Building a Radio Controlled Model Aircraft

NEWNES

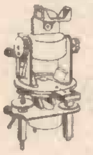
PRACTICAL MECHANICS

1/3

EDITOR: F. J. CAMM

SEPTEMBER 1956

INTERESTING BARGAINS
SATISFACTION OR REFUND

ASTRO COMPASS MK II

Supplied in good condition in sturdy box with instructions for use in Astro Navigation and star identification—also instructions for conversion to Dumpy Level. 25/- post free.

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Ex. R.A.F. Navigators' equipment. Consists of star base and 7 templates covering lats. 0-70 N. and S. Makes star finding and identification relatively easy. With maker's instructions in leatherette wallet. 5/- p. & p. 9d.

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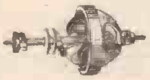
Precision made mechanism, designed for Aircraft, with many other mechanical adaptations. 4in. overall, brand new, 3/9 post free

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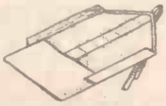
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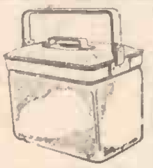
Ex M.O.S., 20 Gauge 18/8, stainless steel. Complete with outer lid as illus. plus inner anti-splash lid, both lids locked secure by depressing handle. Size 16in. x 11in. x 11in. Cap. 6 gal., 57/6, carr. paid.

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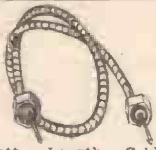

Patt.	Length	Cable	Outer	Price
A	9"	.25"	.43"	2/6
B	18"	.25"	.43"	7/6
C	30"	.25"	.43"	12/6
D	60"	.25"	.43"	15/-
E	72"	.25"	.43"	20/-
F	92"	.23"	.45"	22/6
G	240"	.14"	.33"	30/-
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Pattern K, a 16ft. drive intended for really heavy duty, full details not available at time of going to press will be supplied to interested inquiries.
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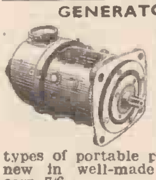
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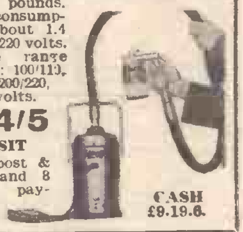

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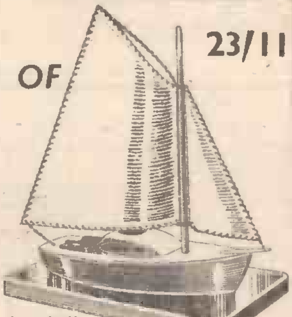
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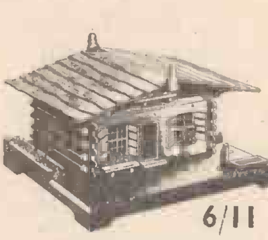
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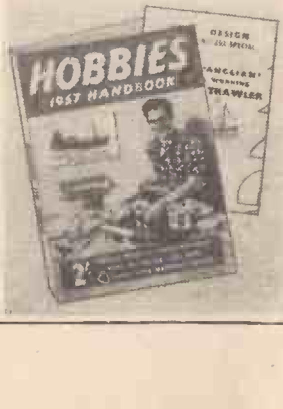

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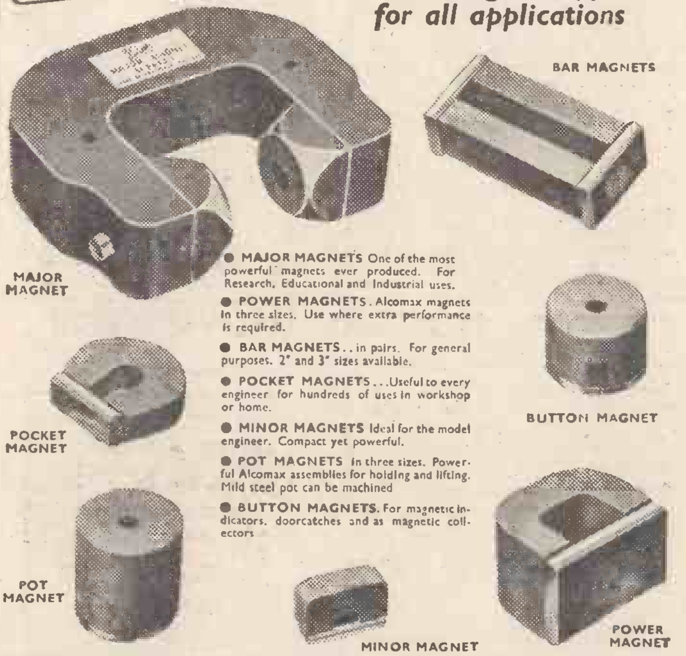

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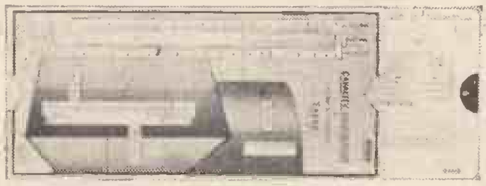

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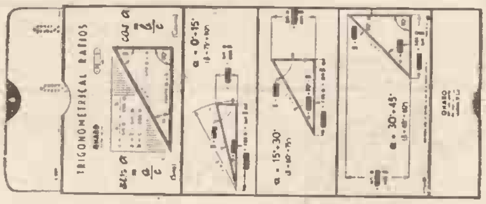

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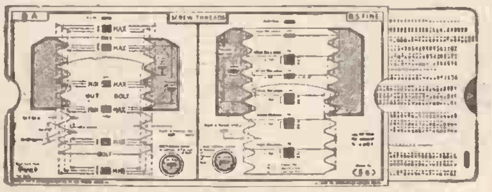

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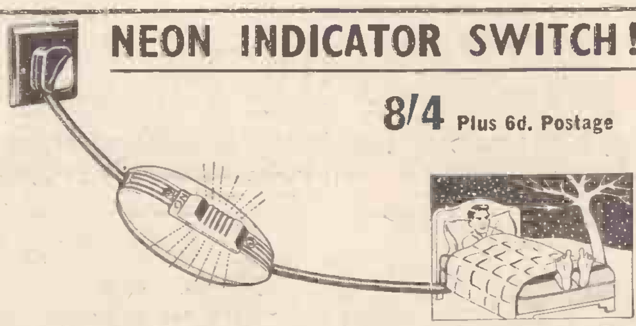

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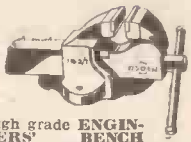

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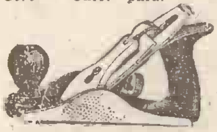

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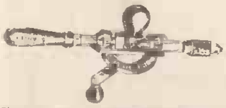

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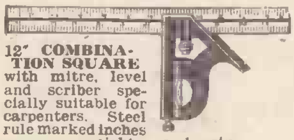

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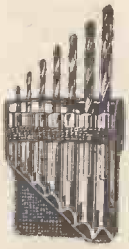

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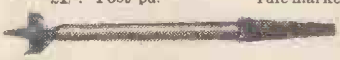

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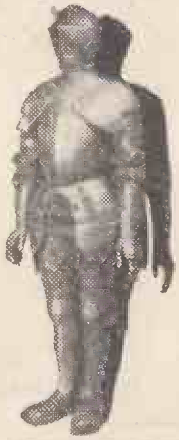

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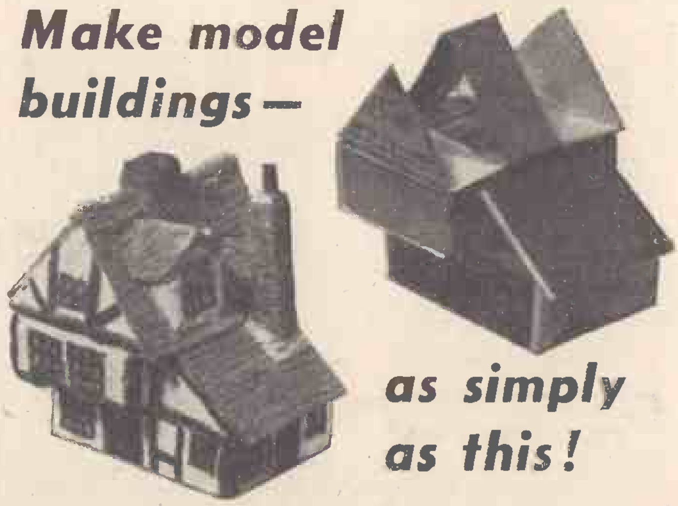

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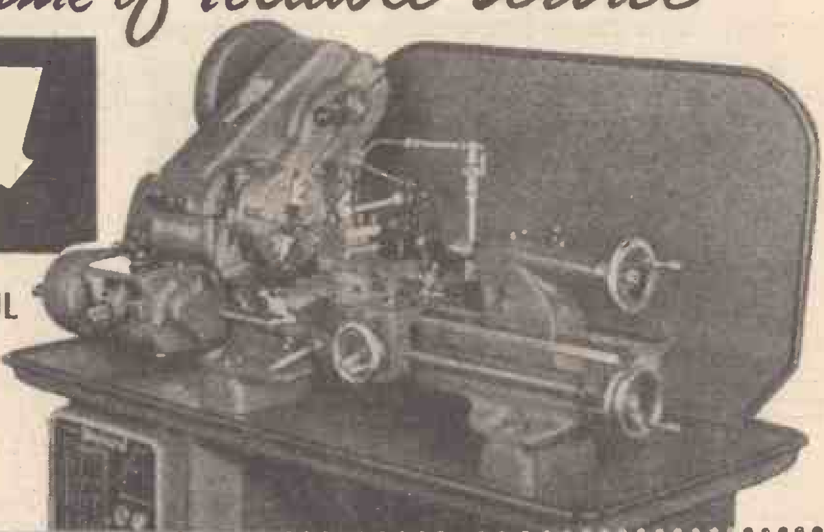

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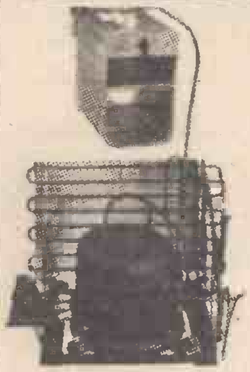

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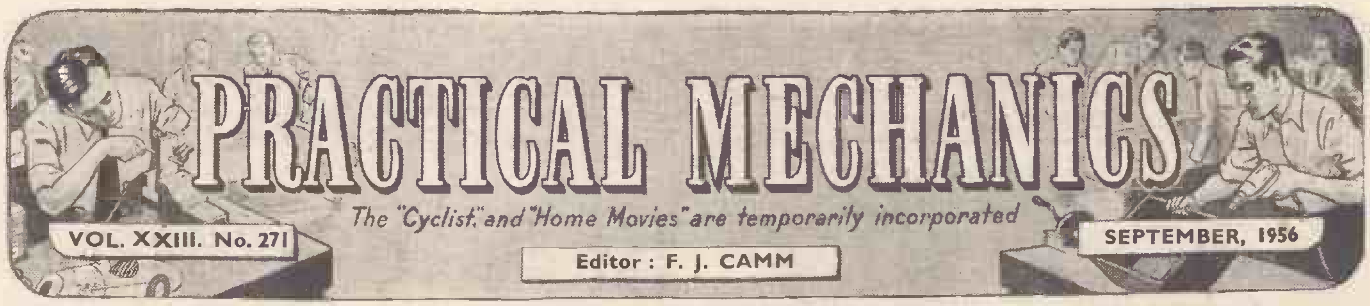

FAIR COMMENT

By

The Editor

The Mouse Satelite

ON July 29th, 1955, President Eisenhower announced that the United States was to launch the world's first artificial satelite. Exactly one year later the British Interplanetary Society released pictures of a three-stage satelite rocket, resulting from a British design study in 1951. This study, which was made at the request of the Technical Committee of the Society in 1950, directed its attention to determining the smallest type of rocket vehicle that could be established in a circular orbit round the earth for purposes of scientific observation. The project was given the name of Mouse, which is compounded from the initial letters of Minimum Orbital Unmanned Satelite Earth, and it was associated with proposals to launch a large instrumented satelite advanced by Professor S. F. Singer which were laid before the Society in 1954. American scientists have acknowledged that the British design studies supplied background information for the Vanguard Satelite vehicle now under construction, and which is scheduled to be launched from the U.S. Long-range Proving Ground, Cape Caneveral, Florida, during the International Geophysical Year, which is the 18-month period between July, 1957, and December 1958. The Vanguard is a satelite rocket of the three-stage type.

Three British engineers are responsible for the Mouse project, Mr. K. W. Gatland (who contributed a long series of articles on the subject to this journal a few years ago), Mr. A. M. Kunesch and Mr. A. E. Dixon; all are long-established members of the B.I.S. and have contributed many technical papers on the subject.

It is noted that there are many points of similarity between the British and the American projects. For example, both are of three-stage construction, both use pivoting rocket motors for stability and control, both omit guide fins. The propellant tanks are integral with the rocket structure to produce useful weight economics. All guidance equipment is installed in the second stage of both and each uses steam jet controls (hydrogen peroxide gas generator) in the second stage for moving the rocket into the desired orbital plane after the cut-off of the driving motor. Each uses a spherical body ejected from the third stage as the artificial satelite. In the case of Mouse this is an inflatable structure of metal foil, which can be tracked optically from the ground. A novel feature is the suggestion that an inflatable satelite might be carried in the third step and ejected from the rocket after it has arrived in the orbit. In view of the near-vacuum conditions prevailing at its altitude of release, it is considered that the satelite should take the form of a light metal foil sphere which would be blown up by means of a capsule of gas to a diameter of from 6ft. to 8ft. A body of this size would be clearly visible by the sun's reflected light just before dawn and shortly after sunset. This compares with the rigid instrumented satelite of only 20in. in diameter used in the Vanguard project. It was, however, recently reported in America that two types of artificial satelite may be developed—one that would emphasise the gathering of telemetry data, which is a radio method and another which would take the form of a large inflatable sphere with excellent visibility but containing no instruments. The latter would be tracked optically from the ground. One of the most important uses of such a satelite would be to determine air drag in the outer atmosphere by measuring the rate at which the body loses height and speed along its orbital track. This will have an important bearing on the design of new high altitude rockets and rocket aircraft. Earlier this year the Americans announced that a rocket-propelled research aircraft now under construction is designed to carry a man 50 to 100 miles into space. Another use for the satelite would be to obtain precise measurements of the shape and dimensions of the earth, which at present is presumed to be an oblate spheroid, but which is far from accurately known. There is still uncertainty of the relative positions of the continents. This can be checked by triangulation from ground stations using the satelite as a point of reference.

The British Interplanetary Society, which has done so much to place the subject on a scientific basis, was founded in 1933 to promote the development of interplanetary exploration and communication by the study of rocket engineering, astronomy, electronics and other associated sciences, and its 3,000 members include many British and foreign workers prominent in these fields.

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End of Volume 23

THIS issue completes Volume 23, comprising issues dated September, 1955, to October, 1956. It must be observed that owing to the printing dispute earlier this year we did not produce the March and April issues, so Volume 23 contains 10 issues only. Indexes will be ready shortly and will be supplied for 1s. 3d. by post.

The Advance of Electricity

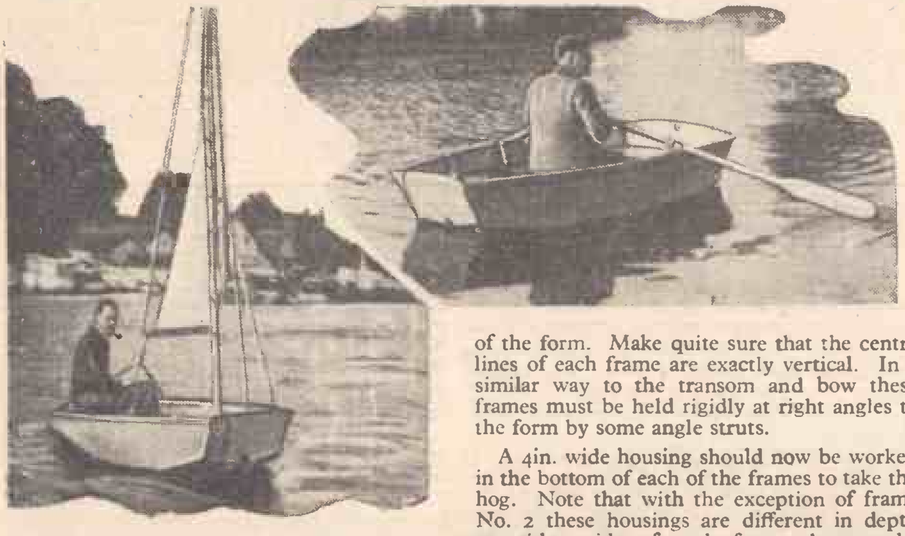
RADIO and television have been more responsible for the introduction of electricity into the home than any of the advertising campaigns launched by the electrical undertakings. It is true that a home without electricity may enjoy radio by means of a battery-operated receiver, but no one has yet marketed a battery-operated television receiver. Radio and TV have been of benefit to the manufacturers of electrical apparatus, and particularly of labour-saving devices such as vacuum cleaners, refrigerators, washing machines and electric fires, apart from hair driers, sewing machines and electric razors. More and more people are now using electric fires and gas fires and the open coal fire is becoming a thing of the past. Thus does the development of one science impact on a number of other industries, many for the better and a few for the worse.—F. J. C.

Building an 8 FT. Sailing Dinghy

An All-wood Family Craft Which Can be Carried on the Car Top

By FRANCIS HOOK

(*Continued from page 467, August issue.*)



THE other supporting members of the building form may be made up from any odd timber available. An arrangement shown in the photograph and diagrams shows a set-up which proved quite satisfactory when building the prototype.

A point to be borne in mind is to arrange the four buttress-like members near frames Nos. 1 and 3 in such a position that the temporary struts across the tops of the frames lie against them and may be screwed to them in order to give some extra rigidity to the construction when one is working on the application of the plywood sides, sheer and chine strips, etc.

When building the form and setting it up for building the boat, it must be stood on an even and level floor. If no such floor is available then the form must be blocked up here and there so that it does stand firm and level.

Temporarily screw the bow and transom in place on their respective ends of the form with some 2in. No. 10 screws. A centre line must be drawn on each piece and these lines must coincide with a centre line on the thickness of the form. It is advisable to fix some temporary braces from the bow and transom to the form board to keep these members rigidly held at right angles.

The three frames are now fitted into their respective slots in the form and the three struts across the tops of the side futtocks must be screwed into position. The frames are held in position securely, but temporarily, on the form by some screws driven through the form and into the frames at the top of the form; also where the struts across the tops of the futtocks pass through the bottom of the form. Make quite sure that the centre lines of each frame are exactly vertical. In a similar way to the transom and bow these frames must be held rigidly at right angles to the form by some angle struts.

A 4in. wide housing should now be worked in the bottom of each of the frames to take the hog. Note that with the exception of frame No. 2 these housings are different in depth on either side of each frame due to the curvature of bottom of the boat. In other words these housings must be faired in to the general curvature of the top of the form, (see Fig. 6 in last month's issue).

In passing it is important to remember that when fitting the frames into the form, frames Nos. 1 and 3 should have the side futtocks arranged towards the bow and stern respectively. This is important in order to preserve the correct lines of the boat when fairing off the side futtocks preparatory to fitting the plywood sides. Since frame No. 2 is midway in the length of the boat it is not important which way round this faces.

Fit the hog into place along the top of the form and easing it into each of the housings in the frame bottoms. A bevel has to be cut at each end of the hog so that it butts snugly up against the transom and bow. It is better to fit the hog at the bow first and screw it with some temporary screws to the form. Next bend it down along the form into frames Nos. 1, 2 and 3 and scribe the correct slope for the butt joint against the transom. In order to saw this slope the hog will have to be removed again from the form. A fair amount of fitting by trial and error will be bound to occur in fitting the hog, but it is an important operation and must be well done, being the backbone of the whole construction. It should be noted that in order to fit the hog finally into place it will be necessary to ease off the screws holding the transom to the form. Screw the hog into each frame and put a screw through the bow and transom into the hog, Fig. 9.

Having done all this and made sure all surfaces pull up snugly together, undo all these screws again and remove the hog. Apply glue and hardener to the joining surfaces and finally screw all together again for the last time.

A word of warning is necessary here. Make a mental note to be sure that the four temporary screws used to hold the hog directly to the form are removed before the keel is fixed to the hog. Another reminder is to keep the resin glue exactly to the place intended so that one may not find the form glued to the hog or frames in odd places when it becomes necessary to remove the form from the interior of the boat.

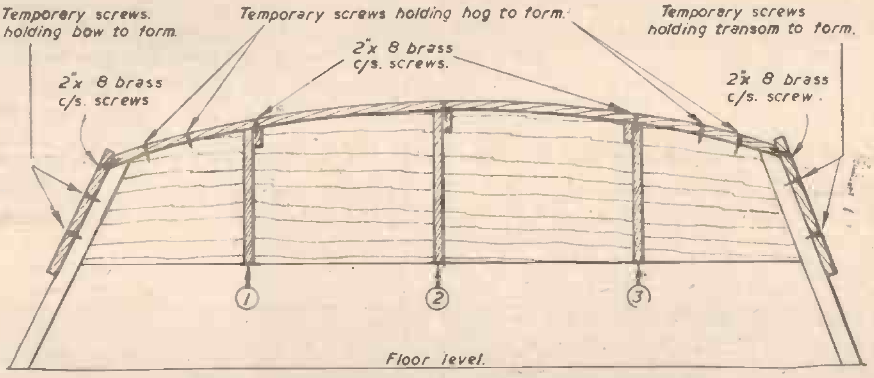


Fig. 9.—Screwing the hog to the form and to the frames.

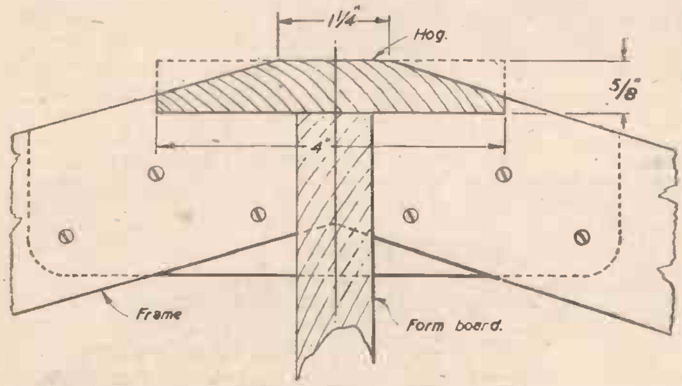


Fig. 8 (Left).—The hog is planed to run in with the slope of the bottom futtocks.

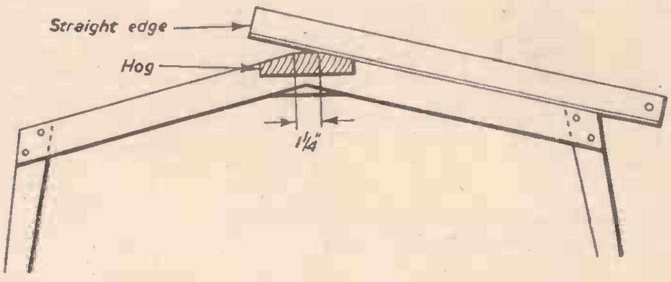


Fig. 11 (Right).—Method of testing the fairing off.

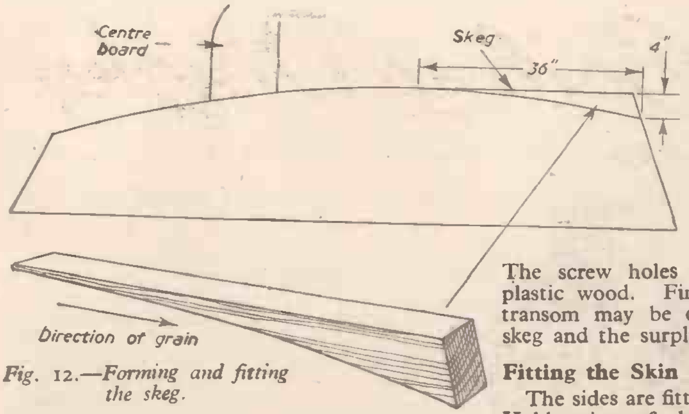
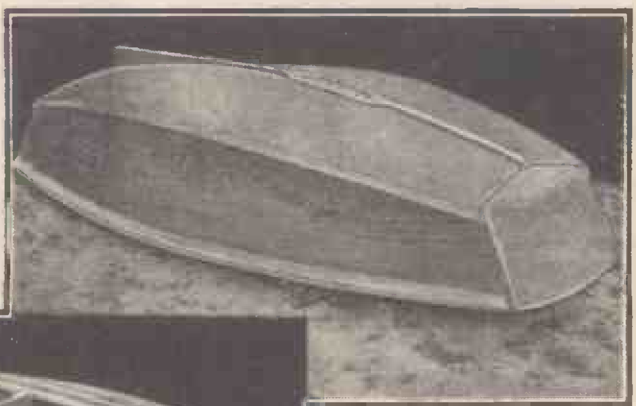


Fig. 12.—*Forming and fitting the skeg.*

Fairing Off

When the glue is set on the previous work the fairing off of the hog and frames may begin. A slope is planed and on each side of the hog to run in with the slope of the bottom futtocks of the frames. A bevel will have to be planed on the bottom edges of the bow and transom so that they run in smoothly with the hog. A 1½in. width must be left unplaned down the middle of the hog on which the keel will be fixed (see Fig. 8). Fig. 11 shows the method of testing the fairing off across the width of the frames. This fairing off will, of course, necessitate a bevel also on the outside of the frame members, both on the bottom and the sides.



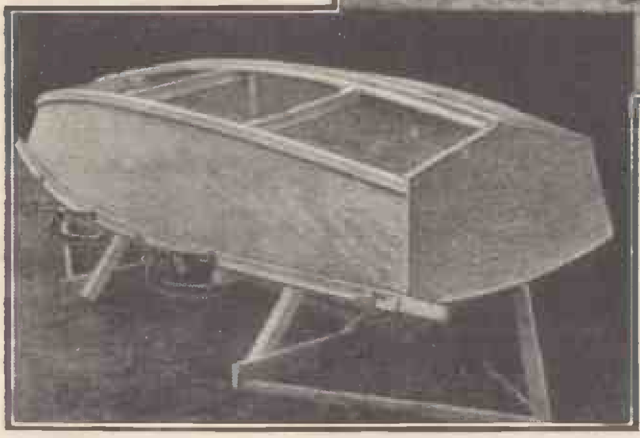


Fig. 13.—*Two views of the boat during construction.*

A constructor is seen testing this fairing in Fig. 10, a photograph which appeared last month. A long, thin lath, free of knots is used to spring over all the frames as shown. No gaps must show between the lath and the edge of the frames so that the plywood covering will make a good contact for gluing and screwing during the next stage of construction.

Fitting the Keel

When the edges of all the frames, transom and bow have been faired off the keel may be fitted. This is a strip of wood 1½in. x ⅝in. finished size which is glued and screwed to the hog. Before doing so remember to remove the screws which were put through the hog into the top edge of the building form.

The Skeg

The skeg is about 36in. in length and 4in. wide. Before cutting this out to the shape of the keel make particular note of the way the grain must run (shown in Fig. 12), so that when in use there will be no tendency to rough up the grain when dragging it over the ground. The skeg is glued and screwed to the keel, and the heads of the screws should be well countersunk. When the glue is set the bottom edge of the skeg can be smoothed off with a plane to run in smoothly with the line of the keel. The screw holes can be stopped with plastic wood. Finally, the slope of the transom may be continued through the skeg and the surplus wood sawn off.

Fitting the Skin

The sides are fitted first to the frames. Hold a piece of ply against the side in its approximate position and secure in place with one or two screws at the top and bottom of each frame. Mark out the approximate sheer and chine lines, allowing about ¼in. extra. At the same time lightly mark round the frame members to show where the screw holes will be located and the glue applied. Remove the plywood and saw out to shape. Between the lines drawn round the frames drill 3/32in. diameter holes for the screws. These holes should be spaced about 3in. down the frames and at 2in. spaces for the bow and transom.

Apply the resin glue to the frames, bow and transom and the hardener to the plywood. Replace the plywood in the original position and hold by the first screw holes. Drive the screws in just flush with the wood, arranging the last turn of the screw so that the slot in the head of the screw is running down the length of the boat.

Plane off neatly all the surplus ply above the chine line.

Prepare next the four strips for the chine and sheer, each 9ft. x 1½in. x ⅝in. finished size. Cramp these to the centre frame first and working alternately on either side bend the strips down in place and cramp to the other frames (Fig. 13). They can be bent round fairly easily without steaming them, but if it appears to be too much of a strain they must be steamed for about two hours in any of the usual arrangements of pipes and boiling kettles used by the amateur. The chine and sheer strips should be drilled at the frames, transom and bow, the holes countersunk and held in position by some 2in. x No. 6 brass countersunk screws. Before removing these strips for gluing mark a pencil line along the plywood to show the width of the strips as a guide in drilling the holes for the screws which will be put later through the ply into the strips from the *inside* of the boat.

Remove the chine and sheer strips, and between the lines on the plywood showing their width drill some 3/32in. holes at 3in. centres approximately.

Apply glue to the inside of the strips and hardener to the ply and repeat the process of securing them. The plywood is screwed to the chine and sheer strips from the inside with ⅝in. x No. 6 brass countersunk screws. Arrange the heads flush as before, head slots pointing fore and aft.

The chine and sheer strips will have been left overhanging fore and aft and these ends must now be trimmed off to the bow and transom. Spokeshave a quarter round on the ends so that there are no sharp corners. These strips are in course of being fitted in Fig. 13.

Plane off now any surplus ply protruding above the chine strip and at the same time fair off the edge of the chine strip so that it runs in line with the line of the bottom futtocks. Test with a straight edge.

Fitting the Bottom Skin

Place the other two pieces of 8ft. x 2ft. plywood in position on the bottom of the boat and scribe lines parallel to the edge of the keel. Saw off the surplus wood and finally plane the edge down to the line and slightly bevel it so it is a snug fit against the keel.

When a good fit has been obtained scribe a line on to the plywood around the transom, bow and chine, and along the frames from inside the boat. Trim the plywood to within ¼in. of the outer lines as before and drill 3/32in. holes for screwing to hog, transom, chine, bow and frames. Space the screws at 3in. centres.

Apply the glue and hardener, place the bottoms in place and screw down as for the sides.

Trim off the overhanging edges of the ply at bow, transom and chine.

The happy moment has now come when the boat may be removed from the building form. Unscrew the various bracing pieces on the inside of the boat and the screws through the bow and transom on the outside, and it should be quite an easy job to ease the boat off the form. When it is off it is advisable to screw back in place the three cross strips to the tops of the three frames, and leave these in place until after the seats are in position. They can be seen still in place in Fig. 14.

(*To be continued*)

Fig. 14.—*The hull after being removed from the form and three bracing strips replaced.*

A SKELETON MARIONETTE

A Novel, Fully-articulated Puppet

By JOHN C. LOWDEN

NO real puppet troupe is ever complete without a fully jointed skeleton. He is the star of the cast, and his history is so long that his origins are untraceable.

"Billy Bones" is my smallest, lightest and cheapest puppet. He is easily manipulated, and the construction of puppet, control and coffin can be undertaken with the simplest tools. No costume is required.

The dimensions given are my own doll's dimensions, so laid out because they best suit my purposes. There is no reason why a constructor who feels that a larger doll might be helpful should not increase these dimensions. Even a 3ft. doll would be perfectly practicable. I would not, however, care to advise any major alterations of the proportions.

Those with more advanced anatomical knowledge will notice that many "essentials" have been omitted from the construction—but these "essentials" are necessary only to the human frame. Such items as shoulder blades serve no useful purpose in a skeleton marionette and only add complications. The only essentials are atmosphere and illusion, and the simpler the methods employed the better the illusion.

The Head

After many experiments I found that Church's Alabastine made the most effective heads.

