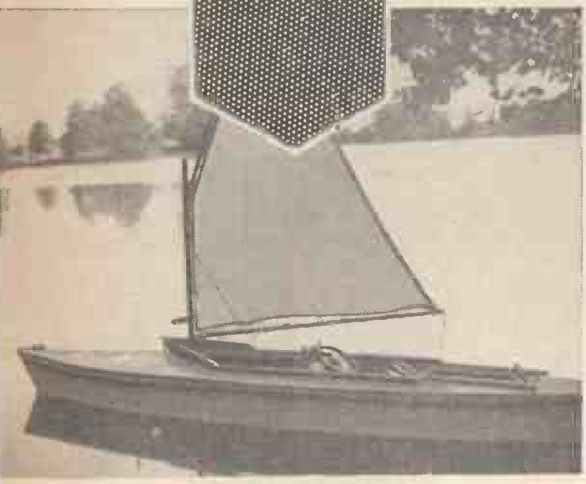
FIG 6 CONSTRUCTION OF SAIL (1/12 Scale)

2 FURTHER PLANS OVER

PM 1 IN 3 BLUEPRINT

Photo 2.—Framework ready for covering. →

14 FT. FAMILY SAILING CANOE



(*Above*) *The completed canoe.*

Photo 1.—(*Below*) *An early stage in construction.*

THE two most important features of this two-seater canoe are its robustness and its stability, this latter being partly due to the flat-bottomed design of the craft.

In order to make a start on the framework and outer skin, obtain the materials in the list below.

Start work by marking out the spine strip and then making a ½in. deep notch where each rib is to go. Set out and cut the timber for the ribs (frames) and then assemble them, using brass countersunk woodscrews. Cut notches ½in. deep for the spine and for the ridge strips in the positions shown in Fig. 1 where layout and dimensions for the spine and ribs are also shown. Side pieces for ribs Nos. 3 and 4 are shaped from the 5in. wide boards. Rib No. 4 is made from 1¼in. thick timber, the reason being that the hardboard pieces are butt-jointed on this frame. When all the ribs are completed and drilled for screws, they are screwed to the spine. Tack two 1in. × 1in. strips to each of the top corners.

Wood for Framework and Outer Skin

Spine: 1 piece 2in. × 1in. × 15ft. long.
Ribs: 2 pieces 5in. × ¾in. × 13ft. long.
1 piece 2in. × ¾in. × 10ft. long.
1 piece 2in. × ¾in. × 12ft. long.
Wide ribs: 1 piece 2in. × 1¼in. × 2ft. 6in. long.
1 piece 5in. × 1¼in. × 2ft. 6in. long.
Ridge strips: 1 piece 2in. × 1in. × 10ft. long.
Bow and stern: 1 piece 4in. × 2½in. × 2ft. 6in. long.
Side boards: 1 piece 5in. × ¾in. × 12ft. long.
Splayed boards: 1 piece 6in. × ¾in. × 5ft. long.
Strips: 8 pieces 1in. × 1in. × 15ft. long.
Hardboard: 3 sheets 4ft. × 8ft. × ⅛in. thick.

The canoe at this stage is shown in Photo No. 3. The bow end and stern end of the two strips have been tacked together and for the first time the curved outline of the canoe appears. The position of the strips is scribed on to each rib, and the ribs are then notched to receive them. The front and back ridge strips are fixed to the ribs and screwed down.

Canoe Top Opening

The side boards are rounded on top and are fixed inside ribs nos. 3 and 4 and their ends are notched on to ribs 2 and 5. Between ribs No. 2 and No. 3 the side boards are cut narrower (the hardboard top will have to go over them here).

Shaping and cutting out the splayed boards is rather tricky. Make the splaycuts to the front edge first; thus it is still possible to make a fresh cut an inch or so back if the first attempt is unsuccessful. The shape of the boards can be seen in Fig. 2.

Bow and Stern Blocks

The shaped blocks for the bow and for the stern

are cut to shape next. Make the splay-cut to the top and bottom first. Hold the blocks against the spine and the ridge-strip (which you have already fixed) to mark them for this. Next notch the spine and top ridge strip into the blocks. Hold the blocks loosely between spine and ridge strips and mark the sides of the blocks for rough shaping. After this has been done fix them in place. The top side strips are chamfered off and fixed to the blocks; Photo No. 5 shows this construction.

All the 1in. × 1in. strips are fixed to the bottom. Photos Nos. 1, 2 and 4 show the canoe at this stage. In Photo No. 4 note the fixing of the side-boards on to rib No. 2, the front fixing of the splayed boards and the additional strips to the bottom between ribs Nos. 1 and 2 (also clearly seen in Photo No. 1). The extra strips are to give protection to the hardboard skin from the canoeist's feet.

Photos 1 and 2 show the completed framework of the canoe, prior to fixing the hardboard covering. The additional seat opening at the back is optional, only a child can sit here, but it may also be found convenient for stowing away and getting at luggage in the back.

Smooth the sides of the bow and stern blocks with a plane. The two cornerstrips at the bottom of the canoe are planed to the same slope as the side of each rib, the ridge-strips at back and front are chamfered off both sides.

Strips of 1in. × 1in. are fastened to the outside of the side-boards and to the outside of the splayed boards to receive the hardboard (see Photos 2 and 4.) All timber, except the side boards to the opening and the splayed boards, is now treated with wood-preservative.

The Hardboard Skin

Unless resin-bonded hardboard is used, a coat of preservative is advisable; it can be applied to the hardboard sheets, or to each piece roughly cut to shape just prior to fixing. Begin with the bottom. Lay a sheet of hardboard on to the upturned skeleton of the canoe and mark around the bottom corner strips. The sheet is then cut out roughly, leaving a strip of about 1in. all around the pencil line. Resin-glue is applied to the bottom of the spine and ribs and strips, the piece of hardboard is placed on to the framework, secured around all edges, at the centre and across the ribs with 1in. panel pins every 3in. Work from one end of the piece of hardboard to the other end (not from both ends towards the middle or you might get a bulge in the middle). Nail a panel pin every 9in. first then put two more in between.

When the first piece has been fixed, join a second piece to it by butting closely together on the 1½in. wide rib. Trim the edges with a coping saw, using the edge strip as a guide but taking care not to cut into the strip. Finally smooth off with a plane.

Hardboard is fixed to the sides in similar manner. Offcuts can be used for the top of the canoe.

Rub down the joints of the hardboard with mastic or other sealing compound. The shell of the canoe is now completed, and the first coat of oil paint can be applied.

Copper Edging

Work the copper strips into a 1in. × 1in. angle strip. Apply a sealing compound to the inside of the copper angle and tack the angle strip to the bottom

Materials for Rubbing Strips

2 copper strips, 2in. wide × 15ft. long, or 4ft. long copper strips overlapped at each joint.
2 copper sheets, 9in. × 16in.

Wood keel:
1 piece 2in. × 1½in. × 15ft. long.

Side strips:
2 pieces 1in. × 15ft. long.

Rudder block:
1 piece 2in. × 1½in. × 9in. long.

Photo 3.—(Below) The shape of the canoe is visible for the first time.

Photo 7.—The completed canoe on its trolley.

Photo 4.—Close up of the splayed boards.

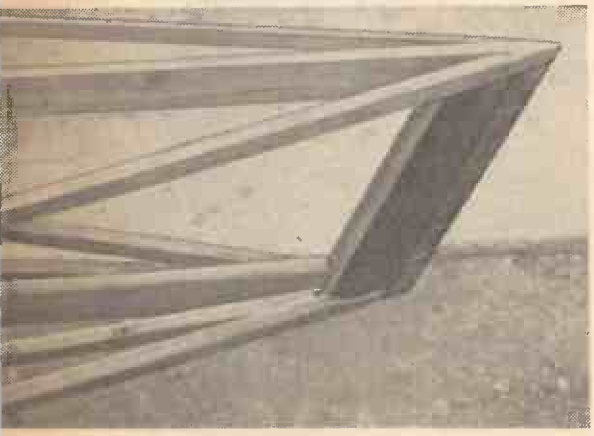


Photo 5.—Close up of bow construction.

edge of the canoe with 1in. panel pins every 2in. (Copper nails are better than ordinary panel pins.) Work the edges of the copper with a small hammer to get them close to the hardboard.

Copper Sheets

Begin by folding the pieces in half, holding them against the bow and stern respectively, then marking out and cutting to shape. Finally nail the edge of the copper pieces through the hardboard into the wooden bow and stern blocks. Give all the copper one coat of paint.

Round off the two outside corners of the wooden side strips. These strips will be fixed 2½in. down from the top outside edge of the canoe (see Photo 9). The strips are not mitred together at the front or at the back, but start about 2in. away from the bow. Drill a hole through the strip for fastening to the bow block and screw down. Bend the strip around the side and mark at each rib and stern block for drilling. Cut and round off the end 2in. short of the stern. Take off the strip, drill all the holes and cut to length.

To avoid difficulty in painting to edges apply the second coat of paint to the canoe first and paint the side strips and keel complete before fixing them.

Round off the front and back end of the keel strip and screw through the hardboard into the spine at 36in. intervals. Ensure that the keel strip is perfectly straight.

To fix the rudder block, cut a triangular groove in the one 1½in. wide side and fix with three long screws into the sternblock; countersink them ½in. or 1in. if necessary.

Seat Slatting and Backrests

For easy fitting and removal, the seat slatting (Fig. 3 and Photo 8) is made in two parts; a short front set and a 4ft. long main set. To make the seat slatting you need:

7 ½in. × 1½in. strips, each 18¼in. long.
7 ½in. × 1½in. strips, each 48in. long.
3 ¾in. × 1½in. bearers, 16½in. long
1 ¾in. × 1½in. bearer, 20in. long.
2 ¾in. × ¾in. bearers, 16½in. long.

The backrests (Fig. 4 and Photo 8) are curved for comfort, they are also fixed on a swivel, so they can be adjusted.

The materials needed to make them are:

8 ½in. × 1½in. strips, 14in. long.
2 ¾in. × 2in. strips, 27in. long.

Also: 2 2½in. × ¾in. strips, 51in. long. These will serve as notch-strips, in which notches are cut for the backrests (Fig. 4). They are screwed to the inside of the sideboards of the canoe opening. Note: notch "b" can also accommodate the board on which the

Photo 6.—(Below) A view of the steering wheel.

steering wheel is fixed, as described later in this article.

For the backrests, cut from the ¾in. × 2in. × 27in. long strips one backrest cross piece and one bottom support, and shape these pieces as indicated in Fig. 4. The ends of the cross piece are rounded off, to fit into the notches. Assembly of the backrest is also shown in Fig. 4. If obtainable, use parana pine for the back rests and for the seat slatting.

Paddles

You will need two planks of preferably poplar, but pine will do, 5½in. wide × 1⅜in. thick × 45in. long. Mark on to the planks the shape for the paddle, as shown in Fig. 5. Cut out roughly first with saw, chisel or axe, then chisel to a smoother surface the inner surface of the flat end and the curves where the stem ends; the other surfaces can be worked with a plane. Finally sand smooth. The finished paddle is shown in Fig. 5.

A 1¼in. dia. copper sleeve is fitted to one paddle, in order that the two paddles can be joined. A small copper strip is fixed to the blades of the paddles and rubber rings, fitted to avoid water running down the stem and into the boat. The space between copper sleeve and the rubber ring is covered with coloured tape. Back rests, seat slatting and paddles are oiled and varnished.

Mast, Boom and Gaff

For the mast obtain a piece of pitch pine 2in. × 2in. × 5ft. 3in. long; for the boom a piece 1½in. × 1½in. × 5ft. 3in. long; for the gaff a piece 1½in. × 1in. × 5ft. long. These members should be straight grained and knot free.

The mast and boom are worked to a circular section, the mast being slightly tapered off towards the top and the boom tapered off towards the outer end. The gaff is worked to an oval section, and is also tapered off towards the top. The sail is fixed to one of the narrow sides. Fix a pin to the top and to the bottom of the mast as shown. Make a joint for the boom, consisting of two screw-eyes (large ones) fixed to the mast, and a drop-pin. Make a tenon joint with a mortice in the mast for fixing the gaff. A wire hook from the gaff will fasten over the pin in the top of the mast. The handle to the mast is not essential, but convenient.

A large screw eye goes into the top of the gaff and into both ends of the boom. Small screw eyes are fixed to the gaff and mast every 6in.

The Sail

Use a bed sheet or other suitable material with a close texture. Lay the assembled mast, boom and gaff on to the floor and use this to obtain the outline for the sail. A hollow double seam is made along the outer edge of the sail, the other edges are bound with "Rufflette" curtain tape. The sail is then fastened to the gaff and mast and to rings on the boom by means of curtain hooks which can be fitted anywhere in the Rufflette tape. A line or cord is pushed through the hollow seam of the outer edge, and tied to the screw eyes in the top of the gaff and at the outer end of the boom.

Mounting the Mast

To the underside of the splayed boards is screwed

(Concluded on page 40)

Photo 8.—(Below) The inside of the cockpit.

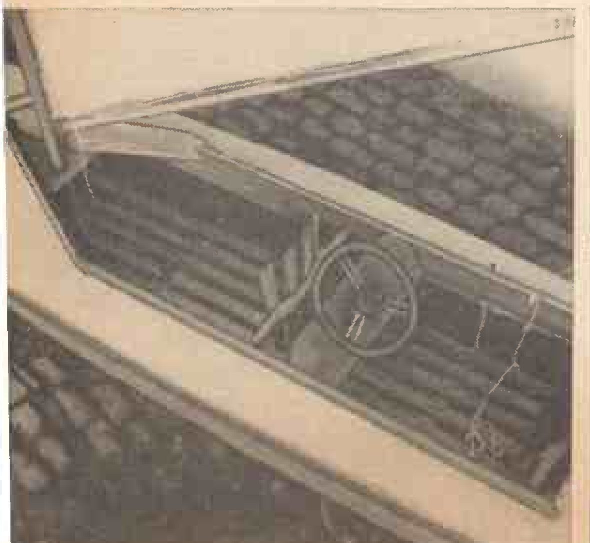
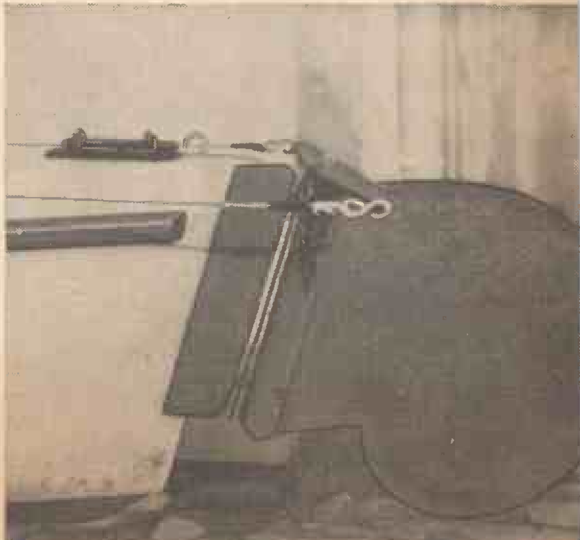


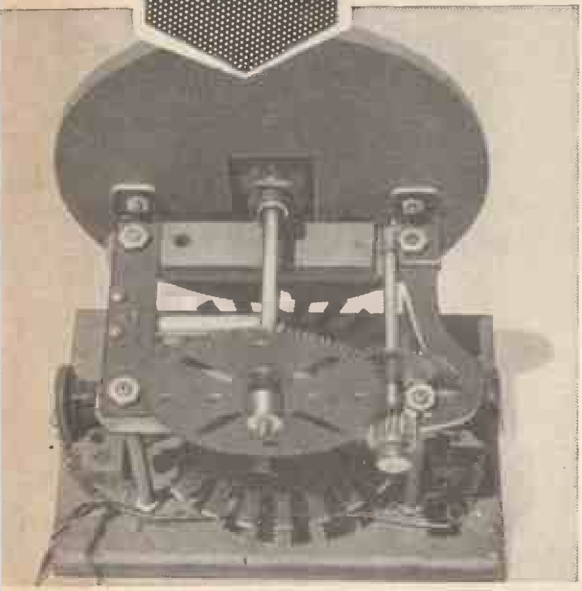
Photo 9.—(Below) The rudder.



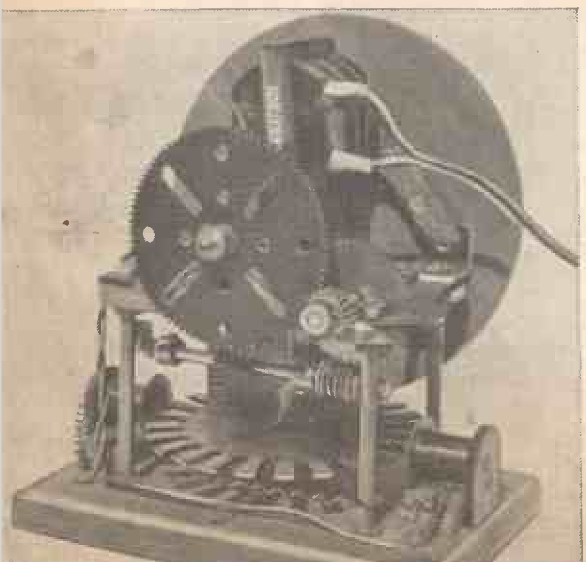
PM 3 IN 1 BLUEPRINT

F. G. Rayer gives details for building a

SKELETON SYNCHRO-CLOCK



(*Above and below*) *Two views of the internal mechanism.*



THIS clock can be made with a few hand tools, and runs from 50 cycle A.C. mains, automatically keeping correct time. High-voltage magnets do not have to be wound, because the clock operates from a small, low-voltage mains transformer.

The Synchronous Wheel

The synchro wheel is shown in Fig. 1. Its exact diameter is not important, but it must have 24 teeth. It is made by scribing a circle on a sheet of thin, soft iron, setting the compasses to about $1\frac{3}{8}$in. radius. This circle is then divided accurately into 24, by using a protractor and marking at each 15 deg. These points are then marked with a punch or small drill. Twenty-four $\frac{3}{16}$in. holes are then drilled, using the punched indentations as a guide. With the same centre, a circle of $1\frac{3}{4}$in. radius is now marked, and the plate is cut down exactly to this line. This is most easily done by using a hacksaw to cut away sides and corners, then finishing to the scribed line with a file. Two cuts are then made to each $\frac{3}{16}$in. hole, to form the teeth shown in Fig. 1.

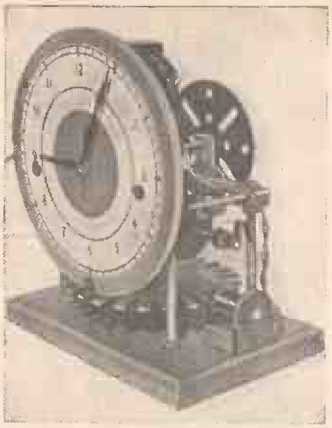
Constructional toy gears and axles will greatly simplify building. The wheel is drilled to be a push fit on such an axle, and is soldered in position about $\frac{1}{2}$in. from one end. The bottom of this axle is drilled to take a small ball bearing, as shown in Fig. 1. This is most easily done by temporarily securing a gear or worm on the axle, and using this as a guide for a drill of the same diameter as the axle.

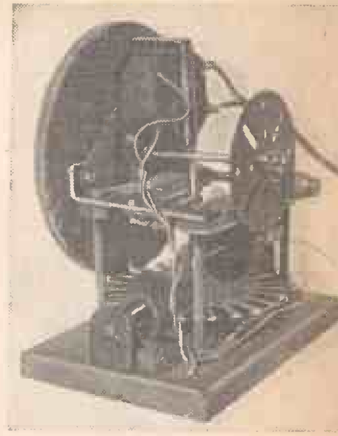
The wheel, having 24 teeth, will rotate at 250 r.p.m. This is 15,000 revolutions per hour. The required reduction ratio (15,000 : 1) is made up by two stages of worm gearing, and a pair of gears. Gear 1 has 50 teeth, providing 50 : 1 with its worm. Gear 2 has 60 teeth, and is driven by worm 2. Gears 3 and 4 mesh together, as in Fig. 2, and provide a 5 : 1 ratio. This gives 50 × 60 × 5 in all, or 15,000 : 1. Readily available constructional toy gears can provide the 5 : 1 ratio, these particular items having 19 teeth (gear 3) and 95 teeth (gear 4).

Worm 1 is made by taking a piece of 20 s.w.g. wire, winding it tightly round the axle, and pulling it out until the spacing between turns is the same as that of the teeth of gear 1. A worm, with grub screw, like that used in the second stage of the drive, can be fitted instead. However, the smaller diameter of worm 1, when made as explained, considerably reduces the very slight rubbing noise otherwise caused here when the clock is running.

Framework and Bearings

The clock is built on a wooden base $\frac{1}{2}$in. thick, and approximately $3\frac{3}{4}$in. × $5\frac{1}{2}$in. Four threaded rods $3\frac{1}{4}$in. long, with extra nuts, support the upper framework, which consists of two pieces of wood 4in. × $\frac{5}{8}$in. × $\frac{1}{4}$in., with two metal cross members.





Three views of the clock.

One of these has its end bent up, to hold the dial. The other is shaped to clear gear 2, as shown in Fig. 3. A small bracket holds the dial this side.

The synchro wheel axle turns in a collar to fit, soldered to a rod which is fixed to the metal cross-piece, as in Figs. 1 and 3. At the bottom, the ball bearing rests in a small indentation in a strip screwed to the base, as in Fig. 1.

The axle carrying worm 2 fits into a bearing soldered to the pillar near the worm. The second bearing is soldered to a U-shaped piece of brass, as shown in Fig. 2. This allows adjustment of the exact position of gear 1, so that it runs correctly with its worm.

The axle carrying gears 2 and 3 turns in two bearings bent from brass strip, and drilled for the pillars, as in Fig. 3. The final axle, carrying the large hand and gear 4, passes through the brackets shown in Fig. 3.

All axles must turn freely. Two additional collars prevent lateral movement. A very small piece of rubber or similar material is placed under the grub screw of gear 4, forming a friction drive with the axle, so that the hands can be adjusted when starting the clock initially.

Magnets and Transformer

Laminated cores are unnecessary, each magnet core being iron or mild steel 1in. long and about $\frac{5}{32}$in. in dia. Each core is a tight push fit in a hole drilled in a piece of ebonite $\frac{3}{4}$in. wide and $1\frac{1}{4}$in. high. Discs of thin insulating material $\frac{3}{4}$in. in dia. are fitted about $\frac{1}{16}$in. from the free ends of the cores, leaving about $\frac{3}{4}$in. winding space. The cores are covered with tape, and the bobbins are wound about three-quarters full with 26 s.w.g. enamelled wire.

The finished electro-magnets are screwed to pieces of wood $1\frac{1}{4}$in. × $\frac{1}{2}$in. × $\frac{1}{4}$in., as in Figs. 2 and 3. A single screw holds each magnet unit to the base. By loosening this, the magnets can be swung slightly, to adjust the distance between cores and the synchro wheel. The magnets are diametrically opposite, so that both cores simultaneously have a tooth near their ends. The distance between core ends and teeth should be $\frac{1}{32}$in. to $\frac{1}{16}$in.

The two magnets are wired in series, and to the primary of a small transformer, as shown in Fig. 4. This transformer has a 200/250V. primary. A secondary giving 4V. is adequate. If the clock does not start easily when first made, reverse the leads from one magnet, to obtain opposite magnetic polarity. The transformer is mounted on strips behind the clock dial, this being done only when other constructional work is completed.

Hands and Dial

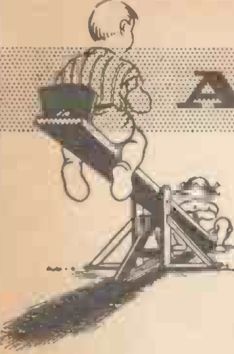
A 12 : 1 ratio is required between the hands, this being obtained by the small gears shown in Fig. 3. These are most easily taken from an old, disused clock.

The hands are cut from thin metal, to the shape and length shown in Fig. 5. The dial is made from sanded and varnished 3-ply, with a thin card dial marked out as in Fig. 5, and glued in place. At the back of the dial, the plywood is cut away sufficiently to receive the small 12 : 1 gears. Two 6BA bolts hold the dial to the brackets shown in Fig. 3.

The general appearance of the clock will be good if all parts are carefully made. Wooden items should be varnished, and allowed to dry, before assembly. Metal parts can be black, or treated with clear lacquer. A dome topped cover, made from perspex, is ideal protection for the finished clock. Good quality flex should be used for the mains connections, and if exposed primary joints are made at the transformer, these should be covered with insulating tape. If a base deep enough to hold the transformer were made, this component would be hidden.

