Hobbies
NEW ANNUAL

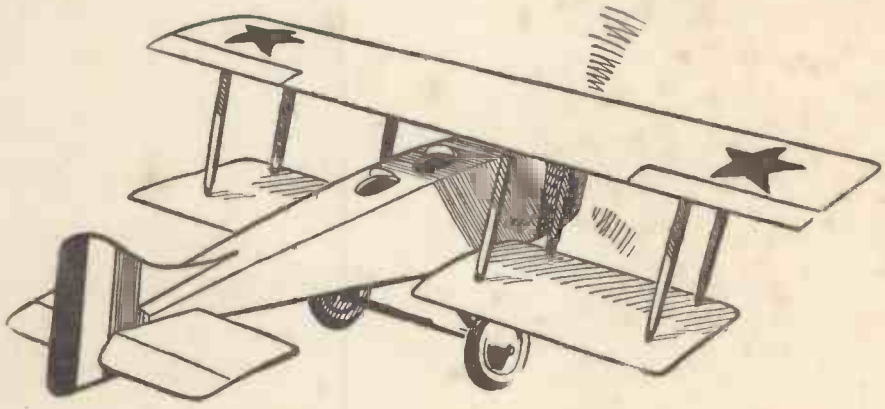
EASY-TO-MAKE WORKING MODELS
OF AEROPLANES, TRAINS, STEAM ENGINES, GUNS, BOATS, SUBMARINES, DYNAMOS, CRANES, ETC., ETC.

Hobbies

NEW ANNUAL

of

EASY-TO-MAKE WORKING MODELS AND HOW TO BUILD THEM



Edited by F. J. CAMM

(Editor of "Hobbies")

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EDITOR'S FOREWORD

UNLIKE most Annuals, which endeavour to blend fiction with practical instruction, this volume, which now makes its first appearance, caters only for those interested in **making** things. It has been modelled in the belief that there is a large number of readers whose practical interests are not entirely satisfied by the mixture referred to above. HOBBIES NEW ANNUAL is new in that respect, for a sincere effort has been made to cater for every practical hobby interest. It is at once an Annual and a Manual!

The matter included has been specially selected because the articles dealt with do not require elaborate equipment or a heavy outlay on materials. None of the articles are **suggestions,** for everything has been made and tested. It is unfortunately true that many articles are written, describing things which have never actually been made. In that respect, too, this Annual is new; and it is thought that the diversity of subjects, the super-abundance of illustrations, and the textual treatment will appeal to those many thousands of practical hobbyists who at present have had no Annual of their own.

In one other way this Annual differs from all others, for if the slightest difficulty be encountered in making up any of the articles described herein, the reader can obtain the services of an expert who will speedily help the reader out of that difficulty. Merely address a letter to the undersigned, c/o the Publishers, explaining the point on which you need advice. It will come to you by return of post.

F J. CAMM.

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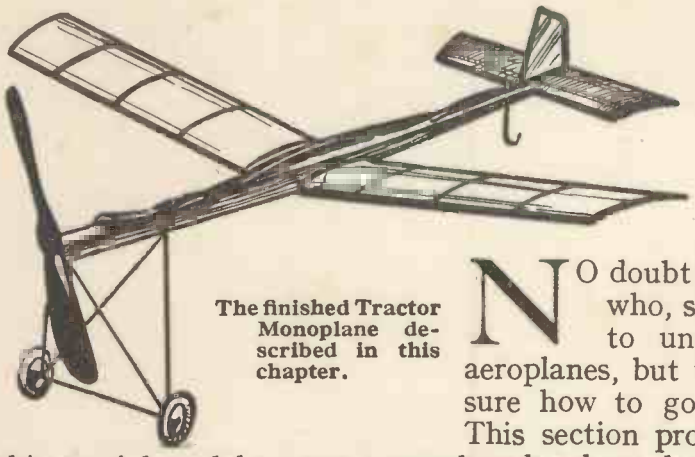
A LONG-FLYING MONOPLANE



The finished Tractor Monoplane described in this chapter.

AN EXCELLENT 300 YARD FLIER—AND ONE WHICH COSTS ONLY 2/6 TO MAKE

NO doubt there exists a very large number who, so far, have never yet attempted to undertake the making of model aeroplanes, but who, though they are not quite sure how to go to work, are extremely keen. This section provides their opportunty, because this special model-tractor monoplane has been designed for them. In addition, the actual parts which are needed are shown in half-size drawings on pages 7 and 8, so that one can check off the construction as one goes along, and be sure that it is done correctly. Thus, the absolute beginner can be certain of results, and can produce for himself the splendid model illustrated. This is no baby; it is a real flying plane, measuring 34 in. long, and with a wing span of 30 in. and having a hollow fuselage.

Assembling.—As sketched on pages 7 and 8, the tractor monoplane shown has a hollowed fuselage, and a section of it on the design (pages 7 and 8) shows the depth to which this hollowing is made. The wood to be used is grooved throughout its length, and all the maker has to do is to put on the cover strip and glue it securely down, tying the body up temporarily with string until the glue has set. Whilst this is happening, the planes themselves can be got out, and a diagram is given scale size of

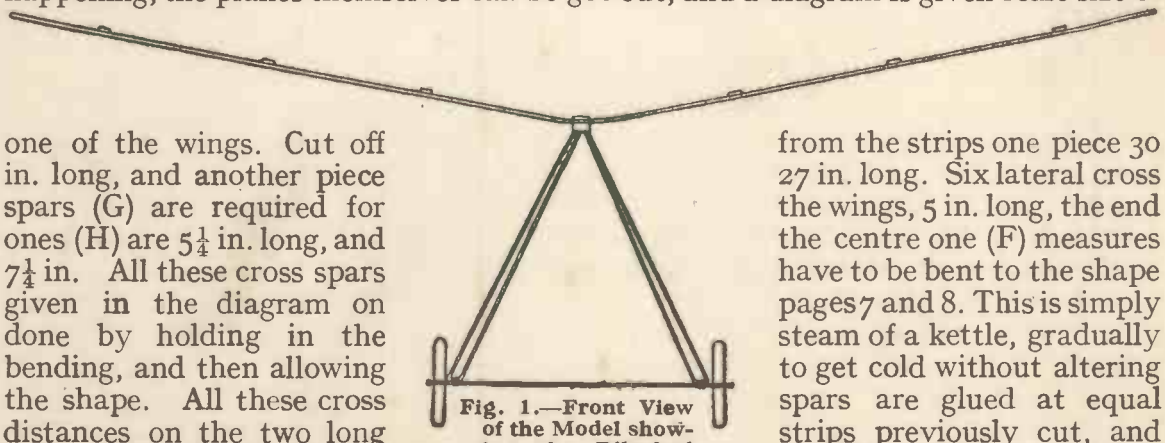


Fig. 1.—Front View of the Model showing the Dihedral Angle.

one of the wings. Cut off from the strips one piece 30 in. long, and another piece 27 in. long. Six lateral cross spars (G) are required for the wings, 5 in. long, the end ones (H) are $5\frac{1}{4}$ in. long, and the centre one (F) measures $7\frac{1}{4}$ in. All these cross spars have to be bent to the shape given in the diagram on pages 7 and 8. This is simply done by holding in the steam of a kettle, gradually bending, and then allowing to get cold without altering the shape. All these cross spars are glued at equal distances on the two long strips previously cut, and at each joint one of the small nails is driven through to give

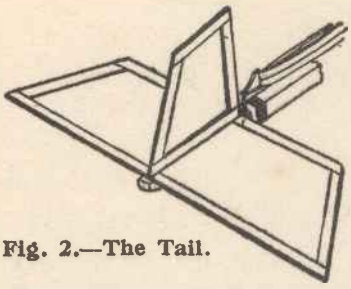


Fig. 2.—The Tail.

additional strength. Each wing of the plane must then be lifted until they rise at the angle shown at Fig. 1. The longest strip of silk is now required to cover this plane. It is stretched from wing to wing first, and then across its narrower width. Turn over round the edges of the wood and glue securely down on the underside. Do not apply the glue too thickly in any case, but rather get it very thin and tacky before pressing the parts in place. The only other silk-covered parts are the tail plane and the rudder. Both of these are shown in the constructional diagrams on page 7, so that there is no trouble in cutting off strips of the wood in order to make up these two parts. Before putting on the silk of the rudder, however, it is necessary to fix a wire stanchion round with about 1¼ in. projecting below. This wire is bound with the twine supplied, and the silk of the rudder glued over all of it. This wire stanchion passes later through the fuselage, and is bent underneath, as shown in full-size on page 8. The tail plane, like the wings, has a centre strut projecting beyond its ordinary width, and this is the strut by means of which the whole part is bound down to the tail end of the fuselage. It is then glued in place, and additional strength is given by the macrana cord being turned round half a dozen times and then glued again. The rudder is now stood upright along the centre of the width of the fuselage, and the wire stanchion stuck through a hole and turned down underneath. In front of the rudder is the tail skid, which forms the boss to which the elastic motor is fixed. The exact shape of this wire is given on page 8. It is put through before the skid is bent, then turned the right shape, and fastened in place by the cord being bound round it and glued. Make a good joint for the eyelet of the elastic by wrapping a small strip of tin round, and soldering fast, or by adding a braced eyelet and squeezing flat with pincers. A sketch of the tail is given at Fig. 2.

At the other end has to be fixed the undercarriage and a propeller. For the undercarriage, a piece of 18 S.W.G. wire is used, and bent to the shape shown by the detail at Fig. 3. A cross strip is added, as can be seen, to provide the axle for the wheels. This is 7 in. long and is bound on with wire and soldered firmly.

The Axle.—Sufficient of the axle is left projecting to take the bushed 2-in. wheels, and, when they are fitted, a small brass eyelet or cap can be put on and fixed with a spot of solder. The wheels will then run true, and are, of course, finished by having the rubber tyres put over them. The whole of this undercarriage is sprung on to the front end of the fuselage. Its position is plainly shown on page 7, where it is bound tightly with macrana cord. The two ends of the wire fit over the nose, and the turned end is on the underside. The open ends lie by the side of the right-angle bracket, which is the prop for the propeller-shaft. This little brass angle plate is screwed down so that