First, rig up a simple modelling stand, consisting of a flat base, about 4in. by 3in. of any wood. Drill in the centre a hole to fit a dowel about ½in. diameter. Glue a 6in. length of dowel firmly into the hole.

To make a mould for your skull use a good size piece of modelling wax. This will serve many models. Roll a ball about the size of a fairly large grape-fruit and mount it firmly on the peg of the stand. Mould under the ball, around the peg, a "neck" about 2in. long. Then, with a penknife, carve out a skull. You will find ample guidance in any simple textbook on first aid. Model along the lines of Fig. 1, keeping reasonably to

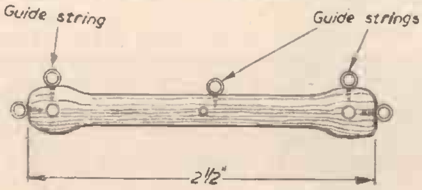


Fig. 2.—Details of the collar bone.

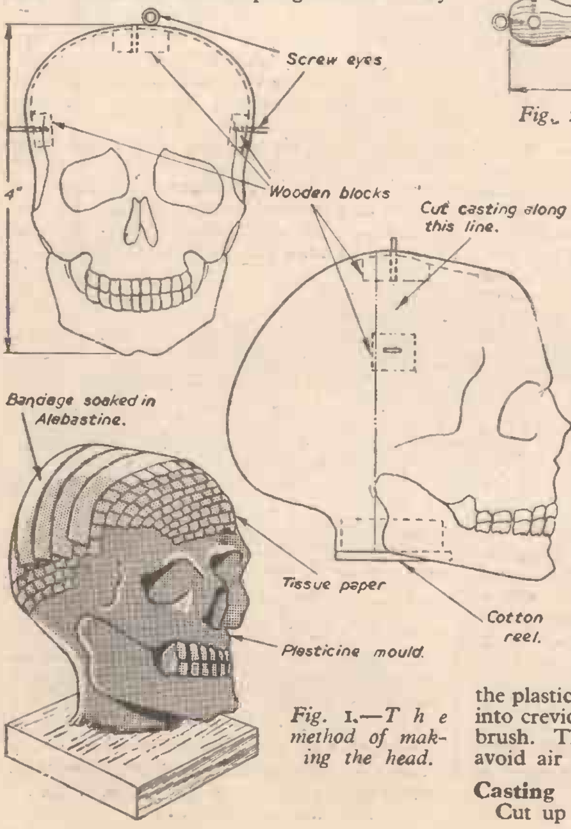


Fig. 1.—The method of making the head.

proportion, unless you are deliberately striving for grotesque effects. Above all be bold. Do not try for finicky details—these will inevitably be lost. Apply any fine details at the end of the job, not at the beginning.

When modelling, try to avoid "undercuts," as these and "pinches" cause complications when the outer head is removed.

Papering the Head

After obtaining a satisfactory model it must be *completely* covered with small pieces of wet tissue paper. The fine paper used to wrap bread is ideal. Tear it up into stamp-size pieces. Soak the pieces in a saucer of water, then apply smoothly in the manner shown in Fig. 1 until the entire head is covered with wet paper. This process is essential; it would be impossible to remove the head proper if it were allowed to set on the plasticine. When papering, push the paper into crevices with bristle tips of a small paint-brush. This helps to preserve detail and to avoid air bubbles.

Casting

Cut up a new roller bandage, 1in. or 2in. wide, into small pieces up to 3in. long. Any larger is difficult to manage. The function of the bandage is to act as a reinforcement to the Alabastine.

Mix a tablespoonful of Alabastine with cold water in a saucer to the consistency of thin cream. Do not mix too much at any one time. Dip the pieces of bandage in the mixture one at a time and apply them to the model, patting them into place with the brush. Continue until the head is completely covered, and then wind one or two layers around the neck. Allow the model to dry overnight. When ready to apply the second coat, brush on one coat of liquid Alabastine first, then apply a second complete layer of bandage as before. At least three coats of bandage are required and four are better still. Allow the model to dry completely.

The dried cast can easily be removed, since Alabastine expands as it dries. Pencil a line from the neck, over the ears, across the top of the cranium and down to the neck (see Fig. 1). Using a razor blade, or a thin sharp penknife, cut straight along the line. Cut deeply; right into the plasticine.

If the cutting has been done carefully, both halves of the cast may be drawn gently away from the mould. The mould is left undamaged and it can be used again if identical heads are needed, as often happens in puppetry.

Of the two halves of the head the rear half needs no further attention. The neck should be filled in with a plug of wood,

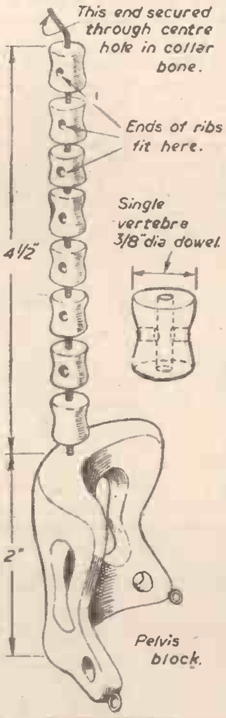


Fig. 3 (*Left*).—The vertebræ and pelvis block.

The author's "Billy Bones."

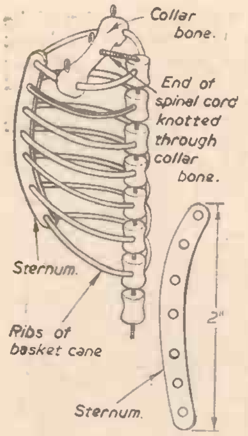
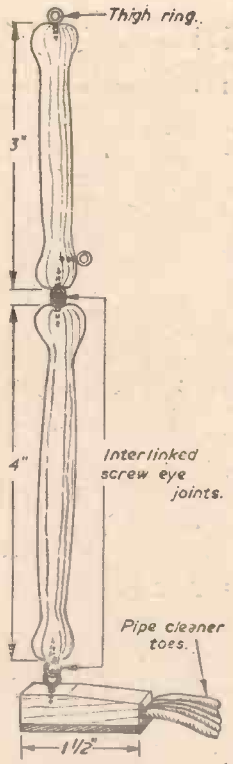
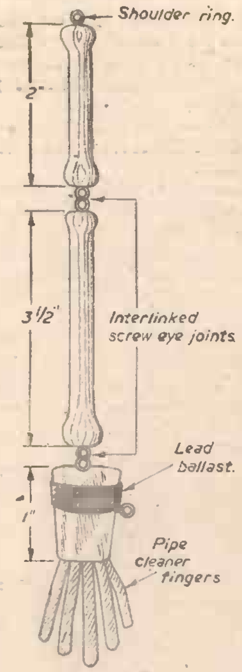


Fig. 4.—The sternum and rib cage assembly.

Fig. 5 (Right).—Details of the arms, legs, hands and feet.





drilled down the centre; a cotton reel is often a ready-made neck plug.

Wood Blocks and Screw Eyes

At the top of the facial half a small block of softwood is needed and this should be glued inside the skull, above the neck plug. The purpose of this block is to act as a firm base for a tiny brass screw eye. This is screwed centrally through the modelled head and into the wooden base.

To ensure a firm fixture for the screw eye apply a spot of Balsa cement to the tip of the screw point.

In the case of a skeleton marionette a string must pass straight through the skull, so that the skull can be lifted during the performance. Drill a fine hole through the skull and wooden block. Pass the string through the hole in the block, through the hole in the neck plug, and tie a ring or other stopper to each end. This will secure the string.

Two screw eyes are also screwed in position just above the ears and small base blocks glued inside the skull to receive them. The purpose of these eyes is to act as guides.

The two halves may now be jointed together. Apply a liberal smear of liquid Alabastine to both raw edges, and place them in contact. Cover over the joint with a strip of bandage. After this cover the entire skull with a final layer of Alabastine soaked bandages, paying particular attention to any weak parts.

After drying, the skull may be brushed over with one or two coats of rather thin liquid Alabastine. The texture of the bandage will disappear, leaving a smooth white surface.

Painting

First paint over the surface of the skull a coat of thin glue size to give a hard, fine surface. Follow this with white paint, either poster colour or flat oil paint. Eye and nose cavities, teeth and jaws are best painted with dark green poster paint.

I give all my puppet heads a coating of clear varnish, which I find makes them less liable to chipping and keeps them bright and clean. This method of moulding heads can be employed with great success for any type of head, and it is not restricted to skeleton marionettes.

Collar Bone, Spine and Pelvis

All the bones, with the exception of the ribs, may be carved from any softwood. No special timber is necessary.

The collar bone is carved from a piece of softwood about 2½in. by ½in. by ½in. Three holes are drilled as shown in Fig. 2. Five fine brass screw eyes are inserted in the positions indicated.

The spine is made of eight bobbins of ⅜in. dowel about ½in. long. These are roughly shaped to give the effect of vertebræ, as shown in Fig. 3. A hole about ⅛in. dia. is drilled down the length of each dowel, and through each hole is threaded a strong cord—picture cord is perfect. A fine hole is drilled across the diameter of each bobbin, about half-way along its length. This hole is to accept the ends of the ribs when the rib cage is assembled.

The spine terminates at the pelvis, a block of wood shaped as in Fig. 3. The holes are for effect purposes. The lower end of the cord is attached to the pelvis by drilling a fine hole through which the cord is threaded. The cord is secured by a pin or staple.

After attaching the pelvis to one end of the spine, the other end of the cord may be knotted to the central hole in the collar bone. This may be seen in Figs. 4 and 7. To allow the spine a certain flexibility about ¼in. of slack should be allowed.

Two screw eyes should be inserted into the pelvic block, as will be seen in Fig. 3.

The Sternum and Ribs

The sternum or breast bone should be cut and drilled as indicated in Fig. 4. The material used is ¼in. thick hardwood or plywood. The exact size of the holes depends upon the thickness of cane used to make the ribs.

The ribs are made of scraps of medium thickness basketry cane. Seven 6in. lengths are required.

Assembling the Rib Cage

The seven ribs are first wetted, and then cemented centrally into the breast bone. The ends of the top rib are passed through the outer hole in the collar bone, and drawn through until they can enter the holes across the top vertebra. There they should be cemented in a loop. To avoid movement, cement the rib where it passes through the collar bone.

Each rib should now be bent, fitted and cemented to its own vertebra. The resulting rib cage, shown in Fig. 4, is light and strong.

It will be noticed that the lowest vertebra carries no rib. This gives flexibility and a "waist."

The Limbs

For most puppets a rather complex joint is required for knees and ankles, but for the skeleton the best joint is made by interlinking two fine screw eyes. The simple construction of arm and leg is shown in Fig. 5. A linked screw-eyed joint should be provided for ankles and knees, and a single screw eye at the upper end of the thigh bone and shoulder end of the upper arm. A screw eye is also needed on the lower end of each thigh bone, immediately above the knee joint.

Hands and Feet

The hands should be made from blocks of wood about 1in. by ¾in. by ¼in. Do not make them too small, as much of the effect is due to large, ghostly hands. Drill fine holes down the length of the hand, and thread through ordinary pipe-cleaners about 1in. long to serve as fingers.

The feet are similarly constructed, but blocks measuring 1¼in. by ⅞in. are used, and the pipe cleaner toes are at least 1½in. long.

The hands and feet need to be ballasted with lead, thin "soles" and "bracelets" of ⅛in. sheet lead being affixed to feet and hand blocks as shown in Fig. 5.

When the hands and feet are completed, they should be jointed on to the arms and legs.

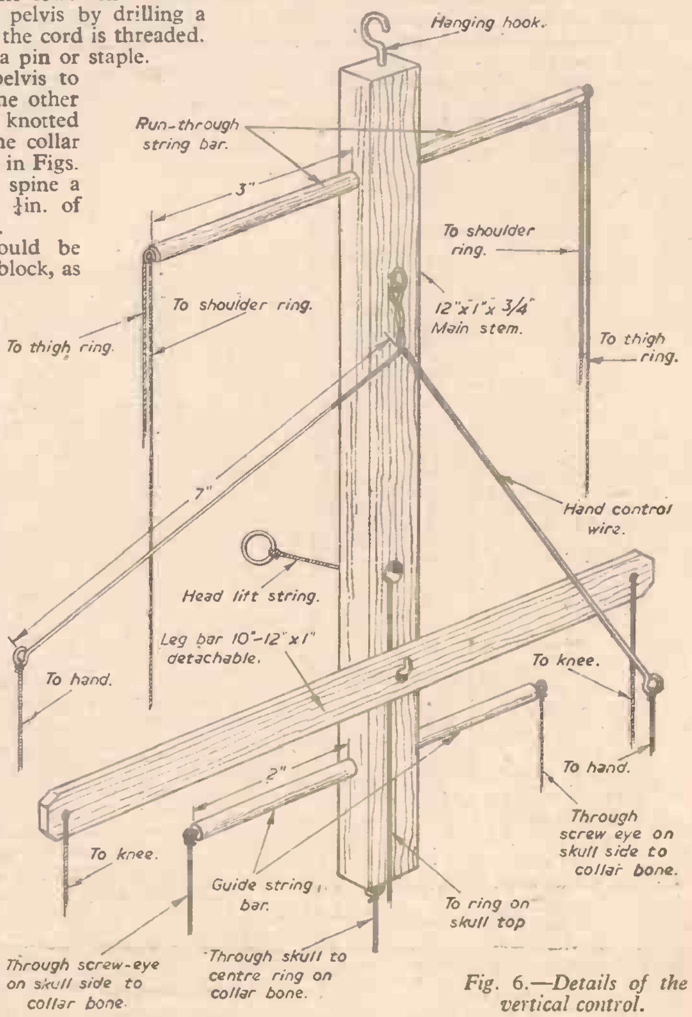


Fig. 6.—Details of the vertical control.

As the components are finished, they may be painted with flat white oil paint.

The Control

Before the assembly can begin a vertical control must be made as shown in Fig. 6. The main stem is 12in. by 1in. by ¾in. The two crossbars are made from ¼in. diameter dowel. A hole is drilled to receive the head-lifting string. The detachable leg bar is 10in. by 1in. by ⅜in. lath, drilled at the centre to fit on a hook screwed into the main stem. The hand control is a length of wire 14in. long. Two loops, one at each end, are turned up on the ends of the wire. The wire is bent at the centre, and twisted around once or twice to form a finger grip and loop. A fairly substantial screw eye is inserted into this loop, and the wire arm control is screwed to the main stem.

Stringing and Assembly

For stringing use No. 18 carpet thread. Black is the most usual, and it is improved by rubbing lightly with cobbler's wax. The operation will be made easier by reference to Figs. 6 and 7.

Hang up the control at shoulder height, and once having started do not alter this height. First knot the guide string running through the skull to the screw eye in the centre of the collar bone. Pass the other end through the screw eye at the lower end of the main stem of the control.

Tie an end of string to each of the upper screw eyes on the collar bone. Pass the string through the screw eyes above the ears. Finally, knot the ends of the strings to the outer screw eyes on the lower crossbar of the control. These three strings serve to control the skull and prevent twisting of the head and body. Two more strings are necessary to complete the assembly. Tie one end of a string to the screw eye on the thigh bone. Pass the end through the screw eye on the pelvis. Lead this end up through the outer screw eye on the collar bone. Continue to the upper crossbar of the control, pass the string through the screw eye, then return down. Pass once more through the outer screw eye of the collar bone, then tie on to the screw eye at the shoulder end of the arm.

The stringing process is a vital operation, and care should be taken not to secure the knots until the figure, suspended from its control, stands erect on the ground, perfectly balanced and with arms and legs touching the trunk.

The Head-lifting String

A string is knotted to the screw eye on the top of the cranium. This is taken up to the hole in the main stem of the control, passed through, and the loose end secured with a finger ring. A pull on this string will effect a most horrendous elevation of the head. This will, of course, descend by its own weight when the pull is released.

The Leg Strings

One string is knotted to the screw eye above the knee joint. The leg operating bar is hung on its hook on the main stem, and the string is tied to or through the end of the bar. This string should not be tight. The other knee joint may now be strung to the opposite end of the leg bar.

The Hand Strings

A string is now secured to one hand, either at the wrist joints or at a point on the block corresponding to the thumb. Lead this string to the loop in the bent wire control on the main stem, and knot on to that. This string must not be tight to allow full manipulation of the hands and arms. Repeat the stringing with the other hand.

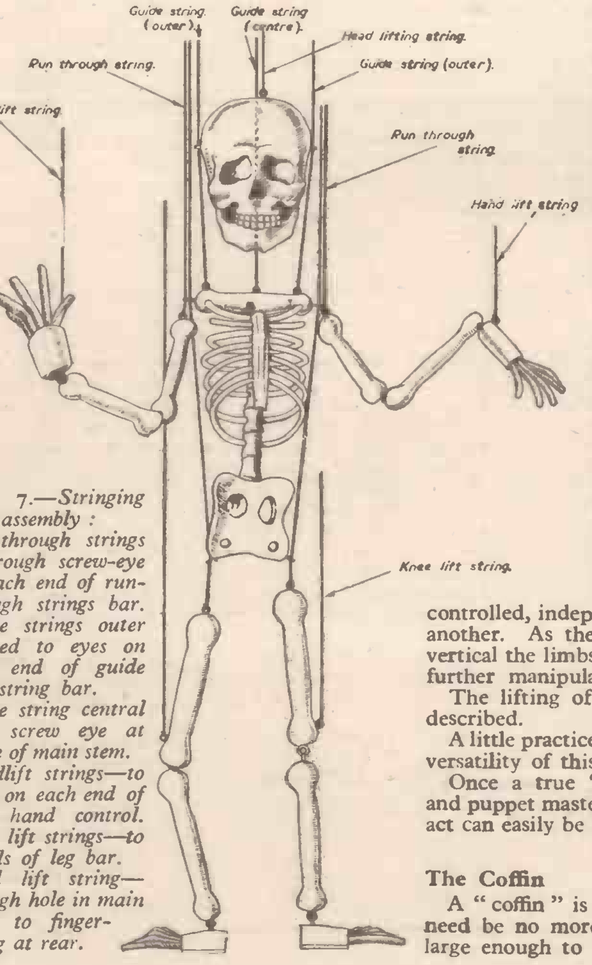


Fig. 7.—Stringing assembly: Run-through strings—through screw-eye on each end of run-through strings bar. Guide strings outer—fixed to eyes on each end of guide string bar. Guide string central—to screw eye at base of main stem. Handlift strings—to loops on each end of wire hand control. Knee lift strings—to ends of leg bar. Head lift string—through hole in main stem to finger-ing at rear.

Manipulation

First hold the control in the right hand at shoulder level. Unhook the leg bar with the left hand. The leg action is given by movements of the leg bar. Remember—the doll cannot walk—it must be carried along while the leg movements are simulated.

The main control is held at the "web" between the thumb and first finger. These digits, passing round the main stem, grip the wire control of the arm at the point where it is twisted. Arm movements are effected by raising, lowering and rolling the wire control.

When operating normally the control must hang vertically. Deliberate dismembering of the doll is achieved by tilting the top of the control forward. The limbs part away from the trunk, and may then be individually controlled, independent of the trunk and one another. As the control is returned to the vertical the limbs return to the trunk without further manipulation.

The lifting of the head has already been described.

A little practice will soon reveal the amazing versatility of this amusing puppet.

Once a true "rapport" between puppet and puppet master has been attained, a simple act can easily be worked up.

The Coffin

A "coffin" is the first requirement. This need be no more than a plain wooden box, large enough to accommodate the puppet at full stretch. The lid of the box should be hinged at one end, and a screw eye inserted at the other. A string terminating with the finger ring is tied to this screw eye. A shaped coffin as shown in Fig. 8 is more realistic.

The puppet is laid to rest in his box, his strings lying on the puppeteer's side. The lid is gently closed over the strings.

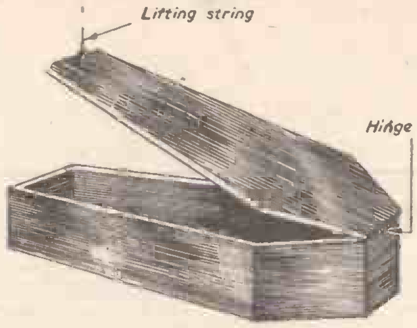


Fig. 8.—The simple coffin.

A Suggested Act

To open the act the coffin lid is slowly raised fully open and the lifting string secured within reach. By skilful manipulation each arm and leg can be brought out individually, doing a little dance before the trunk and head are lifted from the coffin. When the several parts are fully revealed the doll can go through its routine of dance, with frequent dismemberment, reassembly, and elevation of the skull.

At the conclusion of the dance the skeleton re-enters the coffin, the lid of which can be closed. A particularly hair-raising effect is to leave out one arm. This can be manipulated to knock on the coffin lid, which then reopens to admit the missing member before finally closing.

Obviously this needs music of one's own choice, as well as careful rehearsal, but the turn is well worth while.

Staging

A full-scale marionette theatre is, of course, a source of great pleasure, but it is by no means essential. Many audiences prefer to see the puppeteer at work. A simple stage may easily be arranged with the kitchen clothes horse. The framework is covered with dark curtains, or even a suitably eerie backcloth. The puppeteer works behind this, concealed up to his waist by the screen. His hands and controls are clearly visible and are, in fact, part of the show.

If "house lights" are dimmed a wonderful effect can be obtained by illuminating the scene with a green painted bulb in a small table lamp, shaded so as to illuminate only the stage area. This lamp is, of course, on "stage level."

Storage

Puppets *must* be hung up clear of the ground at all times other than actual performance. Never allow anyone to touch them prior to going "on." The final result is inevitably a tangle. In storage wrap your skeleton in the sleeve of an old shirt, stitched at one end, with a tie string or draw string at the other.

Aquarium Heaters

How to Make the Various Types of Unit for Maintaining Correct Water Temperature

By P. MAGINNESS

A TROPICAL aquarium may be heated, using any of a number of sources of heat. Small oil or gas burners installed beneath the tank, separated by a baffle plate of thin metal to prevent the flame from impinging directly on to the glass, are useful methods when an electricity supply is not available, or in an emergency. Unfortunately, these methods involve the aquarist in a fair amount of maintenance and need adjusting at frequent intervals; although it is possible to have automatic temperature control it is both complicated and expensive.

By far the most convenient and easily controlled source of heating is by means of electricity, utilising a simple heating coil, either immersed directly in the water (this being the most efficient) or by mounting the element below the tank base. Four different models, each having its own merits, are described below, all being easily constructed by the aquarist, no electrical knowledge being required.

Standard Immersion Type

A length of Pyrex glass tubing of 1 cm. (4/10in.) outside diameter is cut to a length of 5in. by nicking with a fine triangular file, gripping in a cloth with both hands, the thumbs along the tube and pulling outwards and downwards, away from the crack.

A length of asbestos string, ⅛in. diameter, is secured at one end of the tube, ⅛in. from the edge, with sodium silicate (waterglass) and allowed to set. The string is now wound round the tube in the form of a spiral, leaving a gap the thickness of the string between neighbouring turns and finishing ⅛in. from the end, again fixing it with a blob of sodium silicate. This process is simplified by winding the string on to the former in two lengths, side by side, and then after fixing the end of the first piece, removing the second, leaving an accurate gap. The completed former is given a coat of sodium silicate and allowed to dry out thoroughly, preferably with heat in the later stages. The spiral element is now taken and fixed securely to the former by binding tightly with several turns of thin copper wire; a spot of silver solder will hold it in position.

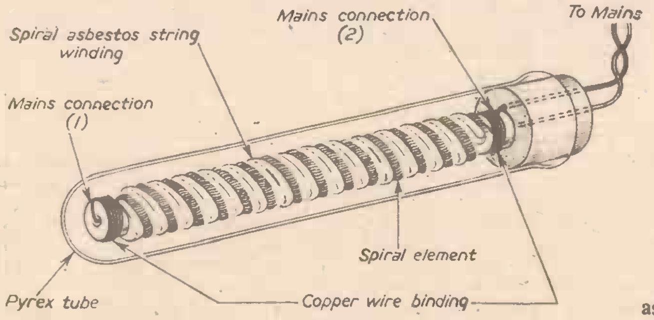


Fig. 1.—Standard immersion heater.

The element is carefully stretched and wound round the former in the gap; a small amount of trial and error will guide you in the amount of stretch necessary, but the element will be approximately 4ft. long when wound. The end is secured as before with copper wire and silver soldered.

Connecting wires are taken through the rubber bung, as described in previous article on thermostats, and attached to the bound ends of the element by further binding and soldering. The wire to the end of the element remote from the bung passes through the glass tube, being stripped of insulation.

Place the completed assembly into the Pyrex test tube (6in. × ⅝in.) but do not completely seal the tube. Carefully connect the heater to the electricity supply and allow it to warm up for a few minutes, disconnect and, while still warm, push home the bung and seal. This action is necessary to prevent any pressure developing while the heater is in use.

Circulatory Heater

This heater has been designed to promote a better circulation of the heated water than the conventional type, and also to have as much of the heating surface in contact with the water as possible. The coil assembly is made in a manner similar to the previous one with the exception that the inner glass tube is cut 7in. long, and the winding commenced 1in. from the end and finished 1in. from the other end. A piece of Pyrex tubing, 7in. long and ⅞in. bore, is equipped with rubber bungs bored in the centre to take the glass former tube, and also with a connecting wire through each bung. One of the connecting wires is secured to the end of the element as before and the wide tubing slipped over the former and pushed home. Sufficient slack should be left inside the tube to allow the coil former to be withdrawn sufficiently far to enable the remaining connection to be made. The connecting wires are now gently eased out until the bung almost seals the tube, the heater is warmed up as before and the bung fully secured, again easing out the connecting wires until no slack remains in the tube. This heater should be mounted on a slight incline to promote circulation.

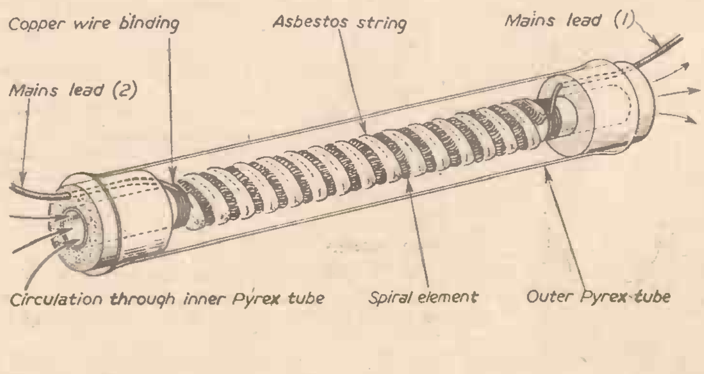


Fig. 2.—A circulatory heater.

Simple Unobtrusive Heater

This form of heater is the most simple to construct and is also the most adaptable for use in the aquarium. Even in full view it is almost indistinguishable from its surroundings, especially if the ends are buried.

Pyrex tubing, 3mm. inside diameter (approx. 4mm. O.D.) and of length 20in., is bent in the form of a hairpin, the two parallel arms being approximately ¾in. apart and of equal length. Two small rubber bungs (½in.) are bored half-way through the broad end to make a watertight fit with the glass tubing, and drilled from the narrow end for the connecting wires, as shown in Fig. 3. The connecting wires are now taken through the bungs, leaving about 1in. slack at the broad end. One end of the element is twisted to the connecting wire and silver soldered, the other end being taken through the tube by means of a piece of thread and secured to the second connecting wire. One bung is pushed on to the glass tubing and the element warmed up as before, the second bung then being sealed. Pull out the connecting wires gently until the element is within ¾in. of the bungs; these wires should be stripped of insulation for ½in. of this length to prevent overheating of the insulation. This heater is designed to

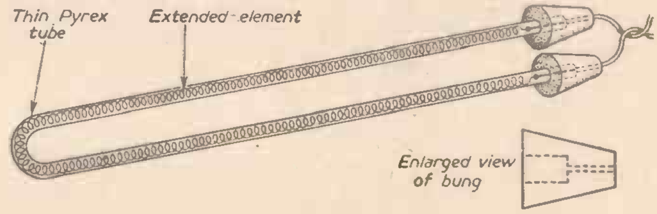


Fig. 3.—A simple unobtrusive heater.

fit a tank of 1ft. minimum length and to heat evenly the full length. In larger tanks there is no reason why the glass tube should not be straight, in fact it may be tailor-fitted to suit the geography of the tank. It will be found preferable to have the element extended to approximately 18in. and the heater will then run at a comparatively low surface temperature. If difficulty is found in making a watertight joint for the connecting wires, the design may be modified as shown in Fig. 4. To enable all connections

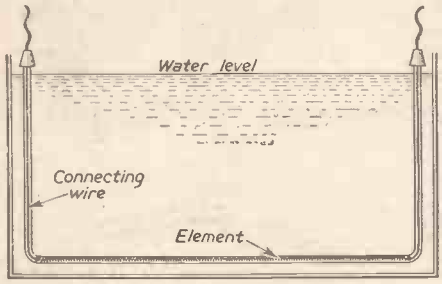


Fig. 4.—A modified heater with all connections above water level.

to be above the water-level, the element should be only along the horizontal portion and the connecting wires be of bare tinned copper wire; this will be found to be almost invisible. If it is preferred, these heaters may be satisfactorily buried slightly in the gravel, due to the low surface temperature.

External Base Heater

This heater meets the needs of those enthusiasts who dislike any artificialities such as thermostats and heaters in their tanks, and also has the advantage of being completely out of contact with the water. If used with the external thermostat previously described, there will be no apparatus inside the tank to spoil the setting. The dimensions given are suitable for a standard tank with a base 18in. × 10in.; for other sizes they should be modified accordingly.

A sheet of hard asbestos cut to size 14in. × 6in. × ¼in. is obtained from a builders' merchant and drilled as shown in Fig. 5. The element is now stretched and

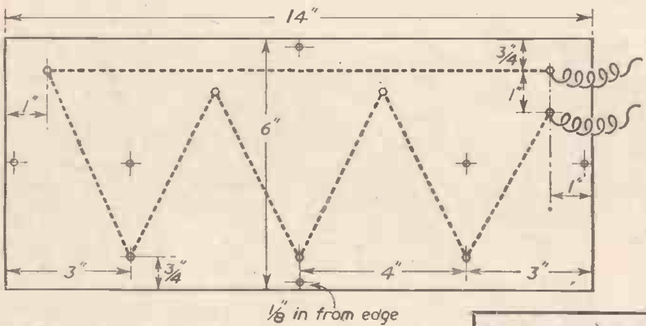


Fig. 5.—Asbestos base showing position of elements.

fastened down at each bend with small bolts, counter-sinking the heads on the underside of the asbestos. A thin sheet of asbestos, the same size as the base, is bolted underneath, preventing the live screws from being accidentally touched. The screws holding the element in position should be filed off flush with the nuts. A piece of perforated zinc sheet is cut as shown in Fig. 6 and the edges bent at right-angles to make a shallow tray 1in. deep and ¼in. smaller than the asbestos base. The perforated cover is drilled for two fixing bolts opposite the holes in the base. Locating pieces of bent metal, held by the false base fixing bolts, keep the cover in its correct lateral position. The connecting wires for the electricity are secured to the two bolts, holding the beginning and end of the element and passing through a small hole in the cover. An earthing wire should be taken to the cover via the fixing screw and the cover fastened down. A frame of 2in. × 1in. wood set on edge is made to raise the tank, and the heater mounted with small angle pieces so that the metal top is ¼in. below the top of the sides. When the heater is in use the heater top will be approximately ¼in. below the glass base of the tank, depending on the thickness of the angle iron frame and the putty. A small hole is drilled in a convenient place in the wooden underframe for the connecting wire, also serving for ventilation. Staining the frame and polishing will enhance its appearance. Very little heat is directed downwards and it will not generally be found necessary to take any precautions in this respect unless the aquarium is to be installed on a polished surface; if this is so, a sheet of heat insulator, such as cork or soft asbestos and felt, will suffice.