There is negligible stress on bearings and gears, but a trace of thin oil should be placed on bearing surfaces. When current is applied, the wheel will turn until teeth are opposite the magnet poles. The clock is not self-starting, but will continue to run when the projecting top of the synchro wheel axle is spun at 250 r.p.m. After a few trials, it will usually be possible to start the clock quite readily. Re-starting is only necessary after it has been allowed to stop because of interruption of the mains supply to it.

If the clock hums, when running, this shows that one magnet is too near the wheel, and it should be swung back slightly, as already described. The operating voltage and magnet windings are in no way critical. If a 6V. transformer should be to hand, the bobbins can be wound full with 32 s.w.g. or similar wire, for this. A small bell transformer is suitable.



A CHILD'S See Saw

Simple but sturdy. By Jameson Erroll

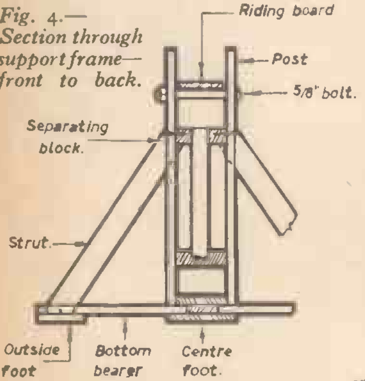


Fig. 4.—Section through support frame—front to back.

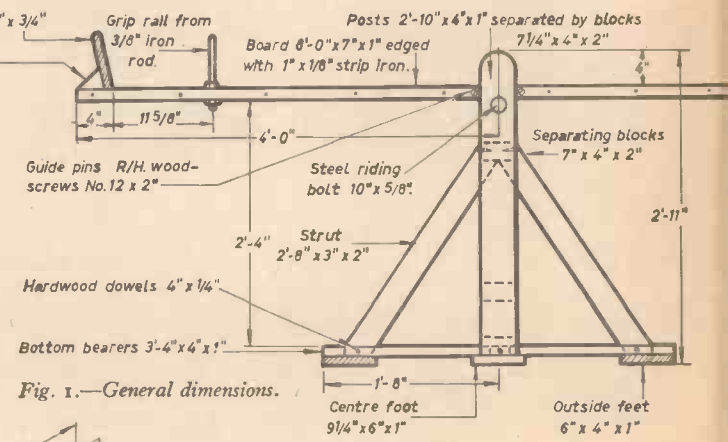


Fig. 1.—General dimensions.

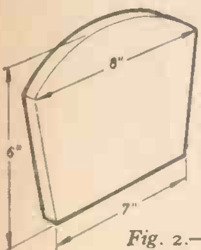


Fig. 2.—The back rest.

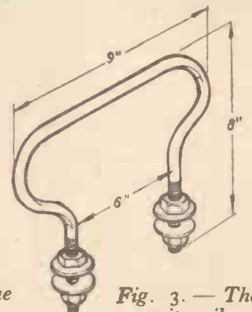


Fig. 3. — The grip rail.

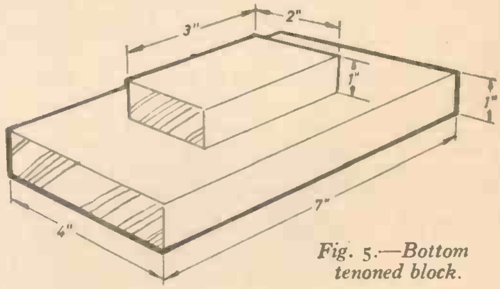


Fig. 5.—Bottom tenoned block.

THE see-saw consists of a riding board mounted on a strutted frame. Good quality deal may be used.

The board is 8ft. long, 7in. wide and 1in. thick and is strengthened by screwing 1in. × ⅛in. strip iron along both edges; the screws should be 1in. No. 8's. Two back rests (see Fig. 2) are screwed in position from the underside of the board, their bottom edges being bevelled to the necessary angle. They are further supported by two angle blocks to each rest; the slope is approximately 100 deg.

The grip rails, shown in Fig. 3, will possibly call for manufacture by the local blacksmith unless the constructor has facilities for heating and bending the ⅜in. round iron rod himself. With care, it is possible to bend them cold but the job calls for patience and a certain amount of skill. The ends are threaded ⅜in. Whit. for about 2in. to allow for top and bottom thick nuts and washers. Holes are drilled in the board at 11⅝in. from the back rests and the rails firmly bolted in position.

Four guide pins are used to prevent the board sliding along the riding bolt, and for this purpose No. 12 wood screws are used; they are placed at 4½in. centres and 13/64in. holes must be drilled in the strip iron to clear the shank of the screws.

The posts consist of two 2ft. 10in. lengths of 4in. × 1in. rounded at the top and separated by two 7in. × 4in. × 2in. blocks to which they are firmly screwed. The upper block is fixed 10in. from the top of the posts; the lower block 6in. from the bottom. At a point 5½in. from the top a ⅝in. hole is bored through both posts to take the 10in. riding bolt which, if easily obtainable, should be of steel although iron will do. Another block, cut from 7in. × 4in. × 2in., is required for the foot of the posts and Fig. 5 shows how this should be cut to form a tenon which fits into a slot cut in the halved bottom bearers. Cut down the edges first, then across, leaving a tenon 3in. × 2in. × 1in.

The bottom bearers are halved at right angles at the centre and will require to have mortices cut through each end to receive the struts. At the top, these struts are birds-mouthed to engage with the posts and top separating block. Both Figs. 1 and 4 show this plainly. Note that the bottoms of the struts are pegged with ¼in. dowels to prevent any tendency to ride out of the mortices although this should not happen if they are a good fit.

All corners and sharp edges should be rounded and all woodwork thoroughly glasspapered. Apply two coats of good quality undercoating and finish with bright colours in hard gloss paint.

MAKING A MIRROR

This is the Final Instalment of the "Handling Sheet Glass" Series

by S. M. Charlett

Fig. 1.—Washing the glass with tap water.

THE preparation of mirrors is quite a simple procedure and requires the observation of only one very strict rule. *The glass must be scrupulously clean before attempt is made to produce a mirror surface on it*, and this involves a very strict cleaning procedure. The glass should be well washed with a hot detergent solution (the writer uses a 20 per cent. solution of Teepol in water) and then thoroughly rinsed in distilled water. From this stage onwards the glass should only be handled with rubber gloved hands, and then only by the edges, to avoid contaminating the surface. After rinsing off the detergent, the glass should be washed with tap water (Fig. 1) and then again rinsed with distilled water. After being allowed to air dry, the glass is ready for mirroring.

Silvering

Reagents required:

1. 10 per cent. aqueous silver nitrate.
2. 10 per cent. aqueous potassium hydroxide.
3. 10 per cent. aqueous solution of sucrose containing 0·5 per cent. concentrated nitric acid, and 10 per cent. methylated spirit.
4. Ammonia solution, S.G. 0·880.
5. 1 per cent. aqueous solution of 0·880 ammonia.
6. 1 per cent. aqueous silver nitrate.

To silver a surface area of, for example, 36 sq. in. take 100 ml. of (1) and add (4) until the precipitate which forms is almost redissolved, then complete the process by adding (5) drop by drop until the precipitate has just redissolved. To this add 50 ml. of (2) and again dissolve the precipitate with (4) and (5). When this is done add (6) drop by drop until the solution assumes a very pale sherry tint, then make the total volume up to 350 ml. with freshly boiled, cooled, distilled water. Place the cleaned glass in a flat dish, a photographic dish is ideal, with the face to be silvered uppermost.

Dilute 50 ml. of (3) with 150 ml. of freshly boiled, cooled, distilled water. Add this to the mixture prepared as above, mix well and tip into the dish containing the glass (Fig. 2). The liquid will at once start to blacken and the deposition of the silver surface will begin immediately. The process will be complete within 30 to 40 minutes, but may be accelerated by placing the dish on a water bath. Hastening the process, however, is not recommended as the grain size of the deposit will be large and the mirror will not be as effective as one in which the deposit is of fine grain.

When the action is complete the liquid should be decanted into a beaker, and the glass well washed by repeated gentle flooding with distilled water. The glass, left untouched in the dish, should then be flooded with two changes of methylated spirit and finally with two changes of benzene, after which it should be allowed to dry. The surface which has been silvered may then be sprayed with a thin solution of a plastic, such as methyl methacrylate or Perspex, in a suitable solvent, giving several coats, and allowing to dry throughly (see Fig. 3). The mirror can now be handled. Any deposit may be removed from the face with a piece of cotton wool damped with a little dilute nitric acid (Fig. 4).

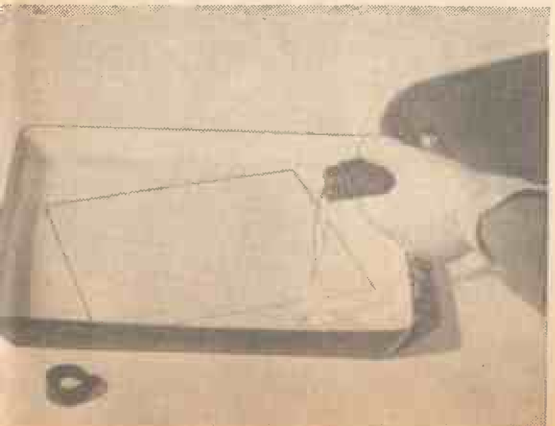


Fig. 2.—Tipping the reagents on to the glass.

Fig. 3.—Spraying the surface with plastic.

The silvering solution should be treated with hydrochloric acid to precipitate any excess silver. If this is not done, the solution will in time deposit a very delicate explosive compound which can prove exceedingly dangerous when handled.

A second method of silvering, widely used in the United States of America, and taking longer than the method described above but not having the explosive deposit characteristic, is as follows:

Reagents:

1. 500 ml. 10 per cent. aqueous silver nitrate, acidified with three drops of concentrated nitric acid.
2. 10 per cent. aqueous triethanolamine.

Clean the plate to be silvered as described earlier, and place in a dish as in the technique above. To 100 ml. of (1) add 40 ml. of (2) with constant agitation. Then add a further quantity of (2) a drop at a time until the precipitate formed just dissolves. Pour immediately into the dish containing the glass. Allow the action to continue until the desired surface has been deposited. The length of time is learnt by experience but the following is a general guide. About 15 minutes' action will deposit a reflecting surface such as is required in interferometers where transmission and reflection are about equal. A totally reflective surface will be produced in 24 hours. When the desired surface has been attained the liquid may be decanted and the plate treated as described in the previous technique.

The Black Mirror—Reagents:

1. 1 per cent. aqueous thiourea.
2. 4 per cent. aqueous lead acetate.
3. 2 per cent. aqueous sodium hydroxide.

The surface to be treated in the same way as under *silvering* to ensure that the glass is chemically clean. One face should be completely covered with adhesive tape, or otherwise sprayed with a solution of plastic, to prevent any deposit taking place on it.

A mixture of 100 ml. (1) 25 ml. (2) and 50 ml. (3) is prepared in a flat dish, and warmed to 40 deg. C. on a water bath. The plate is immersed in the warm liquid for 30 minutes, and then carefully removed, taking care to avoid touching the untaped surface. The plate should be stood on edge and allowed to drain dry, *it should not be washed.* Spray the surface on which the black has deposited with plastic, as for an ordinary mirror, and clean the uncoated side.

Fig. 4.—Removing deposits from the glass.

PUZZLE CORNER

1. Rubber Boots

A FACTORY owner decided to issue rubber boots to all male members of his staff who would, or could wear them. Five per cent. of the staff were one-legged, and half of the others preferred to wear their own shoes. How many rubber boots does the owner have to issue?

2. Picture Postcards

A man was offered a certain number of picture postcards at 4d. each or a similar number of coloured ones at 5d. each. Not wishing to change a pound note he counted his loose change and found that if he bought the 4d. cards he would have 1s. 1d. over whereas if he bought the 5d. cards he would require another sixpence. This sum he borrowed from his wife and bought the coloured cards. How many did he buy?

Answers

1. He needs to issue as many boots as there are male members on his staff. If one half of the remainder, being normal two-legged men, prefer to wear their own shoes, that is equivalent to all the remainder of the normal men wearing one boot apiece. The question of the percentage of one-legged men doesn't enter into the problem; the answer will always be the same.

2. The 1s. 1d. he had over plus the 6d. he borrowed was sufficient to enable him to buy the coloured cards which cost one penny more than the plain ones, therefore there were 19 cards.

home-made

CHEMICAL LABORATORY APPARATUS

Part 2

By K. Given

This instalment deals with the making of a Bunsen burner and spirit lamp, etc.

QUITE good beehive shelves may be made out of small cans such as cocoa tins. The top part of the tin is cut off with snips (or old scissors) taking care to keep the bottom part of the tin symmetrical and about 2in. high. It is then checked by placing on a table with the cut side downwards. Probably some types of tobacco tin would not require this initial cutting. A $\frac{5}{16}$in. approx. hole is drilled in the centre of the bottom and a small semicircle of about $\frac{1}{2}$in. radius is taken out from the cut edge. This will be clear from Fig. 11.

The tin is likely to go rusty so it may be completely tinned with tinman's solder or painted with white oil paint. No doubt a cellulose lacquer would answer the purpose just as well. A white colour gives the piece of apparatus quite a professional look.

Jam jars make very reasonable beehive shelves. The first operation is to cut the bottom off (as with the tin above) using the hot wire technique. The cut surface is then ground with carborundum until the shelf stands firm. A hole is then drilled in the bottom (this process will be described later) and another in the side. The diameter of these holes is not very important, about $\frac{1}{4}$in. to $\frac{5}{16}$in. being quite suitable. In lieu of the hole the glass may be cracked out in a semi-circle by using the red hot wire in a sand bath (see Fig. 11).

The wire, fitted with the foot switch, etc., is made into a suitable loop placed on some sand in an enamel plate, the edge of the " jam jar " is pressed carefully in place and the current switched on. About half those tried will successfully crack out a semi-circle. Since some failures are inevitable it is best to grind down afterwards.

Beehive shelves should not be ground on top (i.e., the bottom of the old tin or jam jar) as if this surface is dead smooth water will not be displaced from the gas jar. Beginners often have difficulty in filling jars with oxygen, etc., because greased jars tend to make too good a joint with the shelves. If the tin one is too smooth a few blunt punch marks carefully made will cure the trouble. Jam jars are naturally slightly bumpy on the bottom and need no special treatment.

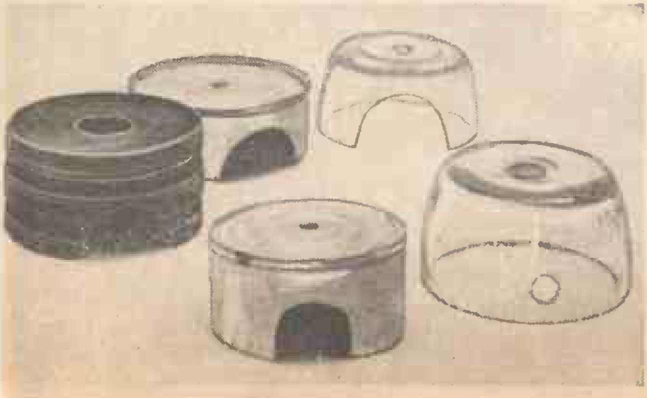


Fig. 11.—Various home-made beehive shelves and one commercial type on left.

Drilling Holes in Glass

After many experiments a technique was devised which gave 100 per cent. success. Fig. 12 shows the basic idea. A small piece of copper tube (obtainable from Messrs. Whistons, garages, car breakers, etc.) is fitted over the shank of an old drill or other round piece of metal. It is then put into an ordinary chuck on a hand brace or small electric drill. It can be fixed (i.e., by soldering) to the shaft of any small electric motor. The author tried a small 12V. fractional horsepower ex-service type and found it excellent. Very little power is required for drilling glass.

The inside of the copper tube is filled with carborundum (medium) powder paste made with water as for glass grinding. Some paste is placed on the glass where it is to be drilled. If the drill is now gently lowered on to the glass a cutting noise will be heard as the paste grinds into the glass. A small tin of rather wet paste is placed by the operator, and he puts very little of it on to the tip of the copper tube every few seconds. Adjust the pressure (which is very light indeed) until optimum, shown by the greatest grinding noise. Once the initial cut is made and the drill located the rest is easy. Do not press too hard, especially when you get towards the end of

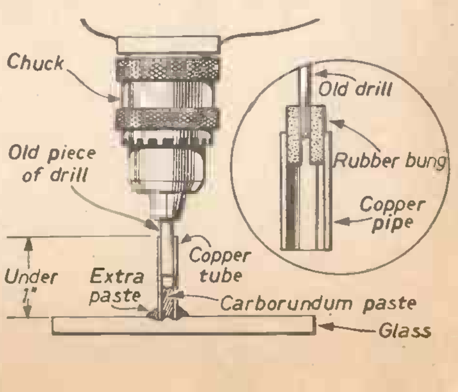


Fig. 12.—Basic technique for drilling holes in glass.

the cut. Drilling is shown in progress in Fig. 13.

Drilling by hand is rather a laborious job, but is quite possible. To drill a 5/16in. hole through the base of a jam jar would take about 40 minutes by hand. About 15 to 20 minutes with a motor or drill which does not run too fast. A very fast motor flings the paste off by centrifugal force. Practise drilling some old glass before tackling actual apparatus.

The initial cut can be awkward, but a mark or two with an ordinary wheel glass cutter will get the paste cutting rather more quickly and a piece of wood with a hole in it held in position over the glass will often prove useful in keeping the end of the copper tube in the correct location. As the tube grinds down into the glass the centre gets a core of glass in it. Sometimes, when the glass to be drilled is over ¼in. this has to be chipped away with a small screwdriver. The thinner jam jars should be selected for drilling.

There is theoretically no limit to the size of hole which may be drilled by this method; it was found that ½in. could be tackled quite easily, but larger sizes were extremely difficult to get going initially.

Fig. 13.—Drilling in progress.

A Home-Made Bunsen Burner

A Bunsen burner may be made very easily from brass, copper or iron tubing and the author bought a bundle of assorted brass and copper tube offcuts from Messrs. Whistons, New Mills, Stockport.

One piece of tube must have a diameter of about ½in. and be about 4½in. long while another must be a sliding fit inside it. In practice a tube of 7/16in. will slide nicely inside one of ½in. if the tubes are of 22g. metal. A slight skim with a file may just be necessary. The smaller tube is 2in. long. A few inches of small bore tube about 3/32in. in diameter is required.

The base is a tin lid of any diameter over 2½in. and with a flange of about ½in. to ¾in. About 1in. from one end of the 2in. tube a hole is filed to the approx. size shown in Fig. 14. About ½in. from the " short end " a ⅛in. hole is drilled through one side. This piece is then soldered into the centre of the tin lid. This is clearly shown in Fig. 14. The fine tube is carefully bent at right angles so that when put into the ⅛in. hole it will project just above the air hole. The other end of the ⅛in. tube leads into the top of a 5/16in. piece which is soldered into the hole in the side of the tin lid.

The best way of soldering this is to tin all parts first. Place a nail in the short length of pipe and squash up the end with the nail in with a vice or molegrips. Withdraw the nail. The fine tube will now fit in nicely. Solder the 5/16in. tube to the tin lid rim. Carefully adjust the fine tube, holding it with pointed pliers, spot it in position with solder, then solder permanently.

Solder a small ring of copper wire round the 7/16in. piece just below the air hole but above the gas pipe. The hole is then filed in the long length of pipe so that it coincides with the lower hole when the larger pipe is resting on the copper wire ring. The burner is shown in Figs. 14, 15 and 16.

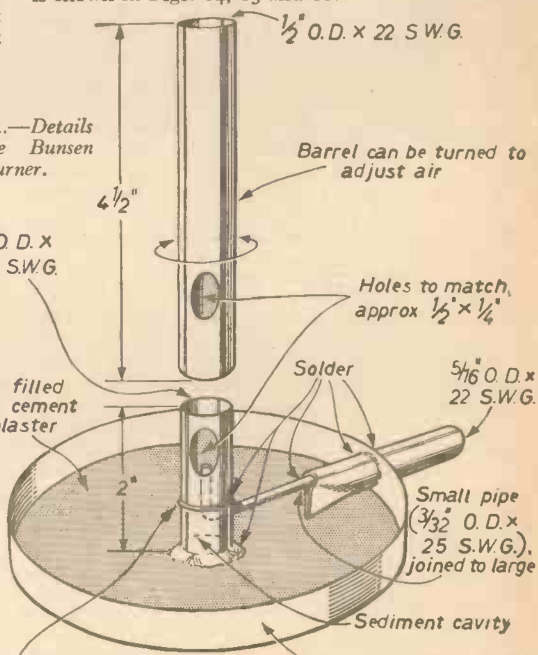


Fig. 14.—Details of the Bunsen burner.

Testing

With the air hole closed (turn the barrel) the flame should be yellow and about 3in. high. Open the air hole slowly and the flame should go almost colourless and eventually form a blue cone and make a roaring noise. This is the hottest flame possible on this burner. If no roaring flame is obtained, increase the size of the air holes. If the flame tends to " fire back " you may have made them too large or the copper gas tube " jet " may be too small.

Never let the burner "fire back" as carbon monoxide is produced, the barrel can give you a nasty burn and if left for some time could melt the soldered joints. A home-made burner of this type should not be left unattended until it is known to be quite trustworthy. Make sure no gas leaks out of the soldered joints.

When completely tested, fill the base with plaster

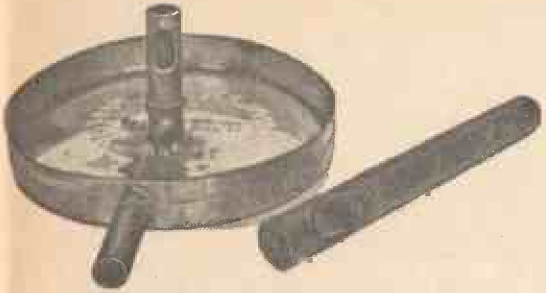


Fig. 15.—The Bunsen burner in construction.

of Paris and let it set. Probably cement would also do. Paint with black enamel. The completed Bunsen is shown with a commercial model in Fig. 16.

Home-Made Spirit Lamp

While a builders' blowlamp or Bunsen type are very useful and adaptable, a spirit lamp can be used for many experiments including the preparation of oxygen. It is important that the top of such a burner is airtight or the bench may be set on fire when moving the lamp. Nothing saye methylated spirit must be used.

Commercial spirit lamps consist of a glass container with a porcelain wick holder and a glass dome extinguisher. An equally good lamp may be made from a small glass jar with a push-on type lid. A popular brand of sieved baby foods (Trufood) is marketed in jars a little bigger than an egg cup with a push-on lid fitted with a rubber gasket. These are ideal for conversion. A small golden syrup tin may also be used (Fig. 17).

Construction

The lid is drilled with a hole to take a 1½in. length of copper or brass tube of between ¼in. and $\frac{5}{16}$in. i.d. The tube is then soldered in position. See Fig. 17. A good length of wick is preferable, say about 1ft. per lamp, and the round-type sold by ironmongers under the title "Dolly Lamp Wick" is admirable. Asbetos-type wicks will not work in these lamps. If the local ironmonger cannot supply the right diameter wick obtain some ½in. ribbon wick and roll it round in a spiral or over another piece of round wick. About ¼in. should be showing above the lamp. It should be trimmed dead level with a sharp pair of scissors or a razor blade. Slight adjustment of flame height may be made by pulling the wick up or down with an old pair of tweezers.

It is an advantage to paint the containers (even the glass one), and certainly the tops, with a bright aluminium paint to stop reflected radiation from overheating the container. Alternatively a small round disc of absestos mat or sheet may be dropped over the wick tube. For most ordinary experiments these refinements are not necessary, but where prolonged heating of flat, shiny metallic surfaces is contemplated, reflected heat could cause a flare-up. This is of course possible with the commercial-type instruments as many experimenters will have found out.

When using methylated spirit always take precautions against fire. Fire sand is useful.

When not in use spirit lamps should have something over the wick to stop wastage of spirit by evaporation and contamination by dust. A small medicine bottle or test tube may be inverted over the wick tube. The bottle should be high enough not to actually compress the top of the wick.

(*To be continued*)

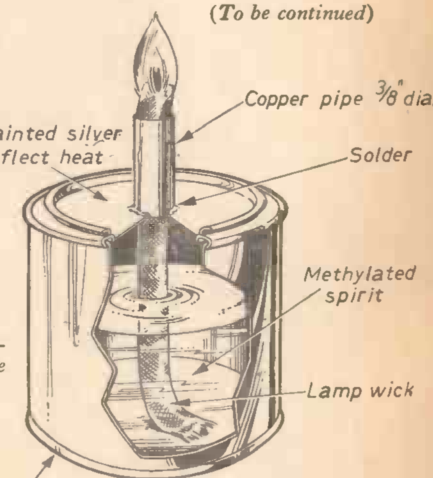


Fig. 17.—Details of the spirit lamp.