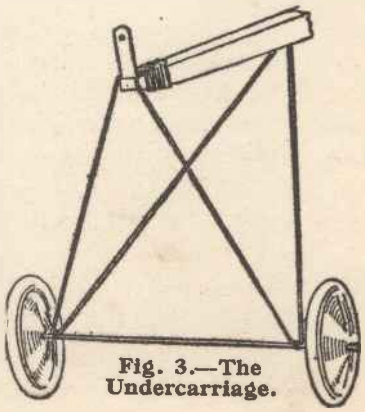
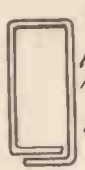
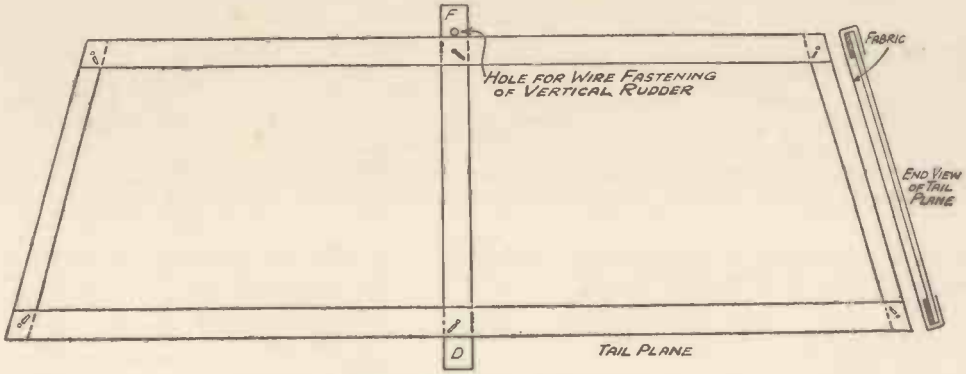
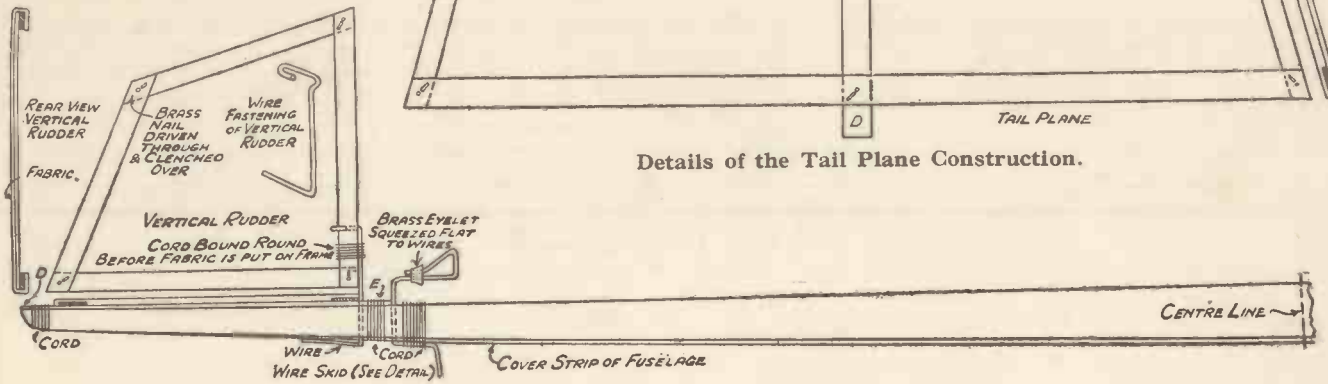


Fig. 3.—The Undercarriage.

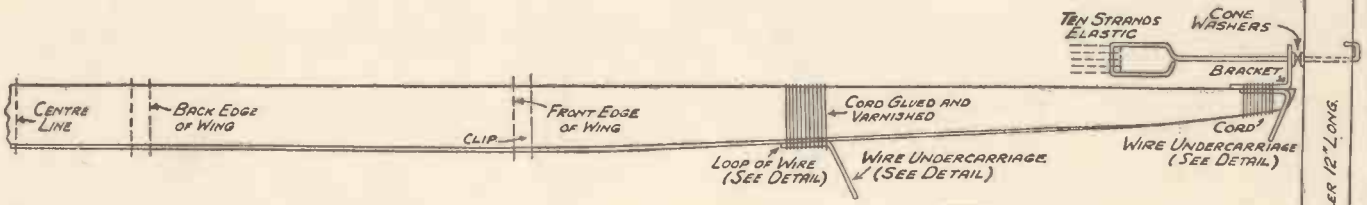




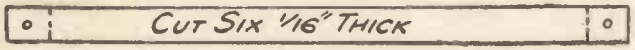
Details of the Tail Plane Construction.

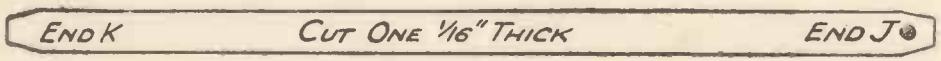


The Fuselage, Rudder, and Propeller Assembly.



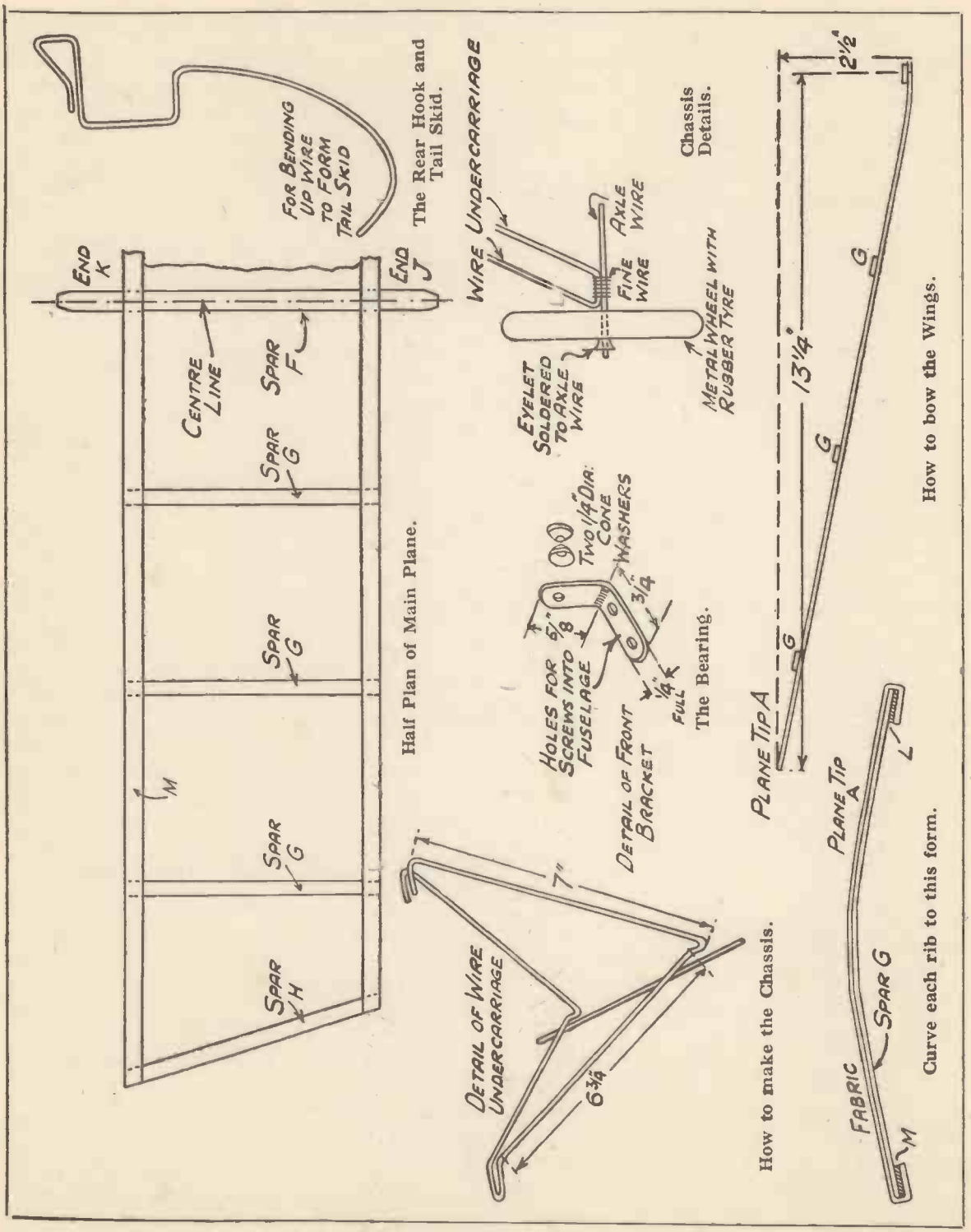
DIAGRAMS OF SPARS F.G.&H





DETAIL SHOWING HOW FUSELAGE IS BUILT. THE BODY IS GROOVED & A COVER STRIP GLUED OVER.

Model Design by F. J. Camm.



The Rear Hook and Tail Skid.

Half Plan of Main Plane.

Chassis Details.

The Bearing.

How to make the Chassis.

How to bow the Wings.

Curve each rib to this form.

the end of it is just level with the actual nose of the fuselage. The wire undercarriage can now be fixed with macrana cord and a coating of glue. See that the front brass angle bracket is very firm, because this has to take the strain of the twisted elastic. The propeller is held by a square pattern hook already turned. The square end is for the elastic. Put the other end through the brass angle plate, and then place in position the two cone washers, pass the wire through the propeller (its position is shown), turn over the end of the hook, and force into the front of the boss. This is shown clearly in the drawing at Fig. 4. Be careful to fix the propeller with the shaped edge of the blade forward, so that when the elastic is turned later on the convex surface will meet the air first. The action is to cut the air and throw it backwards, thus drawing the model itself forward.

The Elastic Motor.—The elastic required is 22 ft. long, of a suitable texture to make a powerful drive of the propeller. This is looped to provide 10 strands, the two ends being tied together very tightly, with strong thread, whilst the elastic is being stretched. It passes through the loop behind the propeller and through the stanchion just in front of the tail. The position of the wings is indicated on page 7 by an upright vertical mark, but this, of course, cannot be taken as definite, because each builder will alter the balance with a little more solder, or glue, or string, or weight of wood somewhere. This mark, however, indicates the approximate position of the front edge of the wing spar. This wing is held in place by a loose collar formed of a piece of suitable strip metal. Two of these are required, and they are cut off just the right length, so that when they are turned round the fuselage they will grip the projecting strut of the wings firmly. Put the wing in place, pass a piece of string round the projecting portion and round the fuselage, in order to cover all the length of the strip of metal required. Solder the two ends of the strip together to prove that they will grip the main plane firmly when brought up to position. The model is now complete, and can be tested out for flying. For the first time give the propeller 200 turns, increasing this gradually until the maximum of 600 has been reached. Test out on a short trial flight by holding the machine well above the head, and launch gently into the air. If it tends to ascend nose first, the main plane must be moved back a little. If there is a tendency to dive, on the other hand, it must be pushed forward a little.

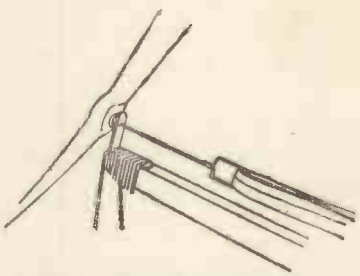


Fig. 4.—Details of the Bearing, and Propeller Shaft.

Correcting Faults.—If the model tends to fly in circles set the rudder; the rudder will affect the line of motion of the model in exactly the same way as the rudder of a boat affects the direction of travel of the boat. Make quite certain that the airscrew is wound in the correct direction, which is such that, when the model is held in the hand and the airscrew allowed to revolve, the air is driven towards the tail. It is very important to keep the front and rear edges of the plane quite true, and to see that the tail and mainplane are in line with one another.