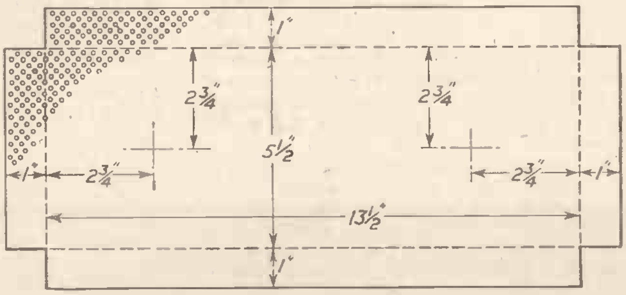


Fig. 6.—The perforated zinc cover.

Sizes of Elements

I have purposely left the details of wattage of the elements until the last because a great deal depends on the location of the aquarium. In theory, providing the thermostat is working, and will handle the load, it does not matter how powerful the heating element is; it will only heat the water to the same ultimate temperature as will a heater of less power. In practice a rapid raising of the water temperature is to be deplored, and the sensitivity of the thermostat is also affected due to the residual heat in the heater raising the temperature of the water even after it has been switched off. Provided the aquarium is situated in a house where the internal temperature does not drop much below 45 deg. for long periods, the rule of 10 watts per gallon of water is quite satisfactory, with some power to spare. In a living-room which is heated a lower figure will suffice; an outside fish-house, unless well insulated against the cold, will require slightly more to prevent the heaters

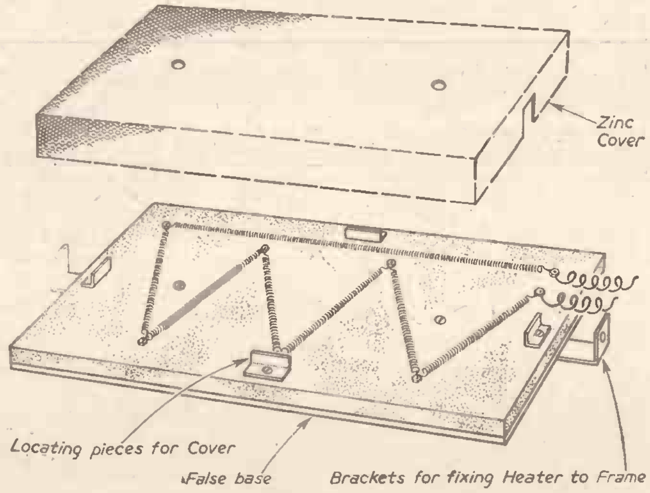


Fig. 7.—The complete assembly.

from being overworked during cold nights.

I personally am not in favour of having heaters rated at more than 100 watts, preferring to have two or more in large tanks for better heat distribution, and also, in the event of a heater failure, the effect is not as noticeable. A further advantage of having heaters of the same rating is that they are all interchangeable in the event of a replacement being necessary. The table will serve as a guide. Eighty watts is specified for the small heaters for the reason that this size of element is obtainable from the supplier named.

SUGGESTED RATINGS OF HEATERS FOR STANDARD AQUARIA

Dimensions (inches)	Approx. capacity in gallons	Rating of heater(s)
18×12×12	9	80 watts
24×12×12	12	100 watts
24×15×15	18	2 heaters 100 watts
36×15×15	28	3 heaters 80 watts

PARTS LIST AND SUPPLIERS

The Technical Services Co.
Spiral elements 80 and 100 watt, 1s. and 1s. 1d. each.

Laboratory Furnishers
Pyrex test tubes, 6in. × ⅝in..
Pyrex tubing, 1 cm. O.D.
Pyrex tubing, ⅞in. bore.
Pyrex tubing, 3 mm. I.D.
Rubber bungs.

Local Chemist
Sodium silicate (waterglass).

Local Builders' Merchant
Hard asbestos, approx. 9d. per square foot, cut to size.
Perforated zinc.
2in. × 1in. wood.

P.V.C. connecting wire.
Assorted small nuts and bolts.
Asbestos string ⅛in. diam. from local plumber. In case of difficulty, Ellis Sykes, 7, Princess St., Stockport.

Using Lenses

Arrangements for Simple Microscopes, Magnifiers, Lanterns, Binoculars, etc.

By F. G. RAYER

HIGH-QUALITY lenses are obtainable cheaply from ex-Service stores, and can be used with success in home-made equipment. When the construction of optical items of this nature is considered, doubt may be experienced upon the type of lens to use.

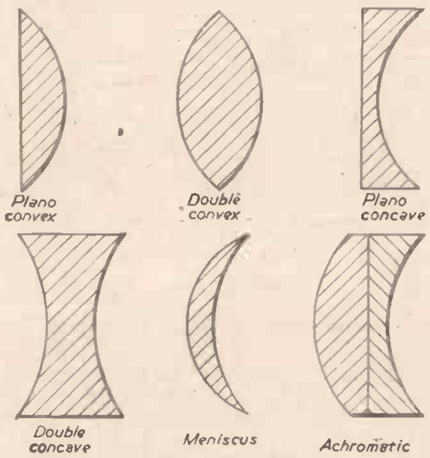


Fig. 1.—Six of the various types of lens in common use.

Several types of lens exist, those most often employed being shown in section in Fig. 1. These types may be divided into two broad classifications: positive, or magnifying lenses, and negative, or reducing lenses. The former, whatever their shape, will be thicker in the middle than at the edges. The latter, however, will be thinner in the middle than at the edges. Each has a special function, and cannot be replaced by the other type.

Referring to Fig. 1, the plano-convex and double-convex types will be magnifying lenses, generally referred to as "positive" in type. The plano-concave and double-concave types, however, are reducing glasses, or "negative" lenses. They cannot be used for magnifying because they disperse the light rays, instead of bringing them to a focus. Both positive and negative lenses may be had in meniscus form. This can give a flatter field, and for this reason a simple lens used in a box- or other simple camera will usually be of meniscus type.

All such simple lenses, of either kind, may be a single glass. This is in order for magnifiers, etc., or equipment where the very edge of the field embraced by the lens will not be used. As a lens resembles some part of a prism, at its edges, light rays passing here are broken up into spectrum colours, and subjects at the edge of the field may be brought to a focus at a different distance. These faults (rainbow hues at the edge of the field of view, and curvature of field) can be avoided in more advanced lens designs. One such type is the achromatic doublet, consisting of two glasses, either cemented together or held in a mount. Such achromats are used whenever best results are wanted, especially in binoculars or other optical assemblies embracing a large field of view, and where maximum definition is required.

Focal Length

The best kind of lens to employ in any particular equipment will become clear, but the matter of focal length must first be dealt with. With a positive lens, the focal length is that at which parallel rays of light are brought to a sharp focus. If lenses of unknown focal length are to hand, this figure can easily be determined, as shown in Fig. 2. The sun is the most ready source of parallel rays of light, and the distance between lens and a card is adjusted until the image thrown is reduced to the smallest spot. The distance between card and lens can then be measured, and is the focal length.

With negative lenses, no image is thrown, and the matter is somewhat complex. However, this can readily be overcome by using a simple practical method, which determines the focal length closely. To do this, a pair of compasses is set with points at such a distance apart as to equal the *diameter* of the lens ("D" in Fig. 2). This setting is then retained, and a circle drawn on card, its *radius* being equal to "D," or its diameter to twice "D." Distance between lens and card is now adjusted, as with the positive lens, until the sun's rays exactly fit the 2xD circle. The distance between lens and card is then measured and expressed as a negative value, e.g., −3in., if the measured distance was 3in., and so on. This is the focal length of the negative lens.

Application as Magnifiers

Any positive lens will magnify, the effective magnification increasing as the focal length is reduced. The *diameter* of the lens has no influence whatever on magnification, only governing the size of the field embraced by the lens. Magnification may be expressed by dividing the focal length of the lens, in inches, into 10. For example, a lens of 1in. focus will magnify 10 times, or be a 10x magnifier. A 2in. focus lens would magnify five times, or be a 5x magnifier, and so on.

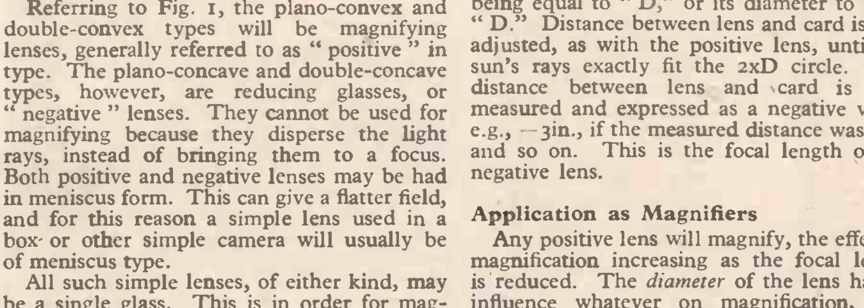


Fig. 2.—An easy method of finding the focal length of a lens.

The main advantage of using a simple magnifier lies in the brilliance of the image and large field embraced. This fact makes the simple microscope popular, one arrangement for this being shown in Fig. 3. Here, the lens is fitted to an arm, the height of which can be adjusted. A glass plate forms the stage, and light may be directed up through this by a mirror, the angle of which may be set to suit the source of illumination. With such a method, a magnification of 20x will be achieved with a ½in. focus lens. If an achromat is used, the microscope will be comparable in results to laboratory instruments of this type. The field of view is very large compared with a compound microscope, and the illumination of the subject very good, as light losses are small. For average purposes, lenses of 2in. (5x) and ½in. (20x) will be useful.

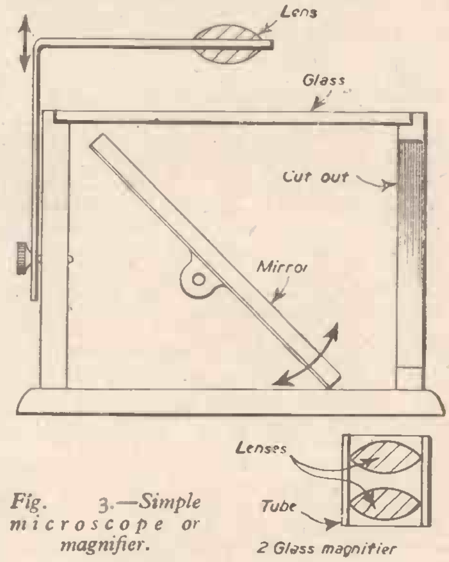


Fig. 3.—Simple microscope or magnifier.

When a lens is of very short focal length it cannot be of large diameter, so that the field of view becomes very small. This may be overcome, and a flatter field obtained, by using two lenses close together, as shown in Fig. 3. These may be fitted in a short tube or other mount. If they are plano-convex, the convex sides are placed adjacent. The total magnification will be approximately equal to that of both lenses used alone—e.g., two 5x lenses (2in. focus) would provide 10x, or now have a 1in. focus.

Projectors and Lanterns

Fig. 4 shows an optical arrangement suitable for a small lantern, the lenses being held in suitable tubes by means of small rings or circular spring clips. The dimensions actually given need not be followed exactly, since the picture thrown by the lens can still be brought to sharp focus, even with other lenses than those given, by adjusting the distance between plate and lens, or lantern

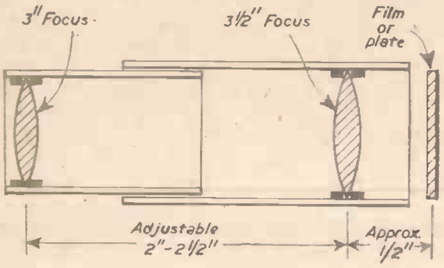


Fig. 4.—Sectional view of a typical projector or lantern lens.

and screen. Here, again, single glasses will do well, but achromatic lenses will give better results towards the edges of the field of view. If two achromats are employed then the definition may equal that of a high class projector lens.

When making a lantern it is best to arrange matters so that both the distance between lenses, and between rear lens and plate, may be adjusted. Sliding tubes made to fit inside each other are suitable for this. It is also necessary that the lenses be of large enough diameter, or the corners of the picture may be lost. The *minimum* focal length, for a given lantern plate, may be found by measuring the diagonal of the plate. For example, a 2in. × 2in. plate will have a diagonal of approx. 2⅞in. so that a lens assembly of shorter focus than about 3in. could not normally be used, without danger of losing the corners of the picture. An average projector lens has a focal length about one-third greater than the length of the diagonal. That is, 4in. for the 2⅞in. diagonal or 2 × 2 slide. Longer focal lengths can be used, but it will then be necessary to have the lantern farther from the screen, to obtain a picture of given area.

When two or more lenses are separated by a fairly large distance it is no longer possible to measure the focus from one glass, as with a single lens. The focus of the combination may, however, be found as explained in Fig. 2. It will then be found that as the distance between glasses is varied (as in Fig. 4) so the focal length of the whole assembly is modified, which is a very useful feature in a home-made projector.

Opera Glasses

It is not proposed to deal with compound microscopes, telescopes and other systems using more than two lenses, at the present, but the simpler type of binocular may be constructed by providing an optical system such as that in Fig. 5. With this type the light rays from the subject are converged by the field lens, which is of magnifying type. Since the eye cannot form an image from such converging rays, a negative lens is used to spread them after magnification. The positive lens forms the field objective, and the negative lens the eyepiece.

Such an optical system cannot give the high magnification obtainable with a telescope or prismatic binoculars (which are virtually two telescopes together). However, the field of view can be large, and the degree of illumination great, which accounts for the popularity of such simple binoculars, especially for use in poor light. If achromatic lenses are employed, the standard of definition can be excellent.

Magnification may be adjusted to some extent by modification of the focal length of the lenses, but the figures given in Fig. 5 are very good for average purposes. In view of the difficulty of computing the magnification from systems of this kind, a simple experiment is best made to discover if lenses to hand will be satisfactory. As with the other systems, the diameter of the lenses will not influence magnification, but will govern the field of view. Very tiny lenses are not much use, for this reason.

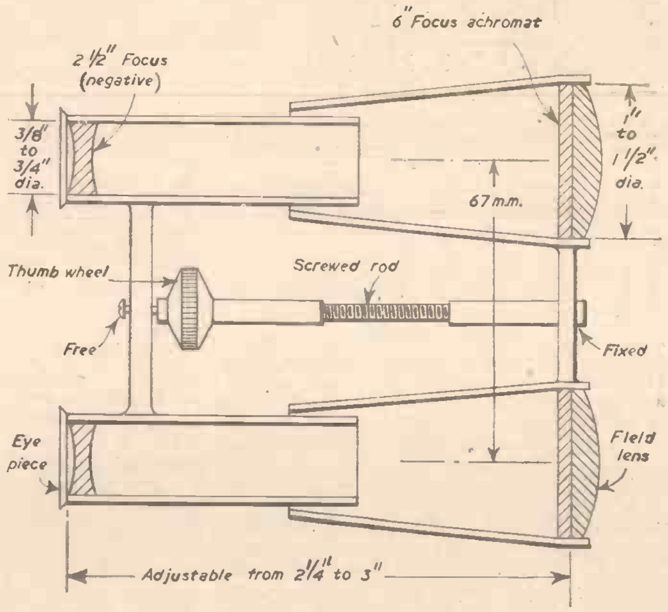


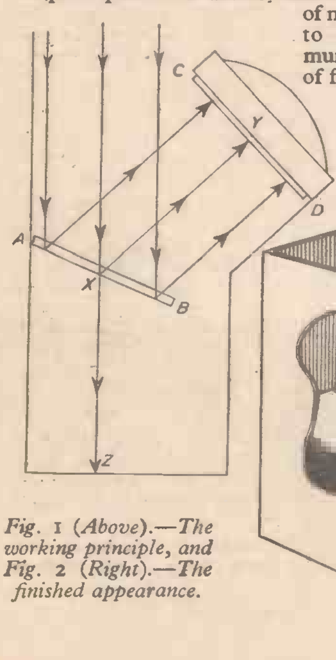
Fig. 5.—" Opera " glasses.

Such an optical system forms a simple telescope of low magnification, if the lenses are fitted in tubes. A diaphragm, or disc with centre hole, may be placed between the lenses to cut down stray light and thereby increase contrast in the image. Opera glass type binoculars consist simply of two such lens assemblies side by side, identical objectives and eye-pieces being used.

An Enlarger Focusing Aid

Details Received in Response to a Request Published in "Information Sought"

TO increase the accuracy of focusing an enlarger use is often made of a focusing aid. This article deals not only with the principle of the device, but also a method of magnification to give maximum accuracy of focus.



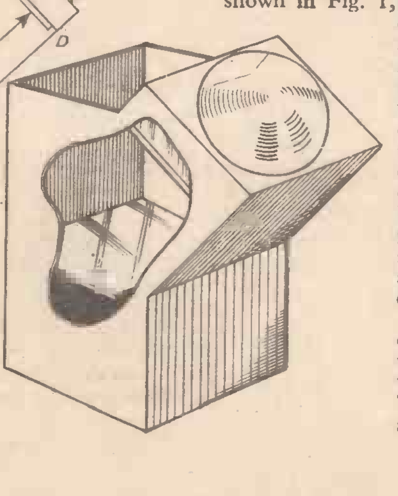


Fig. 1 (Above).—The working principle, and Fig. 2 (Right).—The finished appearance.

Materials for, and method of, construction are not given, being left to suit requirements.

The basic principle of the focusing aid, as shown in Fig. 1, is that the light from the enlarger enters vertically and is reflected from the mirror AB on to a ground glass screen CD. The distance from X to Y, at the centres of the mirror and screen respectively, must equal X to Z, the points to calculate from being the back of the mirror and the ground surface of the screen. This is essential if accuracy of focus is to be obtained.

The device takes the form of a box open at the top and with a sloping front, where the screen is positioned. The mirror forms an angle of 22½ deg. with the base, and the screen an angle of 45 deg.

The magnification of the image is obtained by a similar principle to that used in a transparency viewer, namely by the fixing of a plano-convex lens above the ground glass screen, as shown in Fig. 1, and it is suggested that a lens of 3½in. diameter and focal length of approximately 5½in. be used.

In order to obtain maximum overall magnification without distortion, it is necessary to find the distance of the lens, from the screen, by trial and error. This position will be found an inch or two above the screen.

It will be best to make a scale drawing of the device before construction commences, and the suggested design and appearance of the completed article appears in Fig. 2.

WATCH REPAIRING for the Amateur

By F. J. CAMM

The Fourth Article Of a Series on the Repair and Adjustment of Wrist and Pocket Watches

Pinning Up

HAVING found the pinning point of the hairspring, it should be passed through the hole in the stud and locked with a pin. A similar procedure for making the pin is adopted as for the collet. It is filed slightly tapered and much longer than is necessary and the side of the pin which is to be in contact with the hairspring must be filed flat. If left round it tends to distort the hairspring as the pin is pushed home.

Having by trial and error filed it to the right shape, gently try it in the hole and mark the cutting-off point. This point may be partly filed through so that after pushing home the excess may be snapped off, or it may be cut off with a pair of side cutters, as shown in Fig. 34. Now pass the outer coil of the hairspring through the two pins on the regulator, or through the buckle, which is sometimes used in place of pins. We are now ready to give the watch a trial, but first ensure that you have fixed the hairspring on the balance staff so that the stud is at right angles to the impulse pin. This may be tested by removing the stud from the balance cock after it has been pinned up and observing whether it lies in the centre of the balance arm. Presuming that to be so, place a little oil in the jewel holes by means of the oiler (a piece of wire pointed off and flattened at the end) and reassemble the cock into the movement, giving the mainspring a few winds. If all is in order the watch should commence to tick, and if it does so fully wind the watch, set it to time and check it against a watch or clock known to be going to correct time. If this master watch or clock has a second hand set the second hand of the watch to coincide with it. Thus you will be able to observe hour by hour whether the watch is gaining or losing, and you will be able to make adjustments to the hairspring without having to wait 24 hours. If the watch is gaining the hairspring must be unpinned at the stud and a little of it slacked out, of course setting the watch in beat again by turning the collet with a thin screwdriver placed in its slot. On the contrary, if the watch is losing a little of the hairspring must be pulled through. A sufficient length of hairspring is left projecting through the stud to permit of this adjustment—usually about a quarter of a turn. It is necessary to ensure that the hairspring expands and contracts quite concentrically.

The buckle on the end of the regulator has a foot in which is a screwdriver slot and this may be turned to admit the hairspring, then the foot is again turned to prevent the coil jumping out. It is important to observe that the second coil of the hairspring does not touch the back of this buckle as the hairspring expands and contracts. Otherwise the rate of the watch will be affected — it will gain rapidly.

Breguet Hairsprings

When dealing with the Breguet hairspring, however, a different procedure is adopted and it is necessary when breaking the spring down to length to get it as near as possible to time, since once the overcoil has been formed the watch can only be brought to time by means of the screws round the rim of the balance, and if the watch is badly out, say, several minutes a day gaining or losing, it may not be possible without using timing washers to bring the watch to time, if it is going fast, or if it is going slow by filing the heads of the screws, a practice not to be recommended, since it means continuous repoising.

First select a flat spring, presuming that a replacement Breguet of the right strength is not obtainable from the material dealers, and attach the collet as with a flat hairspring. Then, with a pair of tweezers gripping the outer coil, vibrate the balance and count as before, unless you have a counting machine which consists of a balance correctly sprung and against which the balance and hairspring receiving attention may be adjusted until both vibrate at the same rate. Having found the vibrating point, the overcoil must be formed as shown in Fig. 35. This is done with special die-nosed pliers. It will be seen that two bends are made half a coil from the vibrating point—the outer coil is brought in so that it is of smaller radius than the body of the spring. Carefully adjust this overcoil so that when on the balance the regulator pins just pass over it without distorting it. The height of the overcoil is, of course, important. It must be made so that it does not foul the underside of the cock or rub on the centre wheel. It is a common fault that some overcoils are set too high, slightly touch the cock as a consequence, and cause the watch to gain. The spring must be lightly pressed between the regulator or index pins so that there is no movement. Move the regulator to make certain that in traversing it from fast to slow the hairspring is not distorted. The curve of the overcoil must be adjusted so that it is circular for a length equal to the full traverse of the index pin. Any play between the overcoil and the index pins will account for as much as 12 seconds a day between the dial and pendant-up positions. Otherwise the pinning up to the stud and the final testing is carried out as for a flat hairspring.

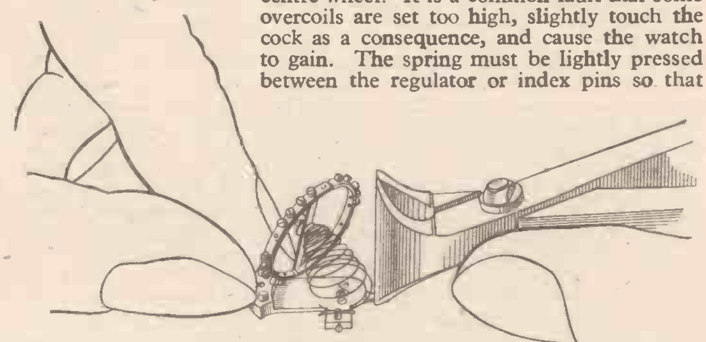


Fig. 34 (above).—Cutting off the locking pin after passing the hairspring through the stud.

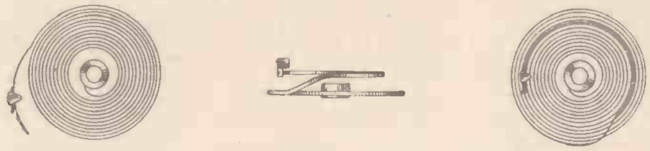


Fig. 35 (left).—On the left, a flat hairspring. Centre and right, a Breguet hairspring in end and plan view showing the overcoil.

Fitting Hands

Cards of hands, minute, hour and seconds, are available from the material dealers in a wide range of styles, such as moon, spade, cathedral, luminous, etc. It is seldom that an hour hand is broken and repairs are mostly confined to the minute and second hands. An hour hand must be selected of the right length, and of the right hole diameter to fit the pipe to close up and bind on the cannon pinion hand which is too tight, as this may cause the pipe to close up and bind on the cannon pinion which passes through it, and to stop the

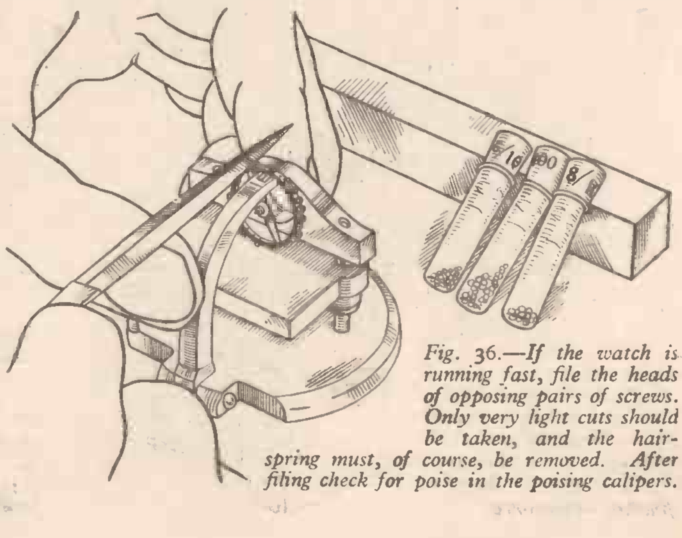


Fig. 36.—If the watch is running fast, file the heads of opposing pairs of screws. Only very light cuts should be taken, and the hairspring must, of course, be removed. After filing check for poise in the poising calipers.

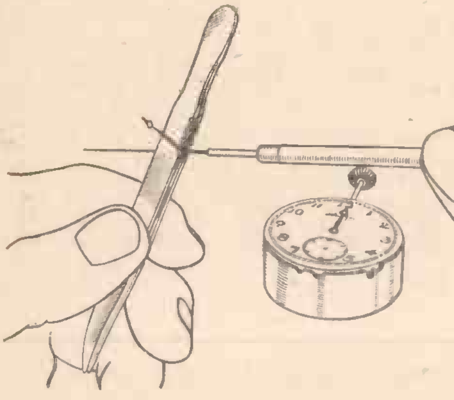


Fig. 37.—Broaching open the hole in the minute hand. The boss is held at the back of a pair of notched tweezers. Various sizes of broaches are available for this purpose.

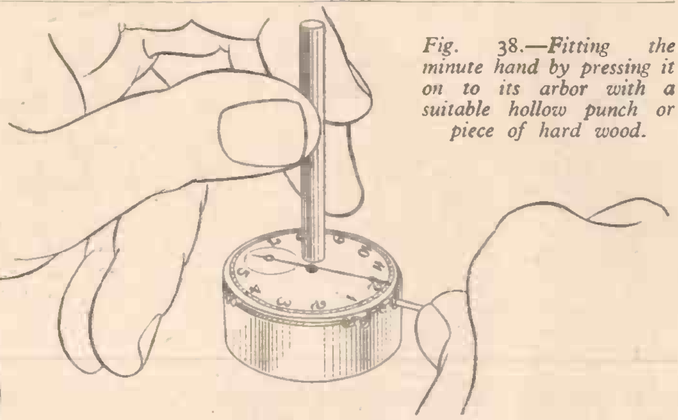


Fig. 38.—Fitting the minute hand by pressing it on to its arbor with a suitable hollow punch or piece of hard wood.

watch. If the hour hand is already there, and the minute is missing or broken, select a hand which matches up in character with it, and see that it is of a length just to reach the outside of the minute circle. In general, watch hands are not interchangeable. The minute hand is a press fit either on the cannon pinion or the centre arbor, and the hole has to be broached out very carefully so that the hand presses on without slackness. Broaches are used for this purpose and they are obtainable in a variety of sizes. The hands should be held in a pair of tweezers notched at the back end to grip the boss of the hand (Fig. 37). If the boss of the broken hand is still on the watch this is a most useful guide for hole size. Place the broken piece on the broach and proceed to open up the new hand until it just touches the old piece. Then remove the latter, give the broach a further turn or two, when the hole size should be correct. An hour hand is of correct length when its tip just overlaps the inner edge of the figures on the dial. The second hand is right when its tip just reaches the second circle. Second hands are a more delicate operation and they may be held in a special tool made for holding second hands whilst the fine broach opens out the hole in the pipe, or if the second hand is of steel it may be held between the fingers.

The minute hand may be pressed on with a suitable hollow punch. On some of the very cheap watches the cannon pinions carrying the minute hand are made of brass, and particular care is necessary to ensure that this is not distorted or closed up. The minute hand may be pressed on in a jewel press or by holding the movement over a suitable stake which supports the pivot of the hour wheel, projecting through the back plate (Fig. 38).

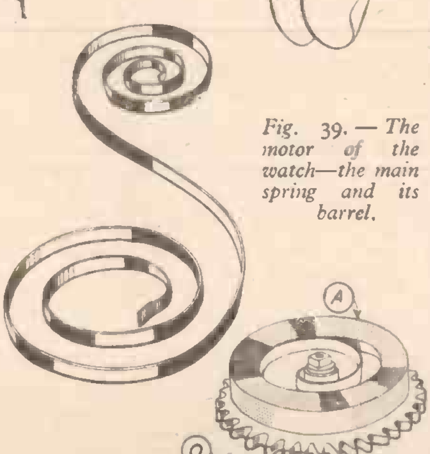


Fig. 39.—The motor of the watch—the main spring and its barrel.

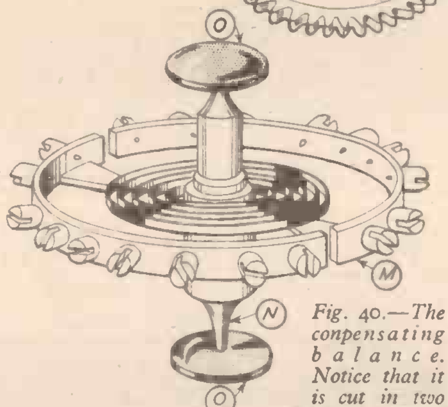


Fig. 40.—The compensating balance. Notice that it is cut in two places round the circumference to allow for expansion and contraction with temperature changes. The rim of the balance is bi-metallic, and consists of an inner rim of steel and an outer rim of brass fused together. Owing to the difference in the coefficient of expansion of steel and brass, the balance contracts as temperature rises, and expands as it drops. The pivots, it will be seen, run on end stones, fixed over the jewel holes.

The Watch Train (Figs. 39 to 43)

The motor of the watch is the mainspring, which is wound into a drum-like box called the barrel (A), its outer end being fixed to the barrel drum and its inner end fastened to the barrel arbor. It is coiled on that arbor when the watch is being wound up. From the barrel-toothing the motion is communicated to the pinion (B) of a wheel (C), which meshes with (DE). Therefrom, the motion is transmitted to (FG). On the axis of (DE) is fixed the minute hand. From this hand another train of gears (not shown here) sets the hour hand going 12 times slower. On the axis (FG) is fixed the little second hand. It is easy to understand what would result if the movement has no further gear mechanism: simply that the effort of the barrel would give the highest speed to the axis (FG). Here interferes the escapement, which must regulate this speed and bring it within the exact measure of time. The wheel (G) sets a wheelwork, called "escape wheel" (K), going through the pinion (J). Said wheelwork acts on the lever and sets the latter in a wigwag motion. The extremity of the lever (L), called "fork," gives alternate impulses to the principal piece of the watch: the balance wheel (M). This wheel, owing to its mass, cannot oscillate very rapidly. It is regulated exactly by adjustment to the length of the hairspring and the precision of the running depends on this adjustment almost exclusively. The balance wheel, the axis of which has two conic and very thin pivots, revolves in jewel holes, with a view to reducing wear and friction to a strict minimum. What happens if your watch receives a strong shock? Of course, it may be still running. However, it is not the case generally and any of four accidents may occur. Owing to the weight of the balance its pivots (N) may be broken or twisted. The jewels—there are two at each extremity of the axis—may also be broken, either one or the other, or even both.

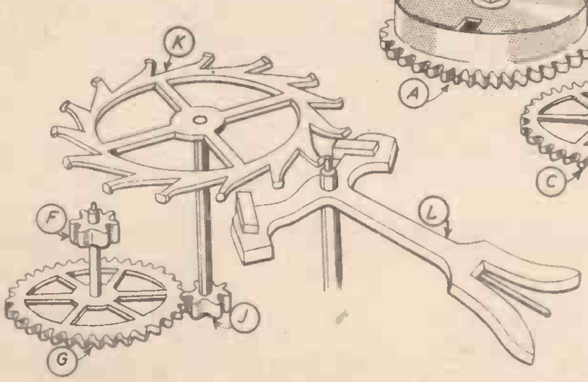


Fig. 41.—The escape wheel, pallets, and seconds wheel.