Fig. 16.—The completed Bunsen burner alongside a commercial model.

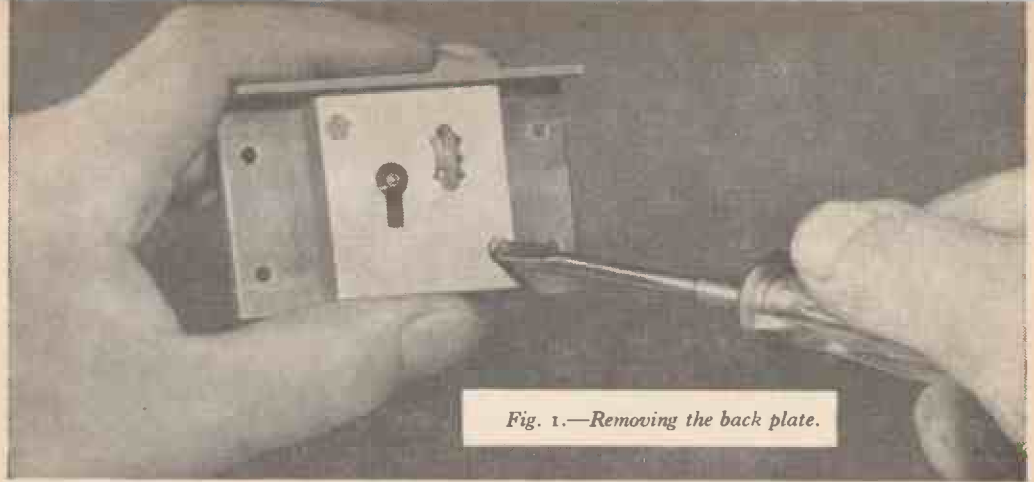


Fig. 1.—Removing the back plate.

KEY CUTTING IS SO SIMPLE

Just follow the instructions and photographs

By J. W. Tomlinson

ONE does not have to be a locksmith to make a key, neither does one need any special tools, with the exception of perhaps a ward file. Taking for example a simple drawer lock, a key can be made in less than an hour by any self-respecting handyman.

To make a start, buy a suitable blank from the ironmongers, taking the lock with you as a guide for size. Remove the two screws that secure the backplate, as in Fig. 1, and dismantle the lock. If it is a two-lever lock, the parts will look like those in Fig. 2. There can, of course, be more levers, but for the purpose of this article two will be ample.

Mark the key blank for width by holding it as shown in Fig. 3, and making a scriber or pencil mark in line with the keyhole. Place the key in a vice and saw off the surplus metal (see Fig. 4). Next, assemble items " D," " C " and " B " to item " E " (Fig. 2), place the key in position as in Fig. 5, and scribe a mark level with the top lever. Saw off the surplus metal as before, and trim the blank neatly with a smooth file. Check that it will slide through the keyhole, and that the height of the blank is level with the top lever.

Remove the two levers, and holding the blank square with the back of the lock and with the end of the blank parallel with the lock face (Fig. 6), scribe a mark in line with the bottom of the slot of item " D," Fig. 2. Remove the surplus metal, using a small smooth file or a ward file just to the thickness of item " D."

Assemble item " C," Fig. 2, hold the key in position as for locking and remove metal in stages by filing, until, when the key is parallel with the lock face, the protrusion in the lever is clear of the peg in the backplate (Fig. 7). The key can now be fully turned, moving item " D " to the locked position.

Repeat this process with the second lever, slightly round off the corners or the key, and the key is finished. Reassemble the lock and check that the key moves freely in locking and unlocking. If it does not, dismantle the lock, and start by checking each stage for smooth action. All that may be required is a little polishing or the removal of a sharp corner.

Fig. 2.—Exploded view of the lock.

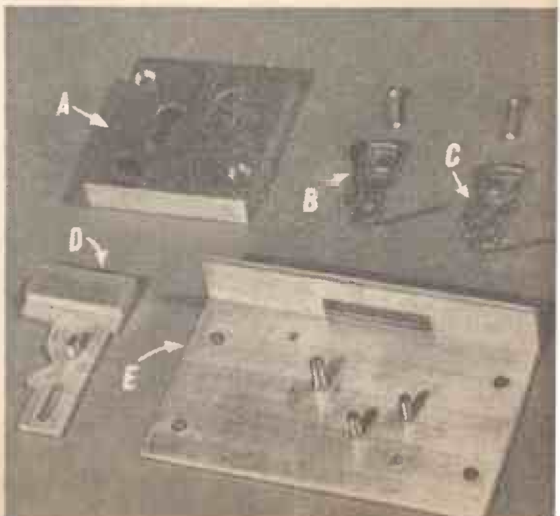


Fig. 3.—Marking the key blank for width.

Fig. 4.—Sawing blank down to width.

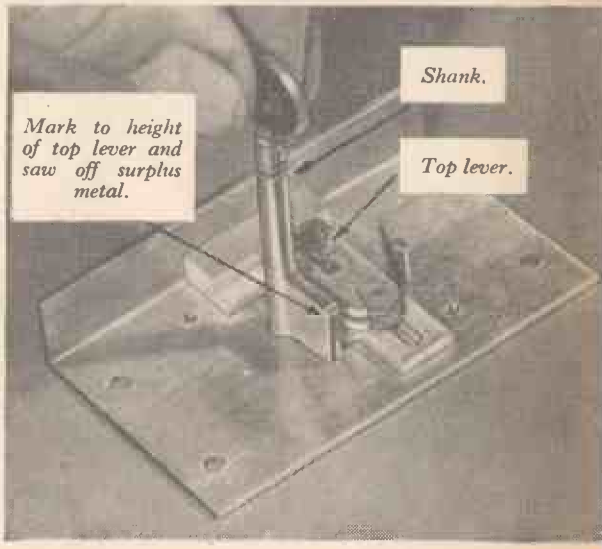
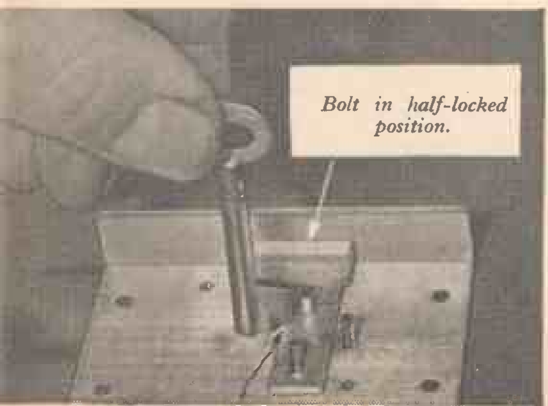


Fig. 5.—Marking the length of the blank.

Fig. 6.—(Below) Marking to fit the bolt.



Scribe a mark in line with the bottom of the slot in the bolt and remove the surplus metal to the thickness of the bolt

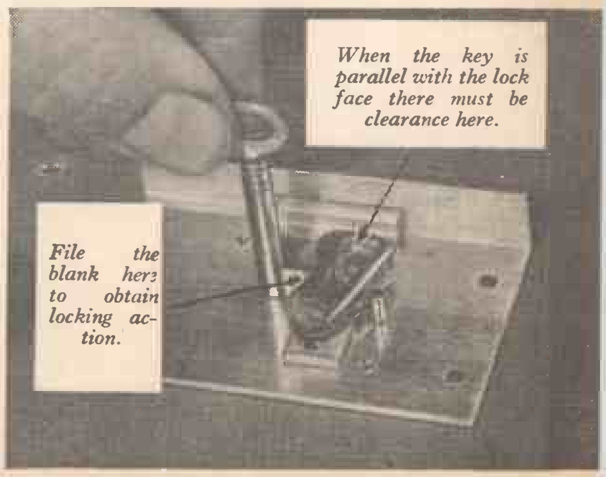


Fig. 7 (Above).—Cutting the blank to the levers.

CANADA'S RADIO TELESCOPE

This new installation will help to increase man's knowledge of outer space.

By Donald S. Fraser

ON the 20th June, the Dominion Observatory's giant new radio-telescope went formally into operation, at Penticton, British Columbia.

The big, bowl-shaped stellar scanner creates the impression of being bold and new. Measuring 84ft. across, it is mounted on a 50ft. tower. Day and night it will sweep the sky, tracking down and studying radio signals from outer space.

Location

Two giant cranes swung the massive, circular mass of structural aluminium alloy into position at Penticton. In this quiet, secluded setting, protected by the encircling hills of the Okanagan Valley, heavy snowfall, ice storms, high winds and man-made radio waves are at the required minimum. Here, a team of Canadian astronomers, headed by Dr. J. L. Locke, chief of the Stellar Physics Division, will collect signals from stars millions of light years away.

The new radio-telescope will penetrate the curtain of atmospheric dust which formerly limited optical observations, enlarging by tenfold the distance man can " see " into space. Star-scanning will go on in all kinds of weather, adding immeasurably to the hours of observation formerly possible. The 90-ton telescope, one of the largest in the world, will pick up radio waves given off by objects in the heavens. These waves are transmitted to a control building where studies of the electrical currents will give scientists a new insight into the composition of space.

Transmissions from the radio-telescope are unlike radar signals which are received when an electrical impulse bounces off the surface of an object. The new device is like a large, powerful ear trained on far distant space. Although the signals themselves are not heard, they activate equipment in the control building, which records them on a special graph. Such recordings will form the basis of radio-intensity charts covering the whole astronomical sphere. The telescope may pick up signals from regions where stars are in the process of creation.

A similar telescope manned by a team of American scientists at Green Bank, West Virginia, reports it is receiving on a frequency which scientists feel would most likely be used by beings on another planet trying to signal other planets.

Canada's new radio-telescope has an 84ft. dia. parabolic, dish-shaped antenna. While actual specifications have not yet been released, this should mean that it would have a 25ft. focal length, and full hemispherical coverage for latitudes greater than 30 deg. Drives: polar axis tracking at sidereal rate; slewing at 15 deg. per minute of time, with differential gearing to permit incremental motion at scanning rate of 0·1 deg. per minute of time. In declination, slewing should be at 15 deg. per minute of time and scanning at 0·1 deg. per minute of time.

Harvard University recently installed a similar radio-telescope, the specifications of which are given here. It comprises a 60ft. reflector with a tripod feed support, and equatorial mount, a drive system with indicators and a control station, and a steel support adjusted to the latitude of the installation.

Intensity of incoming signals is recorded on special graphs which astronomers translate into important information.

This particular reflector was sectionalised into 32 pieces for maximum transportability and ease of erection. Sectional construction does not impair the surface accuracy. Surveying techniques at Harvard established that the accuracy was maintained to 0·125in. of a true paraboloid in all reflector positions.

The Axis

The reflector is rotated about two axes, the polar and the declination. The declination axis consists of a large steel tubular member called a torque tube. The reflector is attached rigidly to the torque tube. The drive motors, gear train and synchros associated with the declination drive are housed within the turret. Declination motion is in two modes, scanning and slewing. Scan is at a variable rate in either direction. Control circuits adjust the speed from 0 to 0·00243 r.p.m. at the torque tube, or about 52·5ft. of arc per minute maximum. The control circuits may also be set to slew in declination at a constant rate of 15·5 deg. of arc per minute. The slew motor is not operated simultaneously with the scan motor. In order to protect the mechanism, a protective circuit, consisting of time delay switches and clutches, disengages the scan motor from the gear train as the slew motor starts.

The three drive motors, gear trains and synchros associated with the polar drive system, are housed in the upper portion of the support tower. Three motions or modes of operation are imparted to the reflector about the polar axis. Tracking from east to west is accomplished at one revolution in 24 hours sidereal time. Scan rotation is in either the east or west direction at a speed adjustable from 0 to maximum, up to 4·83 minutes of hour angle per minute. Scanning may be superimposed on the track function. Slewing is done in either direction at a rate of 60·6 minutes of hour angle per minute. The polar axis consists of a single roller bearing 7ft. in diameter. The outer bearing race is fixed to the tower support; the inner race is fastened to the declination yoke structure. Gear teeth cut into the inner bearing race are coupled to the drive gear train.

The drive mechanism also includes an arrangement of clutches, brakes and torque limiters enabling the antenna to be operated in wind conditions up to 30 m.p.h. With a lesser degree of driving accuracy the antenna may be operated in winds up to 50 m.p.h. Above this velocity, or when not in use, the reflector is locked in the stow position.

Five synchro generators in the drive housing transmit position data to the control panel in the observatory building.

The primary feed is held at the focus in a horn ring which is supported by a tripod of fibreglass spars. The reflector and horn antenna give an angular resolution of 45 minutes of arc when receiving at 21cm. The pointing accuracy obtained from the drive mechanism is less than 10 minutes of arc.

The Harvard telescope has been designed especially for research on the 21cm. hydrogen line, but the rigidity of the reflector makes it suitable for work down to 10cm.

Canada's aim is to also study the distribution of neutral hydrogen (which forms the bulk of matter in outer space) among their own and neighbouring galaxies. Radio astronomy provides the ability to pierce the vast dust clouds that obscure huge portions of space from the gaze of conventional telescopes, and it offers a magnified increase in effective range of study over that of optical astronomy. It is also capable of receiving signals during the hours of daylight and through overcast weather conditions.

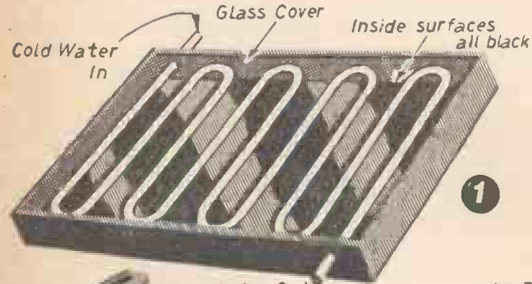
Canada's radio-telescope, which will be used primarily for a study of outer space, can also be used to track earth satellites by the addition of radar attachments. With its larger antenna diameter it should be, naturally, more effective than the Harvard installation described here.

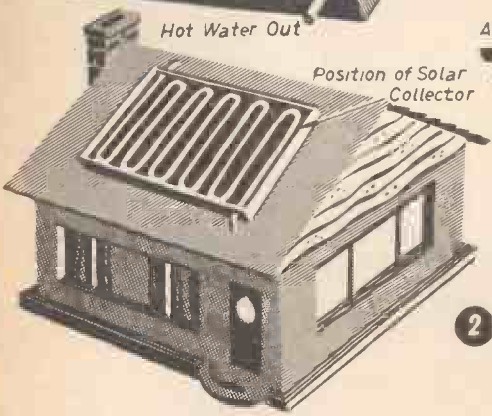
Dr. J. L. Locke of Ottawa heads the team of scientists working on the new telescope.

SOLAR POWER

By R. N. Hadden

How it can be used





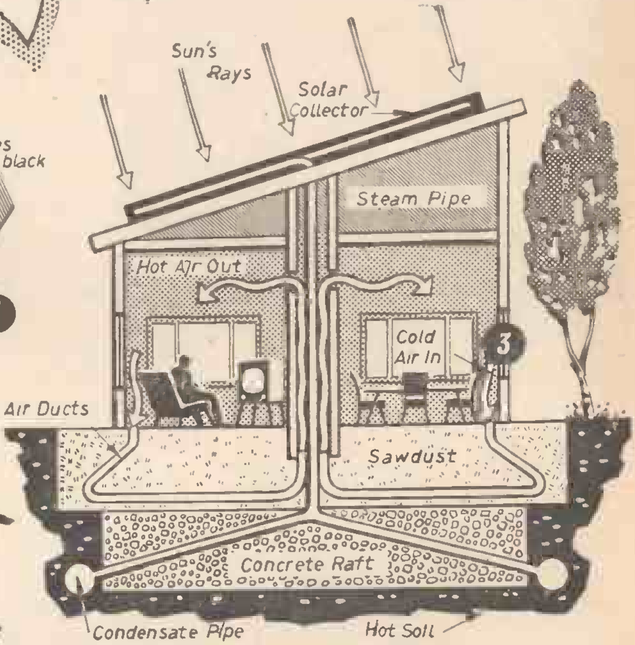


Fig. 1.—A collector.
Fig. 2.—Location of collector on roof.
Fig. 3.—House warmed by solar power.

ONE of the most promising ways in which solar energy can be used is in heating houses in cold climates and in cooling them in hot ones. More fuel is used in the home than by all industries put together, so if we could use sun power for our domestic purposes we would indeed have achieved something.

A Collector

We should have to use what is known as a collector. Fig. 1 shows a simple collector which consists simply of a glass topped box with a coil of pipe inside. The inside of the box and the surface of the pipe are painted black to help with heat absorption. The glass cover to the box is required to prevent heat escaping from the pipe coils. The sunlight which shines on the collector consists of short wavelength visible rays which easily pass through the glass. When these rays strike the black surfaces of the pipes and box they are converted into long wavelength heat waves. These long wavelength heat rays cannot pass through the glass and so the inside of the collector gets hotter and hotter. This heat is absorbed by water flowing through the pipe coil, which can then be used for house heating, hot water, or air conditioning.

In operation the collector is mounted on the roof of a house in such a way that sunlight falls on it directly. This is shown in Fig. 2. As an example the collector just described could be expected to produce one and a half gallons of water at 120 deg. F. for each square foot of collector area, on a sunny day.

Sun-power House

At least one house is being built in this country which will utilise the power of the sun. Fig. 3 shows a section of the house which has a flat roof, where the solar collector is mounted. In the particular house which we are considering the solar collector is of a more efficient design than the one just described. It consists of a series of aluminium-coated parabolic troughs which concentrate the sunlight on the steam raising pipes. Figs. 4 and 5 show what the collector looks like, and how the sun's rays are concentrated on to the steam pipe. It will be noticed that we talk of steam pipes in this collector, and this is because it is so efficient that it actually turns the water into steam.

Referring back to Fig. 3 it can be seen that once the steam has been raised it passes down a central duct in the house to the concrete " raft " underneath. The concrete raft has pipes embedded in it through which the steam flows. As the steam flows through the pipes in the raft it gives up its heat and condenses, the condensate flowing to the return line.

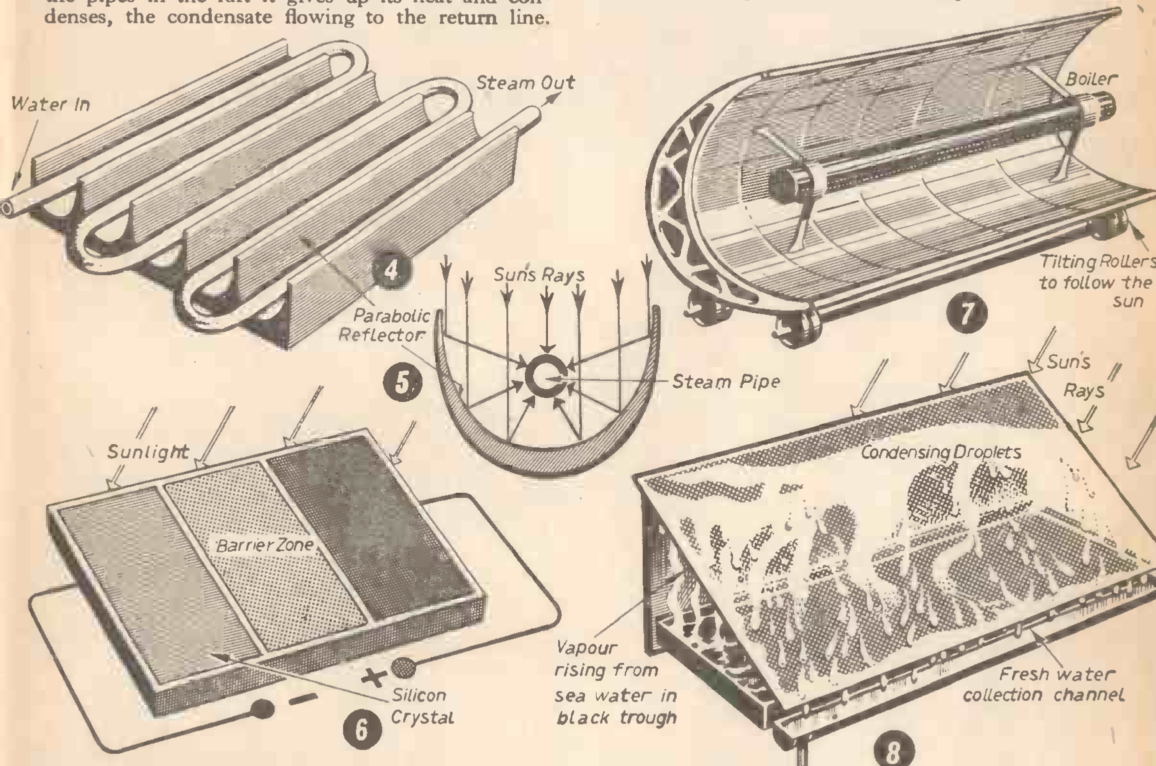


Fig. 4.—Solar collector for steam generation. Fig. 5.—Details of operation of reflectors. Fig. 6.—A solar battery. Fig. 7.—Giant solar powered steam generator. Fig. 8.—Solar still to make fresh water from salt water.

The condensing steam heats the raft up, and this in turn heats the ground underneath. The heat is forced into the ground as it is unable to go upwards due to the insulating blanket of sawdust. Thus it can be seen that all the solar heat collected on the roof of the house is transferred to a " store " under the house.

When the winter comes and it is desired to heat the house it is only necessary to open the air vents which are at floor level. Cold air from the floor sinks down the duct to the level of the concrete raft, where it is warmed by the stored heat. The warm air then rises up the central duct and flows into the rooms, the temperature being controlled by dampers. The house has been designed so that the heat stored will be sufficient to last all winter.

There are other unusual features in this house. Water for washing is supplied from what is collected on the roof while drinking water is taken from the boiled condensate. Waste water from the house goes to a septic tank, and from there to a fishpond. It is claimed that some of the effluent is suitable for fish food and that fish will thrive. The fish are then eaten by the owners of the house. In addition to this some of the effluent is used to irrigate the garden where it is claimed that bumper crops will result. To complete the scheme methane gas is drawn off from the septic tank and is used to drive a gas engine to make electric light, while part is used for a gas cooker.

Cooling System

It is equally possible to use sun power to cool houses in hot climates. This is done by raising steam in the manner just described and using it to work a refrigerating plant. It is not proposed to describe this system in detail, but merely to say that the refrigerating system used is the vapour absorption cycle. One big advantage of using sun power to cool a house is that the more the sun shines the more power there is available to work the refrigerator.

Solar Power

One of the best known solar power generators was built about fifty years ago in Cairo, by an American. This plant was used to raise steam to drive irrigation pumps. Fig. 7 shows the steam generating section. Huge parabolic mirrors were used to concentrate the sun's rays on to the boiler. When in operation this plant produced about 100 h.p. Disadvantages were that when the sun did not shine no power was generated, it was necessary to swing the mirrors to follow the sun and solar collectors cost far too much to build.

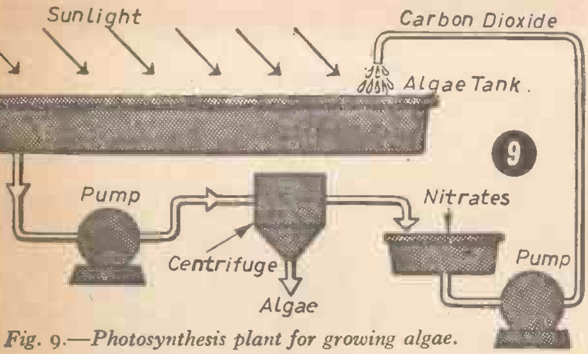


Fig. 9.—Photosynthesis plant for growing algae.

Solar Electric Battery

One of the most promising new developments is the solar electric battery. If this " battery " can be perfected we can look forward to the days when we will be able to generate about 5,000 h.p. for each acre of battery surface.

Although several solar electric batteries have been made the one which seems to hold the most promise is the one developed by the Bell telephone company. This type of battery is used in satellites for operating wireless transmitters. The battery employs a crystal of what is known as a semi conductor, such as silicon. This crystal has the property that when sunlight strikes it electric charges are set up, the negative charges all going to one side of the crystal and the positive charges to the other. Fig. 6 shows the solar battery. When the output terminals are connected together a current will flow. However, this battery is very expensive to manufacture at the moment and can only be used for special purposes.

Distilling Sea Water

One of the simplest and cheapest applications for solar energy is in distilling sea water to provide fresh water. This has been used quite extensively in some arid countries to provide drinking water and water for irrigation.

Fig. 8 shows a solar still. It consists simply of a long trough which holds the sea water. The trough is painted black to assist the absorption of the sun's rays. In some installations the water itself is also dyed black to make even more certain that all the sunlight is absorbed. The sun shines on to the water through a sloping glass sheet. In operation the sun heats the salt water which then starts to evaporate. The water vapour rises and is then condensed on the sloping glass plate which is comparatively cool. The droplets of water run down the glass and are collected in a channel. The salt in the water is left behind in the trough, and is washed out at the end of the day when the sun has gone down, ready for the next day.