Making a Wooden Snake Toy

IT WRITHES AND TWISTS IN REALISTIC FASHION

A REMARKABLY realistic snake can be made from wood by following the directions below. The snake is a novel toy; it writhes about in a realistic manner. The snake is made from two pieces of stripwood, ½ in. by ½ in., which can be anything from 18 in. to 24 in. long. American yellow pine, canary whitewood, or Virginian red cedar are the best woods to use, because of their capacity

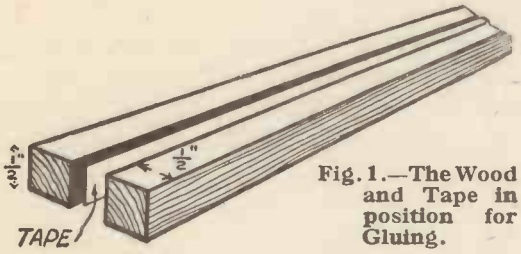
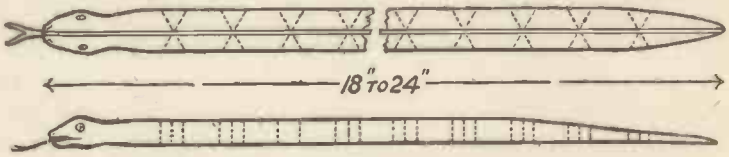


Fig. 1.—The Wood and Tape in position for Gluing.



Figs. 2 and 3.—These Diagrams show how the Snake is cut from two pieces of Wood.

Fig. 4.—Cross Section of the Snake.

to hold glue. Yellow deal, spruce fir, satin walnut, or mahogany are good alternatives. Plane one side of each strip, so that when the strips are placed side by side they fit close together. Then get a piece of ½-in. tape, and put it between these two planed sides, as shown in Fig. 1. Glue the tape and the strips of wood together, and hold them in cramps for about twenty-four hours until the glue is thoroughly hard and dry. You now have a strip of wood ½ in. thick and about 1 in. wide. With a plane taper one end, and shape the wood to the snake shape, shown in Figs. 2 and 3. Fig. 4 shows a section across the centre of the snake to indicate how the edges are rounded. Taper the tail and finish with a file and sandpaper. Cut the open mouth with a saw, and shape the head with a knife. Glue to the inside of the mouth a piece of tape, fork-shaped, to appear like a tongue.

Cutting the Body.—Next, V-shaped pieces of the snake's body have to be cut away, so that it can bend and writhe about. The best way to do this is by using a bench block, as shown in Fig. 5. It is quite an easy job to make a cutting block like this. The two kerfs, or saw-cuts, are at 60 degrees to the top of the block and are used to guide the saw when cutting the snake. A strip of wood (B) is fastened on the bottom board, C to hold the snake secure, and the strip marked D is gripped in a vice. When sawing out the wedges of wood take particular care to avoid quite reaching the tape.

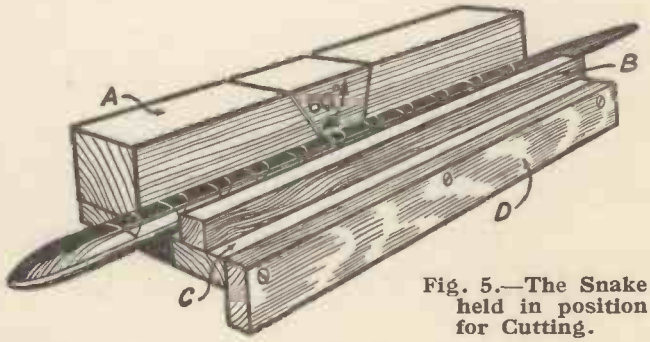
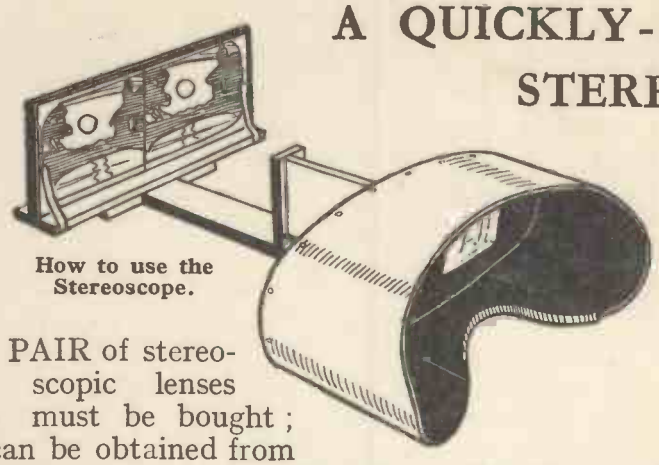


Fig. 5.—The Snake held in position for Cutting.

A QUICKLY-MADE STEREOSCOPE



How to use the Stereoscope.

A simple piece of Apparatus which gives Pictures a Solid and Natural Appearance

A PAIR of stereoscopic lenses must be bought; these can be obtained from any optician at a reasonable price. For the woodwork, mahogany is recommended, though any hardwood would do. For this instrument, wood $\frac{1}{4}$ in. thick is used except where otherwise stated.

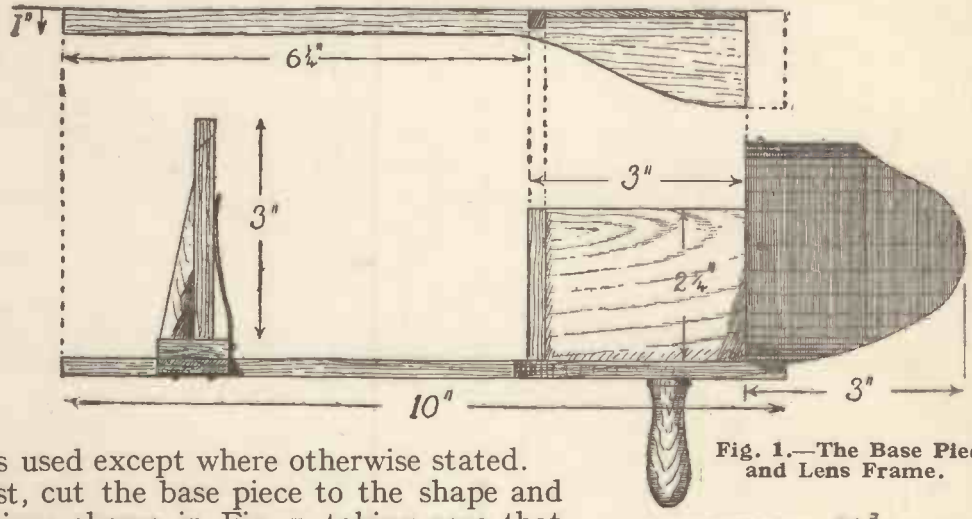


Fig. 1.—The Base Piece and Lens Frame.

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 wood being $\frac{3}{8}$ in. and $\frac{1}{8}$ in. 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 $\frac{1}{16}$ in. smaller each way. These two pieces are then glued together. The centre of the lenses should be $2\frac{3}{4}$ in. apart, the distance of the eyes.

Fitting the Lenses.—The lenses are wedge-shaped, and should be dropped in place, the

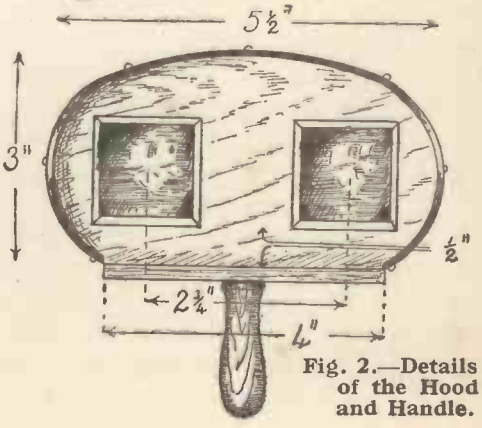


Fig. 2.—Details of the Hood and Handle.

thin edges facing each other. Glue narrow strips of wood round the lenses 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.

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, ½ in. larger all round. Glue this 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, ¾ in. 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.

The View Carrier.—The view carrier is shown again at 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 backboard vertical.

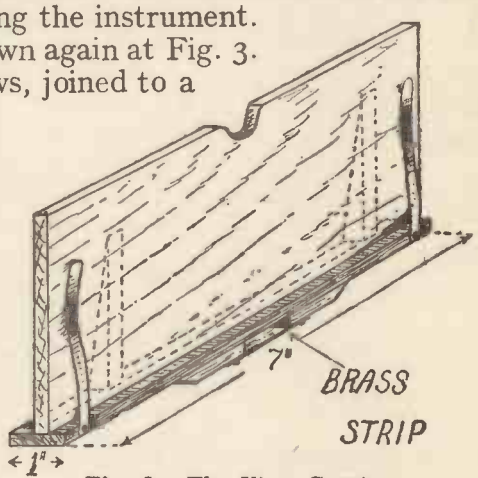


Fig. 3.—The View Carrier.

Underneath are glued two shorter pieces of wood, 1 in. 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 lens for focusing.

The brass strip is bent slightly inwards so as to grip the base piece; the carrier should slide easily yet fit tight enough to remain in any position it is placed.

Polish the woodwork and stain the interior of the hood a dead black.

This instrument will be found of great use to amateur photographers, who may take special pictures to view through the stereoscope here described. Two photographs should be taken instead of one, from points distant from one another as far as the centre of one eye is from that of the other. The photographs are then mounted on stiff cards and the instrument adjusted to give the best stereoscopic effect. It was Professor Wheatstone who first suggested the possibility of making stereoscopic pictures.

The photographs so taken can be made even more attractive by tinting them with any of the paper photographic stains sold by most photographic dealers. Similarly, existing photographs may be copied in the manner outlined to give a second picture which, when used in conjunction with the original, will give stereoscopic effect. The pictures may be portraits or views, but in copying them the camera should be set, not to take a dead-on view, but be moved the distance equal to the eye centres out of line of the centre of the picture to be copied. The copy, of course, will have to be enlarged to the same size as the original.

MAKING INDOOR FIREWORKS

Harmless Fireworks which *you* can make

THE following experiments are performed with chemicals readily obtainable from any chemist. The resulting fireworks are quite harmless, and give rise to endless amusement at parties.

How to make Nitre Paper.—It is exceedingly probable that most amateurs are familiar with nitre or touch paper, but for the benefit of those who have not yet made its acquaintance, we will describe the preparation. A strong solution of saltpetre (potassium nitrate) is made, and in it are immersed several sheets of thin absorbent paper. When thoroughly soaked, these are removed from the solution, drained and dried. The dried paper, when ignited, smoulders vigorously owing to the plentiful supply of oxygen which comes from the heated saltpetre in the fibres. This property makes it of use for fuses on fireworks—a firework fuse consisting merely of a spill of nitre paper.

Fig. 1.—Paint with a Solution of Saltpetre on a piece of Paper, a design employing one continuous line.

Magic Paper.—The experimenter, having grasped the principle underlying combustion of nitre paper will doubtless devise a few entertaining tricks with it. With a paint brush and a solution of saltpetre, paint on a piece of thin paper some design employing one continuous line (see Fig. 1). Make a pencil mark at the commencement of the design, and, when the paper is dry, apply a red-hot needle to the pencil mark. The pattern will smoulder itself into visibility. You might thus regard saltpetre solution as invisible ink.

A Bombardment.—Draw on a piece of paper a picture, showing in the foreground a cannon, and in the distance a castle (see Fig. 2). In the centre of the castle fix a match-head by sticking over it a fragment of stamp edging. Now, with a brush, paint a line of saltpetre solution from the mouth of the cannon to the match-head.

When the paper is dry place it on a tray and apply a red-hot needle to the mouth of the cannon. The " shot " will be seen to travel to the castle which will explode with a crack and burst into flame.

How to make Coloured Fires.—These are popular with every one round about 5th November, but the experimenter will take a delight in making and burning them at any rate.