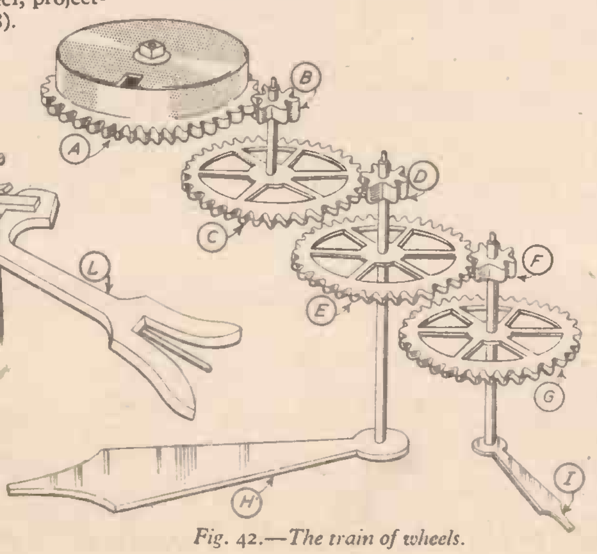


Fig. 42.—The train of wheels.

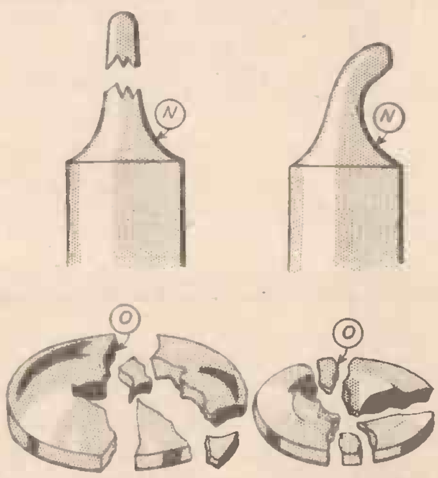


Fig. 43.—What happens if you drop your watch? The pivot may become broken or bent, or the end stones and jewel holes may be shattered.

An ELECTRIC RIFLE RANGE

Try Your Skill Indoors With This Unique Device

By R. BRIERLEY

Fig. 1.—The completed unit.

FIG. 1 shows the complete electric rifle-range and Fig. 2 the general arrangement of the electric rifle complete with target simulator box. Within the simulator box is a miniature target, which is struck by the dart contained in the firing mechanism. This dart completes an electrical circuit, lighting a bulb in the portion of the main target affected or struck. Four 2.5-volt bulbs are mounted within separate compartments of the target proper.

Construction

The target simulator box (Fig. 3) is made from wood, ¾in.-thick base x ½in.-thick sides, secured with 12 No. 3 x 1in.-long screws, which are run down slightly below the surface. Putty over the screw heads and joints before "sanding," staining and polishing the box.

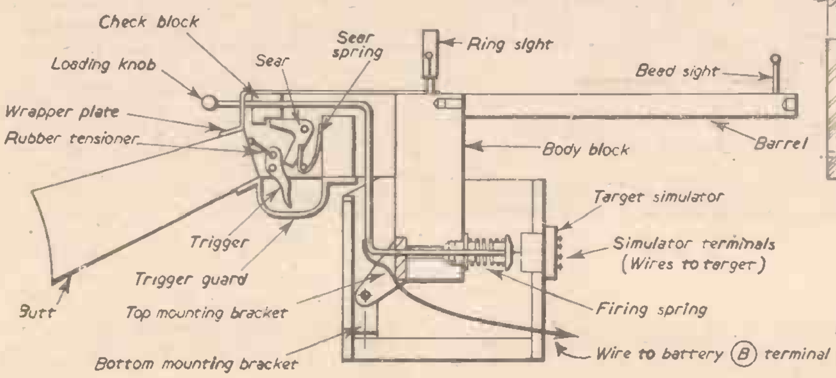


Fig. 2.—Electric rifle arrangement.

A brass base bush and a brass or aluminium rubbing strip are shown in their respective positions on the simulator box. The bush should be a tight fit in the base of the box. Three No. 2 x ½in.-long screws retain the rubbing strip to the lowest side of the box.

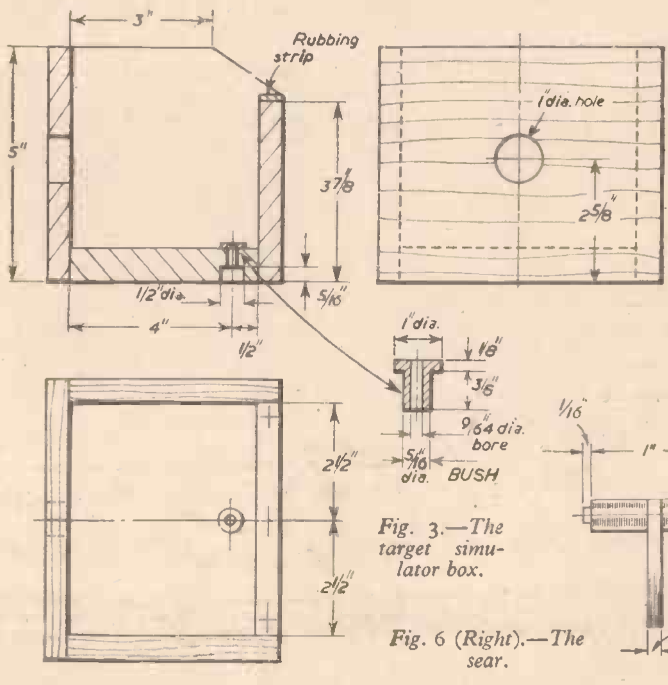


Fig. 3.—The target simulator box.

Next, produce the body block (shown in Fig. 4) from wood, drilling a hole near the top, as shown, to take the gun barrel, and the bottom counterbored hole to take the firing rod. Cut the top mounting bracket, shown in position on the body block, from a small block of aluminium or brass, drilling the guide hole for the firing rod and two holes to take ⅛in. diameter x 1¼in.-long securing bolts. The bottom bracket for securing the body block to the simulator box base, which is also shown in Fig. 4, is produced in a similar manner and put

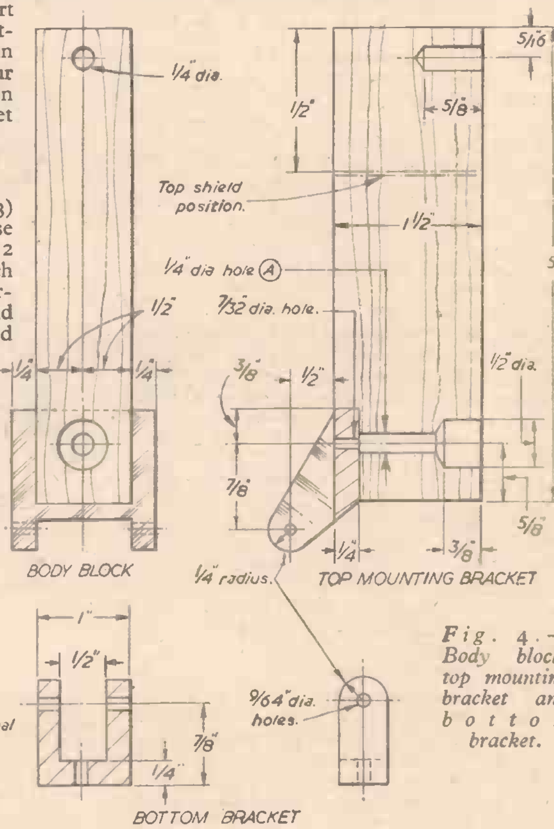


Fig. 4.—Body block, top mounting bracket and bottom bracket.

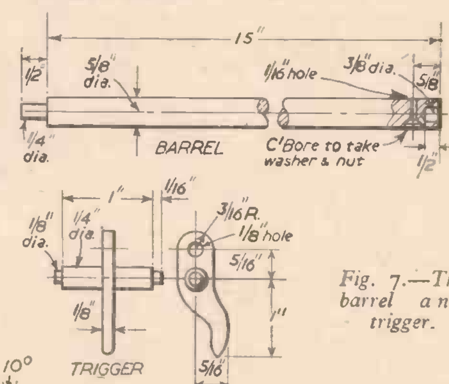


Fig. 7.—The barrel and trigger.

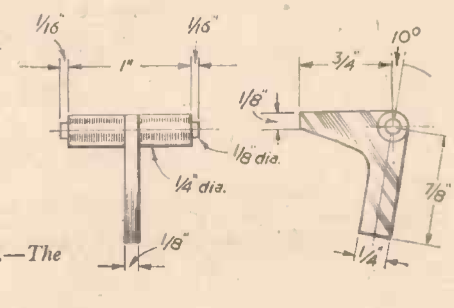
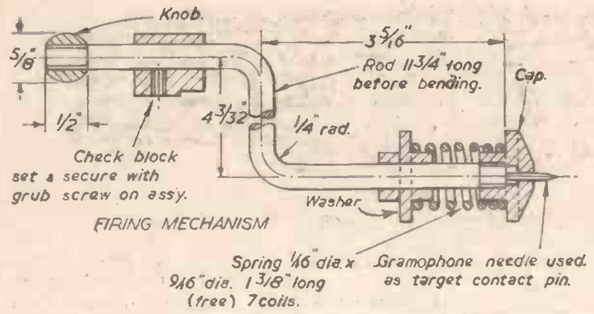


Fig. 6 (Right).—The sear.



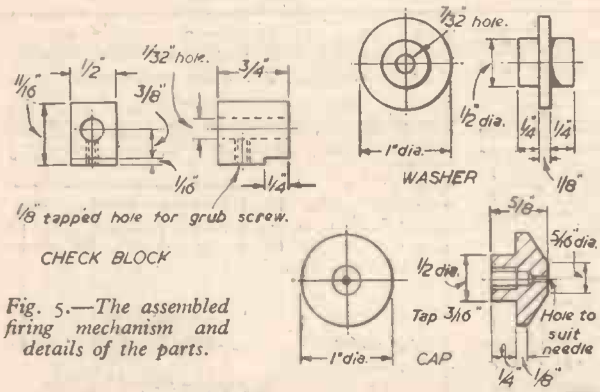


Fig. 5.—The assembled firing mechanism and details of the parts.

aside until final assembly of the rifle unit.

Firing Mechanism

The firing mechanism parts are produced to the dimensions given in the detailed drawing (Fig. 5), and then assembled temporarily, as also shown in Fig. 5, to test the accuracy and function of the unit These parts may then be fitted to the body block by threading the 11¾in. rod through hole A (Fig. 4) and then assembling the washer, spring and cap.

The sear and trigger (Figs. 6 and 7) are cut from steel sheet ⅛in. thick, the twin spigots or crosspieces being soldered in position. Make the trigger guard (Fig. 8) from brass, drilling where shown to take two No. 6 x ⅝in.-long securing screws.

The butt of the rifle (Fig. 11) is cut from wood. Remove sharp edges and sand-paper well before staining and polishing.

Next, produce the barrel (Fig. 17) from ⅝in. diameter dowel rod, treating it in a manner similar to the butt. This piece is drilled at one end to take the front bead sight.

Sights

Parts for the sights (Fig. 12) are made as accurately as possible from brass, the ring for the rear sight being preferably cut from a piece of tube. It may, however, if desired, be made from a strip with a hole at each end for securing to the upright rod after it has been bent or rolled. If the ring is produced in this manner the length of the strip will be 5⅛in. and the hole centres will be 4¾in.

Mark out the pattern (Fig. 13) for the wrapper plate on to a suitable sheet of aluminium or brass, drill all holes as indicated, trim, and after deburring, bend carefully as shown in Fig. 14. Follow the same procedure for making the top shield for the simulator box. The material used for this is 20 s.w.g. aluminium or brass and details and dimensions for drilling and bending are given in Fig. 15.

(*To be concluded.*)

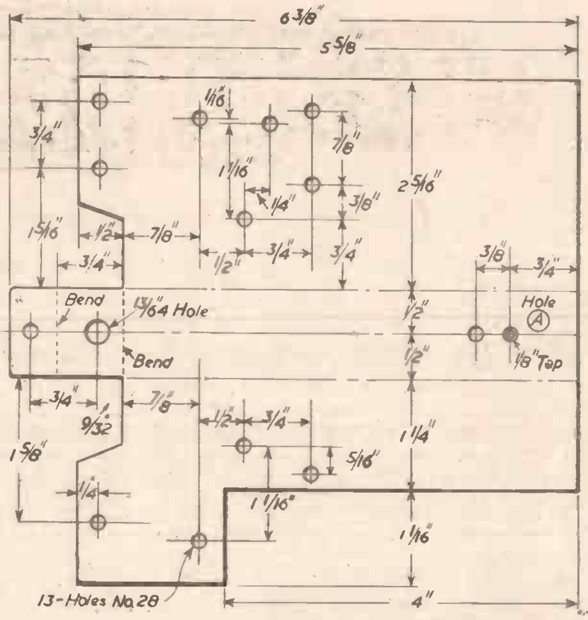


Fig. 13.—Wrapper plate pattern.

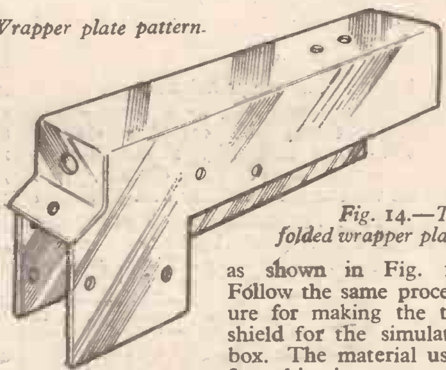


Fig. 14.—The folded wrapper plate.

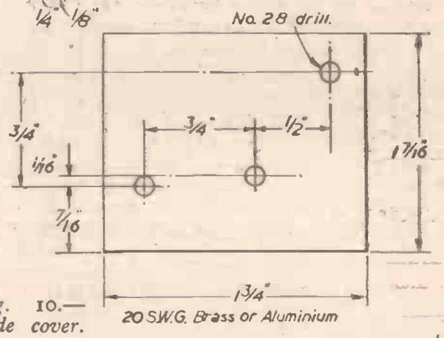


Fig. 10.—Side cover.

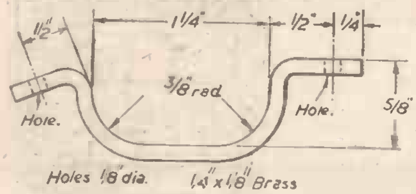


Fig. 8.—The trigger guard.

Fig. 11.—The butt.

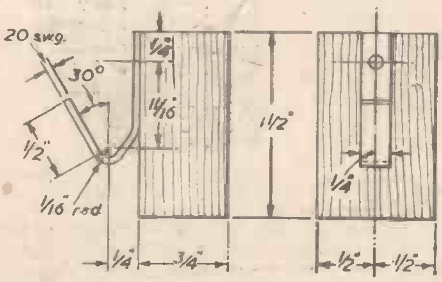


Fig. 9.—Sear spring and block.

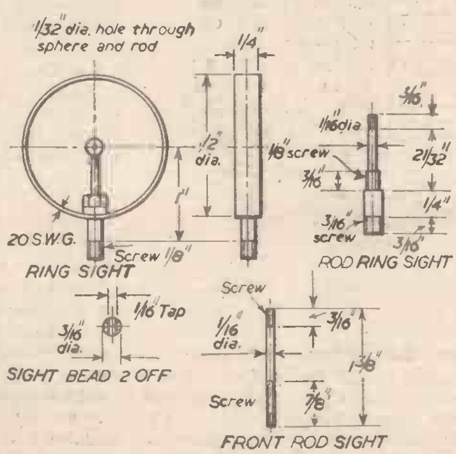


Fig. 12.—Details of the sights.

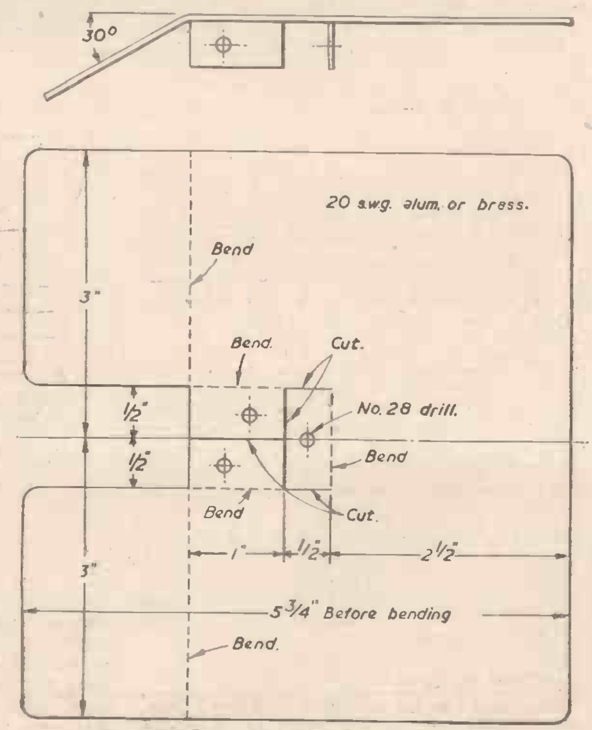


Fig. 15.—Top shield for simulator box.

The Magnetic CRACK Test

The Apparatus and Methods Used to Detect Minute Flaws in Steel Components

By ERIC N. SIMONS

BARS of steel, particularly those which it is proposed to employ for the manufacture of expensive tools, forgings and drop-stampings, have to be entirely free from cracks. It might be imagined that these faults would be readily detected, either by careful visual examination or by some form of ringing test. This is not so. Even the closest visual inspection may fail to reveal a crack, and a test by striking the bar and listening to the ring may be ineffective, for the reason that the crack may be much too small to affect noticeably the tone produced. Moreover, some of the steels are so hard and brittle that a sharp blow might cause fracture.

In consequence, steel users and manufacturers have over the years sought consistently for some apparatus that would enable a rapid and efficient examination of ferrous materials for cracks and other superficial flaws to be made. Some years ago the first practical magnetic crack-detecting machine was put on the market, and since that date magnetic crack detectors have been put into regular use, and have proved extremely useful for the work.

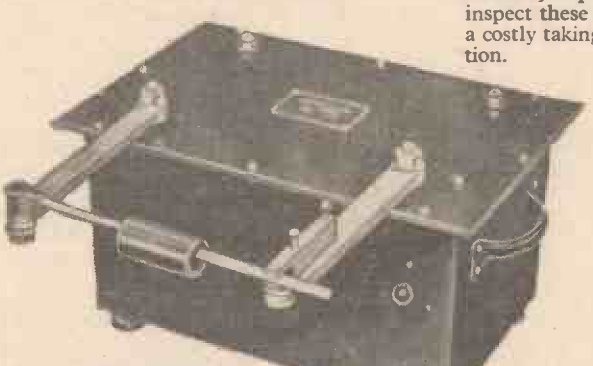


Fig.—1. Johnson-Fel crack detector with ring jig for gudgeon pins, gear wheels or any article that will slide over ⅜in. dia. bar.

The Principle

When discontinuities occur in or close to the surface of a magnetic metal, the magnetic susceptibility becomes considerably less than that of the unflawed metal around it. Consequently, if the surface of the metal is subjected to a magnetic flux, caused by the passage through the material of an electric magnetising current, and assuming the direction of this magnetic flux to be at an angle of 90 deg. to the principal plane of the crack, the crack will fulfil the function of an air gap. As a consequence, the flux will be distorted at the crack and also to a smaller and lessening extent in the region about it, this distortion persisting as far as the surface and even beyond it. The degree and character of the distortion are governed by the magnitude of the discontinuity, the size of the bar or other piece, and the magnetic field strength. If the field strength is raised still further, the distortion extends still further beyond the surface, and it is the distortion at the surface that enables cracks to be detected.

The Test Method

The steel bar for testing is first freed from dirt, grease, etc., after which it is placed across the arms of a machine such as that shown in Fig. 1. These arms may be adjusted to accept work of widely different form and dimensions. The current is now passed through the bar, and when this has been done the bar is taken from the arms and sprinkled with a special powder or solution provided for employment with the machine. The excess of this powder is blown away or removed by shaking, and the defects will at once be disclosed, as shown in Figs. 2, 3 and 4. Wherever there is a discontinuity, in fact, the magnetic field will be interrupted. The same method may also be adapted to the disclosure of incipient cracks, frequently occasioned by fatigue, in such parts as the axles of locomotives, airplane structures and engines. To inspect these by other methods would involve a costly taking down periodically for examination.

Advantages of the Test

The advantages of the magnetic crack detection test are that the apparatus is readily portable and can be connected to the nearest suitable A.C. or D.C. source of current. It is non-destructive and is therefore highly valuable for testing finished products. The surface of the work being tested is in no way marked or deformed. Flaws too fine for detection by visual inspection are shown up clearly. A considerable range of parts may be tested when they are in a half-finished state, with the result that those proved faulty may be rejected before costly finishing work is done upon them. Supplies of raw material may be tested for surface flaws, or, if a machined or ground disc section or slice is taken, for internal soundness.

The Technique of the Test

In general, the most satisfactory results are obtained when the surface of the bar is machined or ground, but parts which have a certain amount of superficial scale, such as those that have been subjected to heat-treatment, may be locally cleaned at a point of suspected defect and magnetically tested.

Fig. 2.—Internal cracks on a sawn and ground disc.

The particles of magnetic powder used in making the test are sometimes suspended in a liquid which is washed over the surface of the work, or they may be dusted on. The direction of the magnetic field is important, because if this is parallel to the long axis of the work no flaws will be revealed, since the thin section of the field that is interrupted has not enough magnetising force to attract the magnetic particles in adequate quantity. It is possible to obtain crack patterns, or "indications," as they are termed, when the angle of the field direction is less than 90 deg. to the long axis, but the results are less satisfactory and become increasingly unsatisfactory as the angle grows smaller. See Fig. 5.

Magnetising in Two Directions

The method of obtaining a 90 deg. flux direction to the long axis of the work is to insert the work in a solenoid excited electrically in such a manner that the axis in question is parallel to the axis of the solenoid. The bar or other part is thus made the core of an electromagnet, and undergoes magnetisation by induction from the magnetic field set up in the solenoid.

Fig. 3.—Crazy cracks on a ground ring.

It should be remembered that a fine crack or other discontinuity in a piece of metal may run at any angle of orientation, so that it is often advisable and even necessary to magnetise it in two directions, the two fluxes being at an angle of 90 deg. to each other. Small components are often tested in this way.

The Flux Strength

The strength of the magnetic field is regulated in a satisfactory manner to a predetermined value, an indicator being provided with the apparatus to show the various field values and the current strengths corresponding to them. In most instances the best flux strengths lie between 30 and 90 ampere turns per cm., but the precise value selected should be held below the point at which the magnetic particles would collect on the unflawed as well as the flawed surface.

Actually the flux strength varies according to the purpose. A higher current is required when it is desired to detect flaws below the surface, such as blowholes, and a lower current for detecting surface discontinuities. Too high a current will be shown by the particles standing up in "whiskers."

The Magnetising Current

Any form of current may be employed for making this test, but D.C. is sometimes used as an alternative to A.C. or rectified A.C., because of its high sensitivity, which means that it will detect flaws both on and below the surface. A.C. can be used when surface flaws alone need to be revealed. Rectified A.C. enables the flux to penetrate more deeply into the material and is therefore useful when parts of considerable cross-section need to be examined.

Permanent Magnets

It is worthy of note that small steel components may be longitudinally magnetised by permanent magnets of the aluminium-nickel-cobalt type, and the same method may also be applied to welds and to places where, owing to some irregularity of form, the normal methods of examination are impossible. The use of permanent magnets has the advantage that the machine is easily carried from place to place and needs no external course of current, while it also consumes no current and is therefore less expensive to operate. In some instances the entire machine has been constructed of such magnets, and the size and form of the magnet circuit has to be designed so that on open circuit demagnetisation will not take place below the B.H. max. point of the magnet material. Moreover, the permanent magnet must be proportional in length to the length of the part to be magnetised, and in addition, the cross-section of the magnet must be large enough to yield the required magnetic field.

Magnetising Long Bars

Long bars and similar work are magnetised in stages by passing the solenoid lengthwise,

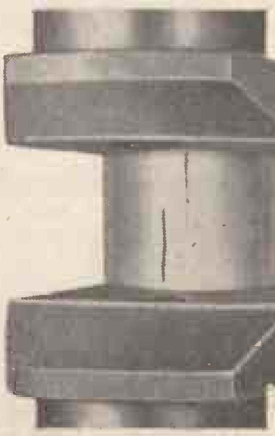


Fig. 4.—Crankshaft with cracks on bearing.

this method being adopted when it is desired to reveal transverse cracks. Extremely short parts may be magnetised parallel to the axis required by locating them in the suitable position in the solenoid. Work, such as barrels, cylinders, girder sections, etc., too massive for insertion in a static solenoid may be magnetised by passing a cable about them in a coil and passing a current through the coil.

Formula for Field Strength

To work out the flux value when a solenoid is employed, use is made of the formula $F = C \times T$, where F is the magnetising force, C the current and T the number of turns of cable or wire.

Circular Magnetisation

Circular magnetisation is that form in which a number of concentric circles are centred on the axis of the conductor, as shown in Fig. 5. Despite the fact that the flux takes a circular path, it is transverse to the work axis and is therefore capable of being used for the detection of flaws lying roughly in the same direction as the axis. If the work to be tested is hollow, the parts should be placed on a conductor bar situated on the axis of the work, the magnetising current being then passed through the conductor bar. This gives magnetisation of the internal surface, which is not obtainable by the normal method.

Dealing with Castings, etc.

Large work, such as castings, welded assemblies, etc., cannot be dealt with by the same method as small components, and for this purpose use is generally made of clamps and other appliances secured to flexible electric cables. In this way it becomes possible to magnetise only those particular portions or areas that need to be inspected. Direction of the flux is regulated by altering the position of the contacts, and it is possible to develop the flux in whatever direction it is required. Sometimes a prod-contact is used, with a flux not more than 1ft. long by several inches in width per passage of current. By making use of successive contacts of this type, consisting of rods of copper with insulated handles, a wide area may be covered; magnetisation in every direction being consequently developed by the circular method.

Continuous and Residual Methods

There are two systems of current application. One is the continuous method, in which the magnetic particles are applied to the part being tested at the same time as the current is flowing. This results in the flux value being a direct function of the magnetising current and the permeability of the ferrous material. The second is a residual method, in which the particles are applied after the current has been discontinued. The flux value is then decided by the amount of magnetism remaining in the work, and is always lower than in the continuous method. This is governed by the ability of the metal to retain the flux which is decided by its composition and hardness. Assuming a specified current, the residual method is not so sensitive as the continuous.

Action of the Particles

The magnetic particles may be applied by either the dry or the wet method, as earlier indicated. They are usually particles of extremely soft iron, with a porous texture, and held in suspense in a special fluid of hydrocarbon type (for the wet method). The air contained in the pores of the porous particles is designed to lower the specific gravity so that they do not sink to the bottom of the fluid, but remain permanently in suspension. The fluid may be of a colour suitable for the type of work. For example, black and red fluids are supplied for use on polished surfaces and black surfaces respectively.

The particles travel to the area of locally intense surface field or area of polarity across the edges of the discontinuity.

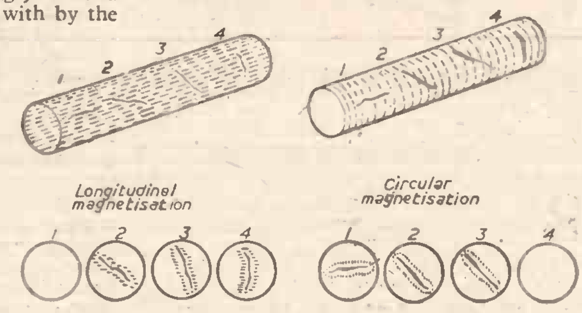


Fig. 5.—Influence of flux direct on magnetic particle pattern.

The Particle Carrier

The carrier for the magnetic particles (usually a petroleum distillate or oil) should not have a flash point below 60 deg. C. and its kinetic viscosity should be 3 centistokes at 38 deg. C. It is permissible either to spray the suspension over the work or to immerse the work in the suspension. The iron powder is usually supplied as a paste for mixture in the fluid. The normal concentration of solid particles in the fluid is approximately 1 oz. per gallon.

The Dry Method

In the dry method, the powder is dusted evenly over the ferrous material by means of a cloth dusting bag, or it may be sprayed on by some form of gun or atomiser. Dry powders can be had in grey as well as red and black.

Coated Work

Many parts that require to be tested may be coated with materials such as paint, enamel, lacquer, plated finishes, etc., for protection against corrosion. These coatings do not usually interfere with crack detection by the magnetic test, but some of the plating films are liable to reduce the sensitivity of the test so that it cannot be used for revealing flaws below the surface.

AN ELECTRICALLY DRIVEN Reciprocating Engine

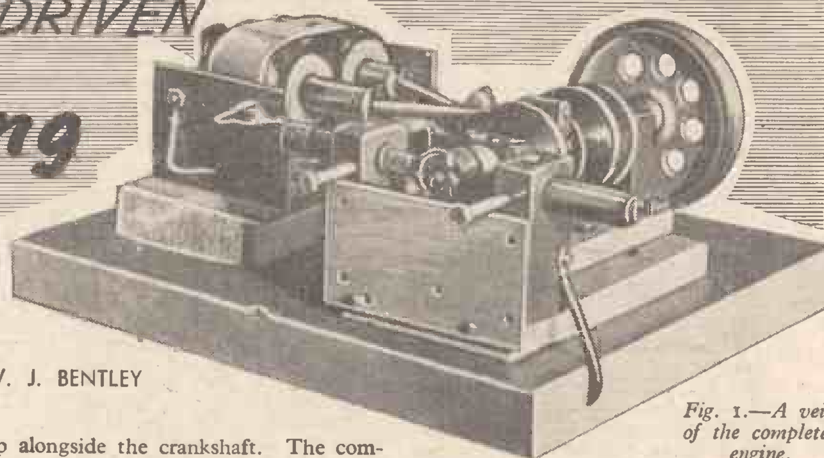


Fig. 1.—A veiw of the completed engine.

Constructional Details of a Novel Unit for the Model Engineer

By W. J. BENTLEY

RECIPROCATING engines are normally of two types, namely, internal combustion and steam driven. I have, however, evolved a third—a magnetic type.

This engine, although not as efficient as the conventional model electric motor, has novelty in that there are more working parts visible to the model engineer. It combines the movements of a steam or internal combustion engine, but is driven by electricity. Figs. 1, 2 and 3 are photographs of the completed engine.

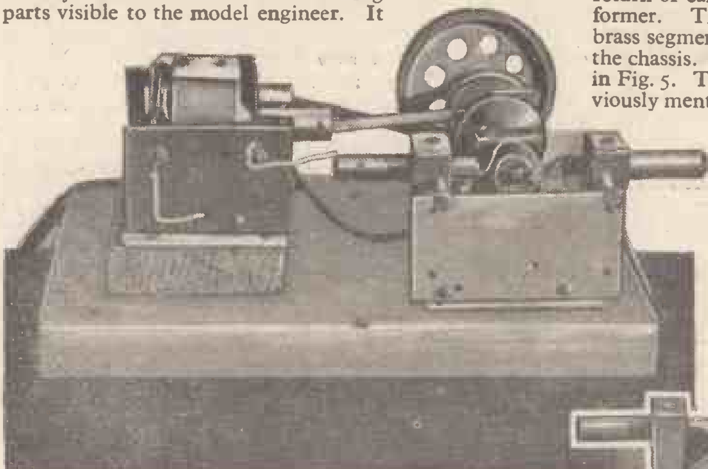


Fig. 2.—A side view.