Perhaps the most exciting development which we can see in the future is in using the sun to produce chemical changes. Of course this happens every day when the sun shines on our crops and trees to make them grow, but in this latest development we would in fact grow our crops in water. The " crops " would then be used either for human food, or would be burnt in a gas turbine to produce power. This chemical process is called Photosynthesis.

Photosynthesis

In this process use is made of the fact that water and the gas carbon dioxide can be combined together to form carbohydrates in the presence of chlorophyl and sunlight. Chlorophyl is the green substance in all plant growth, while carbohydrates are the basis of all fats and proteins. From this we can see that if we can bring the four ingredients water, carbon dioxide, chlorophyl and sunlight together in the right proportions we will be able to make unlimited food, or if we have enough food, unlimited fuel.

A plant to produce these carbohydrates is shown in Fig. 9. The source of the carbohydrates and chlorophyl is a small green algae called Chlorella Pyrenoidosa. The algae are kept in the tank where they " grow " under the influence of sunlight and the carbon dioxide which is injected into the water recirculation pipe. A pump takes suction from the bottom of the tank and draws off water and some of the algae, and passes it to a centrifuge. The algae and water are separated in the centrifuge, the water being recirculated and the algae being collected. Nitrates are added to the recirculating water to provide minerals if the algae are to be used for food. It has been shown in tests that it should be possible to produce 40 tons of algae per acre per year. This is of course very much higher than can be grown in the normal manner. Another advantage is that with only small changes fats, proteins, or carbohydrates can be produced. One of the big problems of course is will we like eating algae?

Solar Furnaces

One other use for the power of the sun, which in its way is very useful but which is never likely to become very commonplace, is Solar Furnaces. These are used for experimental purposes and are very expensive to build. Fig. 10 shows a small solar furnace. It consists of a parabolic mirror very accurately finished so that it brings the rays of the sun to a very small focus. Samples of metals can be melted by placing them at the focus of the mirror, or their heat resistance can be tested. The largest solar furnace ever built is in France. Its parabolic mirror is 31ft. in dia. and can generate a temperature of 5,400 deg. F. at its focus. The amount of heat it collects is so great that it can melt 130 lb. of iron each hour! Another furnace in America is noteworthy in that although it is smaller than the French one, it can produce a temperature of 8,500 deg. F. at the focus. The temperature of the surface of the sun itself is only 10,000 deg. F.

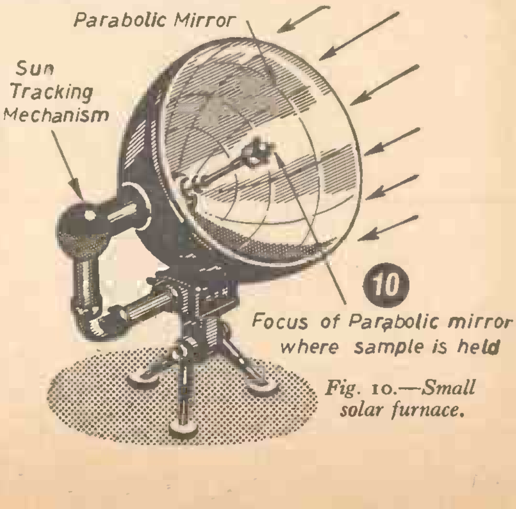
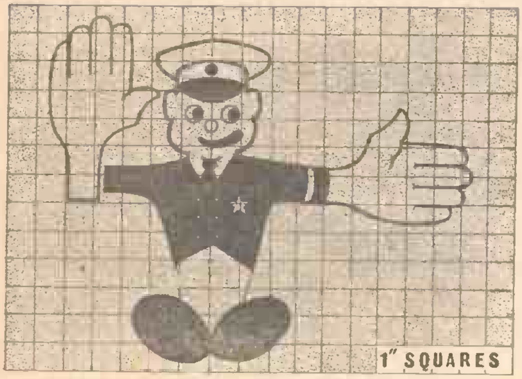
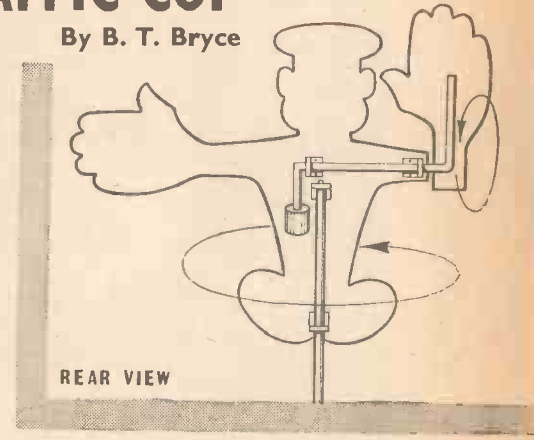


Fig. 10.—Small solar furnace.

A WIND-OPERATED TRAFFIC COP

By B. T. Bryce





FINDING that we have more wind than we know what to do with most of the year round, and having decided that it was high time that it was put to work, I got out pencil and paper and after racking the old brain box for a while came up with the Traffic Policeman described here. It has caused some interest and much amusement in the neighbourhood—and some caustic comments from a real Traffic Policeman living over the street.

Materials and Construction

Plywood is used for the body. The material is ruled with 1in. squares and the figure copied thereon and cut out—the head, body and outstretched hand being cut in one piece. This is well varnished and painted after completion to make it weatherproof. Masonite or thin metal would serve as well.

The right hand is made of tin and pivots on a piece of $\frac{1}{8}$in. brass brazing rod, cranked at both ends. The one end is soldered to the hand and this end should be carried well up into the palm of the hand to strengthen it. The other end carries a counterweight, weighing slightly less than the hand. The hand itself is twisted at an angle to catch the wind—much like a single bladed propellor. At the top of its travel the hand should not quite reach a vertical position but should lie very slightly forward.

The body pivots on a piece of $\frac{1}{4}$in. brazing rod turned down to $\frac{1}{8}$in. at one end to form a bearing. All brackets are made of thin brass drilled to take the rods and fixed to the body with small rivets.

Motivation

The outstretched arm and hand act as a vane, turning the policeman into the wind. The right hand then comes to the raised position, and, being unable to travel any further, tends to turn the policeman out of the wind. The hand then falls and the process is repeated over and over again.

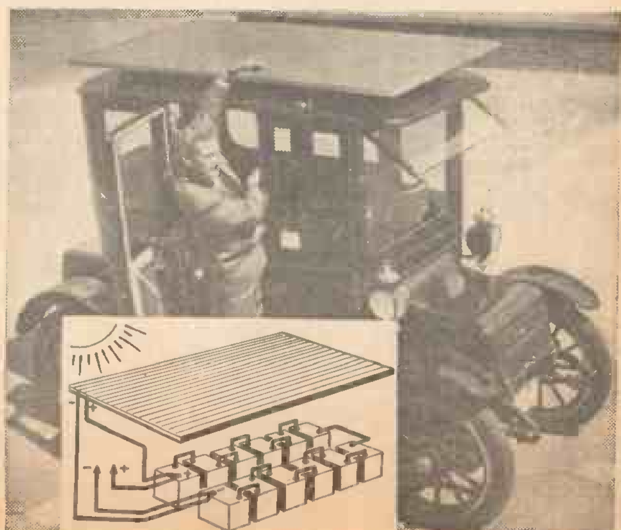
Some experiment may be necessary in regard to the twist in the right hand and the counterbalance weight to get everything working properly.

The original is mounted on the roof of my garage, facing the street and exposed to all the winds.

SUN-POWERED CAR

AN unusual combination of the old and the very new was seen recently in London. The car, a 1912 Baker electric, was, for demonstration of the principle only, equipped with a solar power unit of the same type used in space satellites. In eight hours the solar cells produce energy sufficient to run the car for one hour and the top speed possible is 20 m.p.h.

The principle of operation is that the 10,640-silicon cells on the panel on the car roof convert the sunlight to electricity which is fed into storage batteries (see sketch). From the batteries power is fed to the 3 h.p. motor. Operation when the sun is not shining is possible by means of intermediate storage. An American, Dr. Charles Alexander Escoffery, invented the car.

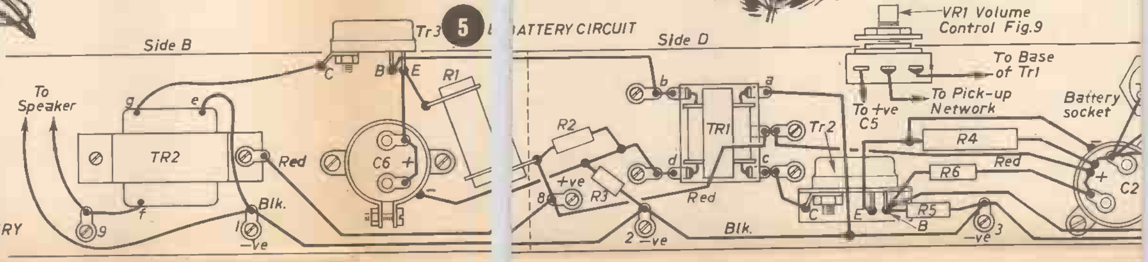


A1

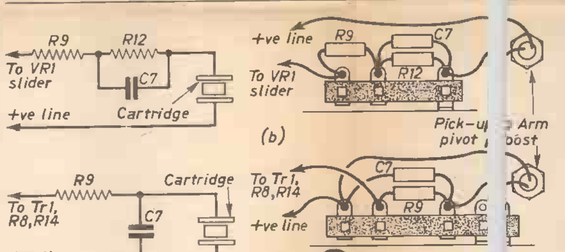
A2

The P.M. Record Players

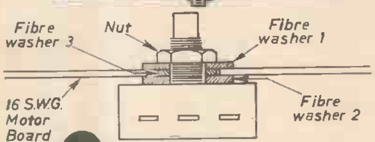
BATTERY MODEL AND MAINS/BATTERY



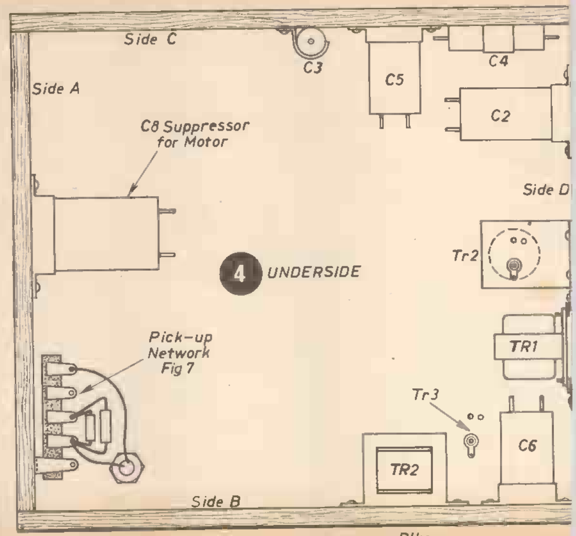
5 BATTERY CIRCUIT



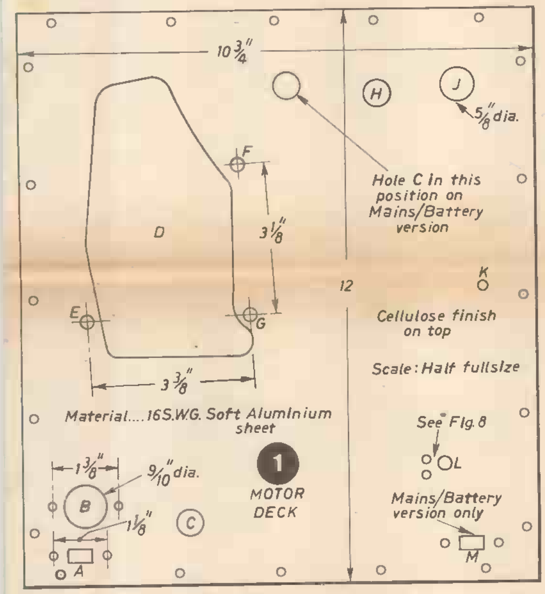
7 PICK-UP NETWORKS



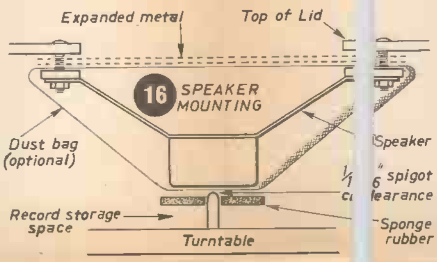
9 CONTROL MOUNTINGS



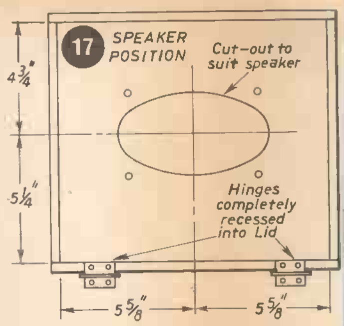
4 UNDERSIDE



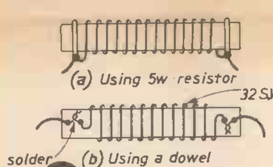
1 MOTOR DECK



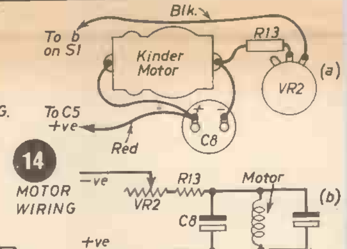
16 SPEAKER MOUNTING



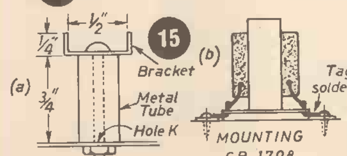
17 SPEAKER POSITION



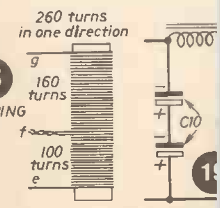
10 MAKING R_1



14 MOTOR WIRING

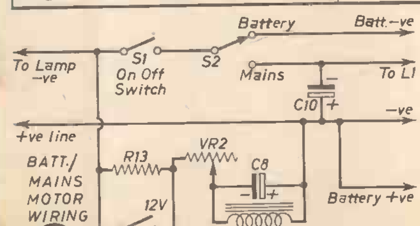


15 P/U REST

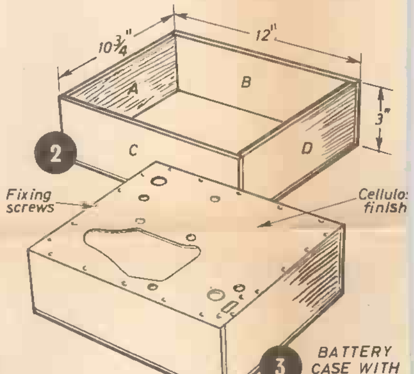


13 TAPPING TR_2

ALTERN... SMOOT...

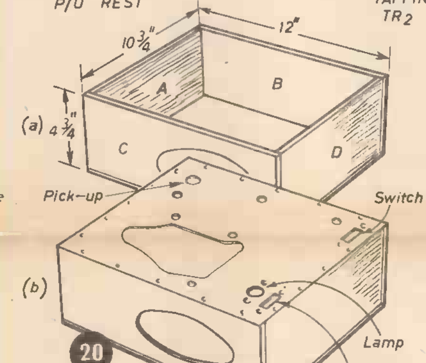


25 BATT./MAINS MOTOR WIRING

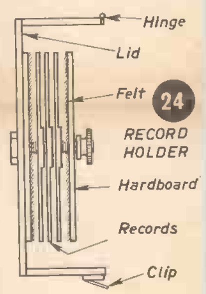


2

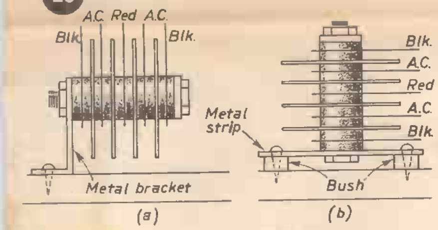
3 BATTERY CASE WITH MOTOR DECK



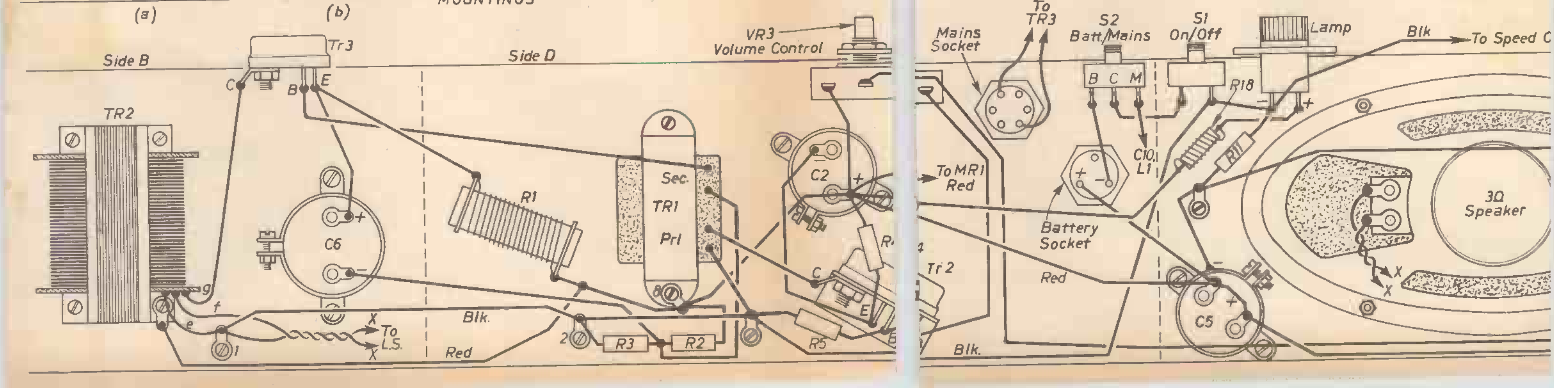
20 BATT./MAINS CASE WITH MOTOR DECK



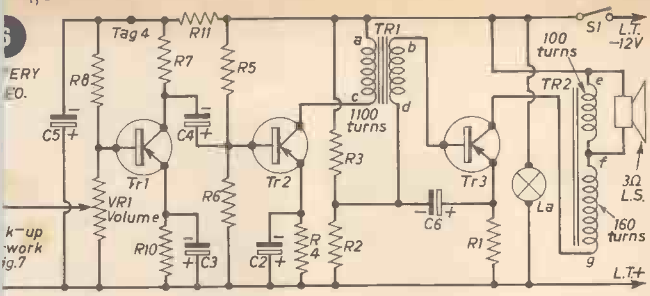
24 RECORD HOLDER

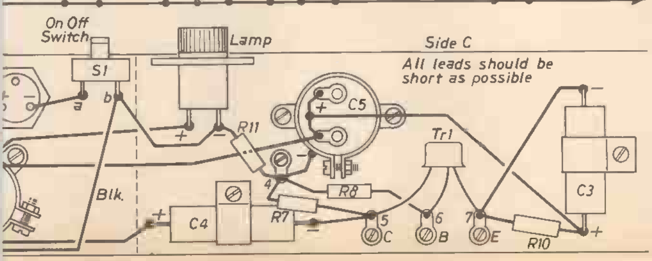


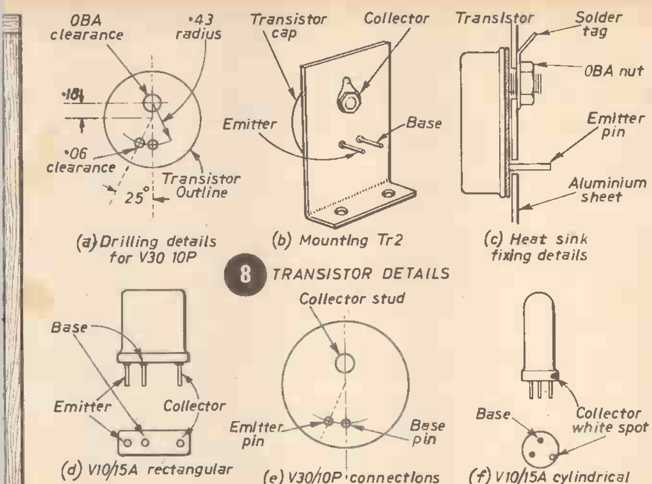
22 RECTIFIER MOUNTINGS



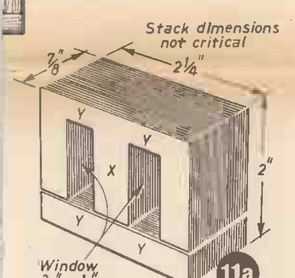
A3



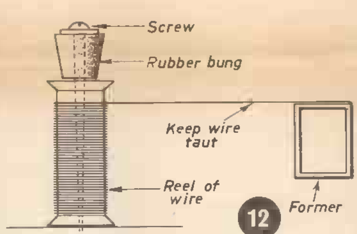




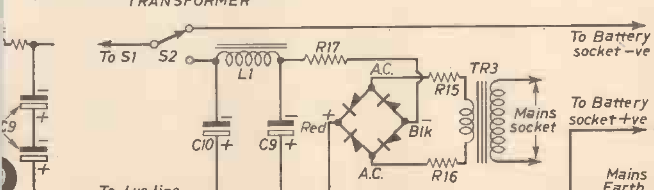
8 TRANSISTOR DETAILS



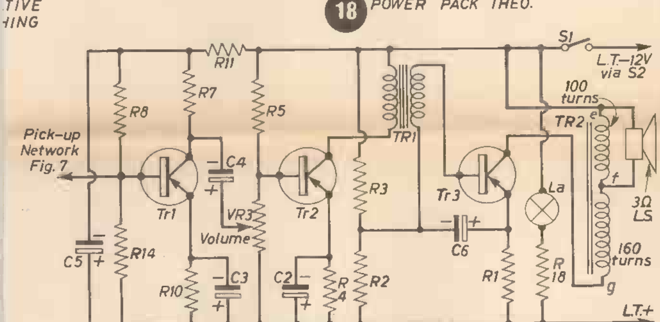
11a TRANSFORMER



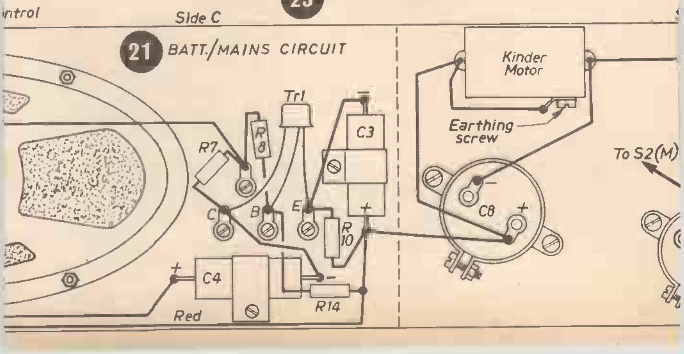
12 WINDING TRANSFORMER



18 POWER PACK THEO.



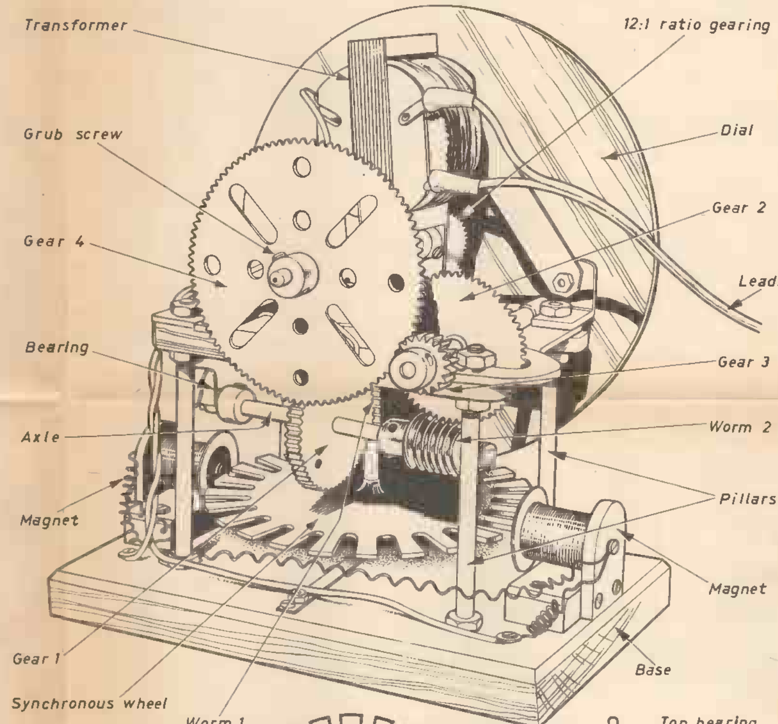
23 MAINS THEO.