It is characteristic of certain elements that they impart to a flame a definite colour. This flame-colouring property of substances is utilised in the production of coloured fires.

Coloured fires consist of a paper cartridge packed with a powder which consists of :

1. A substance rich in oxygen which it will readily liberate under the influence of heat. This promotes fierce and rapid combustion.

2. A substance which will burn under the influence of " 1."

3. A salt of a metal, imparting to the flame the desired colour.

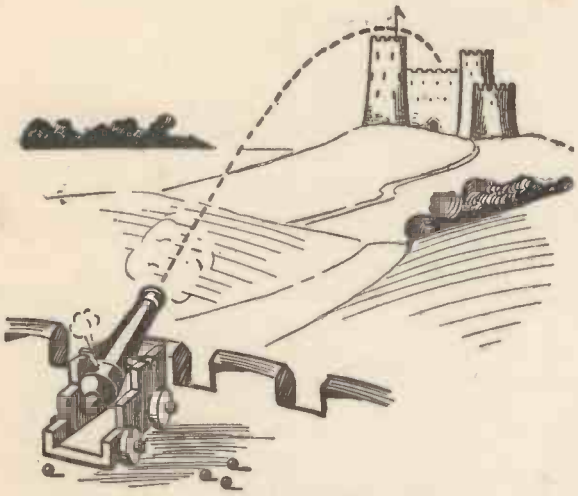


Fig. 2.—A " Bombardment."

Oxygen-containing substances used are potassium nitrate and potassium chlorate. The combustible is usually flowers of sulphur. It is unwise to use chlorate unless considerable care is to be exercised in the production of these coloured fires. Chlorate is liable to explode violently with friction. When mixed with sulphur, the explosive nature is considerably increased, and the mixture becomes highly unstable, detonating violently with slight friction or on being struck. The cautious amateur is therefore well advised to use saltpetre in preference to chlorate.

The Containers for the Coloured Charges.—Cut a sheet of brown paper 3 in. by 12 in., and having well anointed it with a starch paste, form it into a cylinder by rolling it round a 1 in. broomstick. When the paste has set, remove the paper tube, and block one end with a tight-fitting wooden plug, as shown in Fig. 3. The powder, moistened with methylated spirit, is rammed into the paper cylinder until it lies within half an inch of the open end, and into this mass of powder is forced a length of touch paper. A layer of firing powder one-eighth of an inch deep is poured over the coloured fire powder. The touch-paper fuse is thus surrounded by firing powder. Finish off the cartridge by closing it with a disc of cardboard punched with a hole for the fuse. When the fuse is ignited it smoulders down to the layer of firing powder ; this takes fire immediately, and gives off sufficient heat to fire the colour powder ; make the fuses from touch paper as already described. The firing powder is an approximate gunpowder composed of a rough mixture of powdered charcoal, powdered saltpetre, and flowers of sulphur.

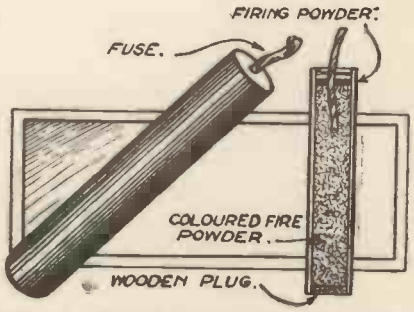


Fig. 3.—Details of the Container for holding the Coloured Fire.

Coloured Fire Powders :

Blue Fire.—Saltpetre, 8 parts ; sulphur, 2 parts ; copper sulphate, 4 parts.

Green Fire.—Saltpetre, 24 parts ; sulphur, 16 parts ; barium nitrate, 40 parts ; lampblack, 1 part.

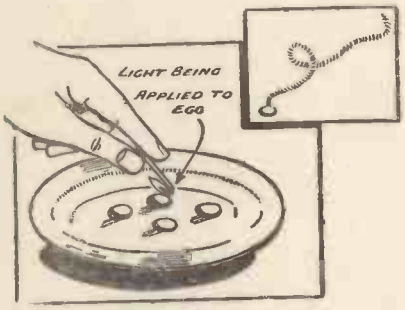
Red Fire.—Strontium nitrate, 25 parts; saltpetre, 15 parts; sulphur, 13 parts; antimony sulphide, 4 parts; mastic, 1 part.

Pink Fire.—Potassium chlorate (use with care), 12 parts; saltpetre, 5 parts; milk sugar, 4 parts; lycopodium, 1 part; strontium oxalate, 1 part.

Yellow Fire.—Potassium nitrate, 4 parts; antimony sulphide, 2 parts; sulphur, 2 parts; sodium oxalate, 1 part.

In making the above powders the procedure in each case is the same. Powder the ingredients separately, and mix them thoroughly.

Making Serpents' Eggs or Pharaoh's Serpents.—There are several ways of making the chemical "eggs," generally known as Pharaoh's serpents, but the disadvantage is that both they, and the ash that results from them, are very poisonous, in addition to giving off an unpleasant smell.

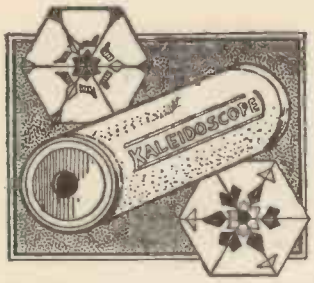


The Serpents' Eggs are placed in a plate and ignited, when they form a lengthy snake.

By making them in the following way, however, both these drawbacks are avoided, and the "eggs," when lit, are just as effective. Only three chemicals are required: 1 part of saltpetre, 2 parts of bichromate of potash, and 3 of white sugar are the proper proportions to use. Pound each of these separately, very finely, then well mix together in the dry state and moisten with just enough of balsam of Peru to enable you to knead the chemicals into a stiff paste, that can be rolled into little balls and allowed to become thoroughly dry. Each egg may then be rolled in a small piece of tissue paper, and storage should be effected in a tightly-corked bottle until wanted for use. Having manufactured the "eggs," apply a light to one of these, and see what happens when the "serpent" hatches.

Put the egg into the centre of a plate or other uninflammable place, strike a light, and apply to any part of the egg. A small spurt of flame, and then a tiny "head" peeps up, quickly followed by a long, writhing body, turning and wriggling in the most lifelike manner until the entire egg has been consumed. Eggs are very easy to make, and very interesting when lit.

The Noisy Floor.—Obtain a little iodine (not tincture), and with a knife gently rub it into a fine powder. Transfer to a dish as much of this powder as will cover sixpence and pour over it a little strong ammonia. Allow to stand aside for half an hour, then pour the entire contents of the dish on to a piece of blotting paper, and leave for a few hours to drain and dry. When the drying operation is completed, a small amount of a brown powder will remain on the paper. This powder must be handled carefully, as it is very sensitive to friction and, with rough handling, may "go off" before it is desired. Gently pick up the paper and sprinkle the powder on the floor. When anyone walks over this part of the floor they will be much alarmed at the tiny explosions which accompany every step they make, much to the amusement of the experimenter.



The Kaleidoscope completed.

How to Make a Kaleidoscope

AN ATTRACTIVE OPTICAL TOY WHICH WILL FORM A NEVER-ENDING VARIETY OF CHARMING DESIGNS

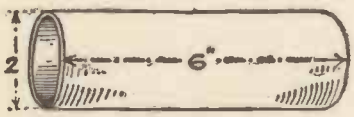


Fig. 1.—The Cardboard Cylinder.

THE kaleidoscope is a most attractive little toy, and the variety and number of charming coloured designs obtainable from one is really remarkable. Our little sketch shows a completed kaleidoscope, with examples of the kind of designs that can be made with one. First procure a piece of ordinary cardboard tubing, 6 in. long and 2 in. in diameter (see Fig. 1). Into this slide three pieces of glass about $5\frac{3}{4}$ in. long by $1\frac{3}{4}$ in. wide, to form a triangle, as shown in Fig. 2. One surface of each piece of glass must be painted over with black poster or other paint, and care must be taken in inserting them into the tube that the unpainted sides are innermost. Over one end of the tube we next lay a stout cardboard disc, in the centre of which is cut a $\frac{1}{2}$-in. diameter hole through which to look. To hold this disc to the tubing, we cut a strip of stout brown paper about 7 in. long and $\frac{1}{2}$ in. in width, and at one side of this we cut a series of niches, as Fig. 3, so that when the paper is glued round the tube, the tabs so formed will turn down on to the card disc and so hold it firmly in place.

Fig. 2.—The Glass fitted into the Cylinder.

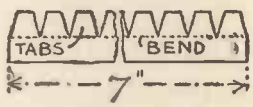


Fig. 3.—How the Paper is cut to hold the Disc in position.

Inserting the Glass.—Now turn your attention to the other end of the tube. The three pieces of glass having been inserted rest on the card disc just referred to, and thus leave a $\frac{1}{4}$ in. or so clearance between the glass and the top of the tube. Procure a circular clear glass the same diameter as the inside of the tube, and lay this on the three glasses. Now cut a ring of stout card about $\frac{1}{8}$ in. wide, and bend this so as to lie on top of the clear glass. Now insert a piece of frosted

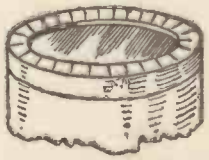


Fig. 4.—The Flat Ring of Card placed on one end of the Cylinder.

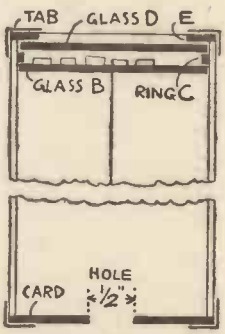


Fig. 5.—The position of all the Parts.

glass of same diameter as the clear piece, and then see that this lies flush with the top of the tube. Now remove this top (frosted) piece of glass, and insert a number of pieces of coloured glass or clear-coloured celluloid of any odd shape and size, afterwards replacing the top glass. Next cut a flat ring of card, and lay this on top of the glass and securely fix it to the tube in a similar manner to the opposite end, as shown in Fig. 4. The section Fig. 5 shows clearly the position of all parts, while Fig. 6 illustrates the manner of inserting each piece. To use the kaleidoscope, hold it up to the light and look through the spy-hole, and then gently turn it.

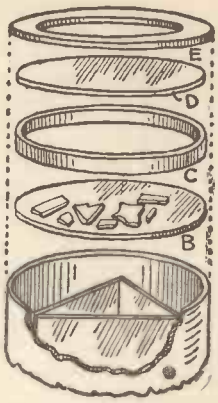
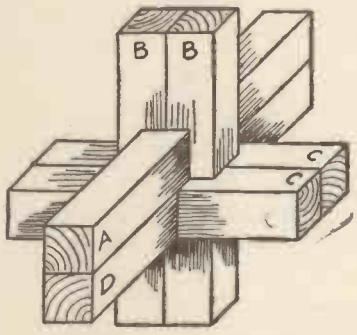


Fig. 6.—How each Piece is inserted.

A SIX-ARM CROSS PUZZLE

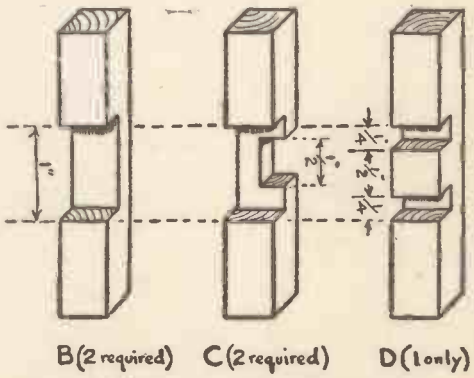


The Assembled Puzzle.