The motor consists mainly of a crankshaft, marine heads, connecting rods and pistons, all actuated by means of a magnetic pull from two coils. These parts are all mounted on a steel or wooden chassis. Fig. 4 is a part-sectional view showing details of the assembly.

Sequence of Operation

This is as follows : electric current supplied from a 12-volt transformer is passed in parallel circuit to two coils. A commutator is situated on the crankshaft and the current after passing through one of the coils continues to a carbon brush and supporting mechanism set up alongside the crankshaft. The commutator is made of some insulating material such as "Tufnol" or wood, and has four brass segments set into its circumference. One of these segments is connected by way of the steel parts of the engine chassis to the return or earth wire to the transformer. The remaining three brass segments are insulated from the chassis. The circuit is shown in Fig. 5. The carbon brush previously mentioned is brought into contact with the segments on the commutator and when the segment connected to the return wire comes into contact with the carbon brush the electrical circuit is completed and a magnetic field is created inside the coil. This magnetic field is powerful enough to draw the piston within it, and in so doing moves the crankshaft round through 90 deg. and takes the commutator out of contact with the first carbon brush. The momentum supplied to a flywheel mounted on the crankshaft carries the working parts on through 180 deg. Then the segment on the commutator comes into contact, this time with another carbon brush unit horizontally opposed to the first and wired up in circuit with the second of the two coils. This, of course, draws in the second piston and once again momentum is supplied to the flywheel, carrying the moving parts round until the first carbon brush makes contact for the second time with the segment on the commutator, causing a magnetic field within the first coil.

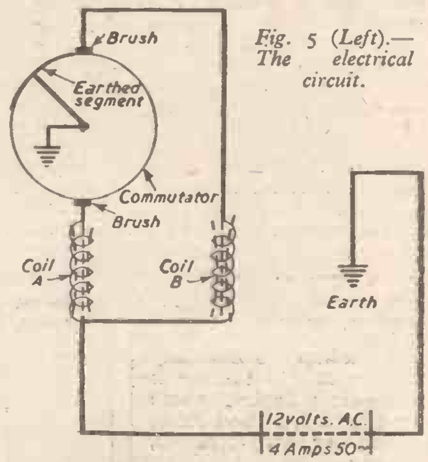


Fig. 5 (Left).—The electrical circuit.

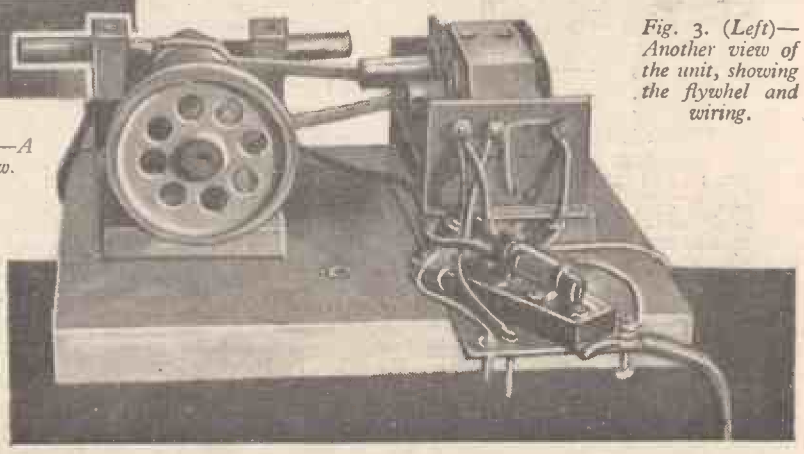


Fig. 3. (Left)—Another view of the unit, showing the flywhel and wiring.

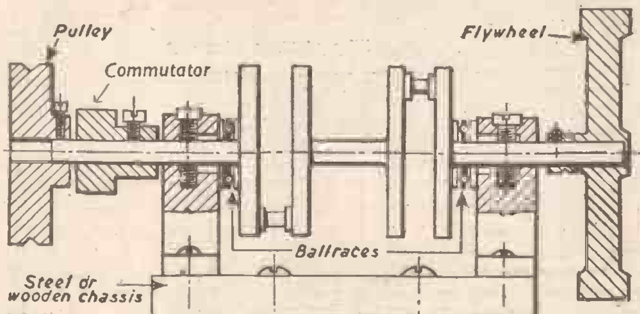


Fig. 4.—A part-sectional view of the crankshaft assembly.

Building a RADIO CO

A Description and Drawing

By Colonel C. E. BOWDEN

MOST readers will know that the use of a transistor in lieu of a normal valve is nowadays providing much lighter radio receivers, and I have found this type of receiver very reliable. It is shown in Fig. 5, installed in the "Radio Rook," which is the model to be described. The designer of this first transistor single-channel model receiver commercially obtainable in this country is Mr. Honnest Redlich whose address is 148, Nelson Road, Whitton, nr. Twickenham, Middlesex.

Size of Model

Very large models around 9 to 10ft. span and over fly with great majesty and steadiness, ignoring minor disturbances and trim inaccuracies, but they are too large to build and keep in the average house. Next come the middle sizes, around 8ft. wingspan, which are almost but not quite so rock steady in the air, but in common with 7ft. and 6ft. models, are still a little large to keep in most homes. The best all-round flying model for transport, housing, robustness and yet good flying ability is around 5ft. span. It is not as rock steady as the larger models, but it has many excellent attributes, and can take single-channel as well as three-channel "tuned reed" receivers, providing engine control as well as rudder. The little 45in. span models have to be very light, with small radio batteries, demand considerable experience to build, and can be tricky to fly.

The 5ft. class "Radio Rook" is therefore, chosen, as being most likely to form a good allcomers' model, that can take a variety of engines and receivers. The model is expectionally stable for its size and very robust. It is the ideal model for flying for fun and if a generous rudder movement is given it will be found a good stunter on single channel, rudder only. The model climbs fast on a 3.4 c.c. E.D. diesel motor or, with the lighter receivers, flies excellently powered by a 2.4 c.c. E.D. diesel or a 2.5 c.c. Frog. Incidentally, the latter motor is one of the easiest starting motors I have used. I, personally, use a Frog 10in. diameter, 5in. pitch nylon propeller for the "Radio Rook" and the model is shown on the ground in Fig. 1.

Types of Commercial Radio Receiver

It is difficult to advise on the most suitable radio receiver to install, because there is much prejudice on the matter and cost must also be considered. The model described is capable of using a wide range of receiver, including multi-channel three-reed. The latter type will give two-speed engine control as well as rudder as desired, whereas, of course, normal commercial single channel can only provide sequence rudder right and left.

The Single-channel, Single-valve Receiver

This type receiver is best for newcomers when fitted with a "hard" valve. The "soft" or gas-filled valve is inclined to change

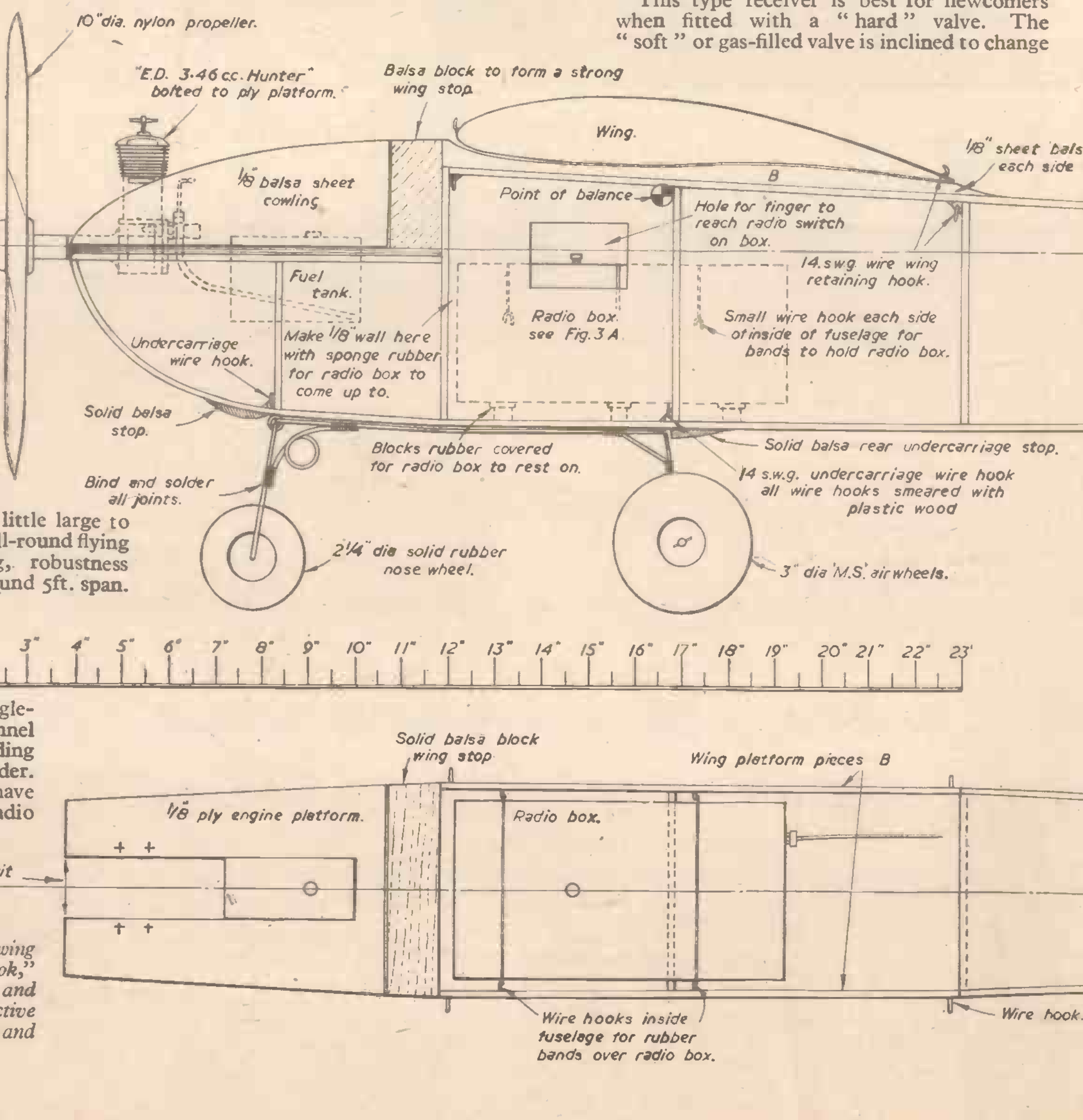


Fig. 2.—General arrangement drawing of the fuselage of the "Radio Rook," with inset sketches showing fin and rudder construction, a perspective sketch of the completed fuselage and the tricycle undercarriage.

...NTROLLED MODEL AIRCRAFT

...s of the "Radio Rook"

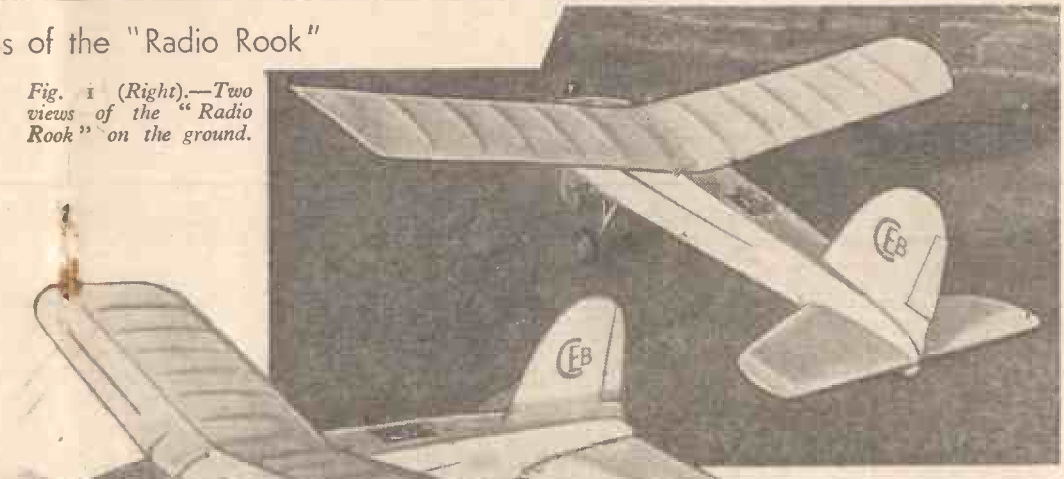
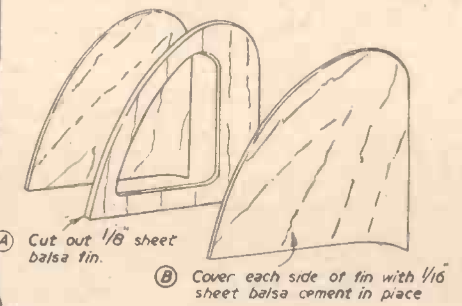


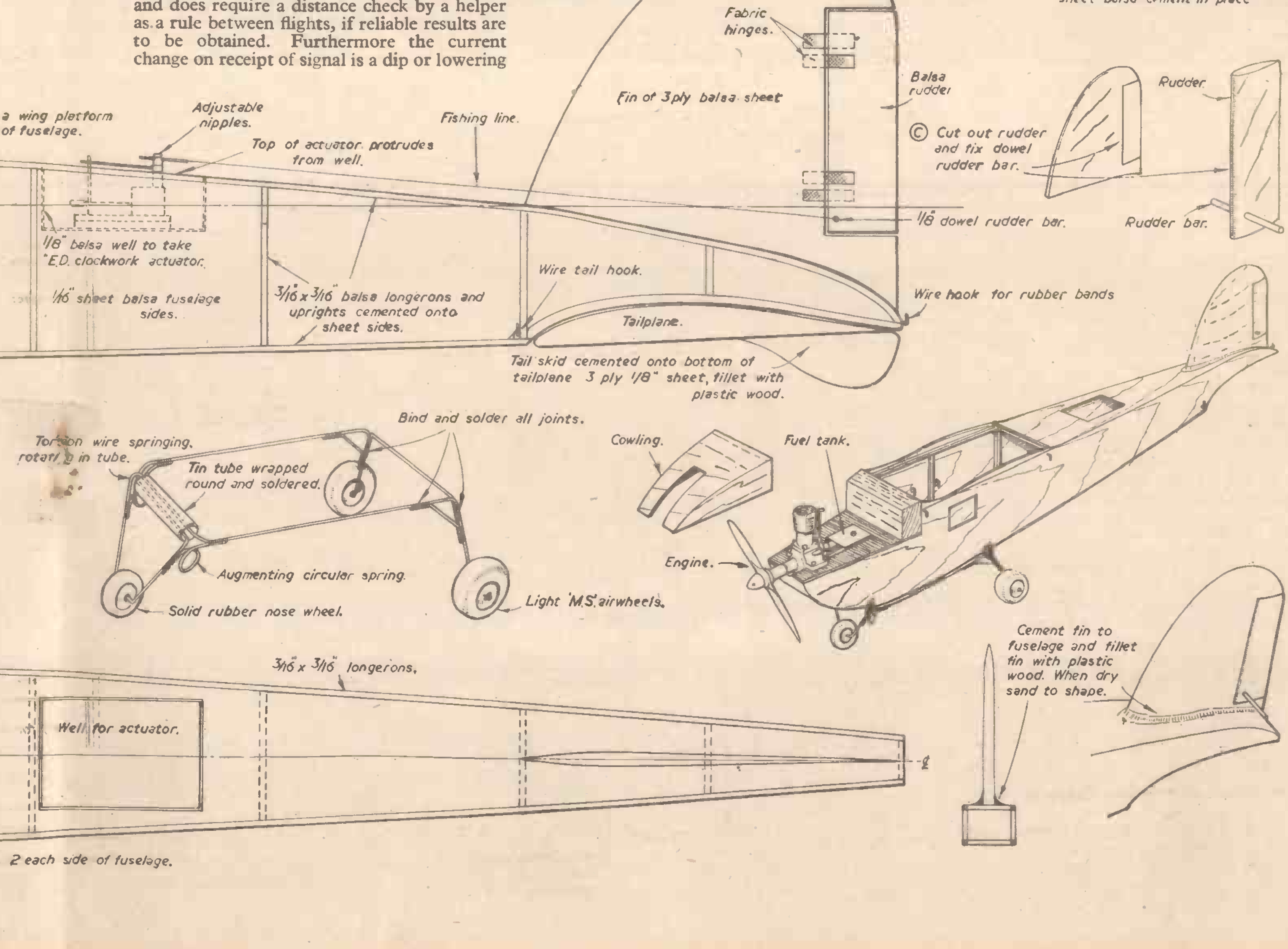
Fig. 1 *(Right).—Two views of the "Radio Rook" on the ground.*

its characteristics too soon, and create difficulties for a beginner. The single-valve receiver is cheap to buy and good fun, but perhaps a little tricky to tune at times and does require a distance check by a helper as a rule between flights, if reliable results are to be obtained. Furthermore the current change on receipt of signal is a dip or lowering of the current, which means that should anything fail in tune, etc., the current drops and the rudder goes hard on which on most models means a spiral dive into the ground. However, if cheapness is important there is much in favour for the modern single-valve receiver, and there are several on the market. The little transistor receiver, which is described separately, is, in my opinion, the "coming thing" in single-valve receivers.

The Three-valve "Modulated" Receiver

At present the only firm making these excellent receivers are Messrs. E. D., Ltd. Among its advantages are very simple single-lever tuning, single-handed tuning and great range. Finally, they are not critical because there is a detector valve and two amplifiers. It is possible to tune single handed by merely resting the transmitter on the control button to keep a signal on, and then walking away for about 20 yards only, and plugging in a meter to the model. Now having switched on the model receiver, turn the single tuning





lever either way until the highest rise in current drops. Place the tuning lever midway between these two drop-off points and you have enormous latitude of tune and range, as far as you can see to control any model, and further. The tuning is then set for the day. It will be noted that there is a *rise in current at the receiver*, to switch on the actuator, and so operate the rudder through the relay; therefore, if the receiver should fail for any reason the model does not spiral, as may well happen on single-valve receivers which drop the current on receipt of signal. These three

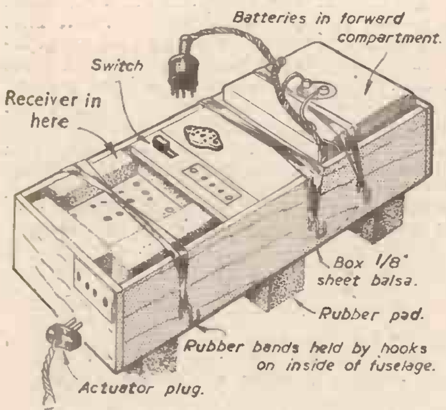


Fig. 3.—*The transistor receiver and batteries mounted in detachable installation.*

sub-miniature valves naturally cost a little more to produce, but single-handed tuning alone makes this receiver worth its extra cost.

Multi-channel "Tuned Reed" Receivers

Multi-channel is perhaps the ultimate to date in the commercial world, providing either three-channel or six-channel control. Designed by Mr. G. Honnest Redlich for his cross channel records and also for non interference yacht racing, these sets can now be obtained from the designer, or Messrs. E.D., Ltd. For the "Radio Rook" we require the three-channel receiver, if multi-channel is decided upon, providing left and right rudder as desired, and the third channel to operate the twin butterfly carburetter on the 3.4 c.c. E.D. diesel motor. This carburetter gives a reasonably slow speed or wide open and was designed by G. Honnest Redlich for competition work. It is now commercially obtainable. Single clapper valves worked by the radio have been tried over the induction pipe of a diesel, but the control is not as effective as by twin butterfly carburetter on a diesel motor.

If it is decided to use multi-channel radio on the "Radio Rook," it is desirable to add 8in. to the wingspan, i.e., two extra panels or ribs are built into the wing, each rib being spaced 4in. apart. The wingspan then becomes 5ft. 8in. This provides a little more wing area for the slight extra weight of multi-channel radio sets, keeping the slow flying characteristics of the model for reasonable winds. If fast penetrating flight is desired, keep to the 5ft. wingspan. The "Radio Rook" has also been built in the 8ft. span size, a size of model that can carry six-channel radio and powered by an 8 c.c. Miles diesel or a 9 c.c. petrol spark ignition motor.

The Power Unit

I advise using the E.D. 3.46 diesel with the Frog 10in. diameter 5in. pitch propeller made from nylon. This provides good power for high flights and stunting if desired.

Three-valve receivers and multi-channel "tuned reed" receivers are best flown with this motor, or any other motor of similar power output with the correct propeller.

Good 2.5 diesels like the E.D. Racer and the Frog 2-49 B.B. will fly the model well with the lighter single valve receivers, and of course, a transistor receiver, although I personally prefer the reserve of power in the 3.46 E.D. diesel. For competitions, a large fuel tank should be fitted just behind the engine, providing several minutes' flight; otherwise a two-minute tank is ample. The fuel height when taking off should be just below the needle valve, and the fuel line is always best taken down to the bottom of tanks well aft to collect fuel if the model is thrown hard when hand launched with a not quite full tank. The forward throw may cause starving if this is not done, for the fuel swills backwards. Radio flying becomes quite hopeless unless the correct engine and propeller, with correct fuel arrangements, are employed. It is quite essential to obtain long duration under full power, without fading or engine failure.

The Radio Gear Detachable Installation

The receiver and batteries are contained in a detachable balsa radio box, covered fabric, because this method permits rapid interchange, removal for servicing and also sliding adjustment for final weight location to get the best trim during the tuning up period. It is an enormous advantage to be able to take out the complete radio for adjustment and repairs, battery changes, and to use the same radio for another model. The radio box has absorbent synthetic foam rubber surrounding the receiver. There are also further vibration and anti-damage rubber strips at the bottom of the fuselage and just ahead of the radio box. Very little damage is ever done with this set-up, and the box is held to the fuselage floor by rubber bands to wire hooks inside the fuselage. These wire hooks are reinforced to the sheet balsa fuselage sides, with plastic wood and cement, see Figs. 2 and 3. I, personally, dislike the usual method of slinging the naked receiver from four hooks in the fuselage by rubber bands. In a heavy landing, or if the model flies into an obstruction, the unfortunate receiver is slung violently back and forth and banged against the fuselage.

The Actuator

This is an E.D. clockwork mechanism, because I prefer the positive no-trouble clockwork rather than the type of actuator operated by rubber elastic, which requires constant renewal and correct tensioning. Tighten up the standard return spring a trifle and always employ a 7½-volt battery, which gives the actuator a sturdy and reliable kick instead of the uncertain little digs of smaller voltages generally used. Reliable flying is the chief aim, and this sturdy model will carry the slight extra weight of clockwork actuator and this powerful actuator battery to operate the rudder. The actuator is partly sunk into the top of the fuselage in a small balsa well, as can be seen in Fig. 1. There are two fishing lines to the rudder crossbar from the actuator. If one of the E.D. adjustable swivel nipples is fitted to each arm of the actuator, small lengths of wire attached to the fishing line ends can then provide instant adjustment of rudder. The twin electrical leads from actuator to radio box should be carefully intertwined and neatly fastened to the fuselage sides, ending at a two-pin plug to fit into the socket in the radio box, see Figs. 3 and 5.

Batteries are in a forward compartment of the ⅛in. balsa radio box to keep weight well forward, and furthermore should the model crash, the heavy batteries do not smash into the delicate receiver. A receiver on/off switch is fitted on a central "deck" in the box, which is reached by means of a rectangular finger hole in the fuselage side, see Figs. 2 and 4. After flying for the day, I also always disconnect batteries in the box, by means of a four-pin plug to prevent any slight current leakages.

Tuning the radio is done before the first flight for the day, with the wings off. If a three-valve receiver, or a transistor receiver is employed, tuning between flights is seldom necessary.

Wing Slots and the Wing Details

Fig. 1 shows that the parallel chord wing of 5 ft. span and 11in. chord is fitted with simple letterbox wing slots carved from balsa sheet. A rectangular-shaped wing stalls last at the centre, and when this feature is further reinforced by wing slots, great stability is obtained against dropping a wingtip, which is a dangerous possibility on model aircraft. Letterbox slots have many advantages, and any slight extra drag is of no moment on a model. The chief asset on model aircraft is stability, especially when fitted with expensive radio gear! Even a

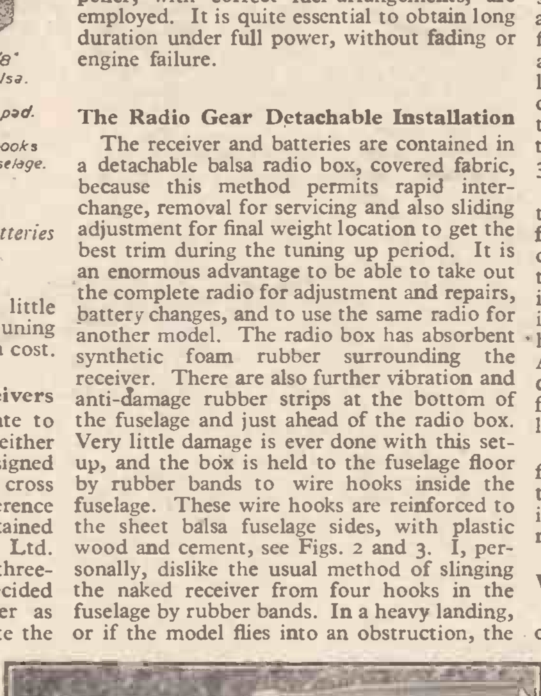


Fig. 4 (*Above*).—*A view showing engine cowling detached and finger hole in fuselage side.*

Fig. 5 (*Centre*).—*The receiver in place.*

Fig. 6 (*Right*).—*The tricycle undercarriage.*

normally stable model can be crashed by an inexperienced modeller through turning too sharply by radio. Models should only be turned in very slight bursts of rudder until the owner becomes experienced. Full rudder help on will always create a spiral dive if the rudder has sufficient action to create stunting. Inbuilt wing slots, however, iron out a stall after a dive, provided there is adequate height

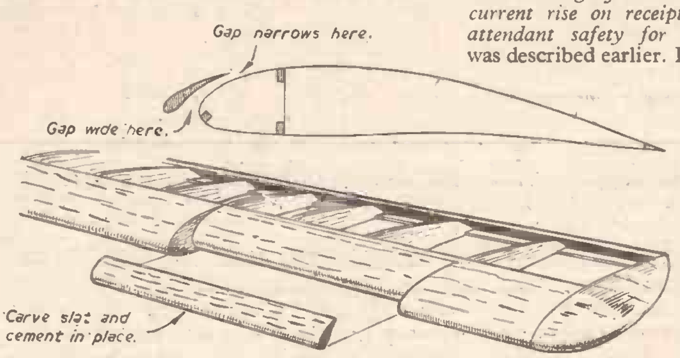


Fig. 7.—Wing slots and wing details.

available. They are very simple to construct from solid sheet balsa, see Fig. 7.

The Tricycle Undercarriage

A tricycle undercarriage is a great crankshaft and propeller saver, provided the front wheel is anchored correctly to take adequately the blow of a poor landing. Most front model wheels are too rigidly fixed to the fuselage. All my models now have a tricycle undercarriage built as a "detachable tray," and held to the fuselage by rubber bands. If the blow is serious, the torsion bar front legs give first, resisted further by two coil springs and in extremis the whole undercarriage goes back on its rubber bands. There are thus three lines of defence. Such a tricycle dolly

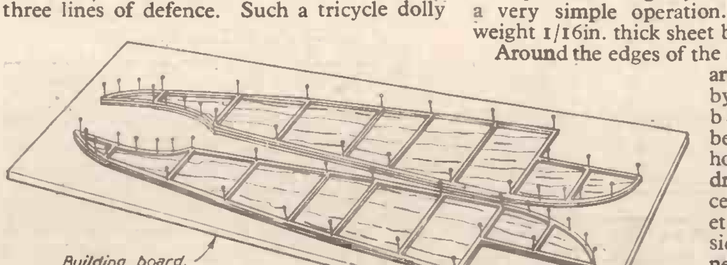


Fig. 8.—Cementing the fuselage sides.

undercarriage is easily removed for transport by unhooking the rubber retaining bands from the wire hooks located in the fuselage sides low down. These hooks are reinforced into the fuselage by plastic wood. Fig. 6 shows the undercarriage construction, whilst inset in Fig. 2 is a sketch that is useful when making up the wire chassis.

When covering the bottom of the fuselage where the tricycle undercarriage sits, I covered the balsa sheet with one layer of thin fibreglass cloth, also carrying this around the engine nosepiece. This is not strictly necessary, but a fine strengthening for those who exploit fibreglass reinforcement. If fibreglass is not used, it is advisable to cement in two little reinforcing pieces of three-ply where the undercarriage rests against the fuselage bottom.

The Engine Cowling

This is a very light balsa sheet affair made from 1/8in. and 1/16in. sheet, then covered with butter muslin or nylon and doped. It is held in position by a rubber band over the top to two little wire hooks on the engine platform. Fig. 4 and a sketch inset in Fig. 1 show the cowl detached.

The Transistor Radio Receiver

Fig. 5 shows the baby transistor receiver made by Mr. G. Honnest Redlich already mentioned, fitted into the "Radio Rook." It is surrounded by light-coloured rubber packing. A transistor itself is really minute, and, of course, battery drain is very low indeed. This Redlich transistor single-channel receiver seen in Fig. 5 *has the valuable feature of a current rise on receipt of signal, with all its attendant safety for a model aeroplane*, as was described earlier. Furthermore, the current rise is around 3½ milliamps, which provides a good safety factor. The receiver is made by Messrs. E.D. Ltd.

The Fuselage Construction

The fuselage side elevation must be drawn out full size from the plans in Fig. 2. This is then laid on a table or flat surface, with carbon copying paper below it, over 1/16in. balsa sheets. The side elevation of the fuselage is then traced on to the balsa sheet. The sheet side of the fuselage is then cut out to shape by safety-razor blade. A second balsa sheet side is then made. As balsa sheet is usually 3ft. by 3in. or 4in. wide, it will be necessary to butt-joint several sheets by smearing the edges with cement and leaving to dry under weights, which is a very simple operation. Lightweight 1/16in. thick sheet balsa is purchased.

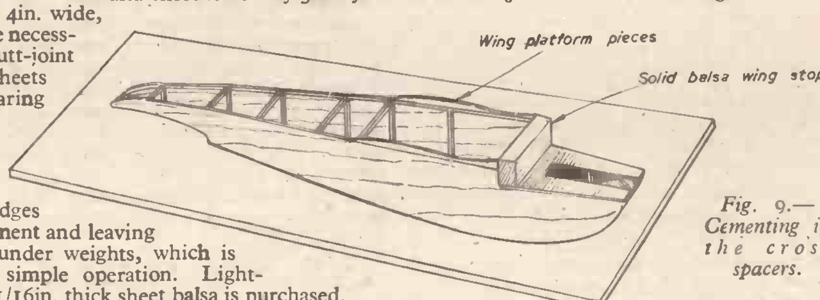


Fig. 9.—Cementing in the cross spacers.

Around the edges of the sheet fuselage, sides are cemented 3/16in. by 3/16in. fairly hard balsa longerons, being kept in place by household pins till dry. Do not forget to cement the longerons, etc., on to the two sides so that in the next stage of erecting them side by side, the balsa longerons are inside. Now cement in the cross spacers of the same section balsa sticks as in Fig. 8 using pins to keep in position. Where the balsa longerons are severely bent to the shape of fuselage I merely crack the balsa wood to the desired curve, the cement and sheet backing stiffen up. The two fuselage sides are cemented together with 3/16in. by 3/16in. balsa spacers, as shown in Fig. 9.

The fuselage is now fitted out with all wire hooks for retaining wing, tailplane and undercarriage, etc., before the fuselage top balsa skin is put in position. These wire hooks are made from 14 s.w.g. piano wire, and where they pierce the fuselage they are well-smeared with plenty of plastic wood and cement to spread the highly-stressed loads over the balsa sheet covering. Do not spare the plastic wood. Small wire hooks are cemented and plastic wood reinforced into the inside of the fuselage to hold the radio box to the floor by rubber bands. Now fix the top and bottom sheet covering in place.