21 BATT./MAINS CIRCUIT

A4

Compact Skeleton Synchro-Clock



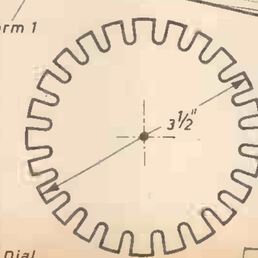
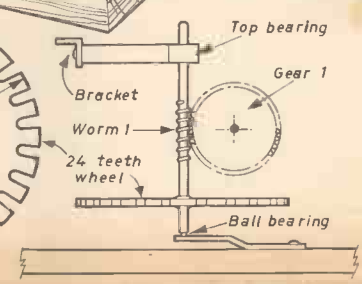
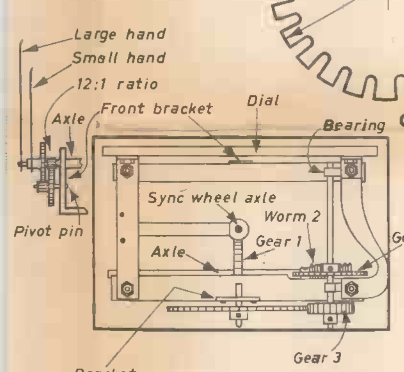


FIG 1 SYNCHRONOUS WHEEL





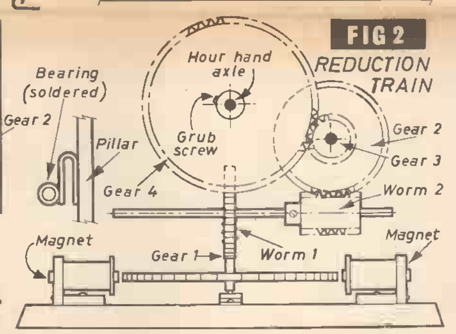


FIG 2 REDUCTION TRAIN

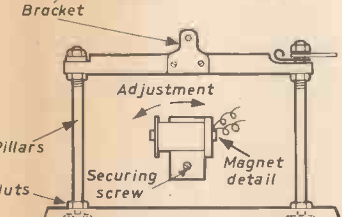


FIG 3 SKELETON FRAME

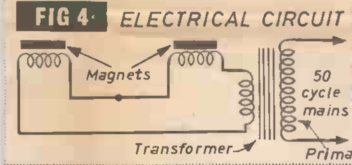


FIG 4 ELECTRICAL CIRCUIT

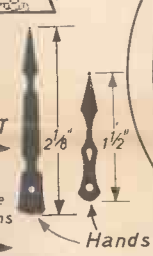
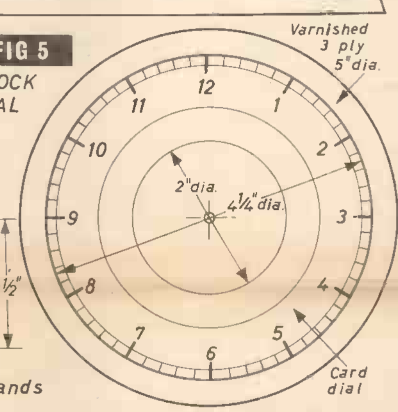
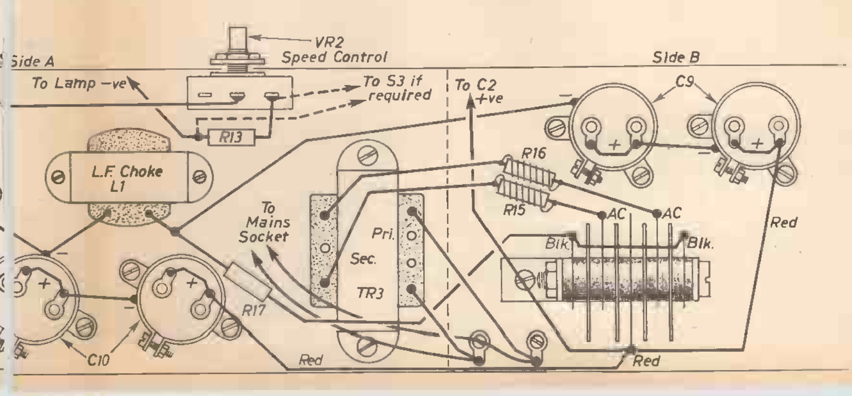


FIG 5 CLOCK DIAL





PM 3 IN 1 BLUEPRINT

BATTERY/MAINS RE

Ideal for the Family Picnic

(Above) Battery version and (below) battery/mains model.

TWO prototypes were constructed, one to work off a 12V. car battery or, after modification, 6V., and another to work off a car battery or the mains. There is no conventional chassis, and the motor deck is the output transistor heat sink, so amplifier and motor box are made up first and fitted with the correctly drilled motor deck, followed by the components. After test the motor box is cleaned up and fitted with hinged lid, catch, etc.

Motor and Amplifier Box

Using ⅜in. thick deal, make the sides as shown in Fig. 2 and prepare the 12in. × 10⅜in. hardboard base. Panel pins are used. The motor deck is made the same size as the base from soft 16 g. aluminium sheet. It is drilled as in Fig. 1, using carpenter's drills. Hole D must be large enough to take the TU9 unit without touching the *blackened* aluminium sheet when grommets are fitted into the fixing holes E, F and G. Ensure that the speed control does not foul the sheet. Do not mount the motor permanently yet. Check the components in their holes as follows:

B. SL82/1/3 Dial lamp assembly.
A. S.645 slide switch.
C. Insulated mounting for Volume Control (Fig. 9).
H. Insulated mounting for Motor Speed Control as for C.
J. Grommet hole for B.S.R. " Ful-Fi " pick-up assembly.
K. Special pick-up holder to be described.
L. V30/10 p. Transistor, see Fig. 8c.

Countersink the holes round the edge of the panel and mount it on the box (Fig. 3).

Mounting the Components

Woodscrews are used mainly for this. The motor deck must not be in electrical contact with *anything* as it is directly connected to the collector of the output transistor. It is not the usual earth. To each component attach a soldering tag and a red pos. lead and connect them all together in lieu of a normal chassis or earth. The electrolytic capacitors usually require different treatment. The position of the components can be judged from Figs. 4 and 5. Keep the laminations of one transformer completely at right angles to the other.

The Electrolytic Capacitors

The double 3,000μF. 6V. working are available from Messrs. R. S. C. Ltd., 29 Moorfield Road, Leeds 12 and the rather more bulky ones from Messrs. Technical Trading Co., 250 Fratton Road, Portsmouth or from Messrs. Radio Clearance Ltd., 27 Tottenham Court Road, London, W. Fixing clips should be obtained at the time of ordering.

If the solder tag on the can is negative, a wire must be fixed before the can is placed in the clip and fixed down. Where double 3,000μF condensers are used the two tags are joined together (Fig. 5).

The battery model

Resistor R1

This is made by winding 350cm. of 32 g. enamelled copper wire on to a 5W. carbon resistor of any value larger than 10 ohms. A wooden pencil might also be used (Fig. 10). The wire is layer wound and soldered to the wire ends or taken through slots or drilled holes in the case of a pencil.

Resistors 2 and 3
If difficult to obtain these could be made up on ½W. resistors in the same way as R1. Forty-six

CORD PLAYER

s.w.g. Eureka is most suitable, but alternatives are given below:

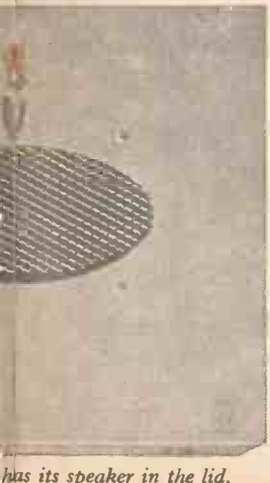
Resistance Wire Chart

s.w.g. (Eureka)	46	40	38
cms. of wire for R2	3·7	13·4	22·8
cms. for R3	30·5	120	190

The Volume Control
A standard control is insulated from the motor deck, using three fibre washers (Fig. 9). The smaller one fits in the hole C of Fig. 1, if it is thicker than the sheet rub it down on glass paper. When mounted test for isolation. Note that the tags do not touch the motor board. If hum is present " earth " the metal casing of VR1 to the pos. line (red).

Transistors
Tr.2 is only used at a fraction of its power rating, to withstand high ambient temperature.
Tr.3 is mounted directly on the panel and is visible near the pick-up head. The two small pins must not, however, contact the metal panel. Tr.2 is mounted as in Fig. 8b in the approximate position of Fig. 5. Always fix *firmly* to heat sink *before* soldering.

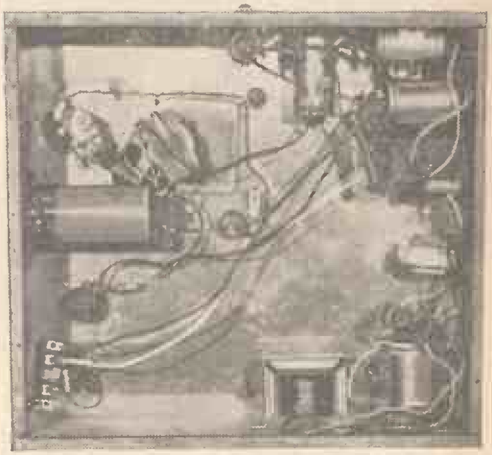
The Driver Transformer (TR.1)
Any normal type output transformer is stripped to give a stack something like Fig. 11. If a former is removed intact it is used. If not then the part of the stack marked X is covered with paper, then covered with paper saturated with Perspex type cement, allowed to dry and the whole lot slid off the stack. A temporary block of wood is fitted inside and the wire wound on. There is no need for end pieces.



...has its speaker in the lid.

One hundred and seventy turns of 28 g. enamelled silk covered copper wire (obtainable from Messrs. Post Radio Supplies, 33 Bourne Gardens, E.4) are wound on leaving 6in. at each end for connections. One thousand four hundred turns of 36 g. enamelled silk covered copper wire are then wound on. It may be easier to do this if a layer or two of transparent adhesive tape is placed over the first winding. A suggested method of winding is shown in Fig. 12.

If a break occurs scrape and solder the join, cover in transparent tape and continue winding. When completed the former is slid on the stack over " X " of Fig. 11. If no former is used cover the four portions marked " Y " with transparent tape to stop the wire touching the laminations. Refit as in Fig. 21.



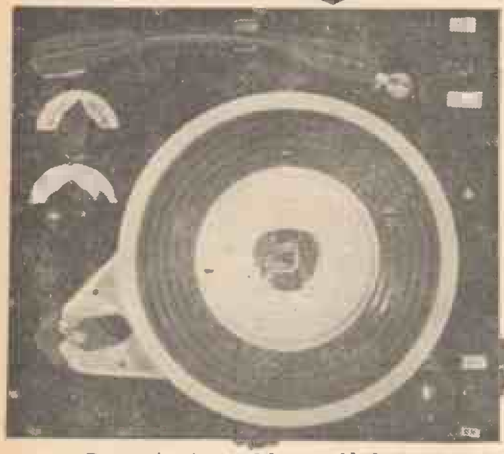
Two views of the battery version wiring.

Output Transformer (TR.2)
Make up as Tr.1, but use a larger mains transformer stack. Use 260 turns of enamelled copper 20 g. A tapping is made as shown in Fig. 13. The wire is looped to make the tapping, and the loop must not be cut when wiring up. Tap after 160 turns. When completed check that there is no connection between the windings and the laminations and that there is a direct connection between the two ends of the coil. When wired the speaker may connect to either end and the centre tap.

Wiring
Those who can read the theoretical circuit (Fig. 6) should use it to wire up the unit. The wiring *position* is not critical, but the shortest possible lead from one place to another should be used. The solder tags 1, 2 and 3 of Fig. 5 are all wired together with a black wire and form the main H.T. line (neg.) which is in the switched circuit.

Tag 4 of Fig. 5 is equivalent to the dot to the left of R11 in Fig. 6. It is the decoupled H.T. supply point for Tr.1.

When the wiring is done copy out the theoretical circuit and then ink it in carefully as each part is checked. Note in particular correct polarity of



Battery/mains model turntable layout.

electrolytics and reading of the transistor coding for emitter and base in the power types and for collector and emitter in the audio one (Fig. 8).

Testing the Amplifier

Wire up to a 12V. supply of dry cells or lead acid cells. On connecting, or switching on a loud click should be heard from the speaker. Touch the base of Tr.1 with a piece of metal held in the hand. Loud clicks should be heard and if mains is wired on in the house loud humming should result.

If a meter is available place it on 1A. range in the main positive lead to the battery and remove the warning lamp. The battery drain will be about 1A. depending on the actual voltage of the battery. Resistor R3 is very critical and is the controlling factor on the standing current drain Tr.3, and although the value stated is very satisfactory some readers may like to alter its value by a few ohms at a time, i.e. to get minimum drain when using dry batteries.

If a pick-up is available connect it directly to the red lead and through a 0·1μF condenser to the slider of VR1. Try out on a record; do not worry at this stage about some distortion as the pick-up may not be compensated. Volume should be more than is comfortable in a normal living room.

The amplifier is made to work safely off voltages from 6 to 15 in high ambient temperatures.

Some of the wiring of the battery/mains model.

Pick-up Network

The network of Fig. 7 a or b may be used, the former giving most volume, the latter better quality.

Motor Mounting

Grommets or fibre washers as for VR1 are fitted into the holes E, F and G of Fig. 1. Use nuts, bolts and washers to bolt the motor in position. Check that there is no connection between the motor's metal mountings and the blackened aluminium sheet. Wobble the motor about a bit and make sure no short can occur.

The maker's copper earthing ribbon from the motor itself to the mounting metal must be kept in place, but the screw used (a self tapper) may need shortening to stop it shorting on to the aluminium sheet.

Wiring up the Motor

The circuit is given in Fig. 14. For operation on 6V., R13 is not required and VR2 could, but need not, be dispensed with. C8 is very necessary and should be wired with short leads. It may be necessary to wire another condenser in parallel to cut out all motor "crackle," as in Fig. 14b.

On 6V. operation, once set, the additive speed control will probably not have to be reset for 33 or 78 records, but for 12V. operation more resistance must be in circuit on 33's compared to 78's.

Motor Consumption

The maker's figures for consumption are: 78's, 55mA.; 45's, 48mA., and 33's, 44mA. If consumption is a little higher than stated R13 may have to be reduced by about 10Ω to get sufficient speed on 78's and conversely if a motor draws slightly less current R13 may have to be increased slightly to run the motor slow enough on 33's.

The Pick-up

This is mounted in hole "J" on Fig. 1; a large split grommet is used and the nut is not done up dead tight so that there is plenty of play on the pivot arm. A small rest bracket (Fig. 15) is made as the one supplied is too tall.

Wiring is shown in Fig. 7 a and b and should present no difficulty. Screened lead is not necessary. If headphones are connected to the leads of Fig. 7a or b and the pick-up stylus gently touched, scratching should be heard, or if placed on a record the music should be heard. If not, the cartridge is damaged or R9 or R12 is faulty.

Speaker Enclosure and Lid

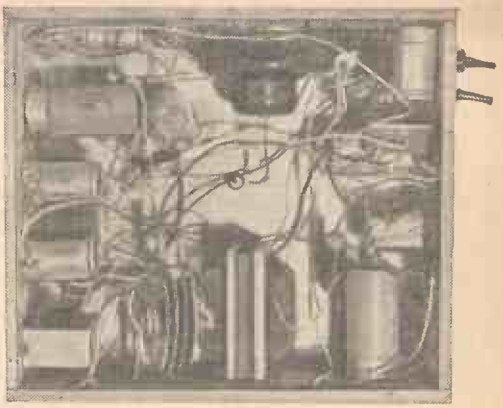
This is made in the same manner as the amplifier box except that it is 4in. deep instead of 3in. With other speakers this dimension could be further modified.

The top is made of ordinary hardboard, shaped as in Fig. 17.

The speaker mounting is shown in Fig. 16. The grill of expanded iron or steel is obtainable from Messrs. Clyne Radio. Small brass hinges are

PARTS REQUIRED

Transistors 2 and 3: Goldtop V10/15A were used in prototypes. V10/30A would probably give higher gain. GET 8 would also probably suit.
Transistor 1: Goldtop V30/10P in the prototypes. V30/20P would probably give higher gain and GET 5 would probably suit.
Motor and Turntable: B.S.R. TU9 four speed turntable unit for 6V. D.C. This motor has a governor incorporated, order through any dealer or consult the makers Messrs. Birmingham Sound Reproducers Ltd., Monarch Works, Old Hill, Staffs for details of stockists.
Battery Input Plug and Socket: Bulgin P360, male and female, obtainable from dealers or Messrs. A. F. Bulgin Ltd., Barking, Essex.
Pick-up: Any high output crystal pick-up is suitable. Prototype used B.S.R. " Ful-Fi " as normally supplied with TU9 unit.
Resistors: All quarter watt unless otherwise stated.
R1. This is home-made. See Fig. 10.
R2. 6Ω. This can be home-made, see text. 1W.
R3. 50Ω. This can be home-made, see text. 3W. plus.
R4. 100Ω.
R5. 4·7K is quite suitable, but experiment can be made down to 1K. A suitable collector current for Tr.2 would be 20 to 40 mA and is controlled by the value of R5.
R6. 1K.
R7. 3·3K.
R8. 47K.
R9. Simple circuit Fig. 7a. 1M. Fig. 7c. 100K.
R10. 470Ω.
R11. 470Ω.
R12. 2M (not required with circuit of Fig. 7a).
R13. See text. Not required on 6V.
VR1. Volume Control. Standard Size. 5000Ω.
VR2. Speed control where voltage is likely to vary over wide limits. See text. Usually any value between 100 and 500Ω will suit. Standard size wire wound potentiometer is suitable.
Condensers: Unless otherwise stated. electrolytic. The first value given is the value used in the prototypes, the second the smallest capacity likely to be suitable. Given in case readers wish to make the amplifier in miniature form.
C1 and C2. 6,000μF. 6V.—100μF.
C3. 100μF. 6V.—25μF.
C4. 100μF. 6V.—25μF.
C5. 6000μF. 6V. was used in both prototypes and no failure occurred, but for perfect safety the working voltage should be 12V. Values down to 200μF. should be quite satisfactory.
C6. 6000μF. 6V.—1000μF.
C7. Fig. 7a. 300pF. to 1000pF. The lower value will give more treble and volume. Try 300 first. Mica or ceramic. Fig. 7b. 300pF. Mica or ceramic.
C8. 6000μF (suppressor for motor) 6V.—1000μF. 6V.
Warning Lamp: Arcolectric SL/82/1/3 from dealers or in case of difficulty from Messrs. Arcolectric Switches, Central Avenue, West Molesey, Surrey. Use low wattage lamp, 12V., M.E.S.
Slide ON/OFF Switch: Arcolectric Thumb Slide S.645. Single pole front mounting.
Driver Transformer: Home-made and commercial types are equally satisfactory. The ratio should be about 7 or 8 to 1. The primary inductance about 2 Henries. Primary turns resistance as low as possible.
Lasky's Radio, 207 Edgware Road, London, W.2, market a suitable transformer GB.1708 (Fig. 5). The turns ratio appears to be 7½ to 1, the primary resistance 100Ω and inductance 1·2 Henries approx.
The home-made one described has a primary resistance of 80Ω and an inductance of 1½ Henries.
Output Transformer: An auto transformer is quite suitable. A ratio of between 2 and 3 to 1 is required.
The primary inductance should be about 100μH. The primary resistance must be as low as possible, even under 1Ω.
Lasky's market one (Fig. 21) which works well (GB1707) although the primary D.C. resistance is rather high. One winding of 29Ω (red wire) is not used. D.C. resistance would appear to be rather over 2Ω. Inductance is 160μH. Ratio is about 2¼ : 1.
The home-made one described has a D.C. resistance of 0·9Ω and the primary inductance is 100μH.
Prototype 1 uses " Lasky's " and Prototype 2 uses home-made transformers to show methods of connection (Figs. 5 and 21).
Fuses: (Not shown in circuits.) Small glass types blowing at about 1½A. (make sure they hold when switching on) would probably protect the big transistors, but not the first (V30/10P) against accidental connection to reversed battery voltage.
Speaker: Any 3Ω type with a permanent magnet that will fit. Prototypes use 6 or 7in. ellipticals.



Battery/mains model component layout.

recessed as in Fig. 17; the recesses in the lid are twice the hinge depth.

A small length of fine cord is used to stop the lid opening too far, or a conventional lever type stop could be used, but remember the aluminium plate is part of the live circuit.

Finishing Off

Attaché type clips can be fitted (obtainable in packets from do-it-yourself stores), a leather carrying handle, and a coat or to of gloss paint, stuck on plastic, or leatherette will give the unit a professional touch. If the unit is to be used actually *in* a car cover the hinges with a little plastic material to avoid a short if they touch the car's metalwork.

Record Storage

Refer to Fig. 16. If the speaker has been correctly positioned (Fig. 17) the magnet will just rest over, but not touch the motor spigot. About four 45 r.p.m. records may be placed on the turntable with a small rubber pad above.

Battery Leads

Large coloured crocodile clips may be used. Colour also the battery lugs. WRONG CONNECTION will certainly damage the output transistor and possibly the others. If a plug is fitted on the dash-board or under the running board (for picnic use) make it a non-reversible type, i.e. three pin without

(Below) Positioning transformer, rectifier, etc.

RECORD PLAYERS

using the third pin. Do not let the metal panel of the unit touch a metal part of the vehicle when in use.

Mains/Battery Version

The basic circuit remains the same (Fig. 23), but the position of some of the components has to be modified to allow the speaker to be fixed inside the cabinet. In addition there is a transformer with full-wave rectifier and a simple smoothing circuit to provide about 12V. D.C. when the car or motor-cycle battery is not available. A two-way switch is used to switch the unit to whichever supply is used; special non-interchangeable plugs are used so that the mains cannot be plugged into the battery operating leads. Ventilation holes for the rectifier are drilled in the base.

The Amplifier Box

This is shown in Fig. 20a. Construction is similar to the box for the battery only unit, but deeper. Cut the speaker oval before assembly. The motor deck is exactly as previously detailed and shown in Fig. 1. The additional hole " M " is required to take the battery/mains switch.

PARTS REQUIRED FOR MAINS/BATTERY VERSION

All parts are as for the battery only model except:

C9 and C10. These are very large 12V. working electrolytic capacitors. If difficult to obtain, wire two 6V. 6000μF. types in series.

L1. Smoothing Inductance. A home-made choke wound with 4oz. of 20g. enamelled copper wire on a stack from an old standard speaker transformer. The inductance should be at least 50mh. and the resistance under 1Ω.

MR1. Any metal full wave rectifier bridge giving 2½A. plus at 12V. will suit. Prototype used Selenium type from R.S.C. (Leeds) Ltd. Good ventilation is necessary and it is well to over-rate the rectifier, or cut large ventilation holes.

TR.3. A small battery charger type is required. Output should be about 15V. at 1½A. or more. Obtainable from Messrs. Radio Supply Co., 29 Moorfield Road, Leeds 12. It is wired permanently for 240V. the other tappings are not required.

S2. Any single pole change over switch would suit. Prototype uses Arcolectric T220 thumb slide switch.

Mains Connection Plug

It is vitally important that the leads used for battery operation cannot be plugged into the mains. Use Bulgin plug and socket P194 which is similar to the P360, but not interchangeable with it.

R14. 4·7K. fitted in lieu of VR1.

VR3 fitted in lieu of R6. Value 5K, wire wound.

R15 and 16. 0·5 or 1Ω, 2W. 6in. of 26g Eureka will suit.

R17. See text.

R18. 15 to 20, Ω3W. or use 24V. warning lamp.

Mounting the Components

Layout is not critical, provided the transformers and choke are all well separated or at right angles to each other no troubles will arise. The metal rectifier is mounted so that air can circulate, two methods of mounting are shown in Fig. 22. General mounting positions are shown in Fig. 21. Note that C9 and C10 have been replaced by four 6V. condensers which are easier to obtain (see Figs. 18 and 19 and components list). Either home-made or commercial transformers obtainable from Messrs. Lasky's may be used. Note the new position of the volume control.

Wiring

Wire the amplifier alone first. This should be tested and the motor and suppressor condenser, speed control and R13 (if required) added. The unit should then be tested again. The complete rectifier and smoothing unit is then wired in and the unit tested for mains operation. Use red and black wires for main D.C. supply all through the unit (see Fig. 21).

In the rectifier/smoothing unit, R17 should be adjusted to give 12V. final output; generally a value of about 1Ω will suit. The unit will work without it. C10 may be doubled in capacity by fitting another similar condenser in parallel if required. The rectifier must never get hotter than 65 deg. F. R15 and 16 may be made in the same way as resistor R1 but using about 6in. to 8in. of 26 g. Eureka resistance wire on a ½W. resistor.