THIS puzzle, although really an old one, becomes new again with every fresh generation of boys that arises. When you hand the puzzle to a friend he will probably find it very easy to pull to pieces, but it is a much more difficult matter to discover for one's self how to put it together again.

To construct the puzzle you require six pieces of wood, say 3 in. long and $\frac{1}{2}$ in. square. The wood should be bought already cut to size by machinery if possible, but if you cut it yourself make sure that it is truly square in section. Put one of the pieces aside, as it requires no further work; call this piece "A." Then cut a groove across two of them as shown at B in the illustration; the dimensions given are for wood $\frac{1}{2}$ in. square; of course, if you use any other size wood, the dimensions must be altered to suit. The C pieces are made exactly as B to start with, and an extra groove cut afterwards. D has two grooves as shown; in every case the grooves are to be $\frac{1}{4}$ in. deep.

Assembling the Puzzle.—To assemble the puzzle take first the two B pieces and place them together, with the slots facing each other so as to form a hole. Lay D centrally in this hole with the two grooves upwards. Then fit a C on each side of the two B's, as shown in the complete illustration; the exact position of the two C's will be quite obvious when you come to their turn. A square hole will then be left between the two B's; push the plain piece (which we have already referred to as A) through this square hole. This will lock the whole six pieces together and complete the assembly of the puzzle.



How the Arms of the Cross are cut before Assembling.

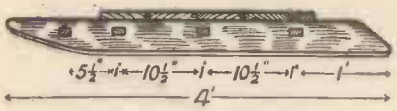


Fig. 1.—Side View.

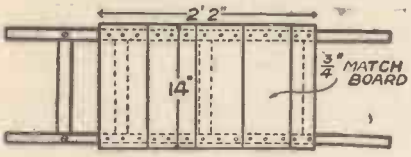


Fig. 3.—Plan View.

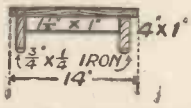


Fig. 2.—End View.

MAKING A SNOW SLEDGE

THE season of sledging is from December to March. A sledge such as that described in this chapter will provide exhilarating sport after a snowfall sufficiently heavy to cover the ground thoroughly. It is a good strong sledge, not one of those flimsy affairs that fall to pieces if they collide with another or "crash" on a bump in the ground. The wood required is: 2 sides 4 ft. by 4 in. by 1 in., four rails 12 in. by 1½ in. by 1 in., tongued and grooved matchboard 2 ft. 2 in. by 14 in. by ¾ in.

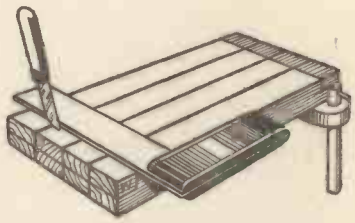


Fig. 4.—Setting out Rails for "Barefaced" Tenons.

The most suitable wood is yellow deal. A good second best is white deal (spruce). Two metal runners are required for the sledge to slide on, and for this purpose obtain two strips of feather-edge wrought iron, ¾ in. by ¼ in., and each 4 ft. long. This strip iron is D-shaped in section. Fig. 1 shows the side view of the completed sledge, Fig. 2 the end view, and Fig. 3 the plan. Prepare the wood to the proper sizes with saw and plane. Then mark out the four rails which are to stretch across between the two sides of the sledge. The marking-out of these rails is carried out, as shown in Fig. 4, by placing the four strips of wood side by side and marking with a marking knife and try-square or with a marking gauge. The pieces "W" are to be cut away to make the mortise and tenon joints, where the rails are joined through the sides of the sledge (see Fig. 1). While marking out this waste wood, keep the four rails securely side by side with a cramp or in the bench vice. The marking gauge should be set to the width of the chisel to be used for the mortising. Now look at Fig. 5. Take each rail in turn and cut away the waste "W" with a tenon saw. First cut in the direction of the grain, as shown in the sketch, keeping on the waste side of the line previously marked with the gauge. Then saw the shoulders of the tenons, across the grain, either as shown in Fig. 6 on a bench hook, or while the rail is gripped in a vice.

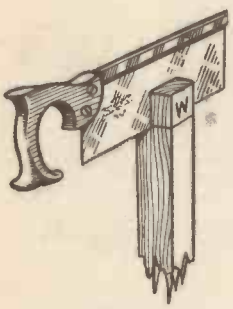


Fig. 5.—The piece marked "W" is cut away to make the Mortise and Tenon Joints.

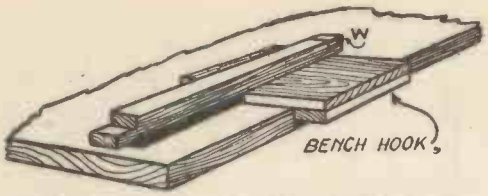


Fig. 6.—The Rail held on Bench Hook to Saw Tenon Shoulder.

Making the Grooves.—The next job is to mark out the two sides of the sledge. The way to do this is shown in Fig. 7. The dimensions are shown in the side view, Fig. 1. The sketch, Fig. 7, shows a mortise gauge being used to mark the positions of the mortises. If you do not possess a mortise gauge, use an ordinary marking gauge by setting it twice, to mark the two lines. The width between these two lines must, again, be the exact width of the chisel to be used for mortising.

If the correct method is followed, the operation of mortising is not so difficult as it appears. Follow the series of operations in Figs. 8, 9, and 10 : hold the chisel in a sloping position across the way of the grain and drive it in ; then hold it at the opposite angle and again drive it in. This enables you to remove a V-shaped piece of waste. Hold the chisel upright and make a series of cuts into the wood, working towards one end of the mortise, keeping the cuts about an eighth of an inch apart, and when each cut is about half-way through the thickness of the wood, push the chisel over, as indicated by the arrow, to lever the waste away. Turn the chisel round and repeat operation No. 3, but towards the other end of the mortise. Then turn the wood over and similarly work the mortises from the other side. Remove the waste by driving a wedge-shaped piece of hardwood, known as a " drift," through the mortise, and trim away any remaining waste adhering to the sides.

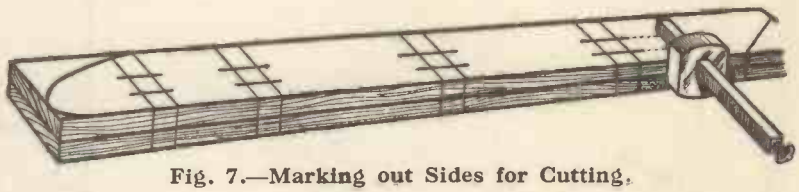


Fig. 7.—Marking out Sides for Cutting.

The alternative way to begin the mortise is by boring a hole with a centre-bit or an auger-bit before commencing to use the chisel.

Now shape the sides of the sledge, using a bowsaw and spokeshave for the curved part at the front. Fig. 11 shows the frame of the sledge ready to be fixed together. Glue all the joints, cramp up tightly, and secure the joints with $2\frac{1}{2}$-in. countersunk head screws, preferably of brass to prevent rusting. The position of the screws in one of the rails is shown in Fig. 12, which also illustrates an improvised cramp made of two pieces of board, two $\frac{3}{4}$-in. or 1-in. dowel rods, and a pair of wedges. After the joints have set, take the cramps off and nail the tongued and grooved matchboard on the top, as shown in Fig. 12 with 2-in. oval wire nails. Punch the nails slightly

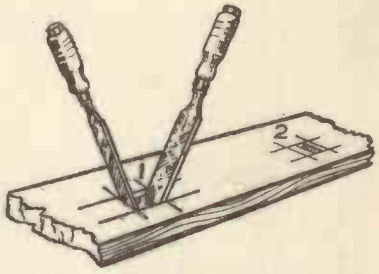


Fig. 8.—How to cut the Mortise.

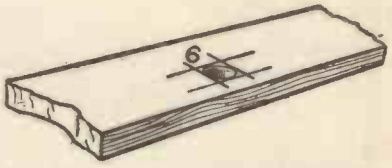


Fig. 9.—How to start the Mortise.

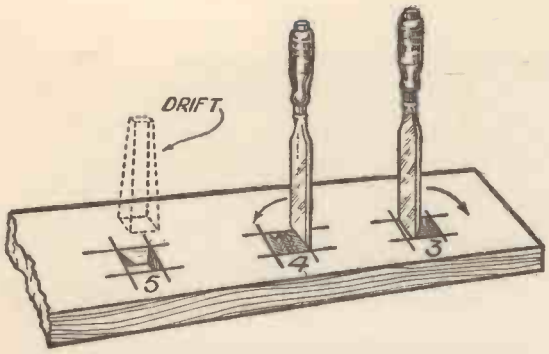


Fig. 10.—Showing the "Drift" which is driven through to remove the Waste Pieces of Wood adhering to the Sides.

below the surface, and clean off the projecting sides and the ends of the tenons with a smooth plane.

Fixing the Runners. — The iron runners are fixed on the bottom edges of the sides with 1-in. screws. These pass through the iron into the wood at intervals of six inches. Mark the positions for the holes in the irons with a centre-punch, then bore the holes with a metal twist drill of a size equal to the shank of the screw to be used. The irons are easily bent to fit the curves. Then fix them securely with the screws.

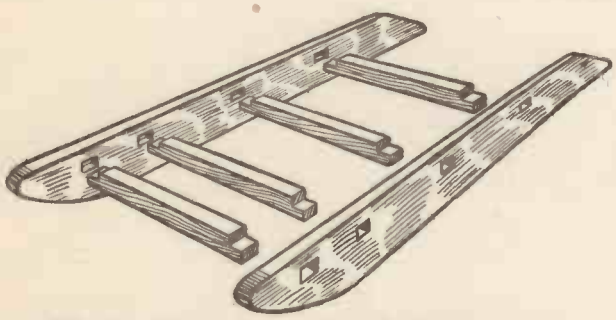


Fig. 11.—The Sides ready to be fixed together.

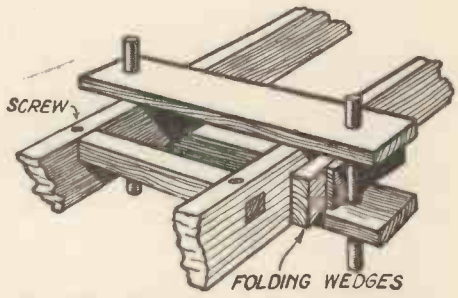


Fig. 12.—Showing position of Screw.

Finish the sledge with a coat of priming paint and two coats of oil-paint of a suitable bright colour.

Another way (though an inferior one) to joint the frame of the sledge is shown in Fig. 13. The rails are the opposite way up, and their ends are notched into the upper edges of the sides.

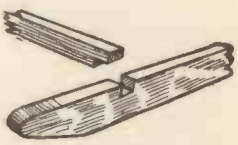
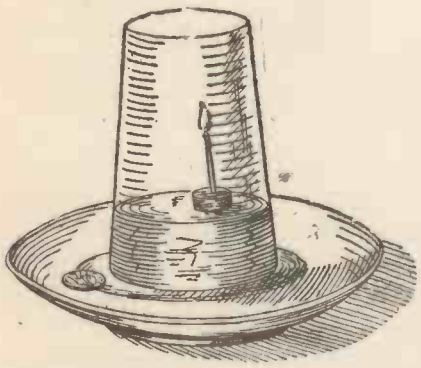


Fig. 13.—How to Joint the Frame.