The Fin and Radio Rudder

The fin and the rudder require great accuracy of construction and great care to prevent warping whilst cement is drying. The fin must then be cemented on to the fuselage top accurately along the centre line, or the model will turn violently. After cementing the fin in position, run a plastic wood and cement filleting along each base to make it rigid with the fuselage.

The fin is made, as shown inset in Fig. 2, of a central 1/8in. balsa sheet slab lightened out in the centre. Again, butt-joint several pieces of sheet where necessary. Now cut out two sides of the fin from 1/16in. balsa sheet and cover the central sheet, smearing plentifully with cement. Place the whole "sandwich" between some flat irons whilst the cement sets. This form of fin will not warp once it is well dried out. Cut out the three-ply balsa rudder and sand everything smooth. Stages of construction are shown in Fig. 2.

The rudder hinges are strips of fabric cemented on after the fin has been covered with fabric. This is shown clearly in Fig. 4.

The concluding article will deal with covering the fin, making the wings and tail and flying the model.

ADHESIVES FOR LAMINATED PLASTICS

Types of Cement : Weakening Factors : Storage : Drying Methods

By W. J. HARDMAN

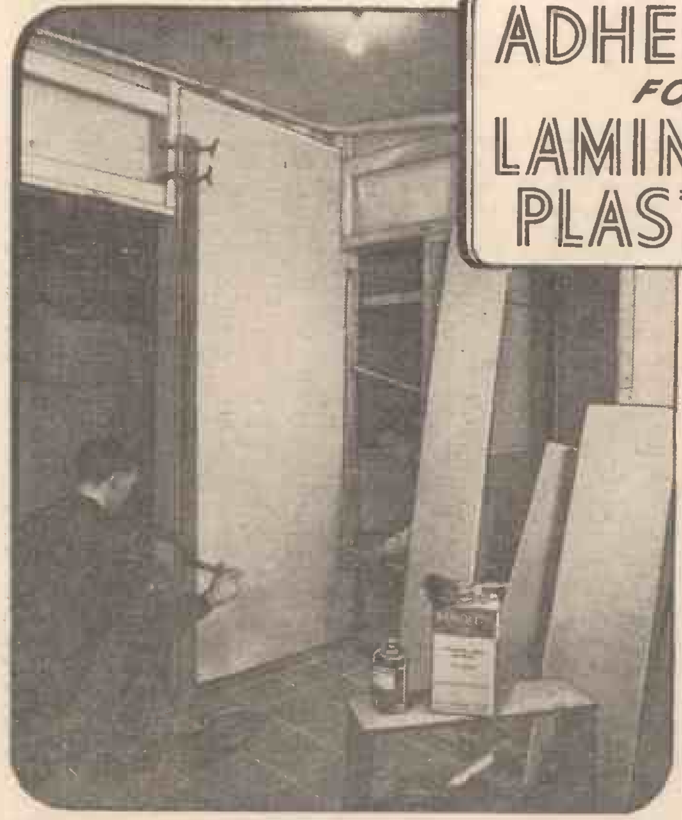


Fig. 1.—A synthetic resin adhesive being used for in situ fabrication. Note the method of using G cramps and wedge struts. (Photo by courtesy of Thomas De La Rue & Co. Ltd.)

ALMOST any adhesive will adhere laminated plastic veneer to common structural materials, but with widely varying results and physical properties not always appropriate to the job in hand.

Before considering adhesive technique, the principles which cause one material to adhere to another should be understood. In most cases adhesion is due to a combination of chemical and physical bonding. Chemical bonding is due to affinity between the materials to be bonded and physical bonding is due to the penetration of the adhesive in a liquid state into the pores of the material. Chemical bonding is of much importance and provides a greater proportion of the strength in the bond than physical bonding and this explains why certain types of materials cannot be joined together easily. A good example of purely chemical bonding is the adhesive action of water when frozen between two glass plates.

Dirt, grease, dust or any chemical deposit on the surfaces to which adhesive is to be applied tend to weaken the strength of the "glue line," and in some cases they will prevent any proper bond forming at all. For this reason metals are degreased by being passed through a bath containing a solution which will remove the grease, or by the removal of the old surface to present a new and clean surface. The use of an emery cloth will, in addition to cleaning, provide a roughened surface, which is advantageous from the physical bonding point of view.

Fish and Animal Adhesives

These include the joiners' hot bone and skin glues. They are generally used hot and may be used for small areas and narrow strips, but are not suitable for large areas as they are too rapidly chilled. The slow setting and unequal absorption of the water content may distort the glued assembly upon drying. They are not advised for conditions where moisture and high humidity are present, also they are susceptible to attack by fungi.

Casein Cements

Casein cements are obtainable in powder form as cold water powder glue, and are easy to mix with water and simple to use. It is essential that they are used freshly mixed and that no stale mix is included, which would only act as a filler. A well set casein glue line provides a very strong joint and it should be noted that during setting the glue line will contract slightly and may pull the laminated plastic into any hollows which may be in the surface of the base material. Due to the high water content of the mixture, setting time will be prolonged and the migration of the water into the base material may set up stresses as the assembly dries.

Being of an organic nature they are liable to attack by fungi, and tend to weaken under a combination of heat and moisture. These characteristics may vary according to manufacture.

If a screw press or clamp is used for obtaining the necessary pressure, it is advisable after one or two hours to give an extra quarter of a turn.

Synthetic Resin Adhesives —Thermosetting

These are generally more simply known as synthetic resin adhesives and one of them is shown in use in Fig. 1.

This group comprises a large number of adhesives most of which have been developed for special purposes, but they can be divided into three main sections:

1. Urea - formaldehyde } or more simply urea
2. Phenol-formaldehyde } phenolic
3. Resorcinol.

From the point of view of cost the urea is cheaper than the phenolic and likewise the phenolic is cheaper than the resorcinol.

All the types, when set, produce a rigid glue line that is not softened by the application of heat. The ureas are used for general fabrication where the base material, such as wood, is porous and reasonable resistance to moisture is required. The phenolics are used where both materials to be bonded are impervious, such as two pieces of laminated plastic, and where greater water resistance is required. Whereas the ureas and phenolics are acidic the resorcinols are neutral and can be used for bonding to a material such as asbestos sheeting and also where high water resistance is required. Some offer boiling water resistance.

In most cases the adhesives are of two parts, the first the syrup, or powder to be made into syrup, and second, the hardener (sometimes referred to as catalyst or accelerator). For the separate application method the two meet in the glue line and for the mixed application method they are prepared as a mixture, which is then applied to the surfaces to be bonded. Both methods result in similar glue lines; it is only in manufacture and the method of application that they differ. The separate application method is being used in Fig. 2.

Some of these adhesives are formulated for cold setting, i.e., room temperature, and others for setting at varying elevated temperatures, but in general they will all set more rapidly at a higher temperature. For some the hardeners may be varied to alter the setting time at a given temperature.

Where setting is carried out under moderate or low pressure the gap filling types are recommended.

Fig. 2.—The reverse side of a Formica top receives a coating of hardener GU.X. The wood core will receive a coating of "Aerolite" 300. (Photo by courtesy of Aero Research, Ltd.)

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Where cost is of prime importance a filler, or extender, is sometimes added to the adhesive, and in general it does not appreciably alter the strength of the glue line but it should be noted that the filler itself may be sensitive to moisture or bacteria.

The type of work which can be carried out using this type of adhesive is shown in Figs. 3 and 4.

Synthetic Resin Adhesives — Thermoplastic

These are generally more simply known as synthetic rubber type adhesives.

This group includes rubber, latex and the newer hycar and neoprene synthetics, and in general provides glue lines with varying degrees of flexibility. The adhesives are solvent based and usually require an open assembly time. Some types, with a high initial tack after air drying, require only momentary pressure to bring the glued surfaces together and, after self-vulcanising, or maturing, offer a high resistance to water and other liquids. They are susceptible, however, to elevated temperatures and the weakening is progressive with rise in temperature and depends upon the type, make and quality of workmanship of the job.

Where these adhesives are to be used for small areas and narrow strips extra care should be exercised since they have a low resistance to a peeling action, especially if there is, in addition, a weakening from rise in temperature.

For vertical panelling the high initial tack types offer a relatively simple method of bonding without need for strutting, etc., whilst for the more simple "Do-It-Yourself" home job they offer a good method of veneering laminated plastic without need for special tools or equipment.

Special Cases

Where it is required to veneer to aluminium or steel with a rigid glue line and a temperature resistance above, say, 275 deg. F., one of the successful ways is the "Redux" method, used by Aero Research, Ltd., Duxford, Cambridge. Pressure is required during setting and if the modified method is used the temperature required is about 220 deg./230 deg. F.

Another adhesive which provides a rigid glue line and heat resistance is from the epoxy class of synthetic resins. This is suitable for veneering laminated plastic to non-porous materials such as metal, glass, china and rubber with light pressure and whilst setting can take place at room temperature it can be accelerated by the use of moderate heat. It can be used as an alternative to the Redux method when the high temperature and pressure are not available.

In a particular case, latex has been added to casein to give flexibility and resistance to persistent moisture and provides a gap-filling adhesive which has fair heat resistance. The mix can be varied so that assemblies may be bent after veneering.

P.V.A. (Polyvinyl-acetate) adhesives are clean and simple to use and are used exactly as received without need for hardeners, fillers, etc., for the veneering of laminated plastics to timber. A relatively short pressing time at a temperature of about 70 deg. F. provides the best glue line, which has a water resistance about the same as animal glues and a temperature resistance from about 120 deg. F. to 160 deg. F., depending upon the humidity of the atmosphere.

The adhesive manufacturers are constantly experimenting to improve standard adhesives and to introduce additional grades and types to serve specific needs.

Weakening Factors

Factors tending to weaken an adhesive joint after it has set are moisture, heat, a combination of moisture and heat, fungoid growth and dimensional changes in the bonded pieces. The effects of these conditions vary roughly according to whether the adhesive is thermosetting or thermoplastic and organic or inorganic.

Fig. 3 (Left).—An executive's desk, designed by the author, in which the exterior is surfaced with Real-wood Formica and the interior with Birds Eye Maple Formica. All the veneering was carried out using a synthetic resin adhesive and without a press.

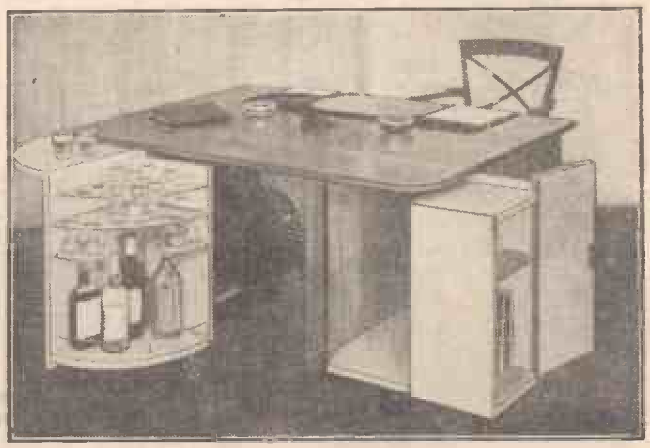

Fig. 4 (Right).—A further view of the desk showing the interior.

Moisture

This can take the form of steam-laden atmosphere, high humidity of the atmosphere or liquids. It should be noted that a higher temperature is a better supporter of humidity than a lower one and that the hot air of a room might be supporting more moisture than that contained in a normal fog or mist.

Laminated plastics are, for all practical considerations, impervious to moisture and, therefore, the only places at which moisture might attack the adhesive are through the exposed joints and through the backing material itself. The effects of moisture are noticeable in animal and fish adhesives which eventually soften and allow the joints to break.

If working temperatures are likely to be excessive the temperature which the adhesive will withstand before breakdown should be determined. Some adhesives will regain their strength upon a reduction of temperature to within their safe range providing the mechanical conditions of the joint are maintained, i.e., providing the joint has not opened.

Heat/Moisture Combination

Heat and moisture combined may take the form of steam-laden atmosphere, natural humidity in a hot country, hot water used for cleaning, etc. The effect of a combination of heat and moisture is to weaken animal, fish and casein adhesives to such an extent that the joint will give way on continual exposure to these conditions. It may weaken some synthetic resin adhesives, but, for the majority of purposes, the weakening is not noticeable and the adhesive will recover its original strength on reversion to normal conditions. Hot water would normally be applied only for cleaning purposes and unless joints were badly made should not penetrate through to the glue line.

Fungoid Growth

Heat and moist conditions can also encourage fungoid growth which is caused through an air-borne micro-organism which attacks any organic material upon which it can feed to such an extent that it will eventually completely destroy the cellular structure and in the case of adhesives, the joint will break down. Fungi will attack animal, fish and casein adhesives and also synthetic resin adhesives if an organic filler has been used.

The strength of the glue line is very great in the case of some synthetic resin adhesives, great in the case of other synthetic resin adhesives and casein cements and lower for synthetic rubber type adhesives. The strength of the synthetic rubber type is good for large areas, but for small areas and narrow strips is generally inadequate.

Storage and Pot Life

The storage life, or the elapse of time between completion of manufacture and use, is referred to as the "shelf life." Most synthetic resin adhesives deteriorate through storage and the maximum time for which they are usable is about six months. Deterioration is usually in the form of loss of spreadability. Synthetic resin adhesives in powder form have an extended shelf life. Caseins and synthetic rubber types do not deteriorate through time alone.

All the adhesives start a setting action as soon as they are prepared, if mixing is required, or applied if of ready mixed type. The period, therefore, for which they can be used after mixing, or applying, is limited. This period is known as the "pot life" and will depend upon the adhesive used, surrounding temperature and nature of hardener if such is used.

Setting may be either hot or cold and would depend upon the particular adhesive used, but in general an increase in temperature will accelerate the setting time. Consideration must be given, however, to the effect of the heat upon the base material especially with regard to the moisture content and also, if the temperature is high, to the laminate itself.

Air Drying

In the case of many adhesives it is recommended that after the adhesive has been applied to the surfaces to be joined it should be left exposed to the air for a period before being assembled to enable the solvent in which the adhesive has been dissolved to evaporate. This method is known as open assembly or air drying. If the air drying time is not allowed, or insufficient time is allowed, then the solvent, instead of evaporating, (i) will remain in the adhesive greatly reducing the setting action, (ii) will remain in the adhesive increasing the susceptibility to softening with rise in temperature, or (iii) a combination of both (i) and (ii). It should be noted that it is not necessary for some adhesives to be in a liquid state to enable them to adhere and in some cases an extremely efficient joint can be made when the adhesive appears to be practically dry.

Pressure Application

In cases where continual pressure is required during setting it may be applied in a number of different ways such as in a press, application of weights, carpenters' cramps or wedges and struts. In each case do not use more than is required by the adhesive and make sure that it is applied evenly over the whole area to be bonded. Too much pressure can result in starved joints. For casein adhesives a pressure of 60 lb./sq. ft. is adequate, whilst for the gap filling type of synthetic resin adhesive only an intimate and even contact between the mating surfaces is necessary. For those synthetic rubber type adhesives with immediate contact bond properties it is only necessary to make sure that the two air-dried adhesive films are brought together over the entire area.

The adhesive manufacturers' instructions on mixing and application should be closely followed.

A BACKING BOARD for darts

Details for Making a Protective Covering for the Wall

By A. H. ROBINSON

THE game of darts is probably one of the most popular in this country. A big drawback in playing in a small house, however, is to find some place to set up the board so that an erratic shot will not damage the wall.

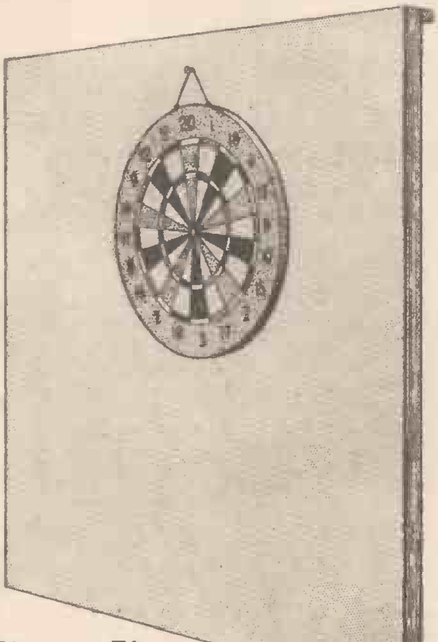

Fig. 1.—The completed backing board ready for use.

It was a desire to discover a solution to this problem that caused the "backing board" shown in Fig. 1 to be designed and constructed. Though big, the backing is very light and can be placed with assurance against a papered wall (it is made to hang from a picture rail), for, having a double thickness with a space between, darts sent wide are stopped before they can reach the wall behind.

For construction of the board, two sheets of medium card 3ft. 8in. x 3ft. 8in. are required. These large sizes probably cannot be bought at a stationer's shop, but a printer would supply them and sheets of card of this size are sometimes found in the packing of large articles.

Should it be found absolutely impossible to get the card in this size then four smaller sheets of 3ft. 8in. x 1ft. 10in. would serve but the one sheet is better.

Seven lengths of wood are also required, four of section 1in. x ¾in. Of these, two (A) are 3ft. 8in. long, and the other two (B) 3ft. 7½in. The other lengths are (C) 3ft. 7½in. of 1in. x 1in. section and two lengths (D) 3ft. 8in. with a section of ½in. x ½in. only.

A simple frame is now made of the pieces (A), (B) and (C) as Fig. 2. Half-joint the horizontal (A) pieces which make the whole frame 3ft. 8in. square. Fit the central bar in recesses cut in the top and bottom horizontal.

Strength is given by the card which is fastened by a series of small but large-headed nails round the frame as in Fig. 3.

Having covered one side turn over and put the card on the other seeing to it that the nail positions come between those of the nails already inserted (Fig. 4). All the nailing should be done with the frame on some flat solid surface to prevent any danger of warping as the work proceeds.

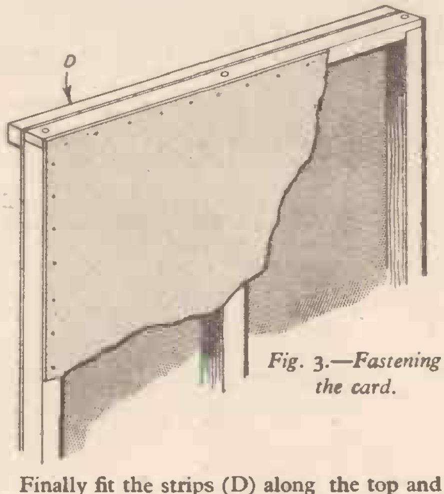

Fig. 3.—Fastening the card.

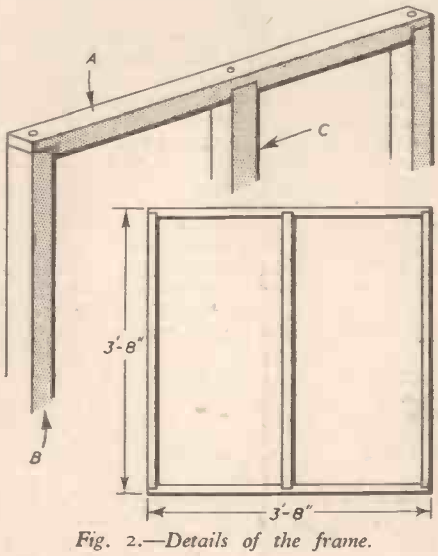

Fig. 2.—Details of the frame.

Finally fit the strips (D) along the top and bottom edges of the back of the board (see Fig. 3). They are attached by a series of 1¼in. screws and the top one is for easy hanging on a picture rail. Finally the screw from which the actual dart board is hung is fixed into the centre strip at the regulation height from the ground.

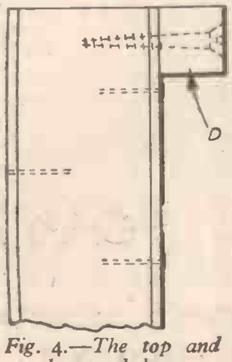

Fig. 4.—The top and bottom ledges.

The whole "backing" is now complete. It is very light and may be carried easily to some place of storage.

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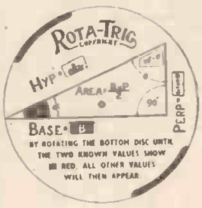

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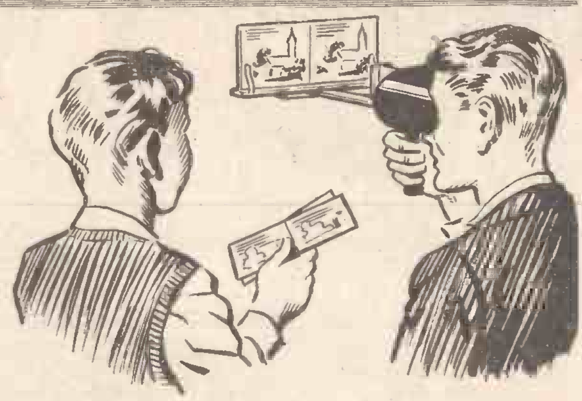
Our Junior Section

View your Snapshots in 3D

Constructional Details of a Simple and Easily Made Stereoscope



A PAIR of stereoscopic lenses must be bought and these can be obtained from any optician. For the woodwork mahogany is recommended though any hardwood would do; wood ¼in. thick is used except where otherwise stated.

First cut the base piece to the shape and dimensions shown in Fig. 1, taking care that the sides of the straight portion are truly parallel. For the lens frame cut two pieces of wood to the shapes shown in Fig. 2, the pieces of wood being ⅜in. and ⅛in. thick respectively. From the thicker piece cut out the holes for the lenses to fit in; similar squares are cut in the thin piece, but about 1/16in. smaller each way. These two pieces are then glued together. The centres of the lenses should be 2¾in. apart, which is the distance between the eyes.

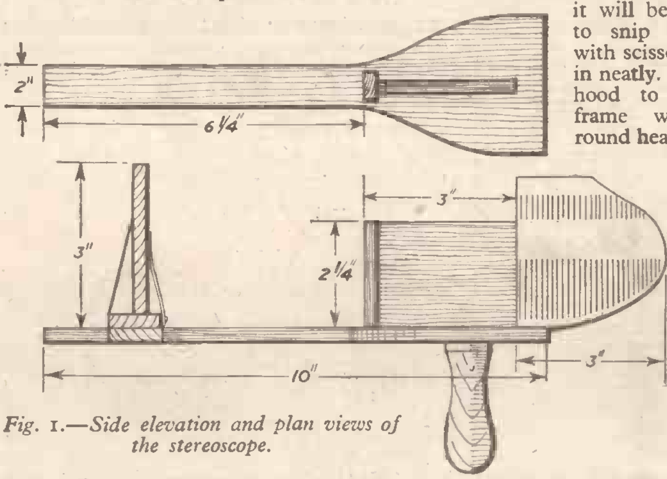


Fig. 1.—Side elevation and plan views of the stereoscope.

Fitting the Lenses

The lenses are wedge shaped and should be dropped in place, the thin edges facing each other. Glue narrow strips of wood round them to keep them in place and remember that the lenses should be flat at the eye side, which will mean that owing to their wedge shape they will be at an angle on the view side.

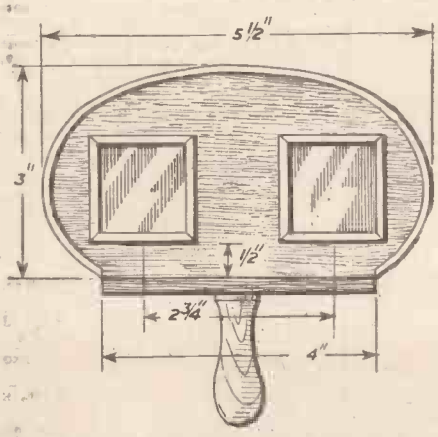


Fig. 2.—Details of the hood and handle.

For the hood, cut a piece of cardboard to the shape shown in Figs. 1 and 2, also a piece of black leatherette, linen, or American cloth, ¼in. larger all round. Glue this latter to the cardboard, turning the overlap to the inside. At the curved part it will be necessary to snip the edges with scissors, to turn in neatly. Screw the hood to the lens frame with small round headed screws and the whole to the base, making sure it is perfectly upright.

The diaphragm is a plain piece of wood glued to the centre of the lens frame and base piece, and fitted at the open end with another strip ⅜in. wide. This is to ensure that each eye sees only one half of the view. A wooden handle should be screwed underneath for convenience in handling the instrument.

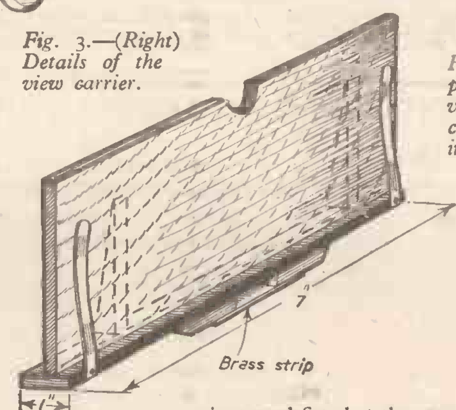


Fig. 3.—(Right) Details of the view carrier.

The View Carrier

The view carrier is shown complete in Fig. 3. It consists of a wooden back support for the views, joined to a narrow strip for a base. In front are screwed two springy brass or tinplate clips, bent to the shape shown, and at the rear two wedge shaped pieces of wood (shown in dotted line) to keep the back board vertical.

Underneath are glued two shorter pieces of wood 1in. apart; these are joined together by the brass strip shown. The parallel portion of the base fits in the slot so formed, and permits the carrier to be moved to and from the lenses for focusing.

The brass strip is bent slightly inwards so as to grip the base piece; the carrier should slide easily yet fit tightly enough to remain in any position in which it is placed. Polish the woodwork and stain the interior of the hood a dead black.

Taking Pairs of Pictures for Stereoscopic Viewing

This instrument will be found of great use to amateur photographers, who may take special pictures to view through it. Two photographs should be taken instead of one, from points distant from each other as far as the centre of one eye is from the centre of another. The photographs are then mounted on stiff cards and the instrument adjusted to give the best stereoscopic effect. The best method of taking two photographs for stereoscopic viewing is to make a flat tray 2¾in. wider than the width of the camera and mount it on a tripod. Stand the camera as far to the left of the tray as it will go and take the first exposure; move the camera as far to the right of the tray as it will go and take the second exposure. You will then have two pictures, each taken with the camera lens at 2¾in. distance from the other. They must be mounted for viewing as shown in Fig. 4.

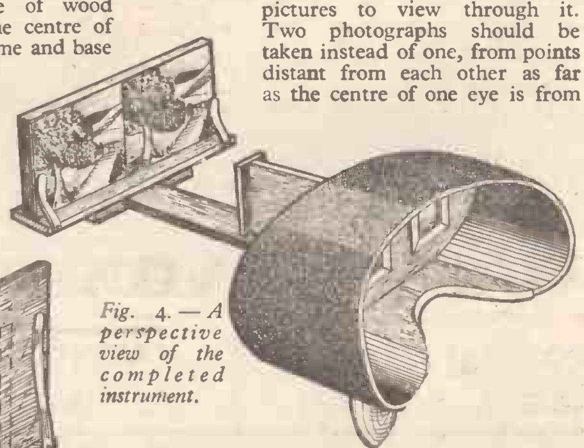
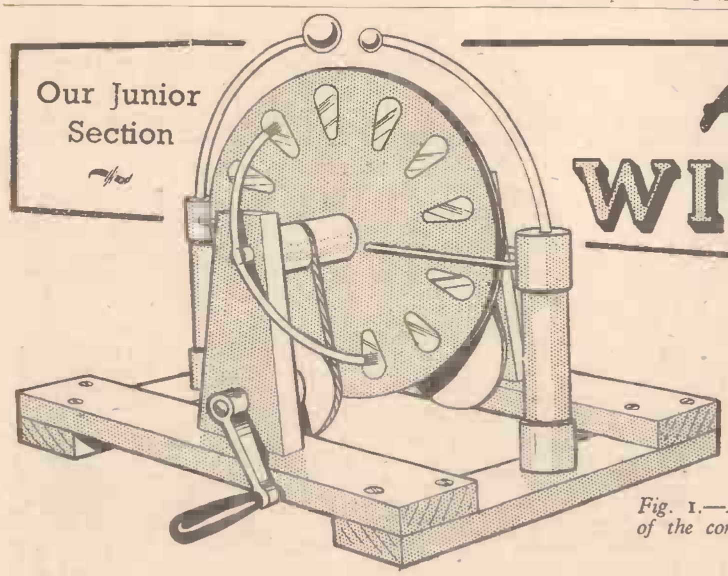


Fig. 4.—A perspective view of the completed instrument.

Our Junior Section



A Simple WIMSHURST MACHINE

Constructional Details of an Interesting Piece of Experimental Apparatus

Fig. 1.—A perspective view of the completed Wimshurst machine.

THE Wimshurst machine, which derives its name from its inventor, is one of the most efficient and yet the simplest of all induction machines, and many interesting experiments may be carried out with its aid.

General Features

The main part consists of two discs (see Fig. 1) made from glass or ebonite, and each having upon one face 12 tinfoil sectors. These

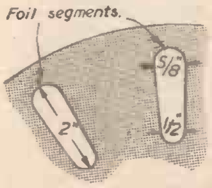


Fig. 2.—Details and dimensions of the tinfoil sectors.

plates, are mounted upon a spindle, and by means of a crank are rapidly rotated in opposite directions. Also attached to the spindle are two conducting rods of brass which have at their ends fine wire brushes that are made lightly to touch the plates as they revolve. In Fig. 1 will also be seen two other brass rod conductors, bent to the shape of a fork, and supported upon columns. Each of these is supplied with a series of pins, projecting from them in the form of a fine comb towards the plates.

As the plates require a little preparation, we will commence with these, which may be cut either from glass or ebonite. Having decided upon the material to be used, obtain two discs of it, cut each 12in. in diameter and about 1/16in. thick; two circular pieces of window glass will answer quite well. In the centre of each is drilled a hole ¾in. or 1in. in diameter, and having seen that all the sharp corners have been nicely smoothed off, give each of them a good coat of shellac varnish upon both sides.

Cutting the Twelve Sectors

A piece of tinfoil is now required from which are to be cut the 12 sectors (of the size given in Fig. 2) for each plate. The foil should be fairly heavy and thick, as the sectors have to stand a certain amount of wear from the brushes. As a guide to aid you to cut them all alike, it is a good plan to cut the shape first in a piece of stout paper, which is then placed upon the foil, folded a number of times, thus enabling several sectors to be cut true to the paper pattern in one operation. Quite a simple method of spacing them out upon the discs, provided, of course, that they are of glass, is to scribe a circle upon a sheet of card and divide it equally into 12 parts, drawing lines from the edge to the centre. Open the compasses and scribe another circle 11in. in diameter, giving a ½in. space between the top of the sector and the edge of the disc. You now have a good template for setting your sectors upon the glass disc, one of which should now be laid quite flat upon the card, and fitted exactly upon the outside circle.

Take one of the foils and carefully brush over one side with strong adhesive, then lifting it with care place it upon the disc exactly over one of the lines upon the card beneath. Proceed thus with the remaining 11 sectors and, when all are in position, smooth them all over very carefully to rid them of any air bubbles and creases. The second disc should now be treated exactly the same, and when both are finished, with the foil sectors firmly set, run the varnish brush completely round the edge of the disc, allowing the varnish to cover about ¼in. of the outside of the sectors.

The Base

For the base you will need four stout pieces of wood about 2½in. wide and at least 1in. thick; make these into a base, the form of which is shown in Fig. 1, putting two screws into each corner to hold it firm. The two supports for the spindle should be, say, 10in. long and 1in. thick, slightly tapered as shown and having two holes for the spindles, ½in. in diameter, in the position shown in Fig. 3. It is advisable to clamp these uprights together when drilling in order that the holes in each correspond exactly. To make a good bearing of the crank spindle, a piece of brass tube, ½in. bore, can be inserted into the lower holes, in which case, of course, you will require to open the holes to the outside diameter of the tube you are using. In order to lock the disc spindle, two screws should be put into the uprights either at the side or on the top. The

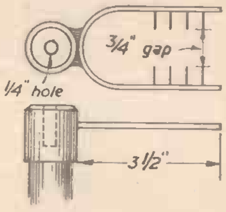


Fig. 4.—Two views of one of the fork-shaped pieces.