Operation on Mains

Mains is plugged in via socket P194. S2 is put to " Mains " and the amplifier and motor switched on by S1. Speed control is set (once the place is known it can be marked).

Operation on 12V. D.C. and 6V. D.C.

D.C. from car battery is fed in via plug P360. The leads should be clearly marked RED and BLACK and there should be no possibility of wrong connection, even of a momentary nature. Large crocodile clips clearly labelled will do, or better still fit a P360 on the dash-board of the car and wire it correctly to the battery.

The best way to obtain universal operation on 6V. or 240V. is to make Tr.3 an 8V. transformer in lieu of 15. Omit R13 and adjust " R " of Fig. 18 for about 6·6V. across C10 on load. The unit will then deliver at reduced volume on both battery and mains.

6/12V./Mains Operation

This is not recommended as connection to 12V. when switched to 6 would be very serious for the motor unit.

However, if Tr.3 is kept at a 15V. type, all that is required is to have a switch across R13. With R13 shorted out unit works on 6V., with switch open on 12V. Thus universal operation is obtainable. The switch must NEVER be left in the 6V. position and MUST always be in the 12V. position for mains operation. See Fig. 25.

The unit will work from model train batteries but it is best to work the motor separately off a 6V. smaller battery to avoid motor interference. A large electrolytic fitted across the battery may help in this respect.

If the component values are altered to the specification given below the consumption will be only about 200mA. with, of course, less volume. The parts are as in Fig. 6, the following values being substituted:

R2, 40Ω	R8, 33K.
R3, 450Ω	R10, 4·7K.
R4, 100Ω	R11, 47K.
R5, 4,700Ω	VR1, 50K.
R7, 5,000Ω	

Tr.2 may be wound with 26 g. enamelled wire tapped at 80, 100 and 220 turns with a total of about 500 turns. This gives rather a high resistance and consumption is limited. The speaker is connected to any two tappings by experiment.

A Darkroom in your Loft

instead of having to make use of temporary accommodation.

by E. W. Summers, B.Sc.

MANY amateurs bemoan the fact that they have only makeshift darkrooms. Blacking-out a room is only one of the drawbacks to be encountered and the storage of equipment is usually a headache.

The answer, of course, is a room which can be used as a permanent darkroom. This is not always available but for many householders there is a space which is seldom thought of—and then only as a dim, dingy and dirty place: the loft.

There is no reason why the loft—or part of it—cannot be made habitable and the blacking out is almost complete already! True, there is no running water (unless the rising main is tapped) but then—contrary to popular belief—running water is not essential; just water.

The author's darkroom measures about 9ft. × 4ft. with a maximum ceiling height of 6ft. 6in. It is completely lightproof, well insulated, easily warmed and cooled—and clean. A printing session starts by taking up a bucket of water into the loft and setting out the enlarging lens, dishes and paper; it ends by putting away the lens, etc., and bringing down the bucket containing dishes, used developer and prints. The prints can then be washed and dried in the kitchen. Fig. 4 shows the lay-out of the darkroom.

Construction

The highest part of the loft is against the party wall (for a semi-detached house) between the chimney-breasts. This space was utilised, the floor being laid first consisting of a catwalk 2ft. wide leading to it from the loft door and then an actual working area of not more than 50 sq. ft. The more compact the room is the easier it is to reach things when sitting down. Stout flooring was the aim and this is most easily achieved by using 1in. planed boards butted together and screwed down to the joists. The latter run parallel to the wall which forms one side of the darkroom and the boards end flush with one of the joists. Uprights of 3in. × 1½in. timber were screwed to this joist and also at the top to the roof beams, packing where necessary to ensure that they were vertical. The spacing of the uprights should be planned to utilise best the sizes of hardboard sheeting to be used for the walls. The author was able to use 4ft. × 4ft. but the size of the loft door opening is the governing factor: the diagonal should be measured, 3ft. 6in. being about the minimum for getting a bowed 4ft. sheet through. Cross battens of any available timber were secured to the uprights, strengthening with corner brackets where required. Other uprights were fixed to the brick wall to make supports for the hardboard forming the shorter walls and two uprights were also erected—in this case at one corner—as supports for the darkroom door. Fig. 3 shows the outside of one of the walls.

The Benches

Before screwing on or pinning the hardboard to

Fig. 1 (Top of the page).—A corner of the darkroom before decoration.

Fig. 2 (Left).—The light fitting in the ceiling with pull-switch.

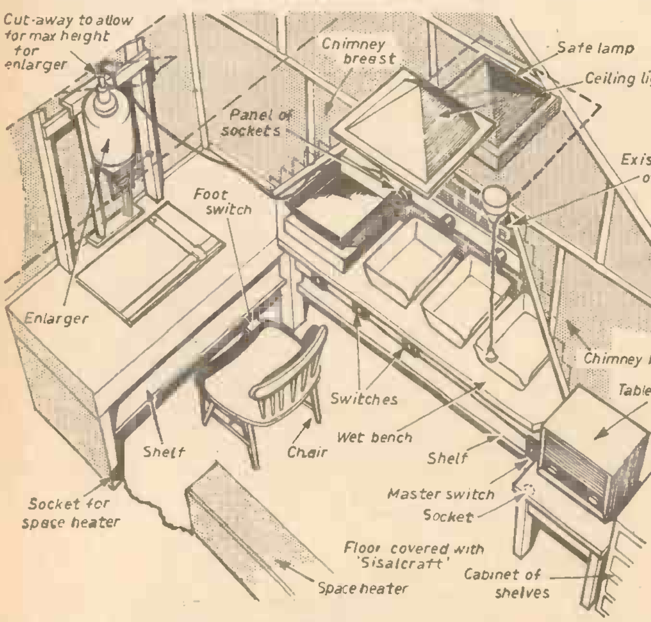
Fig. 3 (Right).—The interior of the loft showing the outside of one of the darkroom walls.

its battens it is as well to install any permanent fixtures. The enlarger bench and "wet" bench should be separate and can conveniently be at right angles, the latter being half under the chimney-breasts. Fig. 1 shows these two benches. Quite heavy timber should be used—especially for the enlarger bench—and small angle brackets screwed to walls and floor usually provide the necessary rigidity. A second-hand bench or table can often be used as "darkroom furniture." The tops of the benches need to be covered with an easily cleaned material.

Electrical Wiring

Before fixing the tops to the benches all electrical wiring was installed. As very little power is used (except for a space heater which runs from a separate supply) the house lighting circuit was tapped. This supply was brought in at a convenient point and a master switch used to control it. A 5A. fuse was fitted into the "line" lead in case of accidental shorting occurring in the darkroom equipment when the remainder of the house will not be plunged into darkness.

From the master switch a lead was taken to a junction box and then separate leads to as many switched sockets as required. In the darkroom



described these are for a safelight, dish heater, enlarger, enlarger/printer and a spare for fan or radio, etc.

Three-core cable was used for safety, the earth lead being taken to the rising water main.

The white light is used for general illumination and its supply by-passes the master switch. It is turned on from a switch close to the loft door but there is also a pull-switch in the darkroom itself. The only other point is 13A. for the space heater (in this case a 1·5kW. convection radiator), the lead for this coming from its own fuse box on the meter board. When fitting up the switched sockets it will be a great convenience if a pair of leads is taken from the switch controlling the enlarger and run to the foot of the enlarger bench. This provides for the installation of a foot-switch.

Having tested the wiring the bench tops were screwed down. The top of the enlarger bench is slightly higher than that on the other bench so that if a spillage of liquid occurs on the wet bench it will not run on to the "dry" one.

Fitting the Ceiling

The ceiling of the darkroom was then fitted. Hardboard was screwed to the rafters but, for economy of materials and on heating what is really wasted space, this need not be to the apex of the house roof. The top of the "triangle" was cut as shown, head clearance being about 6ft. 6in. This roof design also allows for a neat fitting of the general illumination light: a rectangular hole 10in. × 8in. cut in the ceiling to take a sheet of diffusing glass (the opal side of an old safelight serves admirably) which is supported by overlapping half-round beading pinned around the hole. A large wattage bulb was fitted vertically above the glass in a 45 deg. angled batten holder screwed to a rafter and surrounded with a reflector (foil-backed wrapping paper from a bromide paper packet) to concentrate the light. A

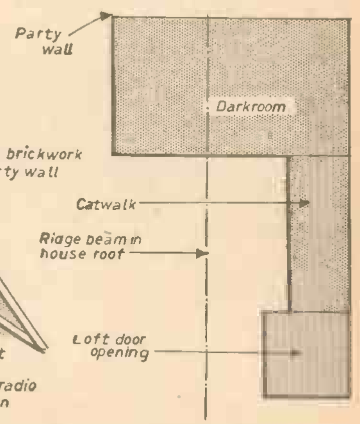


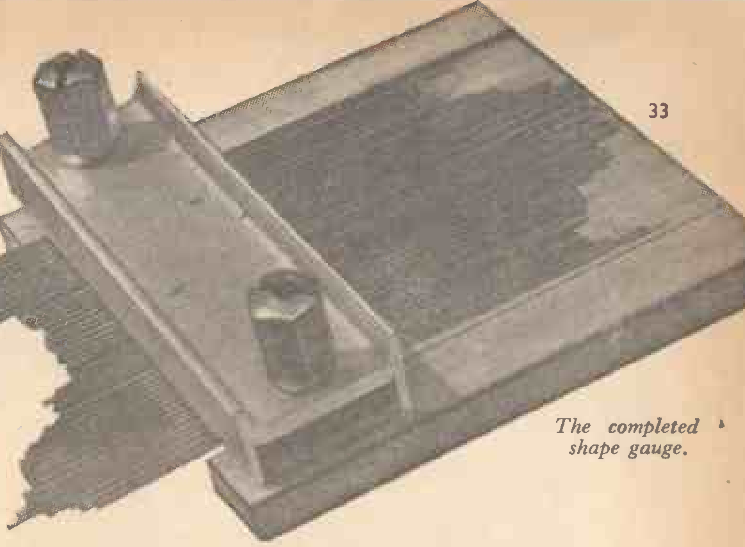
Fig. 4.—The lay-out of the darkroom.

pull-switch completes the fitting. (See Fig. 2.) The walls were now screwed into position and all the joins covered with half-round moulding, quadrant being used in the corners. The safe-light was fitted over the wet bench.

The door is also made from hardboard on a 1in. × $1\frac{1}{2}$in. frame with cross-strut, lap-joints being strong enough for this. A surround to the door of $1\frac{1}{4}$in. × $\frac{3}{8}$in. moulding ensures a snug fit which is lightproof. The interior of the darkroom was decorated quickly with emulsion paint—a light grey being preferred—and the walls and ceiling surrounding the enlarger were papered with matt black paper, although black emulsion paint would serve as well.

To avoid the possibility of spilled liquid penetrating the ceilings of the rooms below in the event of an accident the darkroom floor was covered with "Sisalcraft" paper which is water-repellent.

H. S. Ford says the amateur faced with a profiling job should make



The completed shape gauge.

A SHAPE GAUGE

THE shape gauge to be described is an instrument by means of which objects of irregular form can be quickly and accurately duplicated without actual measurement, and such shapes recorded on paper or other material. Where the matching of an immobile object is required the instrument can be invaluable. In particular, the cutting of linoleum around mouldings, shaped corners or recesses can be more accurately accomplished by even the unskilled worker (see Fig. 1).

The arrangement consists of a stout base plate (1), and a smaller clamping plate (3). Between these are sandwiched a number of exactly identical rods (2).

The clamping plate (3) is recessed on the underside, and is fitted with a pad of some frictionable material (4) which protrudes slightly and rests on the rod layer. At each end of the clamping plate is a clearance hole, and passing through each hole is a setscrew (5), these latter being firmly fixed in the bottom plate (1). Two nuts or wingnuts (6) allow the clamping plate to be tightened down, and as the name implies, clamps the layer of rods, and prevents them from further movements after their pre-arranged positions have been set.

In use the shape gauge is placed in close proximity to any irregular shaped surface that it is desired to duplicate (10), and the rods of the gauge pushed outwards, until the limit of movement to each and every rod is arrived at. The nuts, or wingnuts, on the clamping plate are then tightened, and the gauge removed. It will then be seen that the exact shape of the particular surface is formed, and this can then be transferred to paper, or other material, by means of pencil, or scriber, run along the shape formed by the projecting rods. The rods (2) can be made from medium gauge B.S. wire, brass wire or rod, or might be made of a rigid plastic material. These rods may be round or square section, and the fineness of the shape produced is governed by the gauge or section of rods used. The gauge can be made in various overall sizes.

The Base Plate

This has a slightly raised portion at each side, and at the rear end (11). This construction forms a trough or tray for the rods, and secures an even movement of the rods longitudinally. It is suggested that both base plate and clamping plate (3) be castings of a light alloy, both strong and rigid so that no bending of either is possible on tightening the clamping screws. Two plastic mouldings might be arranged if above conditions were satisfied.

It is suggested that a further top plate (7) might be added, covering a proportion of the rear end of the rods, but allowing the latter free movement longitudinally. This would assure that all the rods are at all times on a horizontal plane, and a tendency for the rods to overlap each other at the back prevented. There must, however, be a sufficient area of the rod layer exposed to allow the rods to be moved forward by hand, or by other external means. A rubber-surfaced block might be arranged to slide along the rod layer, giving a more positive grip and movement to the rods.

The plate (7) is secured to the side edges of the base plate by set screws (8). A knob (9) is convenient for gripping and positioning the shape gauge.

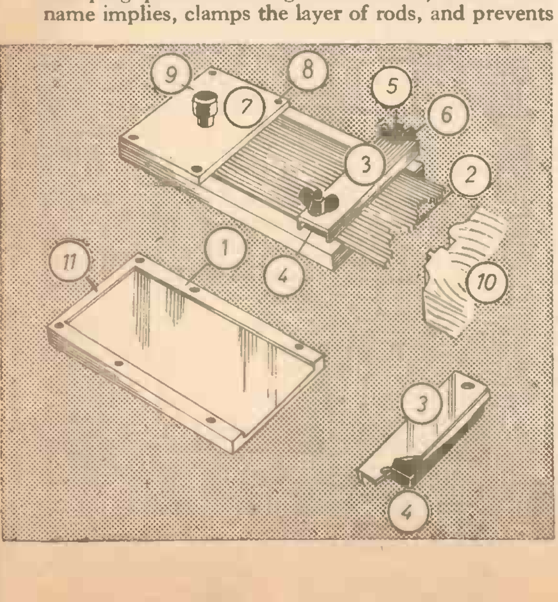


Fig. 1.—Details for making and using the shape gauge.

making a pantograph

A simple instrument for copying drawings to scale

by JAMESON ERROLL

FIG. 3 shows the instrument in action. The terminal " X " is fixed to the drawing-board or table; terminal " Y," which is pointed, is traced along the outlines of the picture to be reproduced; and terminal " Z " carries the pencil which traces the enlarged design on to the virgin paper. It is also possible to produce the design either to the same size as the original or smaller; this will be explained later.

The Bars

Fig. 2 furnishes details of the bars which form the main part of the instrument. They can be made of first-class quality fine-grained wood or of metal such as brass, copper or bright mild steel. Since they are not subjected to any great strain they can be quite thin provided they are rigid. If of wood, it should be about $\frac{1}{8}$in. to $\frac{9}{64}$in. thick, and if of metal 10 or 11 s.w.g. In either case it should be $\frac{3}{4}$in. wide. Three strips each 16in. long and one 9in. long are required. The ends should be neatly rounded and the flat surfaces finely glasspapered if of wood (use " Flour " grade as a final) and highly polished if of metal.

All the holes are made to accommodate terminals or their like having 4BA threads and should therefore be drilled with a $\frac{9}{64}$in. or No. 26 drill. While their distances apart are somewhat selective, they are not critical within a few thousandths of an inch *provided all four match perfectly*. It is therefore essential to clamp the pieces together carefully, in perfect alignment, and drill through the four in one operation. The holes must, of course, be central, and all centres should be accurately pointed with the aid of a fine marking awl and spring punch. First drill the two holes at the extreme ends then the centre one; the clamps may now be removed and 4 BA bolts passed through the holes and tightened with nuts—this will keep the four bars in a firm position while the remaining holes are bored.

The Controls

Four BA wireless terminals were used. Fig. 1 shows the six fittings needed. The pencil holder is easily adapted from the guide-tube of an old type variable wireless condenser. It will be found that the $\frac{3}{16}$in. hole which passes through the centre will just admit a small round section pencil as found in most pocket diaries. A 6 BA locking screw holds the pencil tightly in position at the required height. This pencil holder is marked " Z " in Fig. 3.

The pointer terminal needs no alteration except that the end of the shank is filed to a blunt point. Note that while this point must be on the fine side, since it is used to follow the lines of the original drawing, it must not be needle sharp or it will tear the paper. This pointer is marked " Y " in Fig. 3. The fixed terminal requires a little more adaptation and is really the blocks of two terminals threaded on one shank which, at its lower end, is filed as a wood screw. If this operation is found too difficult, the 4 BA thread may be left and a suitable threaded hole made in the drawing board to receive it. This terminal is marked " X " in Fig. 3.

The guide terminal is very similar to the pointer except that the shank is filed down considerably and finished with a smooth round end which should be finished with " flour " emery cloth and then highly polished. Its sole purpose is to keep the pantograph horizontally level and it *must* glide smoothly, neither making any mark nor offering any resistance. This is marked " V " in Fig. 3 and the two swivel terminals " W." These latter merely require the surplus shank to be cut off with a hacksaw. It will be under-

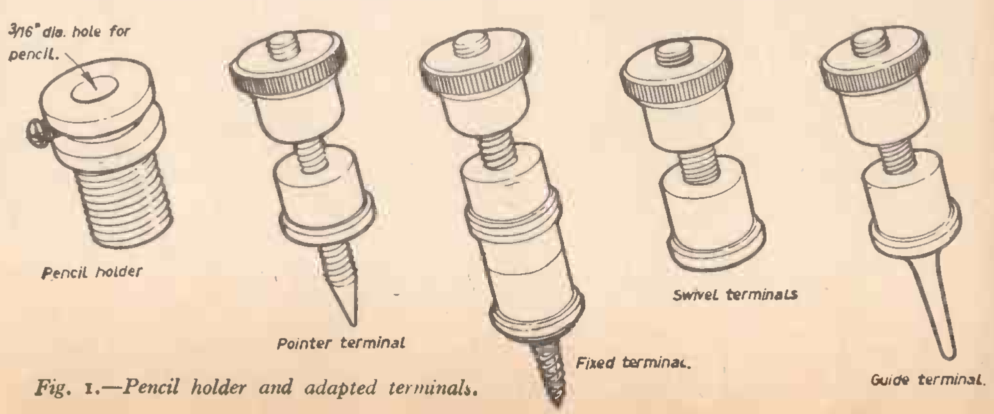


Fig. 1.—Pencil holder and adapted terminals.

stood that the lower portions of all these terminals are tight fits and that only the tops revolve by hand pressure on the milled edges; the bar or bars lie between the terminal heads and bases and are locked or loosened as required.

Enlarging

Having assembled the instrument as shown plainly in Fig. 3, you will have the fixed terminal bottom left and this is screwed near the bottom left corner of the drawing-board. The picture to be copied is now fastened with small drawing-pins to the board as shown, and adjacent to it is pinned the plain sheet of paper on to which the enlarged picture is to be traced. The size of this paper will naturally depend upon the degree of enlargement about to be made. If the swivel terminals are fitted in the holes marked "2" the finished drawing will be twice the size of the original; if in "3," three times the length and three times the breadth of the original, and so on up to eight times, which is the limit of this particular instrument. It could be made to execute greater enlargements but it covers a wide field as it is and greater enlargement would only be needed under exceptional circumstances.

The pointer will be the bottom centre terminal and the fitting lower right is the pencil holder in which the pencil is held at such a height that the pointer just skims the surface of the original. In action, the pointer is guided with the left hand and *the eye kept on the original drawing*. The tendency will be to follow the lines being made by the pencil, but this is fatal to accuracy—keep your eye on the pointer, the pencil will take care of itself. A very slight pressure on the pencil is retained with the right hand with, only now and then, a glance to see that it is marking well. Both swivel terminals, the guide terminal, and the pointer terminal (all of which engage with *two* bars) are kept as tight as possible consistent with freedom of movement. The fixed terminal and the pencil holder must be hand tight.

Drawing Same Size

If it is required to reproduce a design or picture of equal size the fixed terminal should be transferred to "Y" (Fig. 3) and the pointer to "X," the pencil holder remaining at "Z." The swivel terminals should be in No. 2.

Reducing

For reduction from the original, the pencil holder is moved to "Y" and the pointer to "Z." The swivel terminals are moved according to the reduction degree required.

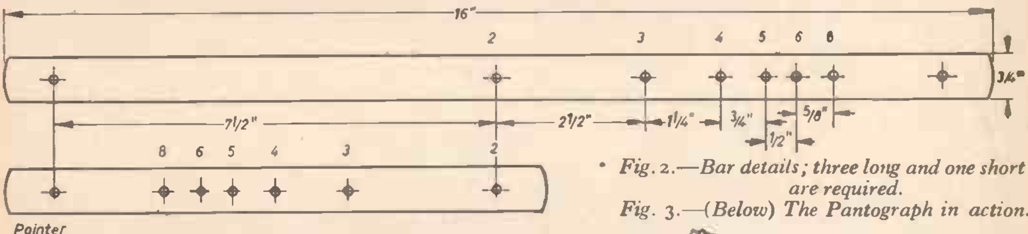
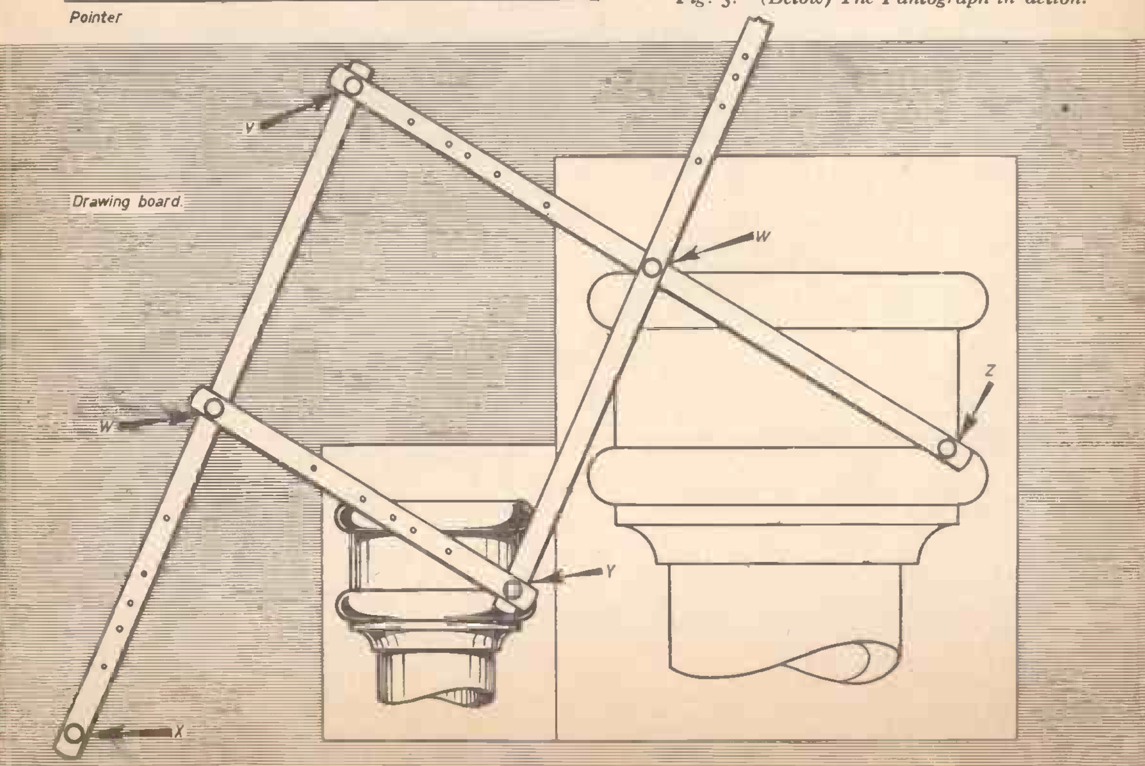


Fig. 2.—Bar details; three long and one short are required.

Fig. 3.—(Below) The Pantograph in action.



Part 8 in our Automatic House Series

IT is fairly easy to make door bolts or to work conventional door bolts by means of motors with limit switches or solenoids operated by push-buttons.

Solenoid Systems

Fig. 67 shows that if the switch is closed the bolt (soft iron) will be drawn into the solenoid by magnetism. A spring (not shown) or gravity is used to make it lock when the current is cut off.