The lighted match placed on the cork will draw the water into the glass, enabling you to remove the coin without putting your fingers into the water.

AN AMUSING TRICK

HERE is a simple and effective trick. You do not require any apparatus other than a coin, a saucer, a glass, half a cork, and a match. Half fill the saucer with water, and place the coin in it. By the side of the saucer place the glass, the halt cork, and the match, and request your friends to remove the coin without placing their fingers in the water. Place the piece of cork in the water, insert the match into the cork, and light it. Then place the glass over the cork and the water is gradually drawn up into the glass, thus enabling the coin to be removed without placing the fingers in the water.

MAKING SIMPLE MOVING PICTURES

How to make a Thaumatrope

THE dictionary tells us that a Thaumatrope is an optical toy consisting of a card having an object painted on each side, which appears to be combined when the card is twirled rapidly round. These instructions and sketches show how to make one of these interesting little toys. A knowledge of simple object drawing is necessary, but most of the subjects one may choose can most readily be copied from magazine illustrations. On a piece of white card of fair thickness, and about 3 in. by 2 in. in size, draw the diagonal lines as shown in Fig. 1 in light pencil. Where the lines join at E will mark the centre of the card, and we arrange our subjects on the centre line each side.

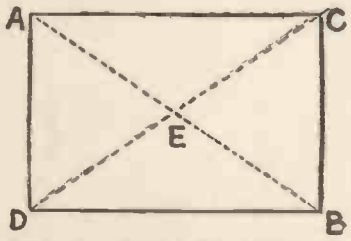


Fig. 1.—How the piece of Cardboard is marked out.

Making it Work.—Taking the hound and hare shown in Fig. 2 the former must be drawn on the line, or, rather, just above the line, as at A; then turn the card over and draw in the hare, also just above the centre line. You must take care to turn the card over on its edge F, G, for if you turn it on edge G, H the figure of the hare will appear upside - down. Taking again, the mouse in the jam jar, Fig. 3, the jar A will first of all be drawn; then, tracing its internal outline, we add the mouse. Now turn the card over on edge F, G, and, measuring up 1¼ in., we draw in the mouse only, as at B. Having completed the drawing make a hole at each end of the card in the centre, and then insert a loop of fine string and, taking the ends between our fingers and thumbs, we twirl the card rapidly round, thus twisting the loop of string. Pull the ends gently and the card will spin, and the hound and hare will appear together, and the mouse will appear to be encased in the jar.

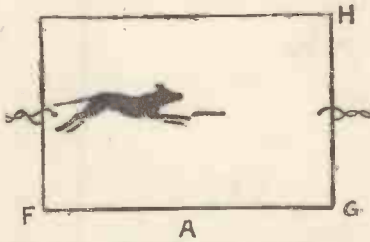


Fig. 2.—The Hound and Hare.

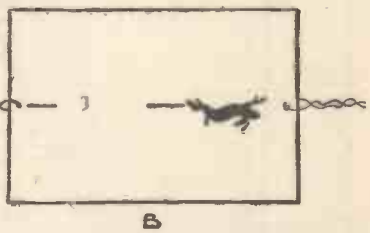


Fig. 2a.—The Card shown in Fig. 2 is reversed and a Hare drawn as illustrated.

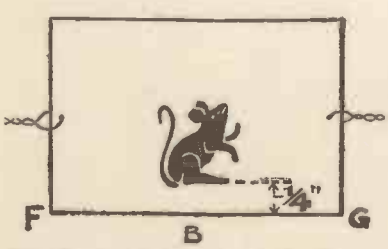


Fig. 3.—The Mouse in the Jar.

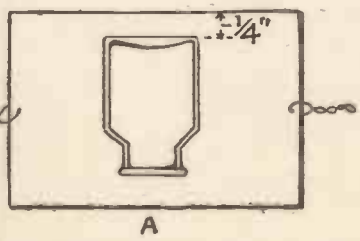
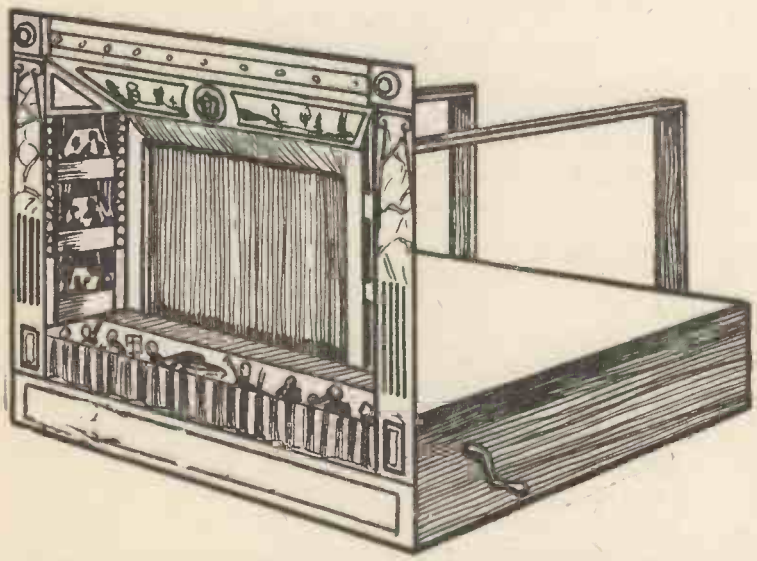


Fig. 3a.—The Glass is drawn on the other side of the Card shown in Fig. 3.

A Miniature Theatre

WE all know the fascination of anything in miniature, which, of course, accounts for the majority of us liking models of any sort. There is something additionally attractive about a working model, and in the miniature theatre forming the subject of this chapter the design consists of the stage and the front part of the auditorium, which includes the boxes and orchestra. The curtain is made to work on a principle well known in theatrical circles, and the scenery racks are reproductions in miniature of the system in use at present in many of our places of entertainment. With such a foundation there are endless possibilities. An ingenious constructor may add electric lighting, a revolving stage, and other mechanical improvements, while those who are more artistically inclined can paint scenery and stage settings. It is interesting to remember that a model stage is not always a toy, as practically all the scenery which is used in the theatres nowadays is first made on a much smaller scale and viewed on a miniature stage similar to the one which we propose to construct.



A View of the Stage Front, showing the Miniature Theatre almost finished.

The Stage Front.—Cut the stage front from cardboard and mount it on a piece of thin cardboard or stout paper. It is advisable to use paste for this, and to moisten thoroughly both the surface of the card and the back of the stage front before applying the paste. Care must be taken to avoid trapping air bubbles. A good tip is to place a piece of clean white paper over the top of the sheet when it is on the card and work these air pockets outwards from the centre with a straight edge. When this has dried, colour with water-colours or crayons. Here is an opportunity for individual taste, and one should remember a few well-chosen tints can look better than a lot of gaudy colours daubed on at random. Next cut out the stage front with a sharp knife or scissors and score down the lines where the cardboard has to bend, as shown in Fig. 1. Where the thick line is

shown, score on the front, and where there is a dotted line, score on the back. Next bend the stage front into its final shape and fix it in position by gluing the squares on the top out sides, as illustrated on pages 25 and 26. Next make the wooden frame to support the stage front. It is quite simple, with overall dimensions of 12 in. long by 10 in. high. The width at the top and sides is $2\frac{3}{4}$ in., and the bottom width is 2 in.

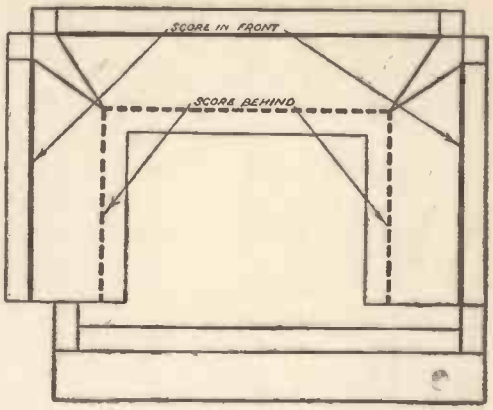


Fig. 1.

How to Bend the Stage Front.

wi **The Base.**—Here, again, only the most elementary carpentry is required. Cut one oblong 12 in. by 8 in., and another 12 in. by $7\frac{1}{4}$ in. These form the bottom and the top of the base respectively. The sides are two oblong pieces, each 8 in. by $2\frac{3}{4}$ in., and drill a small hole $1\frac{3}{4}$ in. from the short edge and $\frac{3}{4}$ in. from the long side, as shown in the illustration. Two other strips are required—one 12 in. by $1\frac{1}{4}$ in., and the other 12 in. by $\frac{3}{4}$ in. It will be necessary to take a little off the end of the longer sides of both of these last two pieces, equal to twice the thickness of the wood used. This allows the "step" (on which the orchestra is mounted) to rest inside the base. The assembly of these parts is quite simple, and can easily be followed from the diagrams.

The Orchestra.—The orchestra is mounted on a piece of wood $\frac{1}{16}$ in. in thickness, and cut out. If desired, two can be cut from the same design, particular care being given to the fact that the conductor must be removed from the set nearest the stage. These can be mounted at once on the "step" of the base in the position indicated on the picture of the completed model.

The Curtain Support.—Mount the design as shown on page 25—cutting two of the supporting portions and one of the top. The small circles cut in the ends of the top are part of the curtain mechanism. The curtain "ropes" must run over a metal runner, which can be either a thin nail driven carefully in from the edge, or a piece of wire inserted in a drilled hole. Some constructors may prefer to drill the holes before cutting the circles. It is advisable to leave the fixing together of these parts until after the curtain has been made.

The Curtain.—The curtain is made of a piece of light material about $7\frac{1}{2}$ in. square, which should be opaque. A piece of brass rod 9 in. long is required to act as a weight and roller. Glue or gum one edge of the curtain to the brass rod and fasten the opposite edge of the curtain to one of the curtain supports in the position shown in the illustration on page 24. Roll up the curtain, and tie it up so as to keep it out of the way while the parts are being put together. The curtain support should now be completed.

Commencing the Erection.—The parts already made can now be assembled. First, fasten the mounted stage front to the base. Before gluing the curtain support to the back of the stage front, hold it in its final position and, with a pencil, mark the position of the four legs of the curtain support upon the stage. Next, between each pair of legs, and at a distance of 2 in. from the sides of the

stage, drill a hole through which the curtain "ropes" will pass. The curtain support is next glued to the back of the stage front, as shown in Fig. 2, and may be fastened to the stage floor by means of small blocks of wood at the base of the rear legs. Do not put these strengthening blocks between the legs or, when the curtain is down, there will be a space between the bottom of the curtain and the stage.

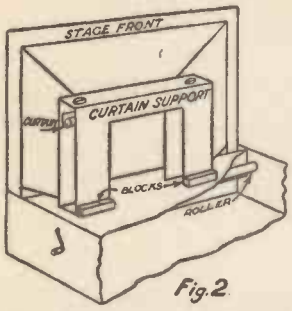


Fig.2
How the Curtain Support is fixed to the Stage Front.