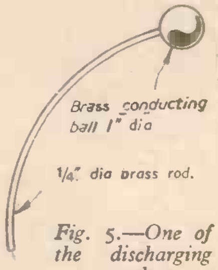


Fig. 5.—One of the discharging rods.

uprights can now be placed into position upon the base, slipping the spindles upon their bearings in order to hold the sides in line while you screw up from underneath. When all is completed, slip the spindles out and give the whole three or four coats of shellac varnish.

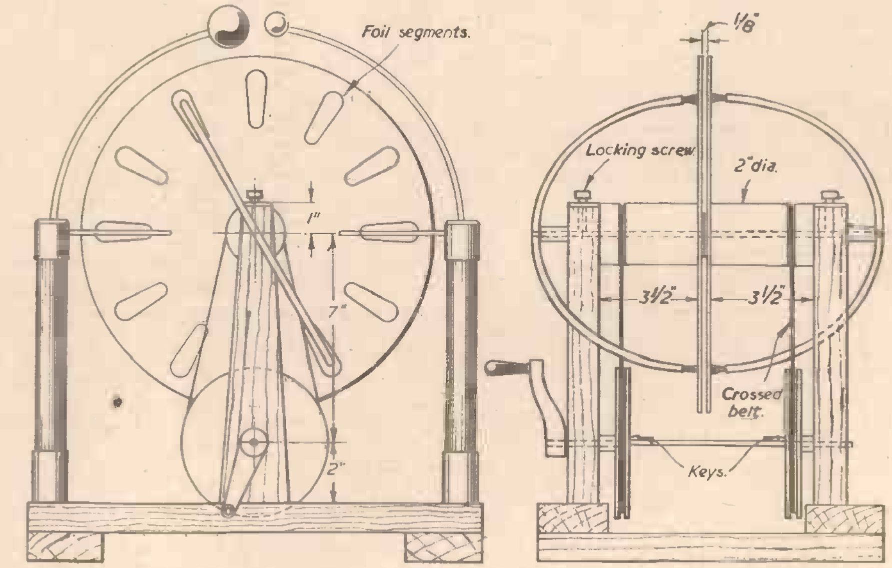


Fig. 3.—Front elevation and a sectioned side view of the machine.

The Bosses

A piece of a good hardwood pole, about 2in. in diameter, will be required, two lengths 3½in. long being cut from it. It is, however, very important that they should be drilled just large enough to turn freely upon the spindle and faced off square at each end in a lathe,

(*Continued on page 531*)

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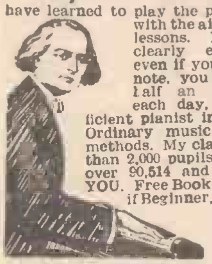

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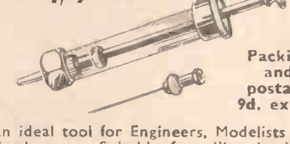

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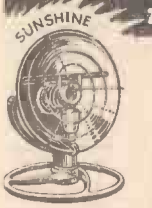

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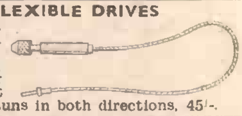

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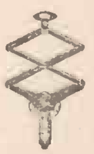

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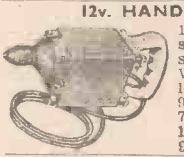

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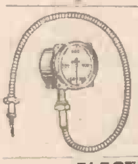

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turning down one end to fit tightly into the hole in the discs. The opposite ends of the bosses should be grooved in order to take the driving belt. Should you be able to obtain the use of a lathe, the driving pulleys can also be turned up and bored to fit tightly upon the spindle, but failing this, cut two discs from a piece of hard wood and, with the aid of a three-square, file-groove them carefully round the edge. Glass tube or Ebonite rod is advised for the conductor sockets, and this should be 1in. in diameter if possible. If these materials are unobtainable, two pillars from hard, dry wood well varnished can be used. Having fixed the diameter, you can now bore the sockets in the base which completes the necessary woodwork for the machine.

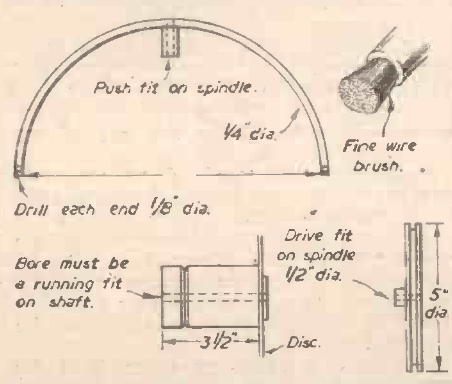


Fig. 6 (Top).—The neutralising rod and details of the wire brush. (Below).—The two driving pulleys.

The Metalwork

For this a length of ¼in. brass rod, about 5ft. long, will be required. Starting with the conductors, cut from the rod enough material to bend the two forked-shaped pieces, as shown in Fig. 4. It is the usual practice to employ brass balls about 2in. in diameter in which to mount all the rods in the Wimshurst machine, but because it is cheaper, these have been replaced by ordinary pieces of round brass rod, say ¾in. or 1in. in diameter; any shaped pieces will, of course, answer the purpose. Fig. 4 shows the method of fixing the fork to the cap.

Care should be taken, however, when fixing the pin points, to see that at least ¾in. clearance is left between the points. When the conductors are completed they can be fixed to the pillars, either by putting a screw down into the centre or by drilling the brass bosses to fit the outside diameter of the pillar. Before fixing them permanently, however, drill a ¼in. hole into the top of each (see Fig. 4) into which will fit the discharging rods. These should now be cut and bent, and at the end of each of these it is really necessary to fit a brass ball (see Fig. 5), as between these two points all the sparking takes place. One of them should be about 1in. and the other ⅜in. in diameter, and although the opposite end of the rod has to be capable of turning round freely in the brass boss, it must be left a fairly tight fit and not allowed to flop about in any direction.

In Fig. 6 is shown the neutralising rod; bend two pieces to shape and proceed to drill the ends carefully with an ⅛in. drill. Into these holes are fitted the fine wire brushes, which can be easily made from a piece of flex stripped of its covering and neatly sweated in, leaving plenty of wire jutting out to be clipped off to length when the machine is assembled. At the centre of the rod, sweat a piece of tube about 1in. long, just large enough in bore to fit the disc spindle, which should be left standing out that amount to receive it. This completes the set of parts required, except for the crank spindle, which should be long enough to pass through the machine and take the crank at one end.

Assembly

Take the base, with the uprights and pillar supports already fixed in position, and fit the two driving pulleys (see Fig. 6) upon their spindle. Should these have any inclination to slip, the spindle can have two flats filed upon it, at the position of the pulleys, which can then be fixed quite securely by means of small keys tapped in. Now take the two glass discs and the two wooden bosses. To mount them, proceed to cut two rings from stout paper to fit over the projection of the boss, and smearing one of them well with strong adhesive, place it upon the boss, and press it firmly into contact. A second ring is now similarly coated and placed upon the disc, which is then placed in position upon the boss. If this has been carried out successfully, about 1/16in. should project beyond the disc, see Fig. 6. Repeat for the other disc. Slide the spindle through one upright, place the discs upon it, and clamp tightly by means of the locking screws, leaving enough spindle projecting at each side to receive the neutralising rods, which can now be pressed on. The brushes should be bent in such a manner as to allow the sides of them to brush the sectors and also to face the direction in which the discs revolve. These rods should be placed in the form of a cross, each of them appearing at what might be termed "five minutes to five."

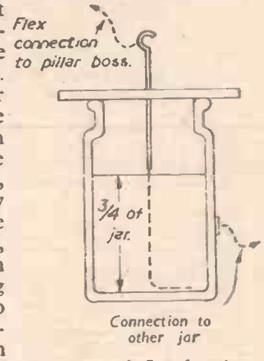
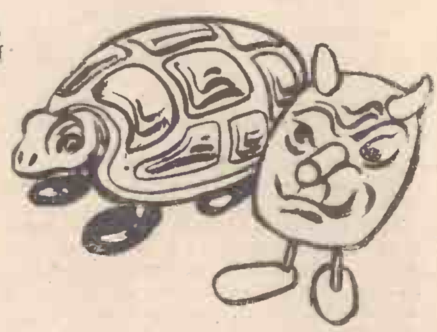


Fig. 7.—A Leyden jar.

How to Obtain the Spark

The machine is now complete and if the crank is turned should generate electricity freely. In order to obtain the spark, two Leyden jars should be obtained or made (see Fig. 7). These are quite simple to make and their construction was described in the Junior Section of our May, 1956, issue. To connect the jars to the machine, a piece of wire is taken from the rod and connected to the pillar bosses, another wire joining the outsides of the two jars. With these so connected, sparks from 3in. to 4in. can be obtained quite readily.

MAKING WALKING FIGURES

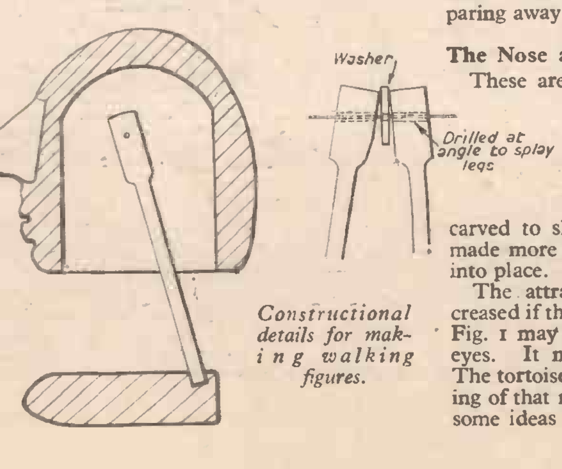


Quaint and Amusing Novelties

THESE grotesque toys afford much amusement to the smaller members of the family, as they may be made to walk quite naturally down a slightly inclined board. Construction can be much simplified by using a lathe, but those not having access to this tool must rely on carving. The hollow interior may be worked with a twist bit and finished with the gouge, boring, say, four holes and breaking down the intervening material with the gouge.

Quaint Designs

There is plenty of scope for quaint designs which need not be confined to the two-legged type. The one shown in Fig. 1, which could be called Mr. Nobody, is usually a firm favourite, and the sectional view shows the method of construction. The wire pivot on which the legs are secured must be placed vertically above the centre of gravity of the body and the top expansions of the legs must be drilled slightly on the skew, as is also shown in Fig. 1, to allow the feet to spread and give the requisite lateral stability. It should be noted that the soles of the feet have an upward curve at the toes, and this may call for adjustment when the figure is put to the test, by paring away some of the toe sole.



Constructional details for making walking figures.

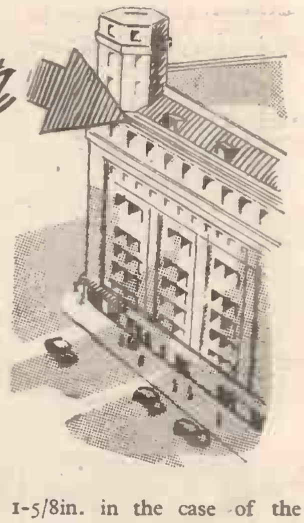
The Nose and Ears

These are separate components glued into their respective places.

The tortoise figure shown in the heading sketch, has four legs, each pair being accommodated in a separate cavity. The body must be carved to shape, and head and tail may be made more easily as separate units and glued into place.

The attractiveness of these figures is increased if they are enamelled. The example in Fig. 1 may be black with red lips and yellow eyes. It may be given tan-coloured shoes. The tortoise should imitate the natural colouring of that reptile. The heading sketches give some ideas for further designs.

Letters to the Editor



The Editor Does not Necessarily Agree with the Views of his Correspondents

Fire Extinguishing Mixtures

SIR,—I note with interest the question and your reply to the enquiry under the above heading on page 430 of your July issue.

As you say, it is very unfortunate that there is no cheap and universal fire extinguishing medium. Because of this it is always advisable to take expert advice before purchasing a fire extinguisher, to make sure that it is suitable, safe and efficient. Such advice will readily be given without charge, on application to the chief officer of any local authority fire brigade.

In your reply you mention carbon tetrachloride and methyl bromide as "all round general fire extinguishers" but you do not mention the extreme danger to health which accompanies the use of these chemicals. It is a fact that the use of either of these two chemicals in a confined space can cause loss of life through inhaling the vapours, particularly when, in the case of carbon tetrachloride, the vapours are decomposed by heat.

There has been considerable research into the toxicity of various fire extinguishing chemicals, and a recent official report issued by the Department of Scientific and Industrial Research and the Fire Offices Committee (Technical Paper No. 2, 1954) states that as little as 0.03 (per cent. volume) of carbon tetrachloride in air, or 0.96 of methyl bromide is an approximate lethal concentration.

Unfortunately it is possible for persons to inhale lethal quantities of the vapours of these liquids without being aware of more than a slight headache, dizziness, feeling of sickness.

It is for these reasons that carbon tetrachloride extinguishers are not recommended for general use but only for special circumstances such as in laboratories, electrical switch rooms, motor rooms, etc., where there will be skilled technical supervision, or for use on motor vehicle fires where they are most likely to be used in the open air, and the vehicle would be emptied of its passengers.

Methyl bromide extinguishers are not approved by the Home Office nor by the public fire services because of the danger to life accompanying the use and even the storage of this chemical in fire extinguishers.

Bearing all these points in mind, the wisdom of asking for skilled technical advice before obtaining fire extinguishers will, I am sure, be appreciated.—ROBERT W. BRAY (Fire Prevention Officer, Southsea).

Making Plastic Wood

SIR,—Mr. N. A. McKenzie asks, in the July issue of PRACTICAL MECHANICS, about using sawdust for making plastic wood. If he wants merely an economical and handy filler, sawdust mixed with emulsion paint ("left-overs" can be used up in this way) sets hard and tough overnight, and shrinks very little. Sawdust and "Cascamite" glue is also a good gap-filler, but expensive. I should not think either is suitable for making into sheets.—J.S. (Ware).

Wind Generating Plant

SIR,—Mr. A. J. Banwell's dynamo is probably at fault, but if he checks that the field coils are neither open-circuited nor shorted to the frame, he might get an idea of its speed-power relation by running it as a motor off a car battery, if means of driving it mechanically are lacking. Another point is that the propeller may be unsuitable. If its pitch is too coarse, it may never get up enough speed to unstall the blades and give its full torque; if so, to use a chain or gear drive as you suggest would make matters worse. Moreover, any sort of gearing exposed to the weather is a nuisance; direct-drive is preferable, even if it means making a new propeller.—W. E. HICK (Cambridge).

Photographic Prints on Metal

SIR,—I hope the following information will be useful to your correspondent in your Information Sought column (July issue).

Prepare a fairly strong solution of potassium dichromate, obtainable from all chemists. Warm some gelatine in hot water and coat, or rather flow, the solution on to the clean, degreased metal plate. Carefully dry the plates in a warm, dust-free place for several days.

When ready for use, soak for a few minutes in the dichromate solution and while still wet expose behind the negative in a printing frame. The exposure is not critical but I would suggest about 30 minutes in strong sunlight. After exposure, wash in fairly hot water when the gelatine unaffected by light will dissolve.

The resulting gelatine layer can be toughened by gentle heating over a gas ring, but this must not be overdone as it renders the gelatine brittle.—A.K. (Oxford).

Drilling Up to ½in. with a ¼in. Electric Drill

SIR,—Many owners of ¼in. electric drills must have wished they could use their drills for work larger than ¼in. diameter and I have evolved a combination tool to enable drilling up to ½in. in steel.

A B. and D. Sander polisher drill and a Fleetway Clipper breast drill are used, but any make of drill and breast drill could be similarly adapted. The drawings are self explanatory. The extra chuck and spindle were obtained from the makers for 12/-, but cheaper chucks with long spindles may be on the market.

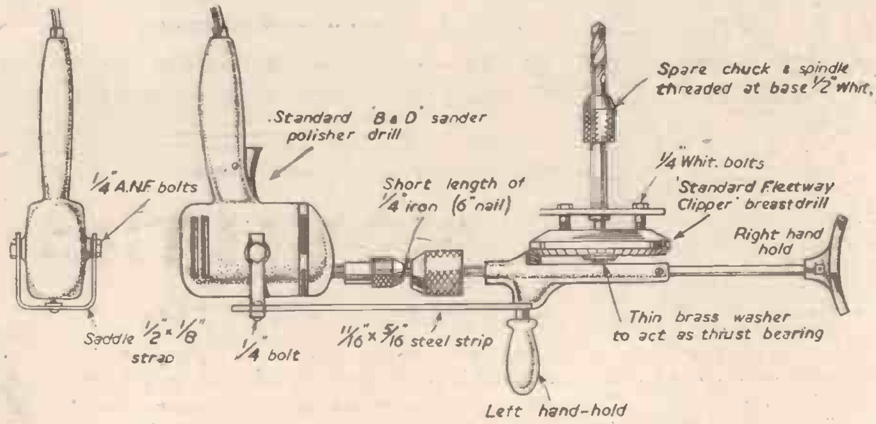
It is important to measure accurately the radius at which the tapped grub screw hole is drilled in the large gear-wheel for fixing the handle. It is 1-5/8in. in the case of the Clipper drill.

A plan view may now be drawn accurately on paper and then stuck on to the plate. Now centre punch through the paper the three holes in the corners of the triangle, together with the centre hole. These should now be drilled ¼in. for the three holes and 3/8in. for the centre. It is important that the plate should be symmetrical or the wheel will be out of balance.

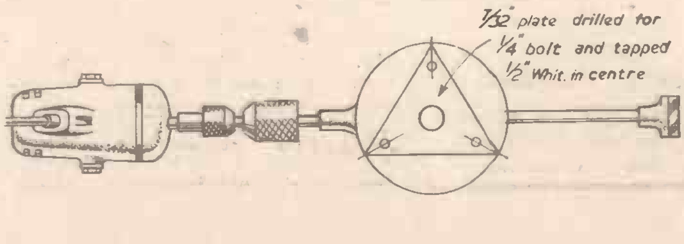
Now make a centre punch mark in the centre of the knob on the gear and place the plate in position, using one of the three ¼in. × 1in. Whit. bolts required, and screwing into the existing hole in the gear. It is now a simple matter to centre punch and drill the two extra holes with a 3/16in. drill. These holes may now be tapped ¼in. Whit. and the centre hole ½in. Whit. Thread the spindle ½in. Whit. for 3/8in. and screw it tightly into the plate: the chuck is centralised by placing the body of the drill in the vice and fitting a drill into the chuck so that the drill point nearly touches the bench. Adjust the three bolts till the drill point ceases to "wander" and the bolts are reasonably tight.

A short length of 6in. nail acts very well as connection between the two tools. The two chucks should be tightened first and then the bolts holding the drill in position need only be tightened with the fingers. These bolts must be ¼in. ANF (American National Fine), obtainable at any Ford dealers', and care should be taken that they are the right

(*Continued on page 535*)



Mr. D. F. C. Vosper's drilling arrangement



length. If they are allowed to " bottom," damage to the field windings of the motor might result. The side handle should, however, be dead tight. A thin ½in. washer must be placed between the big gear and the body to act as a thrust bearing.

Never hold the tool by the electric drill handle, but always by the side handle and the breast piece, which will be found convenient for both vertical and horizontal drilling. Never attempt to drill large holes direct—for instance for a ¼in. hole in steel put ⅛in. and then 3/16in. through first.

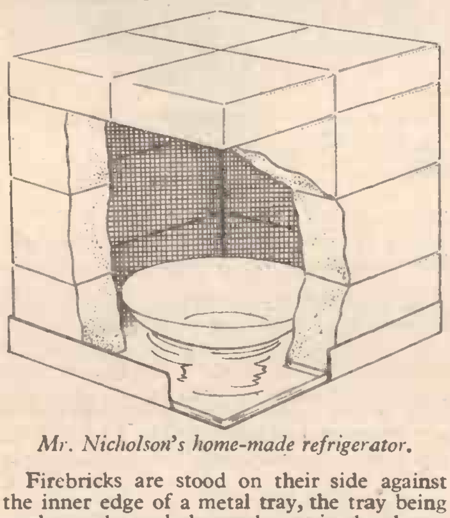
With a little care no overloading need take place—the hum of the motor should not be allowed to drop below the pitch it reaches when doing a sanding job.—D. F. C. VOSPER (Carmarthenshire).

[*In general, these motors are not intended for heavy duty outside the capacity of the chuck.*—ED.]

Home-made Refrigerator

SIR,—Re the query on water-cooled refrigerators in " Information Sought," July issue, these use the cooling effect produced by evaporation of water. When water evaporates it takes up its latent heat of vaporisation of 540 calories per gramme, this heat being extracted from its surroundings and hence from the stored food. The amount of cooling produced is dependent upon the rate of evaporation and such apparatus works best in a draught.

Such apparatus can be made from any porous material, thin unglazed tiles or thin firebricks being suitable.



Mr. Nicholson's home-made refrigerator.

Firebricks are stood on their side against the inner edge of a metal tray, the tray being made to take a whole number as in sketch.

A lid of firebricks fastened together suitably is placed on top. The food is placed in a dish and about ¼in. to ½in. of water is placed in the tray and the bricks damped to start the action. Once started capillary action in the brick ensures working so long as water is kept in the tray.—JAMES K. NICHOLSON (Ards).

Watches That Won't Go

SIR,—I know you to be an authority on watches. Can you explain, therefore, why it is that the impression has got abroad that some people are allergic to watches which flatly refuse to go on them, although they run quite satisfactorily when left on the dressing table ?—H. A. (Coventry).

[*A watch will go on anyone if it is in good order. There is no such thing as a person being allergic to watches. Some watches, however, are not very accurately made. The result is that the purchasers worry the jewellers from whom they bought the watch. His excuse sometimes is that the wearer is one of those persons upon whom a watch will not go. If the balance is in poise, the balance staff has the correct end shake, and the escapement has been properly matched, the watch must go. In every case which I have investigated where the wearer has been informed that the stoppages are due to him (or her) I have found the trouble due to faulty adjustment, bad workmanship or defective parts, and have easily been able to correct them.*—ED.]

Making Transfers

SIR,—Many needlework shops stock a proprietary brand of transfer ink which can be used direct on to a strong tissue paper or, not quite so good, a tracing paper. The best way to go about making a transfer is to draw out the design on a piece of ordinary drawing paper in soft pencil; if it is a repeating design, as on a table cloth one quarter can be drawn then folded over and rubbed so that the soft pencil marks the reverse of the design on the next corner. The design should then be run over in ordinary ink so that it shows through the tissue paper, and lastly the tissue paper is stretched over the drawing and the transfer ink applied direct. It should be left to dry for at least 24 hours before use. This ink can also be used to give additional life to an old transfer. Do not apply the ink too thickly or large unsightly blots will be transferred on to the cloth.—W. D. W. (Maida Vale).

SIR,—*Re* " Information Sought " in your July issue regarding the making of a transfer for embroidery work, a quantity of sugar mixed with ordinary fountain pen ink and used with a fairly wide nib on tracing paper has proved very successful.

Pictures and sketches may be traced from magazines or a copy made of an old used transfer with ease.

The above mixture of sugar and ink dries with a glossy embossed surface, and should be slightly sticky when dry. The amount of sugar can be gauged by experiment. Before ironing on to the material, the transfer should be left to dry thoroughly.

Tracings from magazines should, of course, be done in pencil first and inked over from the opposite side.—K. G. S. LOVETT (Chessington).

Water Refrigerator

SIR,—With reference to Mr. J. Laughton's letter asking for information about a water-cooled refrigerator, the correct name for this type of refrigerator is " Kepkold," and information is available from Kepkold, Ltd. (Dept. 33), 23, Carnaby Street, Regent Street, W.1.—D. W. SAMUEL (Cardiff).

SIR,—I have been using a " Kepkold " water refrigerator for over six months now, and found it to be very good.

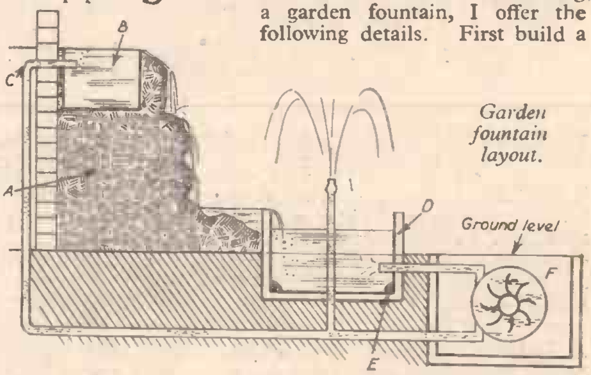
It has four prorous bricks, approximately 18in. square, one on each side, and one on the top. The refrigerator door taking up the whole of the front. Underneath the top brick is a small water tank which holds approximately half a gallon. From the water tank are draped six wicks, as used in oil lamps. These are sandwiched between the bricks and the aluminium interior, and keep the bricks damp even in the hottest weather. We change our water supply daily, and surplus water simply drains off by the overflow outlet. —D. KELLY (Hants.).

Fuelless Energy

SIR,—I often read PRACTICAL MECHANICS, but in your editorial comment I have never seen any reference to fuelless energy. It is my view that scientists today are not giving enough attention to this subject of fuelless energy. The method is quite simple, but would take time and money; all that would be needed is a shaft sunk into the earth, a couple of miles deep, with a sloping shaft connecting with base of other shaft. This method is sometimes used for ventilating coal mines and I think the air intake could be made to work a turbogenerator.—KERR SINGH (Edinburgh).

A Garden Fountain and Waterfall

SIR,—In reply to F. Evans (July issue), who seeks information on constructing a garden fountain, I offer the following details. First build a



Garden fountain layout.

small rockery (A, in sketch above), and build into the top of this a small tank of three or four gallons capacity, as at B.

Next dig a hole at the foot of rockery, as at D, which is lined with flag stones, reinforced with concrete, E. Another hole (F) must now be dug and lined in the same way, to house a centrifugal pump and ¼ h.p. S.P. motor.

All the connections with the exception of the jet pipe (this being of ¼in. brass) are made of ¾in. rubber hose, and buried a few inches below the ground. Once the pond has been filled and enough time allowed for the pump to be primed, the action is continuous. The ex-R.A.F. pump was obtained from Electronic Precision Equipment, Ltd., and does the job well.

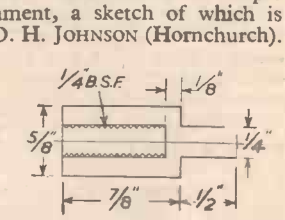
The nozzle I used was the air cone from an old incandescent burner which gives three fine sprays about 4ft. high and is very pleasant to watch.—E. KIRKBY (Hebden Bridge).

Improving a Power Saw

SIR,—With reference to the article in your June issue, " Improving a Power Saw," I find that the threaded spindle on which the saw is fitted is a loose fit inside the bearing.

To obviate this I have devised a simple additional attachment, a sketch of which is shown below.—D. H. JOHNSON (Hornchurch).

Mr. D. H. Johnson's additional attachment.



A Testimonial

SIR,—You can have no idea how pleasant it was to receive (May issue) PRACTICAL MECHANICS once again; a dreary wait. It is fully appreciated the fault for its non-appearance was not yours. Congratulations on an excellent copy; but, then, every issue is excellent and excellent value. Come out to " the back of beyond " in Africa yourself some time if *you* wish fully to appreciate your own journal !—W. DUNCAN, J.P. (Tanganyika).

Keeping Deep Frozen Food

SIR,—Information is sought in the August issue of PRACTICAL MECHANICS by S. W. Poxon (Burton-on-Trent) on the subject of keeping deep frozen food. If the reader would write to H.M. Stationery Office and ask for leaflet " Home Freezing of Fruit and Vegetables " price twopence he would obtain all the information required.—C. H. FOWLER (Oldham).

Trade Notes

New "Steadfast" Hacksaw Blades

THESE new blades are made in two types, the "High Speed" and "Regular Tungsten"; this latter being available both as a rigid and flexible blade. The "High Speed" blades are obtainable from 10in. to 24in. in length, 1/8in. to 2in. in width, .025in. to .1in. in thickness and with from 4 to 32 teeth per inch. "Regular Tungsten" blades are available from 10in. to 16in. in length, from 1/4in. to 1 1/4in. in width from .025 to .062in. thickness and from 10 to 32 teeth per inch. The "High Speed" blade is especially suitable for use in modern high-speed machines. Full details and prices of this range of blades are available from the makers, J. Stead & Co., Ltd., Manor Works, Sheffield, 2.

A Cabin Cruiser for Radio Control

DESIGNED specially for the radio control experimenter, this kit forms a 54in. model cabin cruiser based on a 40ft. customs launch. The sections are pre-cut to shape and ready to assemble by slotting together. All the parts are lettered and numbered to correspond to the diagrams and instructions which are included in every kit. The small sketch on this page gives some idea of the lines of the completed craft. The cabin lifts off in one piece, the lifebelts being used as handles, giving access to all engine and radio units and batteries. The cabin is rubber-sealed to ensure its being watertight and the craft is designed to use electric motors or diesel engines from 2.5 to 10 c.c. The retail price in Great Britain is £9 19s. 6d., which includes cost of packing and carriage. Further information is available from The Model Shop (Newcastle-upon-Tyne) Ltd., 18, Blenheim Street, Newcastle-upon-Tyne, 1.

The radio controlled cabin cruiser.

Electric Blanket Element

THE "Semplex" asbestos blanket heating cord is simply a length of asbestos covered heating cord which is attached by the purchaser to an ordinary blanket thus forming a cheap but efficient electric blanket which will warm the whole bed.

The cord merely has to be stitched to the blanket and no soldering is involved; it is made to a fixed resistance and cannot overheat. There is no thermostat to fail, and the cord is for use on 220-250 volts A.C.

The cord will be of special interest to invalids, particularly those suffering from rheumatic ailments. This product carries in addition, a money back guarantee if not satisfied.

Prices are as follows:

40 W. to cover an area 2ft. 6in. × 2ft., 7s. 6d.
75 W. to cover an area 5ft. × 2ft. 6in., 15s.
100 W. to cover an area 5ft. × 4ft., 18s.
Post paid. C.O.D. 1s. 4d. extra. All enquiries should be sent to Messrs. Wirral Electric, 41, Mill Hill Road, Irby, Heswall, Wirral.

New Wolf Attachment

A PORTABLE saw attachment has now been added to the range of Wolf Cub Home Handyman Portable Electric Tools. An exclusive feature of this attachment (which is fitted with a 5in. diameter rip and cross-cut blade) is that, apart from being suitable for making straight and bevel cuts of up to 45 degrees, the blade can be adjusted by means of two pairs of tapered washers so that grooves of up to 3/8in. in width can be made. A further feature is a permanent spring-loaded telescopic guard, which ensures perfect safety to the operator.

Known as the Wolf Cub No. 12 Portable Saw and Groover Set, the equipment will enable the home handyman to saw and groove more quickly, more easily and more accurately.

Two light alloy castings form a cradle for the Wolf Cub power unit. A pressed steel soleplate is fitted and is adjustable by means of wing nuts for either depth or bevel cutting. A pressed steel rip fence is also incorporated in the soleplate assembly so that accurate cuts may be made without the use of scribe or pencil guide lines. Washers for blade grooving adjustment are numbered to ensure correct assembly and are fitted in pairs on either side of the saw blade, the outer pair being keyed to the saw spindle. Simple adjustment of either of these washers varies the width of groove to be cut. The retail price is £3 19s. 6d.

Multi-Purpose Thread Restoring Tool

LAWRENCE EDWARDS & CO. (ENGINEERS) LTD., of Commercial Building, Kidderminster, have brought out a new model of their Patent Thread Restoring Tool—the "Bolt Saver." It will beof interest to all who have occasion to employ bolts, studs and other screw-threaded parts as it can be used for a variety of jobs. The first of these is for restoring damaged threads.