Current is drawn all the time the bolt is in the off position, but if the bolt is chamfered it will lift itself on closing the door, and " lock in." Current is thus only needed at the instant of opening and a bell-type push switch is suitable. Microswitches can be used or two secret " brass screw contacts " can be shorted with a penny, etc.

Gravity Return System

The bolt may be fitted above the door on a beam or on the door at the bottom and thus the system is not suitable for tall doors unless two bolts are fitted, one on the top beam and one on the door bottom. The bolts fall under action of gravity and may be conventional door bolts with the handle removed and oiled for free action. If the bolts are " slotted " so that they cannot turn they may be chamfered so that they will " lift " when the door is closed. Otherwise current is used to lift the bolts as the door is closed. The circuit for two bolts operated by one switch will be as in Fig. 67 with the other coil connected to " B " and " A." Fig. 68 shows this type of door bolt.

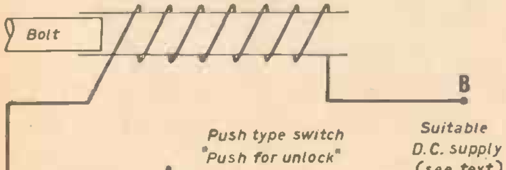
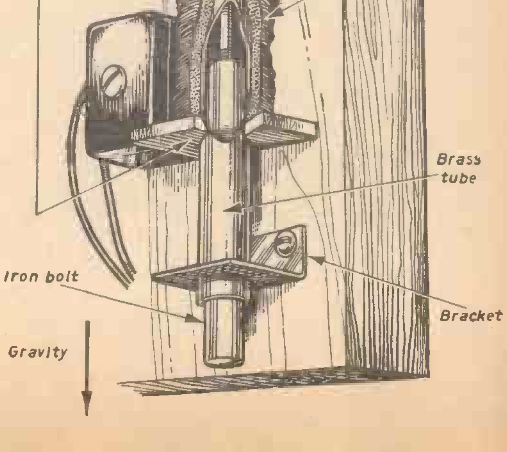


Fig. 67.—Circuit for single coil automatic door bolt.

Fig. 68.—(Right) Vertical automatic door bolt with gravity lock.

Construction

Use a purchased solenoid or wind one on a 3in. brass tube fitted with end washers. Insulate with transparent adhesive tape and wind on 8 oz. of 32 s.w.g. enamelled copper wire or according to the



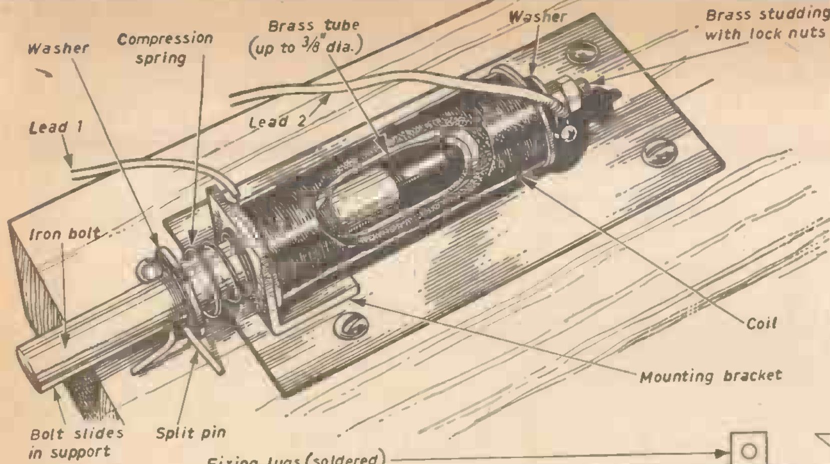
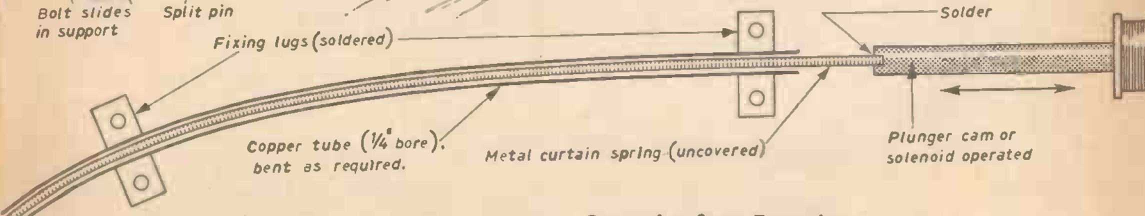


Fig. 69.—(Left) Auto-door bolt using direction indicator coil.

Fig. 70.—(Below) Remotely situated bolt.



voltage available. 24V. D.C. is suggested as suitable for most automatic equipment and a suitable power pack was described in the April 1960 issue. Power packs may be purchased ready made.

Broken indicator coils from car dumps are suitable and can be purchased cheaply. Those used on public service vehicles are for 24V., but short-period operation of the 12V. type on 24V. is permissible.

The bolt is of soft iron and must be larger than the bore of the solenoid interior. The bolt is then filed so that it fits in the solenoid about 1in. but will not go any further or a washer and split pin are fitted as in Fig. 69.

The bolt must then be arranged to pass through a clearance hole in a bracket firmly fixed so that any strain on the bolt is taken by the bracket and not the solenoid. (Fig. 68 and B. Fig. 71.)

The bolt will now fall out of the solenoid of its own accord and this must be prevented by soldering into the bolt a *brass* rod, preferably threaded, and fitted with a washer and two lock nuts. This is arranged to give a small ⅛in. approx. bolting action. The arrangement is clearly seen in Figs. 68 and 69.

Operation from Batteries

The bolts will operate from batteries if they will supply sufficient current; the batteries used for model trains are the most suitable. Failure of the battery will make the bolt "permanently locked" and secret spare terminals should be fitted in case this happened. Car batteries and some battery chargers will operate the bolts well.

Non-Gravity Operation

Fig. 69 shows a similar unit made to work horizontally. A small coil spring is fitted in lieu of "gravity" and the travel of the plunger is controlled by lock nuts as before.

Providing a source of good amperage is available one heavy duty switch can be made to bolt ALL doors in a house by wiring them all in parallel. Suitable fuses should be used in such a system as a short, with high amperage available, could cause a fire.

Operation Remotely from the Solenoid

In some locations there is no room for the solenoid near the door, and a sliding "push-pull" member of a flexible nature is required which can be led through a copper tube to the bolt proper.

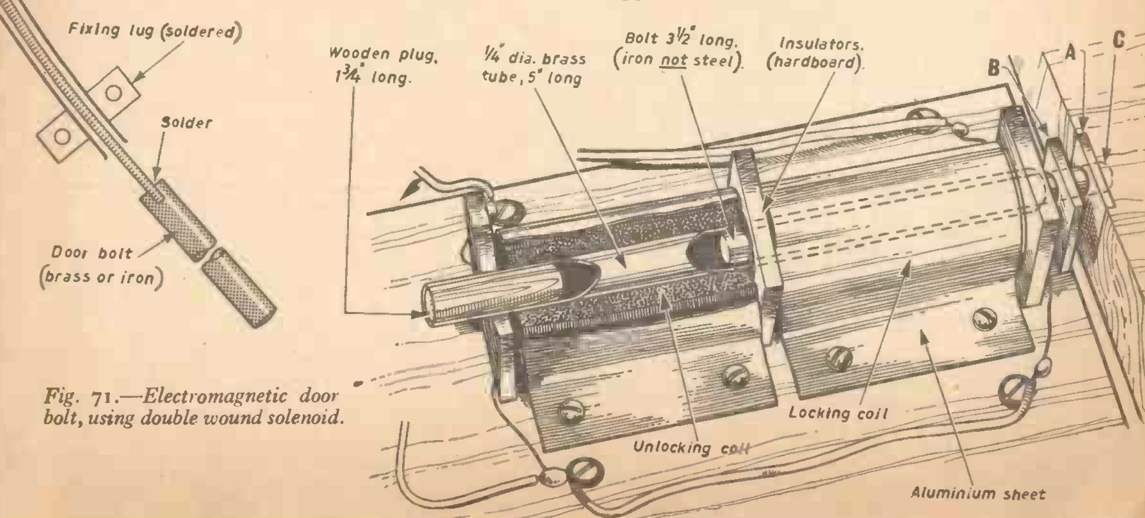
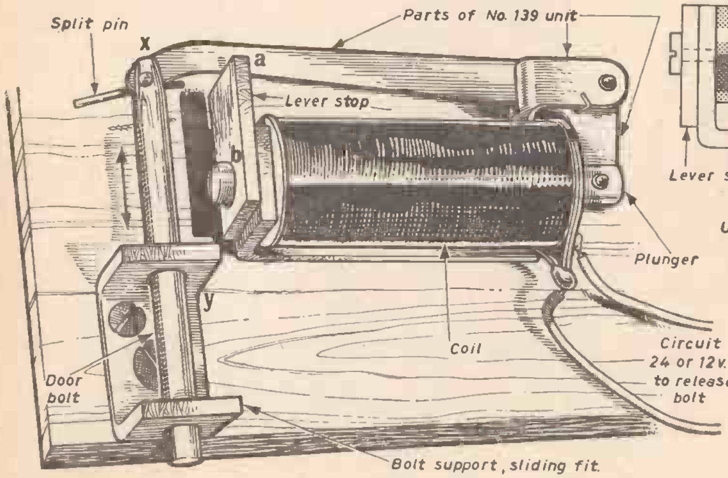
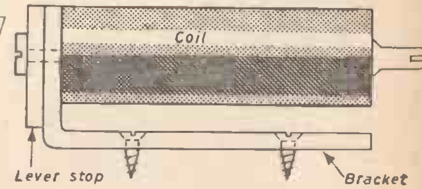


Fig. 71.—Electromagnetic door bolt, using double wound solenoid.





COIL FIXING
Using solenoid 10C/335 (Sallis No 139)

Fig. 72.—Lever operated door bolt using solenoid 10C/335 (Sallis No. 139. Franks No. 156).

Fig. 70 shows how this can be done with ordinary $\frac{1}{4}$in. bore copper tube and metal expander curtain wire of the non-plastic type. Flexible control leads could also be used and an old speedometer cable is suitable. Gravity-operated bolts cannot be used with this system unless aided by a light return spring.

Double Solenoid Automatic Bolts

This device is shown in Fig. 71 and two identical solenoids are wound side by side on the brass tube. Keep approximately to the dimensions shown.

In the model the bolt may be removed when locking of the door is not required, but a combination of this system with those already described may be employed if the bolt is to be permanently retained.

Two micro-type switches, bell pushes or sets of secret contacts are required as shown in Fig. 74. When one circuit is completed, the bolt is drawn to one end of the solenoid tube and thus can be shut or opened at will. The unit must be mounted horizontally and damping against vibrations may be produced by using a light grease or vaseline within the solenoid. A better system is to place a small Alnico or similar magnet in the slot where the bolt projection rests when the door is bolted (Fig. 75). The bolt is then firmly held until the solenoid is energised, the force within the solenoid will be much greater than that in the magnet.

Surplus Solenoid 10C/335 as a Door Bolt

This solenoid is for 12V. operation, but it will take 24V. for reasonable periods quite safely. It is very powerful and is easily adapted as shown in Fig. 72 for use as a door bolt. The bolt will open when the circuit is made (bell-type push), but the bolt may be fitted the other side of the long lever and then contact will lock the door (using current all the time) if a conventional switch is used.

There is a return spring within the solenoid, but if an additional spring is required to withdraw a stiffish bolt one may be fitted over the shaft between x and y (Fig. 72), a compression-type spring being required. The bolt will operate in any position.

For really strong operation of a bolt it is desirable to fit a stop for the lever in the form of a strip of $\frac{1}{8}$in.

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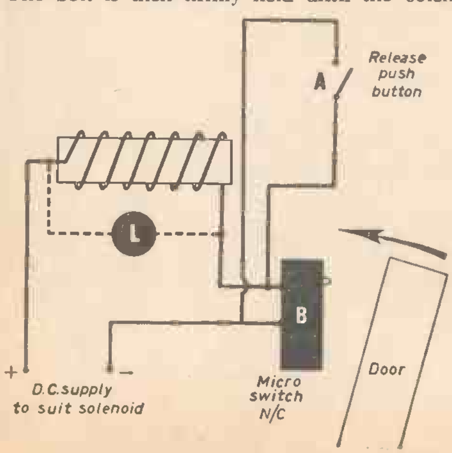
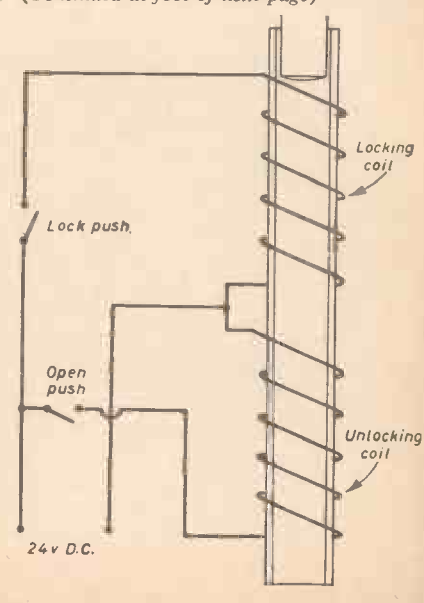


Fig. 73.—(Left) Circuit for automatic locking as door is closed (single solenoid systems).

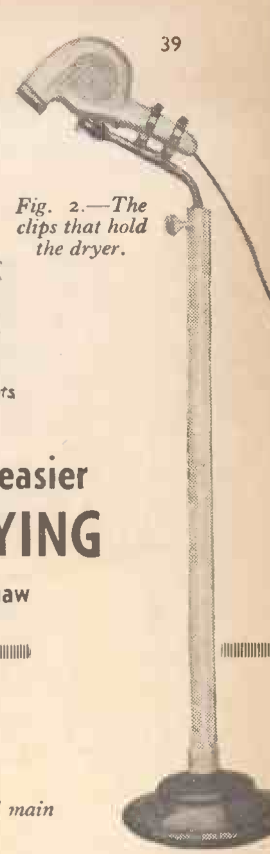
Fig. 74.—(Right) Wiring of electromagnetic double wound door bolt.



THIS stand was devised to enable the hair dryer to be used while leaving both hands free for sewing and knitting, etc. The cost of materials was approximately 12s. 6d. The base member is a Ford type wheel disc, obtained for 2s. 6d. at the local scrap dealers. It is weighted with a piece of mild steel plate, obtained at the same place. A 3ft. piece of ½in. iron, steam or water pipe is used for the main upright member and the adjustable member is a 3ft. piece of ½in. copper tube of the domestic plumbing type which makes a nice sliding fit in the main upright. These two pieces cost 3s. 6d. from the scrap dealers but could be purchased new from a plumbers merchant. Two Terry Spring clips (No. 80/5), hold this particular dryer quite firmly in position.

Fig. 2.—The clips that hold the dryer.

Fig. 1.—Details of the base and main upright member.



an aid to easier HAIR DRYING

By E. Blackshaw

Construction

The base is prepared first (Fig. 1). A hole is drilled in the true centre of the wheel disc to give clearance for ½in. BSP thread. A piece of wood is shaped to conform to the contour of disc and deep enough to make a tight fit between top of disc and steel weight. This is also drilled the same size as the disc. The weight is drilled and tapped ½in. BSP. The main upright member (Fig. 1) is threaded ½in. BSP for approximately 2½in. and a ½in. BSP socket screwed up to the end of the thread. Assemble as in Fig. 1.

The top of the iron tube where it receives the adjustable rod is chamfered off for neatness. Just below the top a hole is drilled and tapped $\frac{5}{16}$in. BSF and a nut of the same size brazed or welded over it to give greater depth of thread for a $\frac{5}{16}$in. BSF, thumb locking screw. The end of this screw is countersunk and filled with solder to prevent it scratching the copper tube. The copper tube is bent to an angle to suit the particular make of dryer used and the exposed open end of the tube covered with a chromium-plated domed-head nut screwed on a short piece of brass rod and sweated into the end of the tube. Just below the end a small rubber bush acts as a rest for the main body of the dryer.

Two Terry Spring clips No. 80/5 are riveted to a piece of brass or copper plate using the existing two holes in each clip. See Fig. 2. The plate is then brazed or bronze welded longitudinally by a fillet to the copper tube. The base is black enamelled and the upright smoothed down and enamelled cream, the copper being polished and left unpainted.

AUTOMATIC DOOR BOLTS

(*Continued from previous page*)

steel or brass exactly ⅞in. between centre of fixing bolt and edge of lever, see Fig. 72, a and b approximately marking the measuring points. 10C/335 is obtainable from Messrs. A. T. Sallis, Brighton.

The coils may be mounted in various ways. One way is shown in Fig. 71 where the coils are firmly clamped over a couple of layers of insulating tape with aluminium or brass sheet. Another is where small steel or brass brackets are soldered to the brass solenoid tube at one or both ends. (Fig. 68.)

Once the bolt is installed and is working properly a small wooden or metal box should be fixed over it and all wires firmly fixed down. Fuses should be fitted somewhere in the circuit or in the power pack (5A. is a suitable value).

Fig. 73 shows a system in which the bolt automatically "bolts" itself once a door is closed. The micro-switch must be fixed to the back of the door post so that it is operated just as the door finally closes. This opens the circuit and the bolt drops. Opening is done by another switch of the micro or push-type wired in parallel with the former one. This is depressed until the door is opened a few thousandths of an inch, the other switch then automatically takes over. Current is consumed as long as the door is open. A warning lamp of suitable voltage may be fitted across the coil, see dotted line in Fig. 73. Fit ball catches.

(*To be continued*)

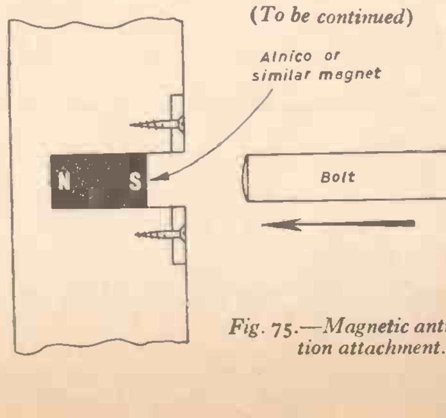


Fig. 75.—Magnetic anti-vibration attachment.

SAILING CANOE

(*Concluded from page 9*)

a 1in. or ¾in. thick × 6in. wide board with a hole in the centre of a diameter to suit the thickness of the mast (Photo 8). The bottom pin of the mast is fitted into a hole which is drilled into the spine.

Place the mast in position. Unroll the sail—which is kept rolled around the gaff and boom. Hold the gaff, push the tenon into position, pin and at the same time fix the gaff hook over the top mast pin. Insert the pin which will hold the boom to the mast. Fix a line by means of a spring hook to the end of the boom. This is your handline to control the sail. Secure all loose pins by means of a short length of thin chain to the mast.

Rudder

Fig. 7 shows all the parts you will need and also construction of the rudder. Photo 9 shows how it is fitted to the stern of the canoe. See that you make a good connection between cross-piece and back-batten; two screws are enough.

The hardboard rudder is cut to shape, fitted intc the slot of the back-batten and secured with two or three nuts and bolts, which go right through the back-batten and hardboard. It is then painted.

A long wire pin is used to fix the rudder to the rudder-block at the stern of the canoe, secure this pin also with a thin chain.

The Steering Wheel

In Fig. 8 are shown the various stages of construction. The steering wheel can also be seen in Photos 6 and 8.

In a board of the length, width and thickness shown in Fig. 8, cut corners and notches; note how the notch slants in the first section. Plant on two triangular wooden blocks as shown. Drill a hole through the centre of the board to suit a ⅝in. dia. copper sleeve, which in turn is to suit the ½in. dia. bolt. Make a metal bracket as shown in stage "b" of the sketch; the width of the bracket is 1in. and it stands up from the board 1in. Drill a ⅝in. dia. hole through the centre of the bracket, and smaller holes at each end for fixing to the board.

Fix two 4in. long 1in. × 1in. blocks to the underside at each end of the board, round off the ends of these blocks (see section). For the steering wheel two 3in. dia. × 1½in. thick blocks are required, and two 4in. dia. hardboard pieces. Drill a ½in. dia. hole through the centre of the blocks and the hardboard pieces.

The wheel is made from 33in. of ½in. dia. copper tubing, giving a 10½in. dia. finished wheel. Cut a rubber hosepipe to suit in thickness and push over the copper tube. Bend the tube to a circle and join with a wooden dowel. If possible work the rubber hosepipe over the joint of the tube. Obtain six 5in. long wire nails, and drill three pairs of holes for them through the wheel and into one of the round wooden blocks. Drill the holes into the centre block slightly smaller so that the nails will grip. Fix together as shown in Fig. 8.

To bring up the screw eyes which are to hold the steering line in correct position build up the underside of the board by means of bearer blocks and a bearer board. Make two hardwood pulleys and fix where indicated. Oil and varnish the woodwork.

Steering Line

A short length of line is wound around the spool once and is put around the pulleys under the board and through the screw-eyes. Leave about 12in. of loose line beyond each of the pulleys and fix a wire hook to each end of the line. At this point it will be necessary to undo the steering line when the steering wheel is removed in order to get in and out of the back seat. Make the hooks of aluminium wire, so they will give should the canoe ever capsize. The board will come out of the notches by itself when you push with your knees under it. How the rest of the steering line is fixed can be seen in Fig. 4. Make another hook and eye connection of each end of the line to the cross-piece of the rudder.

Canoe Trolley

The layout and most important dimensions of the trolley are shown in Fig. 9. Dimensions can be varied to suit the wheels available, or the metal stays for the axle block, or the coil springs, all of which were taken from an old pushchair (see also Photo 7).

If wheels with pneumatic tyres are used the axle block can be screwed directly on to the centre piece.

To make the trolley you need:

Two 3in. × 1½in. bearers, 32in. long. Pad with seagrass or flock under a strip of felt. (The padding should be slightly higher than the keel rails.)

Two 3in. × ¾in. keel rails, 24in. long. They are fixed 1½in. apart to allow the keel of the canoe to go between. The keel strips have a hole which is to correspond with a hole through the keel, or a bracket on the keel, through which a bolt is pushed in order to secure the canoe.

Two 2in. × 1in. cross bearers, 14½in. long.

One 5in. × 1½in. centre piece, 12½in. long.

Two 5in. × 1in. carriers (or side pieces) 24in. long, shaped as shown.

Two base board and axle block of 3in. × 1in. section, 14½in. long.

Make the wooden framework with screwed joints as shown. If the padded bearers have been padded before fixing, screw them from underneath.

The crossed stays for the axle block are to check any sideways movement of the wheels. The stay-wires give the axle block extra strength, but a loose joint is required at the top. This can be made by bending the stay wires to form a long loop, placing a large washer over the loop and tightening the fixing screw just enough to allow for a hard movement of the wire. The axle is secured to the axle block by means of small metal brackets as shown in Fig. 9.

The Cover

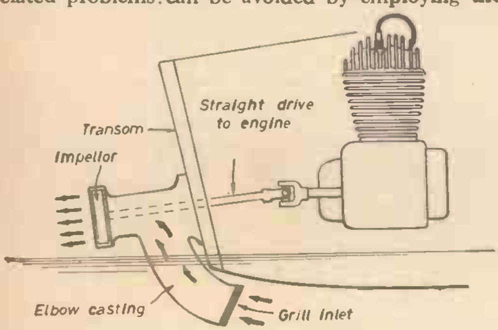
In order to keep rain, leaves, and any unauthorised persons out of the canoe when it is not in use, a removable hardboard cover can be made. This cover has a framework to suit the shape of the canoe opening (complete with the triangular portion at the front) and a curved top (Fig. 10). When placing the cover in position the large screw-eye at the back is pushed over a round-headed screw. The hasp on the front of the cover is placed over the staple which has been screwed to the outside of the splayed board. You can also place the end of a chain—the other end of which is bolted to the landing stage—over the staple together with the hasp, and secure the lot with a padlock. The hardboard cover should be painted.

LETTERS TO *The Editor*

The Editor does not necessarily agree with the opinions expressed by correspondents

Engine Conversion to Outboard

SIR,—With reference to Mr. P. Taylor's query and your reply in the June issue of PRACTICAL MECHANICS on adapting a two-stroke engine for use as an outboard. The newel drive, prop-shaft and related problems can be avoided by employing the



principle illustrated above. Water is drawn from beneath the engine and thrust out at an angle of 90 deg. I have a proprietary engine working on this principle. A similar type is available using a horizontal impeller and a vertical drive shaft, so that using this type the engine could be mounted immediately above as shown in your sketch in the June issue.—Sgt. CRIMMINS (Famagusta).