How the Curtain Works.—Make a wooden roller from a piece of dowelling 11½ in. in length and ½ in. in diameter. This must have a handle at one end made of a short piece of stiff wire and a supporting pin at the other, and is finally mounted as shown in Fig. 3. Take two lengths of strong thread about 18 in. long and wind these round each end of the roller in the same direction. Next fasten the roller inside the base and take the ends of the thread up through the holes in the stage. Take each thread separately—first over the "pulley" in the top of the curtain support, and then, with the curtain down, tie it to the end of the brass rod and wind it round the brass rod several times. Take care that the windings are in the same direction. By turning the handle, the thread should be taken up on the wooden roller, which, in turn, takes it off the brass roller and so raises the curtain. If the curtain pulls up one side before the other, take a turn of thread off the brass roller at that side.

The Scenery Racks.—Cut two off each as indicated on page 25. The final positions of these can be easily seen from the diagram of the base and illustration of the completed model. Care must be taken that the slots in the rack are 8½ in. apart, or the scenery designed for this stage will either be too large or too small. The base of the supports marked "C" may be screwed to the stage from underneath.

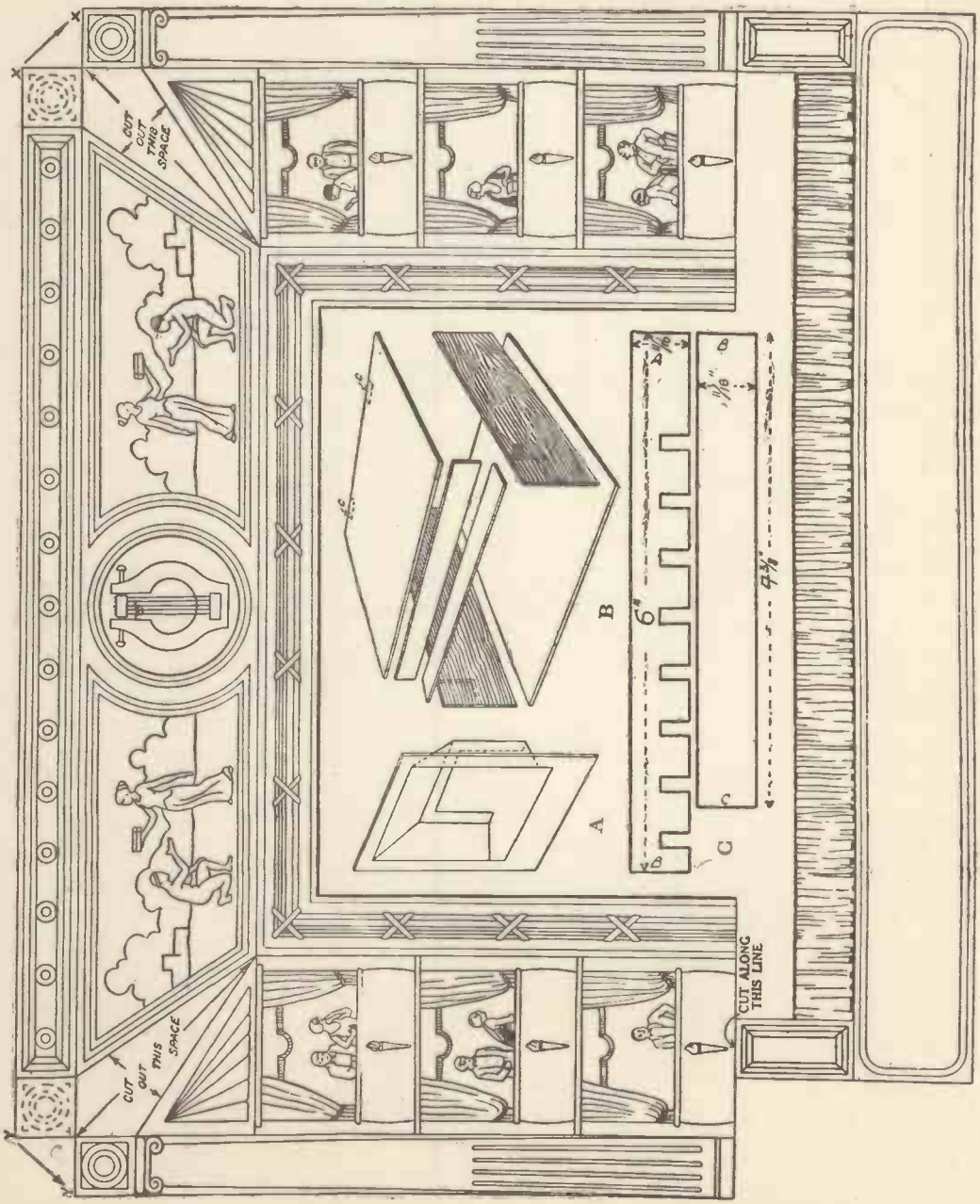

Fig.3.
Detail of the Curtain Roller.

The model is now ready for the scenery. The large pieces of scenery which cover the whole of the back of the stage are known as "back cloths," and the smaller pieces which screen the sides are known as wings.

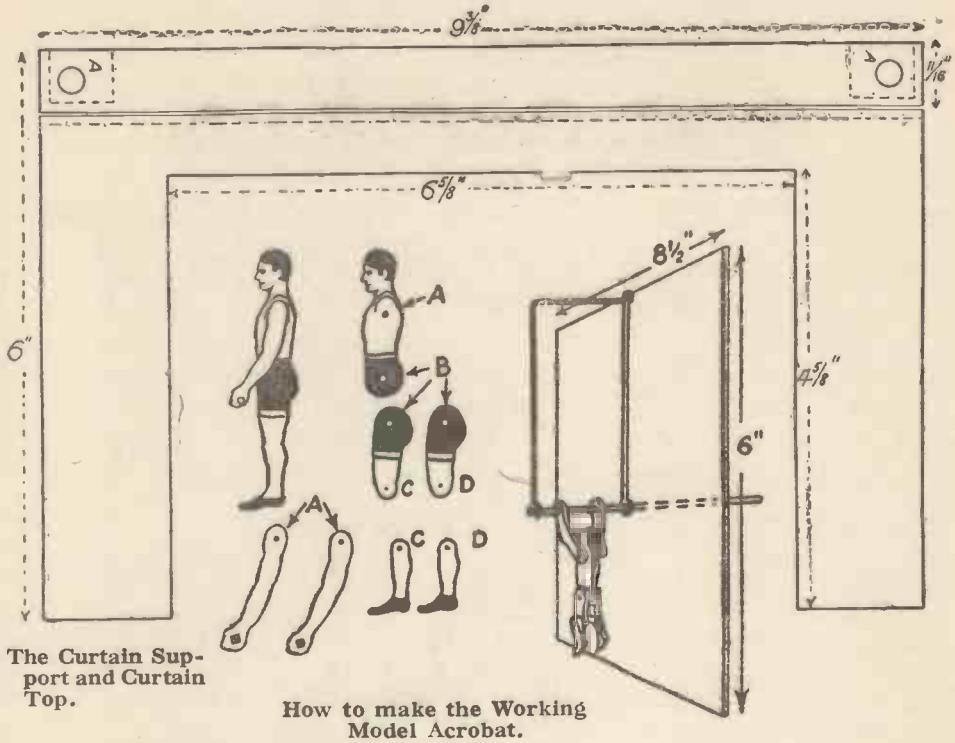
Having completed the stage, we can now give our attention to the scenery. Before going into the constructional details, it must be remembered that the different parts of scenery have special names. The largest pieces, representing the huge stretches of canvas on the proper stages which hang at the back of the scene, are known as "back cloths." The smaller pieces, between which the characters must pass to appear on the stage, are called the "wings."

The Exterior Scene.—Let us first deal with the exterior scene. Cut a piece of wood, $\frac{3}{16}$ in. in thickness, 8½ in. long by 6 in. wide. On this we mount the back cloth. Care must again be exercised to prevent air bubbles between the design and the wood. These may not be very apparent before the piece is in position, but it must be remembered that the lighting of the stage will exaggerate them. A little extra care to prevent these is strongly advised. Next mount the exterior

The Orchestra.



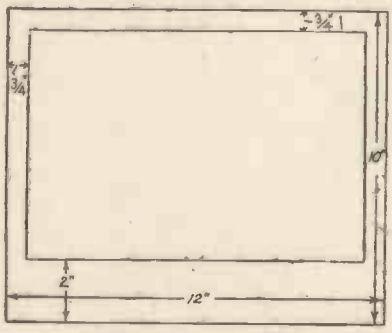
(A) How to Assemble the Stage Front. (B) The Stage Floor. (C) Scenery Rack and Support.



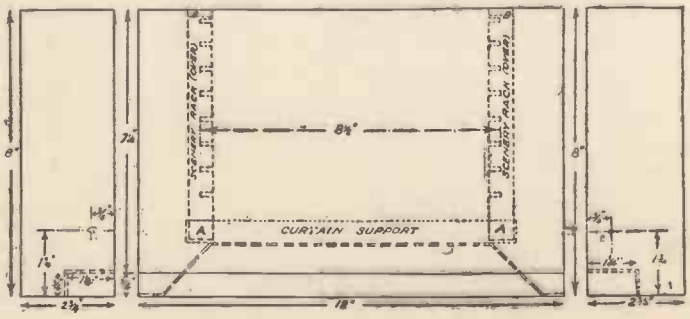
The Curtain Support and Curtain Top.

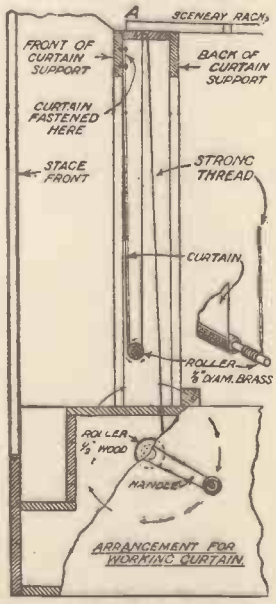
How to make the Working Model Acrobat.

Curtain Pulley Detail.



The Wood Frame on which the mounted Stage Front is Fixed.





This Diagram explains how to work the Drop Curtain.

wings. Some constructors may have some small pieces of wood available which could be used up by mounting them separately. The overall dimensions of each one is 6 in. long by about 1¾ in. wide. The slots in the scenery racks will take wood up to a thickness of $\frac{3}{16}$ in. Now cut the exterior wings out, but do not cut any holes in them nearer than 1½ in. from the long straight edge.

The Interior Scene.—Next turn to the interior scene. The back cloth must be mounted on the reverse side of the exterior back cloth. The wings are also mounted on the backs of the exterior wings, the only points to remember being that the straight edge of the design and the mount must coincide (as shown in the diagram on page 28) and the numbers on the tops must agree. For instance, No. R. 1 Interior has to be stuck on the back of R. 1 Exterior; No. L. 1 Interior on No. L. 1 Exterior, and so on. When this has been done and the design is quite dry, both back cloth and wings must be coloured. In doing this it is advisable to make the colours bright, but harmonious. Soft shades are apt to look dull, and very little black should be used. Make your shadows a dark

Various Stage "Characters."