Damage usually occurs at the leading end of the thread, which, with conventional methods, makes the tool difficult to screw on. The "Bolt Saver" opens up to receive the bolt or other part and does not have to be screwed on to the damaged thread: it will therefore dealt with any type of part—on the bench or on the job. It is not a cutting tool: it re-forms, or re-rolls the damaged thread restoring its original shape without cutting away any metal.

The tool may be used also as a "thread gripper" for holding threaded parts in the vice, as when cutting off lengths of studding, modifying or machining special threaded parts, etc. (see photograph).

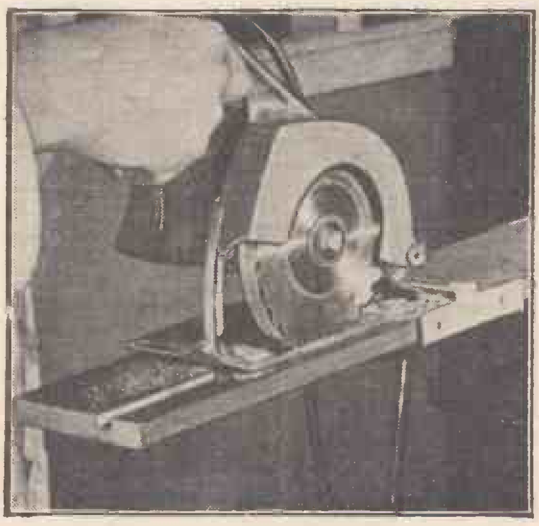
Finally, the "Bolt Saver" may be used for crimping hose ferrules and "O" clips.

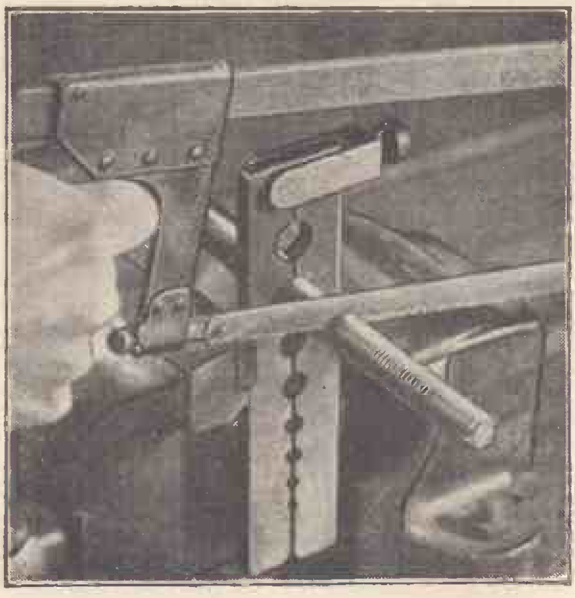
It is a precision tool in suitably hardened and tempered tool steel and may be had in the following sizes, which are all clearly marked: 1/4in., 5/16in., 3/8in., 7/16in., 1/2in., 9/16in., 5/8in. and 3/4in. This new model is now in production, the following types being available for early delivery: Whitworth, B.S.F., A.N.F. (SAE) and U.N.F. The price is 27s. 6d.

The Lucas "Comet" bell.

New Lucas "Comet" Bell

THIS futuristic cycle bell, shown in the photograph above, is known after its shape as the "Comet." The mechanism employed is one of the well-known and well-tried Lucas units and incorporates many of the features of the "Challis" bell. The dome is chromium plated with a red plastic centre, and the price of this modern cycle accessory is 6s. 6d.





(Left)—New Wolf portable sawing and grooving attachment.

(Right)—The "Bolt Saver" thread restoring tool in use.

Your Queries Answered

Foam Fire Extinguisher

I WISH to make a two-solution foam which is stable. The type used in foam extinguishers is required, but as it will come into contact with the skin during its use I am rather dubious as to using the sulphuric acid-sodium bicarbonate solution. Could you give me such a mixture of solutions?—John Harrison (Leeds).

A HARMLESS foam which is fairly stable and which can be used for fire-extinguishing and for other purposes is produced by the following method: sodium bicarbonate 22 oz., aluminium sulphate 30 oz. Dissolve 1 lb. of the above in one gallon of water. Then add 2-3 oz. of saponin and stir rapidly to produce the white foam.

Another formula for foam production is: soda ash 1¾lb., palmitic acid 300lb. Dissolve this soda ash in a small quantity of water. Add the solution drop by drop to the palmitic acid and heat in a basin. Then add magnesium phosphate, 275lb. Stir rapidly until foam is produced.

Palmitic acid is rather difficult to get. In place of it, you may use palm oil, or even mutton fat.

Coal Flowers

SOME years ago I remember seeing a description of how to form a pretty coral-like growth (various colours) on a piece of coal by feeding it with a liquid mixture. I have an idea that ammonia formed part of the liquid.

Could you please supply me with the correct procedure?—W. Fox (Hove).

TO obtain the growths which you describe, place a few small pieces of clean coal (or dry coke) into a basin. Then saturate it with the liquid made up as follows: common salt, six teaspoonfuls; laundry blue (or other blue pigment), six teaspoonfuls; water, six teaspoonfuls; strong ammonia, one teaspoonful.

When the coal or coke is thoroughly wetted with the above mixture, pour on a few drops of red or other coloured ink. Then set the bowl aside and allow it to remain undisturbed.

Coral-like growths will soon appear and will then grow rapidly. The growth will climb up the edges of the bowl and will spread beyond them unless they have previously been greased. When the growth slows down, a few more drops of ammonia on the coal or coke will start it up again.

The phenomenon is one of capillary attraction. The ammonium salts are absorbed by the coal or coke and crystallise on its surface. The micro-crystals thus produced are porous. They suck up more of the solution and crystal growths are formed on their surfaces. In this way, the crystals grow and spread as long as the coal or coke is wet and as long as a little ammonia is present.

Descaling Immersion Heater

I HAVE an immersion heater which is made of nickel-plated tubing with the heating element inside. Due to its constant use it has become heavily coated in fur, which I wish to remove. Scraping would be tedious and the nickel plating would be scratched. Please tell me the best chemical method of removing the fur without damaging the nickel plating. —W. Stigle (Huntingdon).

RULES

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

MODERATELY dilute hydrochloric acid (muriatic acid) is the best solvent to use for descaling. It would be wise to remove the element and treat in a fireproof glass vessel or earthenware vessel so as to have the reaction under control. As soon as the scale is removed wash free from all traces of acid in several changes of water.

Bituminous Paint

COULD you supply me with a formula for dissolving asphaltum for paint making?

Does this paint dry brittle and, if so, could anything be added to make it more flexible?—E. W. Hall (Sheffield, 10.)

THERE are very few organic liquids in which asphaltum or bitumen is *not* soluble: ordinary naphtha is the most suitable. If the bitumen is too hard, the paint film will become hard and brittle and will flake off, especially after exposure to sunlight. If the bitumen is too soft, the paint film will tend to remain tacky, and to soften still more during the summer time.

This difficulty is overcome by blending together a hard and a soft bitumen. We suggest that you gently melt down together 70 parts (by weight) of Gilsonite bitumen (or hard asphaltum) with 30 parts of "65-penetration" bitumen. After this mixture has been stirred together in the molten condition, it can be allowed to re-solidify.

Of this mixture, take about 30 parts and dissolve it in about 70 parts of solvent naphtha. The result will be an average quality black bituminous paint which will dry with a glossy surface. The paint can be made thicker or thinner merely by adjusting the proportions of the bitumen mixture dissolved in the naphtha. The paint film can be hardened or softened by adjusting the proportions of the hard and soft bitumens. The aim is usually (but not always) to obtain a paint film of maximum hardness which can be relied on not to become brittle on exposure or at unduly low winter temperatures.

You should be able to obtain the above bitumens (in small amounts) from any local asphalting firm.

When making up the paint, melt the bitumens first and then very cautiously add the solvent, so that the molten bitumen is, as it were, thinned out gradually by the solvent. This is a much better method than dissolving the cold bitumen lumps in the hot solvent.

Dyeing and Waterproofing a Sail—Removing a Painted Number

I HAVE a boat sail the colour of which was originally turkey red and which has faded unevenly due to being left uncovered when furled; also a number has been painted on it.

Can you suggest any method of improving the appearance by some form of permanent dye? It would not matter if it changed the colour of the sail provided the finished result was even. If it proofs the sail so much the better.

Will any preparation remove the painted number without damaging the canvas?—Wm. J. Reynolds (Cheshire).

YOU might dye the sail and make a perfectly good job of it, but the chances are very much against your doing so. It all depends on the age of the sailcloth, its composition texture, state of wear, surface condition, degree of contamination, choice of dye, method of dyeing and other variable factors.

Few dyes will withstand the vigorous exposure given to sailcloth, and the few special super-fast dyes require special experience and equipment.

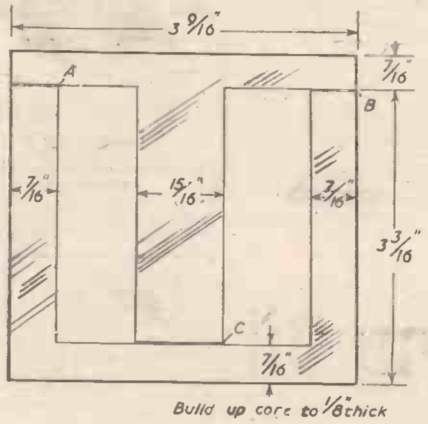
As you want to waterproof the sail as well as to dye it, and assuming that you have no objection to the use of a green stain which, on new sailcloth, would give a green appearance, but which on previously dyed material may give any colour, we suggest copper naphthenate. It is obtainable from many chemical supply firms. It is manufactured by Messrs. Thomas Tyrer & Co., Ltd., Stratford, London, E.15. Two pounds of the material should suffice for even a large sail. Essentially it is a metallic resinate, made from petroleum by-products. It is quite insoluble in water and that is why it is such an excellent rot-proofer and water resistor. Dissolve sufficient of the copper naphthenate in white spirit, paraffin, benzol or solvent naphtha to make up a dark green solution. This is then brushed on to both sides of the sail and left to dry out. If the resulting stain is not dark enough the process can be repeated. The result will be a sail which has been thoroughly water and rot proofed at a minimum of expense. Normally the colour would be green, but that question will be decided by the previous colour of the sail.

If the number has actually been painted on the sail, it would be fairly easy to remove it by treatment with one of the many paint removers now obtainable. Failing that, apply a mixture of equal parts of benzene and acetone kept well shaken up. This mixture will soften any type of paint, including cellulose paint. It is customary to dissolve a little candle-wax (say, 5 per cent.) in the mixture to prevent its evaporating away too speedily. After the paint has been softened, it is scraped off the sail with the blunt edge of a knife. Do not attempt to bleach the number away with any bleaching agent, however mild, since this will inevitably bring about the deterioration of the sailcloth, particularly as the latter is so much exposed to the influences of the weather and of the sea air.

Choke for Fluorescent Tube

I WISH to wind a choke for a 30-watt 3ft. fluorescent tube. Would you please advise me what size core to use, the thickness of wire, the number of turns, etc.—W. Townrow (Essex).

THE core of the choke coil could be built of Stalloy stampings approximately 0.014in. thick to the dimensions given below. A coil on the centre limb of the core should be wound with 1,800 turns of 25 s.w.g. enamelled wire with a layer of thin paper between each of the layers of wire. An air gap should be left at each of the points A B and C of the core. This gap provides a means whereby the choking effect can be adjusted if required and should be used to give approximately 0.34 amps through the lamp under working conditions, or 103 volts across the lamp. An air gap of approximately 0.025in. will probably be suitable. The gaps can afterwards be filled in with fibre or similar material so that the core can be clamped up solid.

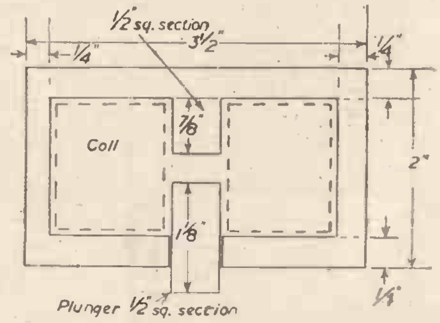


Details of the Stalloy stamping core for fluorescent tube choke.

Electro-magnet Details

I WISH to construct an electro-magnet, which will operate from a 12 volt D.C. supply. It will be required to lift a 4 oz. weight at a distance of approximately ¼in.

Please tell me the number of coils needed, and the size of wire, also the current it will consume.—M. Reed (Crawley).



Details of the electro-magnet for Mr. M. Reed.

WE suggest that you build the electro-magnet core and plunger of soft iron or mild steel to the dimensions given above. The coil could be wound with approximately 1¾ lb. of 23 s.w.g. enamelled wire and will take about 0.7 amps. A lower current could be used when the plunger is in the energised position and, if required, you could perhaps arrange for the plunger to separate a pair of contacts when it reaches the end of its stroke, in order to reduce the coil current and heating. These contacts should be connected in series with the coil with a resistance of about 30 ohms connected across the contacts.

Information Sought

Readers are invited to supply the required information to answer the following queries.

Stencil Film and Paint for Screen Printing

PLEASE tell me how to make stencil film for screen printing and a formula for making paint to use with it.—J. NOLAN (Eire).

Cutting "Perspex" Discs

I WISH to cut 1½in. circular discs from clear Perspex sheet 1/16in. thick. Could you recommend a cheap tool for doing this job, or alternatively how to make one ?—J. A. SCOTT (Renfrewshire).

Cosmic Accumulator

CAN you please tell me how I can make a "cosmic accumulator" ?

I believe it consists of a paper core pointed heavenwards. I would like more details.—N. COOPER (Birmingham, 7).

Electric Blower for Church Organ

I INTEND to convert a hand-blown church organ to electric blower. Can you tell me how to connect up the electric blower to the present bellows ?—G. HERRIOT-HUNTER (Edgware).

"Wet and Dry" Indicator

I RECENTLY purchased a mercury barometer in the top of which is a wet and dry indicator. This part is not functioning and I should like to know the principle on which it works. The base is a plate on which is engraved in a circle from wet to dry in 10 stages. The indicator (or hand, as it were) appears to be made from a piece of hollow wood or cane about 1/16in. in diameter, this being mounted on a stem of some sort and fixed with what appears to be beeswax. The other end of this stem is fixed to the base plate with the same medium. Can you give me any idea as to what materials were used in the making of this instrument and the principle on which it works ?—P. A. BLAKE (Sittingbourne).

Silvering Mirrors

CAN you suggest suitable formulae for preparing mirrors by the spray solution method ?

I have been experimenting with a two-solution spray method, viz., the orthodox silver nitrate/ammonia solution is drawn through a twin jet spray gun and meets a second solution made by mixing just before use :—

(a) Dextrose (Glucose) 2oz.
Formalin Solu. 1½oz.
Water to 2 pints
(b) Caustic soda, 2oz.
Hydrazine sulphate, 1½oz.
Water to 2 pints

} of each 1 part to 4 of water just before use.

This gives a film of silver on the glass which is rather thin and takes too long to build up.

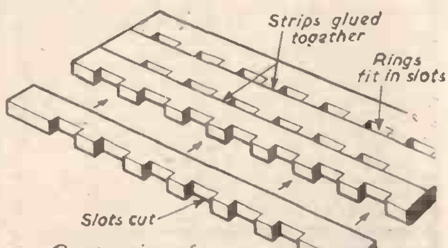
Can you suggest a modification of the solutions I am using or some possibly more satisfactory formulae ? — L. OLDHAM (Liverpool, 19).

Refilling a Compass

I HAVE refilled my compass with carbon-tetrachloride, but it appears on inspection to be attacking the rubber seal in the bottom of the bowl. Could I use Lockheed hydraulic fluid instead ? Would it affect the card, which has the appearance of mica ?—T. ALLEN HENDERSON (Shetlands).

Making Jewellers' Pads

CAN you help me in the construction of jewellers' pads for displaying rings ? I propose fitting new centres to existing frames with fewer slots than the existing ones. I find the slots are formed by recessing ¼in.-⅜in. strips of wood and gluing the back of the next row of recessed strip to form the rows of slots (see sketch). My problem is to cut the recesses in quantity to a uniform depth and width, to avoid the work involved in cutting them individually.—D. MITCHELL (Fife).



Construction of jewellers' pads

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EX-GOVT. ROTARY CONVERTORS 24 volts D.C. Input 50 volts 50 cycles, 1 phase at 450 watts. OUTPUT (complete with Step Up Transformer) from 50 volts to 230 volts, **£13/10/-** each or **CONVERTOR** only **£9/10/-** each.
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A.C. MOTORS, 230 volts, sewing machine size, **35/-**. P./F.
IRON CLAD safety switches, 2 pole, DP/DT 250 volts, 60 amp. new, **18/6.** P./P., 1/6.
D.C. MOTORS, 24 volts, large size, 8/6. P./P., 1/-.
ROTARY CONVERTERS, with all smoothing and control, input 28 volts, D.C., output 300 volts, 260 mA, 150 volts, 10 mA and 14.5 volts at 5 amp., all outputs are D.C., as new, **45/-**. P./P. 2/6.
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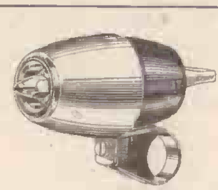

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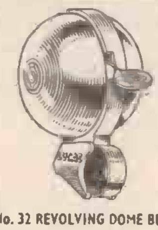

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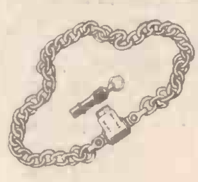

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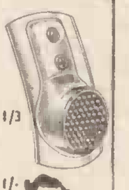

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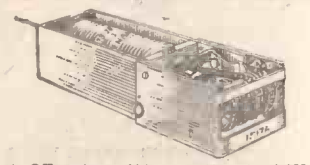

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THE Cyclist
Editor : F. J. CAMM

VOL. XXIV SEPTEMBER, 1956 No. 410

All letters should be addressed to the Editor, "THE CYCLIST," George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2

Phone : Temple Bar 4363
Telegrams : Newnes, Rand, London

WHAT I THINK .... By F. J. C.

M.O.T. TO CONTROL ROAD SPORT ?

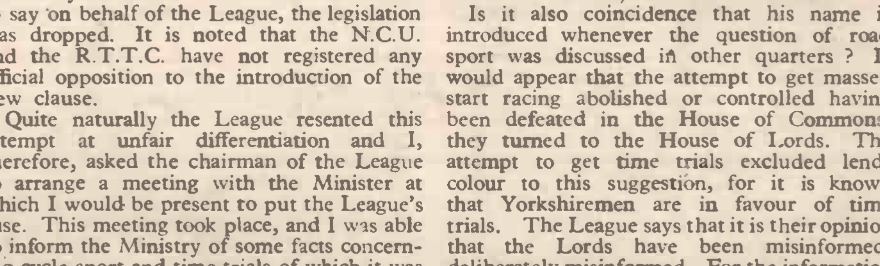
IF amendments to the Road Traffic Bill, 1956, recently introduced by the House of Lords, are adopted, it will mean that the control of all road sport will be placed in the hands of the Minister of Transport. This amendment was added after the Bill had passed through all its stages in the House of Commons. The amendment relating to cycle racing on highways reads : "Clause 12 Regulation of cycle racing on highway : 12.—(1) Any person who promotes or takes part in a race or trial of speed on a public highway between bicycles or tricycles, not being motor vehicles, shall, unless the race or trial is authorised, and is conducted in accordance with any conditions imposed, by or under regulations under this section, be liable on summary conviction to a fine not exceeding two pounds." The R.T.T.C. saw in this an opportunity for a covert attack on the B.L.R.C. by inspiring Lord Hailsham to move an amendment to the Clause in the following terms : "Provided that this sub-section shall not apply to an individually-started time trial, that is any organised competitive cycling event in which each individual competitor starts at a different time of the day, separated from that at which the last competitor in the same event started by a lapse of not less than one minute, and the placings are determined entirely by elapsed times." One would have thought that a sporting body would not have attempted by such an amendment to give the impression that its own sport was not in need of control and by implication suggesting that B.L.R.C. events are. One might equally have thought that the proposal that sport should be controlled by the M.O.T. would have caused the three main bodies concerned to have presented a united front and to have opposed the amendment in general terms, stressing that all cycle sport is so well controlled that such an amendment was unnecessary. It is typical, however, of the methods adopted in cycling politics that the R.T.T.C. should have acted in this way. Unfortunately for them, however, Lord Hailsham's amendment was withdrawn, after Lord Mancroft had stated that the Government would let time trials go on in the manner in which they are at present conducted. He went on to say that circumstances may change, however, and even time trials may have to come under some control, and that they could not be given a completely free hand because changing conditions on the road may one day make it necessary for some form of control to be imposed. The plain fact is that time trials are no better organised than massed start events. There is less danger in a massed start event than a massed finish at high speed and this can happen whether the event is a time trial or a massed start event. Attention was drawn to one or two mishaps which have happened in league events. No one, however, drew attention to the numerous accidents, some fatal, which have taken place in time trials. The R.T.T.C. has had to issue warnings about riders riding at high speed in time trials with their heads well down, because some riders have ridden into the backs of stationary lorries. If the Government cares to investigate the history of time trials it will find that there have been plenty of mishaps, and very few indeed in League events. Moreover, they would find that League events are far better organised and marshalled throughout the race than are time trials. It would be manifestly unfair, therefore, for the law to be amended in such a way as to make an invidious distinction between the two forms of racing. We are glad, therefore, to know that Lord Hailsham's amendment was defeated. In saying this, it must not be implied that we are in favour of the Ministry interfering with this innocuous road sport, whether time trial or massed start. The N.C.U. and the R.T.T.C. see in the proposed new measure a rod with which to attack the League. These two bodies have been doing their best for 15 years to get this newer and much more popular sport abolished, and in the early days I found it necessary to draft a memorandum to the Minister setting forth the facts and I was a member of the deputation which presented it to the Minister of Transport and gave him some background history. At that time, legislation had been proposed largely on the strength of underground attacks by the N.C.U. In view of what I had to say on behalf of the League, the legislation was dropped. It is noted that the N.C.U. and the R.T.T.C. have not registered any official opposition to the introduction of the new clause.

Quite naturally the League resented this attempt at unfair differentiation and I, therefore, asked the chairman of the League to arrange a meeting with the Minister at which I would be present to put the League's case. This meeting took place, and I was able to inform the Ministry of some facts concerning cycle sport and time trials of which it was admitted they were in ignorance. It is possible as a result of that meeting that the new clause may be redrafted. The League alone, when it has raised opposition to Government interference, has fought its battles on behalf of time trials and team time trials, as well as for massed start events.

It is necessary also to point out that the only cycling representative on the M.O.T. Committee on Road Safety is R. C. Shaw, the Yorkshire Secretary of the C.T.C. It is well-known that Yorkshire has dominated the cycling movement almost from its inception. Mr. Shaw, for example, succeeded another Yorkshireman as secretary. Now Mr. Shaw's views on road sport are well known. One has only to refer to the Dagenham Road Safety Debate in 1948 to realise that although the C.T.C. is only concerned with cycle touring (although it endeavours to disguise the activities of some of its members on the road by calling them "hard rider" sections) it is endeavouring to poke its nose into a subject on which it knows precious little, and upon which it is not empowered to speak. The previous secretary, now president, had some bitter criticisms to make of the League, although it is true that he withdrew some of his remarks later on. The remarks of R. C. Shaw at the Westerley dinner, when he attacked road racing, is a further example of his views. It is unlikely, therefore, that the M.O.T. Committee on Road Safety when it discussed road sport received any advice in its favour from this self-appointed authority on road racing. It is grossly unfair that the League is not represented on this committee, and in our interview with the Ministry we stressed this point. One wonders how much Mr. Shaw had to do with the introduction of the new clause in the Road Traffic Bill, for it is known that when Hughes Hallett, M.P., asked in the Commons whether any action was contemplated on road sport, he had previously discussed the subject with R. C. Shaw.

Is it also coincidence that his name is introduced whenever the question of road sport was discussed in other quarters ? It would appear that the attempt to get massed start racing abolished or controlled having been defeated in the House of Commons, they turned to the House of Lords. The attempt to get time trials excluded lends colour to this suggestion, for it is known that Yorkshiremen are in favour of time trials. The League says that it is their opinion that the Lords have been misinformed, deliberately misinformed. For the information of R. C. Shaw and his coadjutors, may I inform them that I made it my business to put the Ministry wise on all of these matters. It may be that the R.T.T.C., the N.C.U. and C.T.C. are seeking by this subterranean method to get the League abolished, or its sport emasculated by rigid control and thus remove the need for negotiations for an agreement between the bodies. I see here the same underhand methods which have permeated the sport for years, and the R.T.T.C. has only itself to blame if those methods recoil on them.

The Ministry should not too blindly accept any advice from its Road Safety Committee on road sport, since there is no one on that committee competent to express a valid opinion concerning it.—F. J. C.



The Oriten—the first Decemtuple, built by the Waltham Mnfg. Co., Waltham, Mass., about 60 years ago. It was intended for pacing and trackwork. It was 23ft. 9in. long, weighed 305lb., and used 30in. wheels with 2in. tyres.

Buying a Used Bicycle

By C. JEROME

Hints to Help You Choose a Sound Machine

MOST people with a bicycle to sell make sure that it is in good order before they invite a customer to see it, but there may be a fault that has been either intentionally or unintentionally overlooked. It is up to the customer to find this before buying, and this article sets out to tell him what to look for.

The Frame

This is the most important and expensive part of a bicycle and it should be carefully examined for any signs of damage. The chief thing that could be wrong is a frame that is twisted out of track, and this is something that is not easy to detect quickly. One indication that all is not well is that the wheels do not line up when the front wheel is pointed directly ahead. The sort of view which is obtained is shown exaggerated in Fig. 1. Another test is to wheel the cycle in a straight line along a smooth surface, after wetting the tyres and seeing if two parallel tracks are made. The back wheel should, of course, follow exactly in the track of the front. Another test which could be tried in a quiet road is to ride the cycle with the hands away from the handlebars. If the machine is badly off balance, frame twist may again be indicated. None of these tests is conclusive, however, as the same effects are possible when the wheels are off-centre.

It is also advisable to look at the enamel to see if it is chipped or peeling or if it has been heavily retouched. Re-enamelling can, in these days, be an expensive item. Pay special attention to the top of the chain stays, under the saddle, and to the rear fork ends. Also, check the rear fork ends for twisting and other damage which could have been caused here by continually using hubs of the wrong width or by a dislodged and jammed chain some time in the past.

The Wheels

Apart from noting the obvious points, such as pitted or peeling chrome, rust, badly worn tyres, etc., always spin the wheels to see if they are true. A slight buckle is not usually a serious thing, but it may indicate a serious "kink" which is beyond the mechanic's power to straighten. This is even more likely if associated with visible damage to the rim in the same spot. Finally, shake the wheel sideways to see if the bearings are properly adjusted.

Fig. 1. (Right)—An exaggerated view of a twisted frame.

Loose bearings will probably mean that the cups, cones and balls are not in too good a condition.

The Transmission

Under this heading are grouped the chainring, chain, freewheel, derailleur gear, etc. Inspect the teeth on chainring and rear sprocket for wear (worn teeth become hook shaped) and carry out the test shown in Fig. 2 to see if the chain is stretched.

The chief things to look for in a derailleur gear are correct alignment—a badly-aligned mechanism is almost certainly damaged—and wear in the bearings of the tension pulley and jockey sprocket. The final test will be to ride the machine, and it should be tried in every gear to see if it runs quietly and smoothly in each.

The truth of cranks can usually be seen by the eye, but bent pedal spindles are not so easily detected. Riding is again the best test and any part that is out of line will make itself felt by a definite twisting motion. Shake the cranks sideways in the same way as you did the wheels to see if the bottom bracket is properly adjusted. If it is loose and has been so for some time, it is probable that new cups, balls and spindle will be required.

The Saddle

A badly neglected saddle is easily recognised. Beware of the saddle that sags, even though the tension bolt is as tight as it will go. Look to see that all the rivets are in place and then at the leather itself to see if it is badly cracked. A new saddle can be expensive.

The Brakes

These are probably the most important items on the machine so far as the rider's safety is concerned, and it is worth checking at least that they are in working order.

Brake parts do not usually cost much to replace, but even small replacements are worth bearing in mind when you are deciding whether or not to pay the vendor's price. Small details are often a good indication of the sort of treatment the machine has received at the hands of its previous owner. It is worth noting, too, whether the normal accessories are included—such things as a pump, front and rear lamps, saddlebag and bell.

The Riding Test

It is always advisable, before buying a second-hand machine, to try it on the road. The points already mentioned should be checked, including, if possible, the "no hands" test for frame twist. Noise is often the first indication of a fault, so listen for noisy bearings. All the moving parts should run smoothly and silently, including the chain. If there is a variable gear, either derailleur or hub type, try the machine in every gear. Brake action should be quiet and smooth with no "snatching;" make sure, too, that nothing rattles.

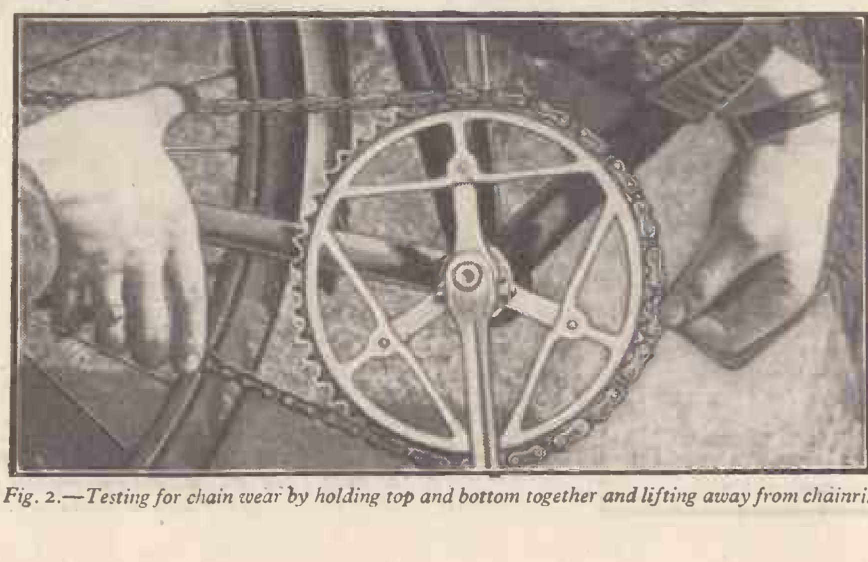


Fig. 2.—Testing for chain wear by holding top and bottom together and lifting away from chainring

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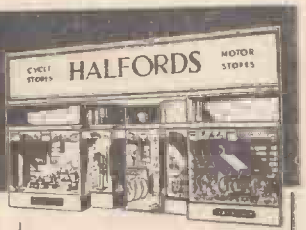

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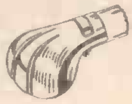

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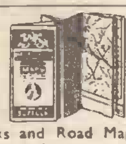

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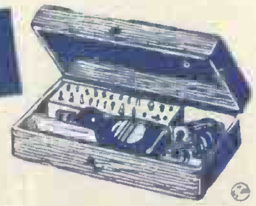

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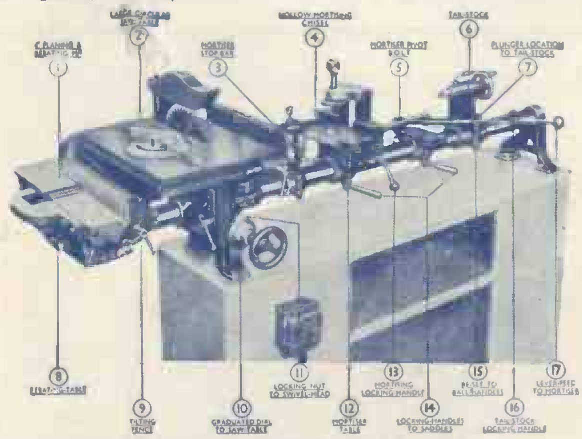

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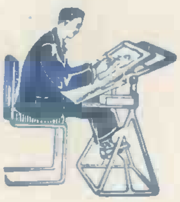

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