An Ornamental Gate

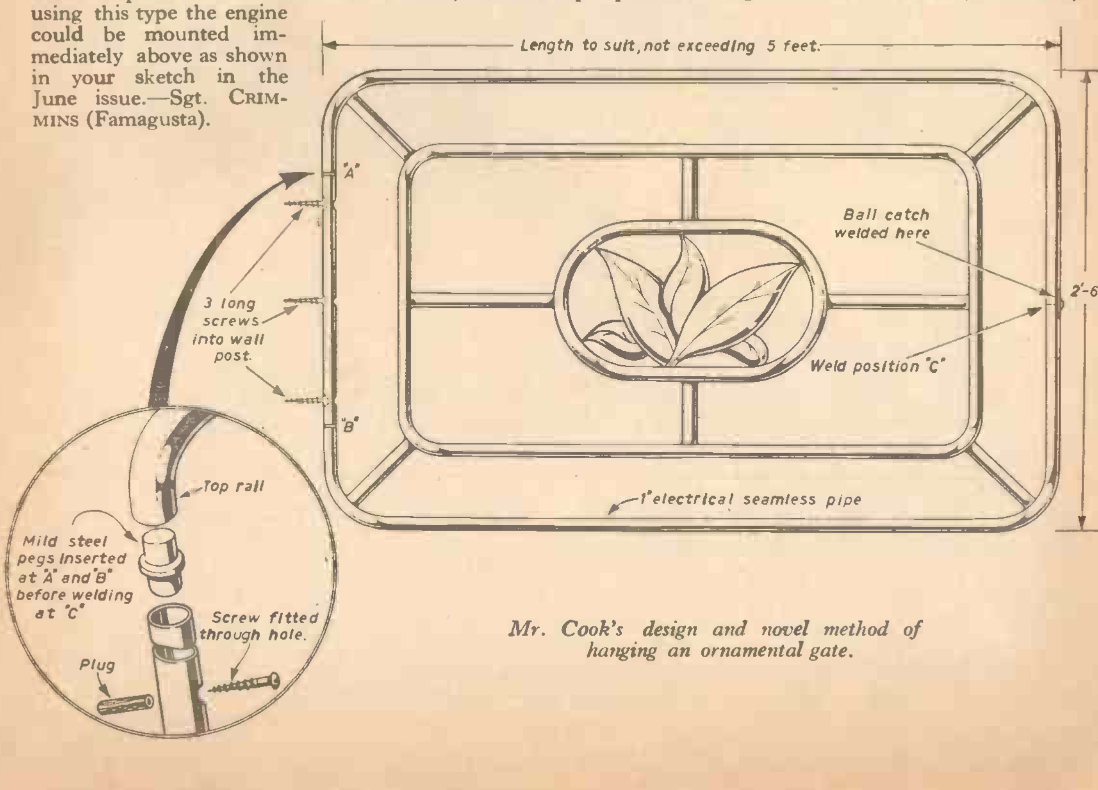
SIR,—A friend asked me to design a light tubular gate, to be fixed between two low walls that made the entrance to his front garden, also that the fixings such as hinges and bolt heads and screws, be hidden.

My drawing shows how this was done, and the finished job was so pleasing that I thought your readers would be interested in its design.

The whole gate is welded (gas) and the centre leaf effect is cut from ⅛in. mild steel plate. Chisel marks completed the leaf design, which was carefully welded in position.

The corners of the main and the inner frames, have 3in. radius bends. The two pegs, turned from mild steel bar, have a ⅛in. ring at the centre on which the whole gate swings; the pegs were turned to suit the inner and outer diameters of the pipe.

The gate was fixed to the wall by three heavy screws, holes being drilled through the hinged section of the gate. The outer holes were filled with putty and painted over, giving the gate the effect of being suspended without support. The gate was given a coat of anti-rust paint then finished with a good quality flat black. Hinges and spring-loaded catch were pre-packed with grease.—B. G. COOK (St. Albans).



Mr. Cook's design and novel method of hanging an ornamental gate.

Wave Power Electric Generator

SIR,—With reference to your article in the August issue, "Power from the Sea", I noticed in the last paragraph that ideas are wanted for utilising wave power. The sketch below shows one way in which I think it could be harnessed. The generator station would be situated off the coast, preferably on the Atlantic side where the waves are larger. It would be built up on piers and the float would be about 12ft. sq. × 6ft. deep. The waves would cause it to rise and fall, operating the rack and pinion drive. The pinion would have to have a free-wheel device incorporated to allow for the fall, drive being on the upward thrust only. How large a generator this would drive, I do not know, but it should drive something!—M. B. S. HIRONS (Letchworth).

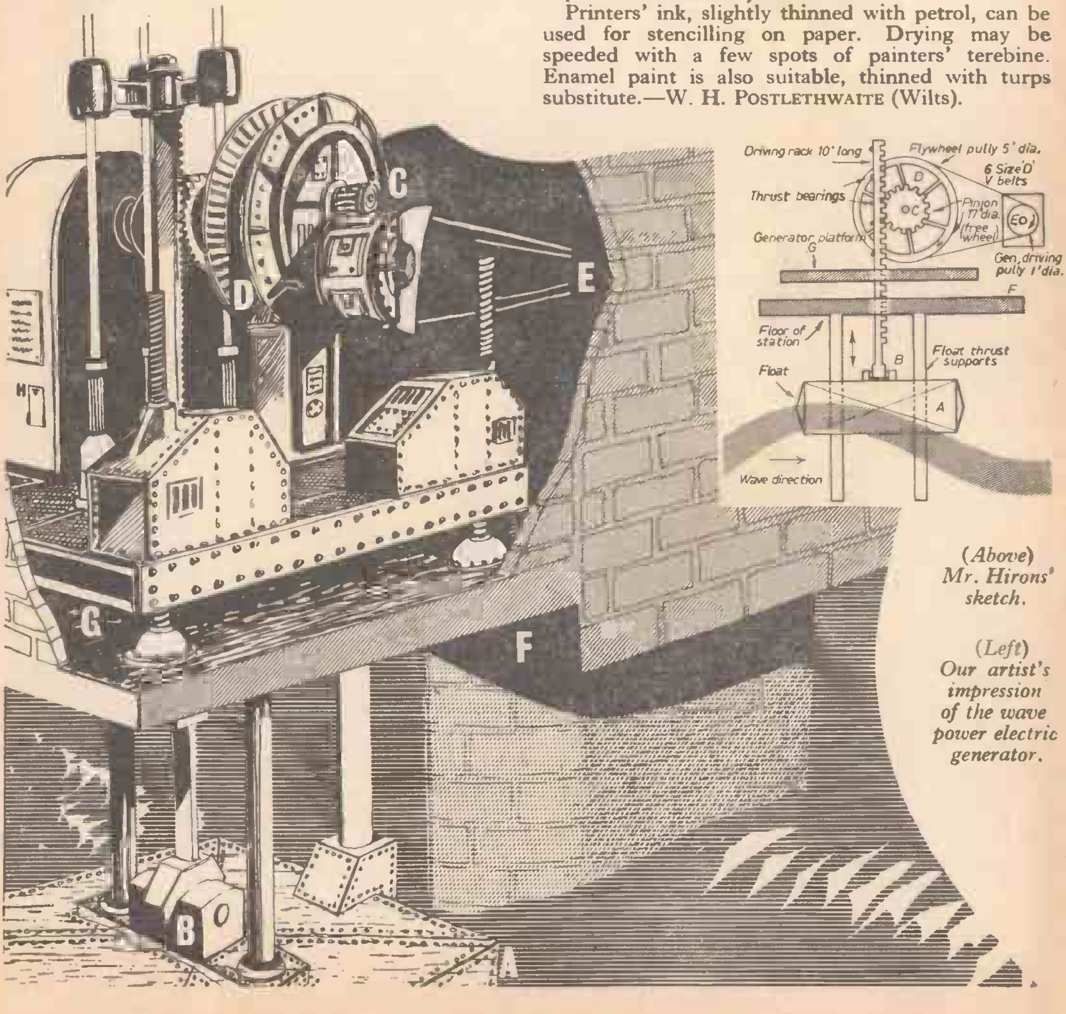
Backing for Inventors Required

SIR,—I should like to comment on the revival of the " Power from the Sea " topic in the August issue of PRACTICAL MECHANICS and to say how much I appreciated Mr. R. N. Hadden's excellent article. However, I consider that should anyone think of a useful scheme for utilising the tide for electrical power he will have difficulty in getting it promoted. Judging by the neglect of many useful ideas, it would seem that we are now creating work to offset the possibility of unemployment by keeping the coal mines working and the oil companies in business. If this opinion is correct, it would seem that a larger financially independent group is required to promote promising inventions.—R. P. BAYLIE (Aldershot).

Stencil Material

SIR,—With reference to Mr. A. J. Palmer's query on a suitable material for stencil cutting, which appeared together with your reply in the August issue, a useful material for this is Whatman drawing paper. Cut the stencils on a piece of glass using a sharp pointed knife. After cutting give both sides of the paper two coats of shellac varnish (orange shellac dissolved in methylated spirit) used fairly thin to allow it to sink into the paper. This hardens and stiffens the stencil and allows the ink or paint to be wiped off immediately after use.

Printers' ink, slightly thinned with petrol, can be used for stencilling on paper. Drying may be speeded with a few spots of painters' terebine. Enamel paint is also suitable, thinned with turps substitute.—W. H. POSTLETHWAITE (Wilts).



(Above) *Mr. Hirons' sketch.*

(Left) *Our artist's impression of the wave power electric generator.*

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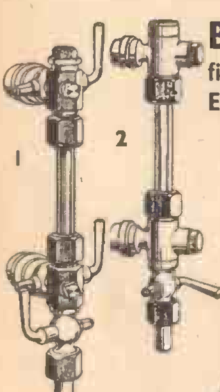

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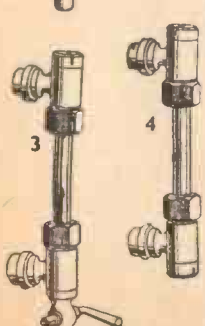

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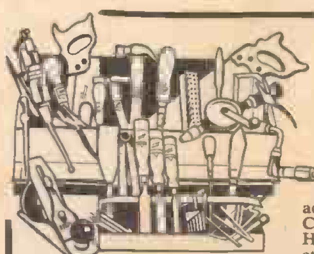

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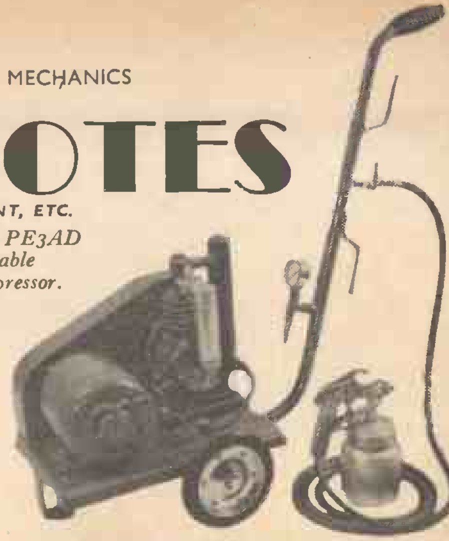
TRADE NOTES

A REVIEW OF NEW TOOLS, EQUIPMENT, ETC.

Portable Compressor

THIS portable version of one of the compressors made by Atlas Copco (Great Britain) Ltd., Hemel Hempstead, Herts., has many uses, notably paint spraying and tyre inflation; thus it is of immediate interest to the garage and repair workshop owner. As can be seen from the photograph, the unit and motor are mounted on a base plate fixed to a two-wheel chassis, equipped with solid rubber tyres and front support. The unit will deliver air up to 100 p.s.i. and is designed for use with Atlas Copco Ecco spray guns L22 and D2.

A pressure gauge and safety valve are built into the handle which acts as a pulsation damper and air receiver. A drain cock is fitted. The compressor is driven through a V-belt by a $\frac{3}{8}$ h.p. British standard electric motor which can be plugged into any domestic power supply of 220/240V.



The PE3AD portable compressor.

Gordon Palm Tree Tool Kit

THE new Gordon Palm Tree combined engineers' and carpenters' tool case contains 85 pieces and retails at £34 10s. Some of the contents are: one $\frac{1}{4}$in. capacity Champment brand hand drill; one set of Dormer twist drills; 4in. pocket level; woodworker's vice; 9in. mitre block; one pair 6in. insulated pliers; one 8in. carpenter's ratchet brace, ball bearing fittings; various types of screwdrivers and spanners, etc. The manufacturers are: Gordon Tools Ltd., Assam Works, Rockingham Street, Sheffield.

The Gordon Palm Tree tool kit.

Barrett Filterbag

THE use of this device enables photographs to be taken by infra-red or violet rays in circumstances where ordinary flash is not permissible. The device is a dual purpose infra-red or violet filterbag which is placed over the flashlight bulb. It is being used by press photographers, the armed services, the police and also has uses in medical and industrial research, measurement of heat-wave lengths and in spiritualism. Further information is available from Mr. A. Barrett, 26 Gap Road, Wimbledon, S.W.19.

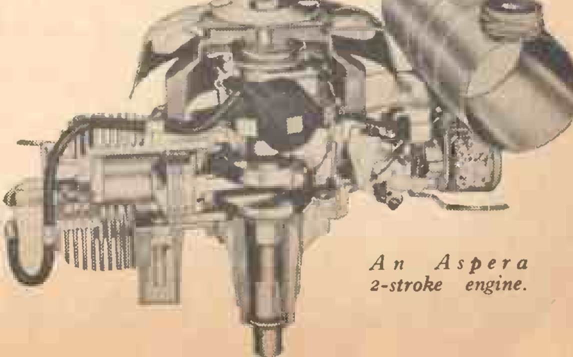
Trade Notes continued.

Hacksaw Booklet

MUCH useful information on the subject of hacksaw blades and their various applications is contained in a small booklet available on request from J. Stead & Co., Ltd., Manor Works, Cricket Inn Road, Sheffield, 2. These hints and tips should interest everyone with a workshop.

Aspera Motors

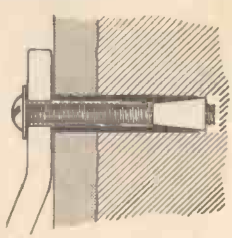
A comprehensive range of air-cooled single cylinder, two- and four-stroke petrol engines of 1 to 6 h.p., made by Aspera Motors of Turin, is being marketed here by Mackay Industrial Equipment Ltd., Faggs Road, Feltham, Middlesex. Of the 28 different types available, 16 are four-stroke and the remainder two-stroke. In the four-stroke range, from $2\frac{1}{4}$ h.p. to $3\frac{1}{2}$ h.p., each can be supplied with vertical or horizontal crankshafts. This is also applicable to the two-stroke range, from $2\frac{1}{2}$ h.p. to 6 h.p. with the addition of a number of variations for special applications. Motors



An Aspera 2-stroke engine.

Two new Stanley products: (above) set of screwdrivers; (left) the Handyrack.

The slotgrip torsion screwdriver.



A Grippoplug in use.

The Collaro tape transcriptor.

are available for every purpose and readers should write for further details and prices to Messrs. Mackay at the address above.

Householder's Toolkit

THE new Stanley " Handyrack " is designed to accommodate the basic necessary tools for household jobs. Its use means that they are packed into the minimum space and are yet readily accessible (see photo). It contains the following tools:

6oz. Warrington hammer, 6ft. " Pull-Push " rule, trimming knife with selection of blades in the handle, 6in. combination pliers with insulated handles, Shaper-junior for trimming, filing or smoothing anything from wood to mild steel, and finally a 3in. plastic handled screwdriver. The 8in. × 2in. rack is painted yellow and the complete kit costs 37s. 6d.

New Screwdriver Range

ALSO new from Messrs. Stanley is a range of screwdrivers in which the modern bolster construction has been blended with traditional style cabinet handles. The former securely locks the blade into the handle, eliminating any danger of twisting under excessive strain, as well as making it possible to temper the blade its entire length.

As mentioned the handle styling is essentially traditional, but in addition dimensions have been studied to ensure comfort and freedom from fatigue in use. The material used is steamed beech and the finish is matt black cellulose. Five sizes are available from 3in. to 10in. costing from 4s. 6d. to 8s.

Slotgrip Torsion Screwdriver

DESIGNED for inserting screws in awkward places, the Slotgrip screwdriver has a blade tip which is divided into three segments. Putting pressure on the slot of the screw automatically turns the centre segment anti-clockwise, jamming its two ends against the side of the slot. Under tension there are thus four points of contact and the screw is locked on the end of the blade. To release, a powerful pull is required. Two sizes are made to fit a wide range of screws in brass, steel or fibre. The price is 7s. 6d.

New Wallplug

THE makers of these new wallplugs, Messrs. Grippo Products, Ltd., Henshaw Works, Oldham, Lancs. claim that they have considerably greater holding power than the conventional type. They consist of a long screw, with a washer under the head and are fitted with an expandable sleeve and tapered brass collet. They are located as shown in the sketch, the action of tightening the screw expanding the sleeve against the side of the drilled hole. They are available 2in. long in drill size No. 8 at 66s. per 100 and in sizes 10, 12, and 14 at slightly increased prices.

Studio Tape Transcriptor

THIS up-to-date design is a product of Collaro, Ltd., By-pass Rd., Barking, Essex. It is a single direction twin track machine operating at speeds of $1\frac{7}{8}$, $3\frac{3}{4}$ and $7\frac{1}{2}$ I.P.S. and it includes among its features, space for a third head, light piano key type controls, fast rewind, pause control, extra knob position, digital counter, three full-screened motor and spool carriers set to accommodate spools up to 7in. dia. or $5\frac{3}{4}$in. spools max.

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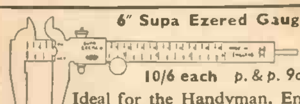

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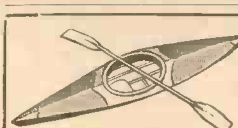

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Handcream from Seaweed

COULD you please inform me how I can extract a handcream from seaweed?—E. Cornelius (Newquay).

WE have not come across the use of seaweed as a base for handcreams; but it would appear to us that you should crush the weed and strain off the fibre from the mucous solution which results from this treatment.

You would then have to preserve this from going bad by the addition of boric acid, which in itself is a mild antiseptic and is smooth to the feel.

To this add whatever perfume you like, of which there is a wide choice.

Vibration in an Iron Lamp

I HAVE an iron lamp stand and when the current is on, the outside frame, which is made of iron-alloy, can be felt to vibrate. At the bottom of the stand there is a ½in. thick solid iron disc to weight it down; this is covered by the iron-alloy frame. The vibrations can still be felt when the lamp is switched off. Could you please suggest something to overcome this?—F. Tuck (Middx.).

WHEN the lamp is switched on the current through the cables will create an electromagnetic field round the cables, causing repulsion between the cables. This repulsion will be of varying force due to the varying and reversing nature of the alternating current, and may create vibration, particularly as the magnetic field will be intensified due to the presence of the iron tube.

However there will be no magnetic field when the lamp is switched off; but an electrostatic field will then be produced, which may have similar effects. It is important that the metal framework of the lamp be efficiently earthed through the third core of a three-core flex, and the third pin of a three-pin plug. The vibration might be reduced by using a circular tough-rubber sheathed flexible cable to the switch.

Non-setting Modelling Clay

COULD you please tell me the composition of non-setting modelling clay or wax? — J. Barry (Cardiff).

MIX china clay with the required amount (determined by trial and error) of glycerine or petroleum jelly, or both. We would recommend glycerine, however, as this retains water.

Black and White Negatives from Colour Transparencies

I HAVE a colour film (still in strip form) from which I wish to take a black and white negative. I thought of putting the film into my camera on top of some ordinary HPS film and then, keeping the lens as far out of focus as possible, expose the film to a white screen. Can you advise me if this is possible and if so can you suggest a method of calculating the exposures? Perhaps you could describe an alternative method.—A. T. Davie (Fife).

IF the colour film is negative (as used to make colour prints) then contact prints or enlargements can be made directly from it. But copying will provide the required reversal if the film is a positive transparency. A slow pan film would be better than HPS. The system you suggest could probably be tried. An alternative would be to press colour film and unexposed film together with glass, or a printing frame. Using a slow pan film, and 50W. lamp at 6ft., the exposure should be about ½ second, but this will depend on the colour film density. If you use cut films, or pieces cut from a roll film, and a developer/fixer such as Monophene, which completes processing in 6 minutes, a number of test exposures could be made quite quickly.

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Non-misting Plastic Windows

COULD you tell me the principle of the specially treated sheets of material used to prevent car windows misting up?—D. E. Challis (Middx.).

THE principle involved is to lower the surface tension between the water (mist) and the surface on which this mist condenses. The material used is a trade secret; but we suspect that it is probably one of the silicones.

Black Nickel Plating

COULD you tell me the electrolytic solution used for obtaining a black nickel deposit on brass? Also would this nickel be a good conductor of electricity?—M. E. Stone (Nottingham).

THE electrolytic solution used for obtaining a black nickel deposit is as follows:

"Nigrax" Nickel Salts	62 gms.
Water to	1 litre

Dissolve salts in hot water to a solution density of 8 to 9 deg. Twaddle at 60 deg. F. Operate at 60 to 70 deg. F.

Current density 1 amp./sq. ft. of cathode area
Current voltage 0·75 - 1·0 v.
pH maintained between 5·8 - 6·0.
Plate for 30 to 60 minutes.

Swill work well with water after plating.

Black nickel is a fairly good conductor of electricity but not as good as copper or silver.

Making Harmless Smoke

COULD you please give me the formula for making harmless smoke?—T. Webber (Wealdstone).

THE formula for making white smoke is:

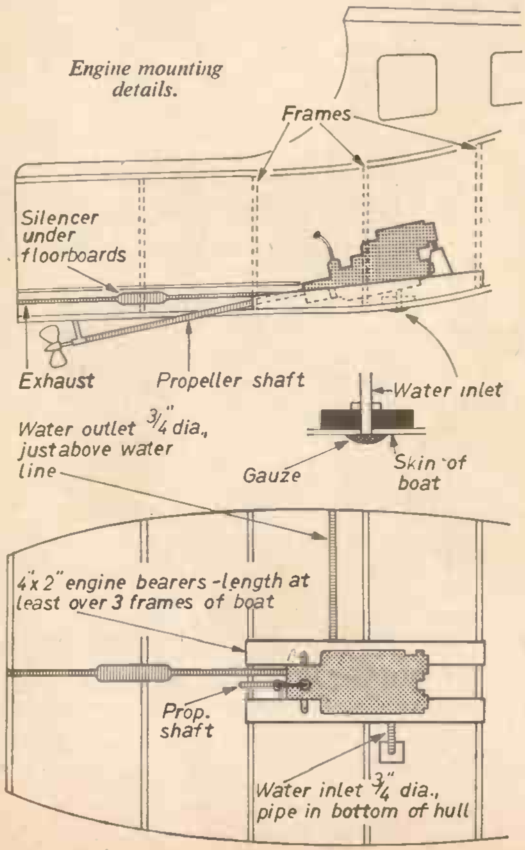
Potassium chlorate	3 parts
Lactose	1 part
Finely powdered Ammonium chloride	1 part

If black smoke is required add a few drops of paraffin.

Building an Inboard Cabin Cruiser

I WISH to build a 14-15ft. boat, using either a Ford 8 h.p. or 10 h.p. engine and gearbox unit mounted inboard and taking the final drive off the back companion flange where normally the carden shaft would fit. Please answer the following:—

a **What mounting would the engine unit require?**
b **What size intake pipe would be needed for the engine unit and where would it be situated?**
c **Where could plans of a boat to seat four people and two children be obtained?**
d **Would a silencer be required for the exhaust or could it be exhausted through the water?**
e **What would be the cost of materials, excluding the engine unit?**
f **Where could I obtain a commercial propeller and shaft?**
g **What speed could the boat achieve?**
—B. V. Avis (Blackpool).



Engine mounting details.

WE give a sketch of the engine mounting (left) and the answers to your questions are as follow:

a The engine can be mounted on a pair of 4in. × 2in. timber blocks of length spreading over three frames of the boat. A suitable slope must be prepared to give the correct angle to the prop. shaft.

b Inlet to intake cooling pipe must be underwater in the bottom of the boat, covered on the outside by a suitable gauge strainer cover; piping ¾in. dia. The outlet should be in the side of the boat just above the load waterline so the functioning of the cooling system can be readily visible.

c A suitable design and kit can be obtained from the Bell Woodworking Co., Leicester.

d Fit the silencer under the floorboards. It could be bound with asbestos string to prevent it burning woodwork with which it might come into contact. Exhaust just above the waterline.

e Such a boat should cost about £120 excluding engine.

f Bell Woodworking Co., Leicester, or Stuart Turner, Henley-on-Thames, could supply the prop. and shaft.

g The boat should be capable of about 8-10 knots.

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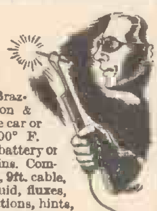

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