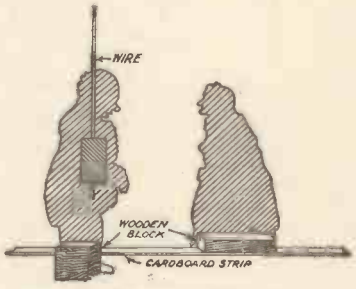
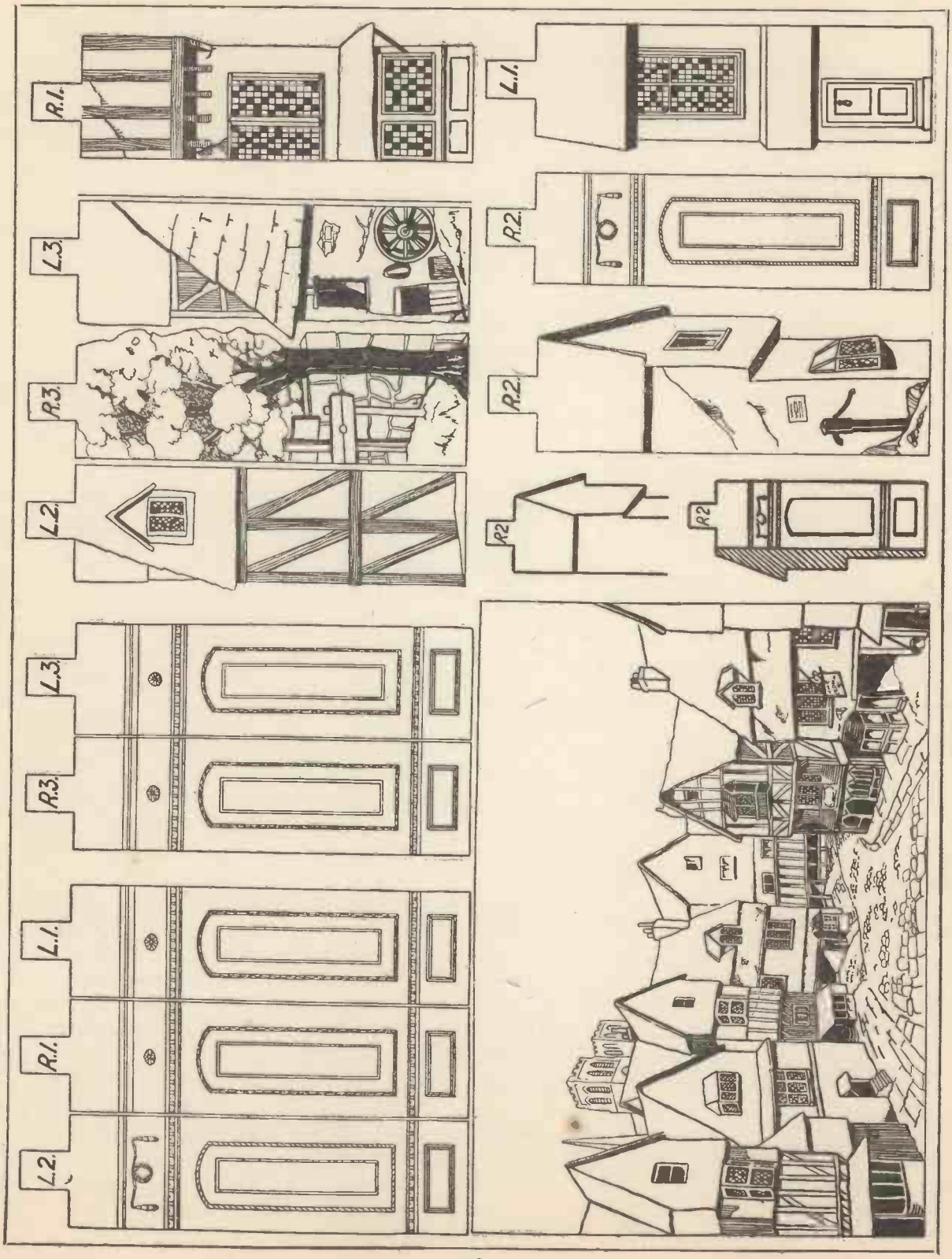


Fig. 4.—How to Mount the Characters.

blue or purple, the result will be more pleasing. A magazine or book illustration makes an excellent guide when colouring your scenery.

The Acrobat.—The figure of the acrobat given on the design (page 26) is simply constructed, and causes great fun. Mount the parts on a piece of cardboard and cut them out very carefully. Fasten the joints with small pieces of thread —which will be found to work more satisfactorily than wire—and put through the holes in his hands a short length of square wire. This is passed through a hole in a piece of wood or stout cardboard, 8½ in. wide by 6 in. high, at a point about 2 in. from one of the long sides. If the wire is manipulated from the back a most realistic performance will be given by the acrobat. To complete the illusion of a trapeze, a line should be drawn on the back cloth from where the wire passes through, running vertically off the card. The end of the square wire nearest the audience should be held lightly by a piece of thin wire, bent as shown in the illustration on page 26. Alternatively, the wire can be supported from below, and a corresponding support drawn on the back cloth.

The Performers.—The actors and actresses for the model theatre should not be bigger than about 1½ in. in height. They can be worked in a number of ways, as shown in Fig. 4. The most common is from the top by means of a wire. Remember to have a block of wood at the feet.


R.1.
L.3.
R.3.
L.2.
L.1.
R.2.
R.2
R2
L.2.
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L.1.
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L.3.

A MACHINE FOR DRAWING FASCINATING DESIGNS

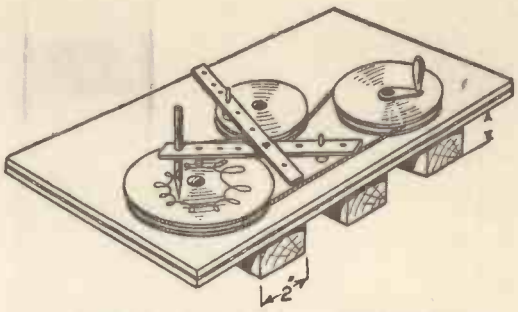


Fig. 1.—The finished Machine.

IN later pages of this Annual (see pages 35 and 68), we have described how to make devices for *copying* illustrations. Here is another type of designograph or harmonograph. It will be noticed that there are no pendulums employed in this simple device; instead, a system of levers and pulleys is employed. It is of simple construction, and employs but few tools in the making.

Baseboard and Supports.—A baseboard of plywood measuring 14 in. by 7 in. is required. As seen in Fig. 1, it is mounted on three supports, each measuring 7 in. by 2 in. by 1 in., the position of the supports underneath the baseboard being arranged so that the centres of the pulleys can be screwed through to these supports for strength (Fig. 2).

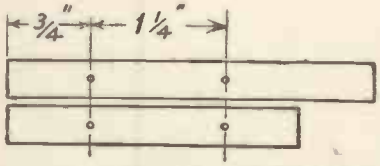


Fig. 2.—Method of Marking Supports for position of Spindles.

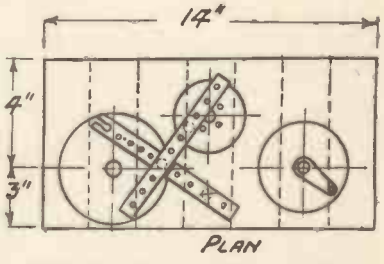


Fig. 3.—The position of the Pulleys.

The Pulleys.—These are made out of plywood. Three pairs of discs will be required, measuring 2½ in., 2 in., and 1½ in. radius respectively. They must be bevelled and fixed to form the pulleys, and then drilled centrally to take a stout-shanked screw for a bearing (see Fig. 5).

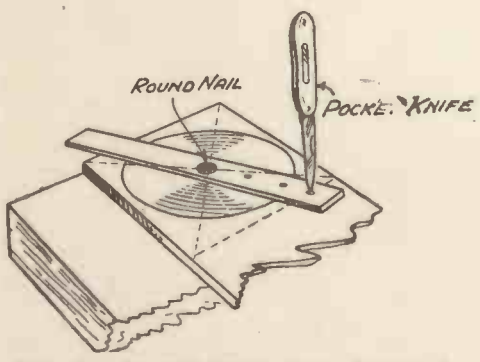


Fig. 4.—Cutting Discs from Plywood.

In Fig. 3 the positions of these pulleys are marked. The large one is the pattern pulley, or table; the next size is the driving pulley, and the small one is the eccentric pulley. In Fig. 4 is illustrated a method of cutting out discs from plywood.

The eccentric pulley must be marked out as in Fig. 6; this method provides for five eccentric positions for the eccentric lever.

The driving pulley should be supplied

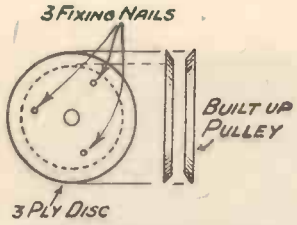


Fig. 5.—Details of the Pulleys.

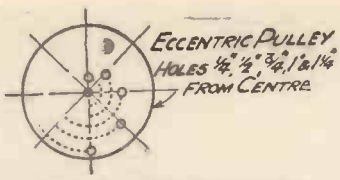


Fig. 6.—The Eccentric Pulley.

with a convenient form of handle. Fig. 9 shows a method of securing such a handle.

Levers and Spindles.—Two levers will be required, 6 in. by ½ in., made from plywood. Provision is made on one to receive a pencil, and each of them has small holes drilled all along the centre at intervals of ¼ in. These are shown in Fig. 8. Next come two spindle supports, made from ⅜ in. dowel rod (see Fig. 7). The eccentric pulley spindle has a metal spindle top and bottom, centrally fixed in the dowel rod. The other dowel spindle has a metal centre rod in one end only, and is fixed into the baseboard in a tight-fitting hole the same size as the dowel rod, ⅜ in. diameter.

The Assembly of Parts.—Fix the pulleys on to battened baseboard with screws. Next, position the pencil lever spindle opposite the eccentric wheel, then fix the eccentric lever spindle into one of the five holes on the pulley. Fix the levers together with a small pin and make a belt to fit round all three pulleys, as shown in Fig. 1.

Fig. 7.—The Spindle Supports.

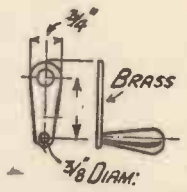


Fig. 9.—The Driving Pulley with Handle attached.

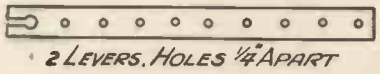


Fig. 8.—The Spindles should have Holes drilled in them as shown.

Place a piece of paper upon the large pulley or revolving table, and fix down with drawing-pins. Slowly rotate the driving wheel by the handle, and this will, in conjunction with the two levers, produce a combined movement resulting in a series of rotating or radial designs.

TAKE CARE OF YOUR POCKET-KNIFE

TO sharpen your pocket-knife, all that is required is a small oil-stone and a little oil, such as sewing-machine oil or olive oil. Place a few drops of oil on the stone, and spread it over the surface in a film. Push the blade forward on the stone, and then draw it backwards; but perform the whole action as a circular motion, so that the entire movement is smooth and continuous. Repeat this about a dozen times; then place the other side of the blade on the stone and repeat the process. It is important that the angle made by the knife blade and the stone should be kept the same on both sides of it. In order to test the sharpness of the blade, place the ball of the thumb gently on the edge and draw it slowly across. If the edge is keen, the blade will pull against the thumb, more so than if it was blunt.

Diagram showing how to sharpen a pocket-knife blade on an oil-stone.

A CLOCKWORK MODEL OF A STEAM WAGON

Made from old clock parts and other odds and ends

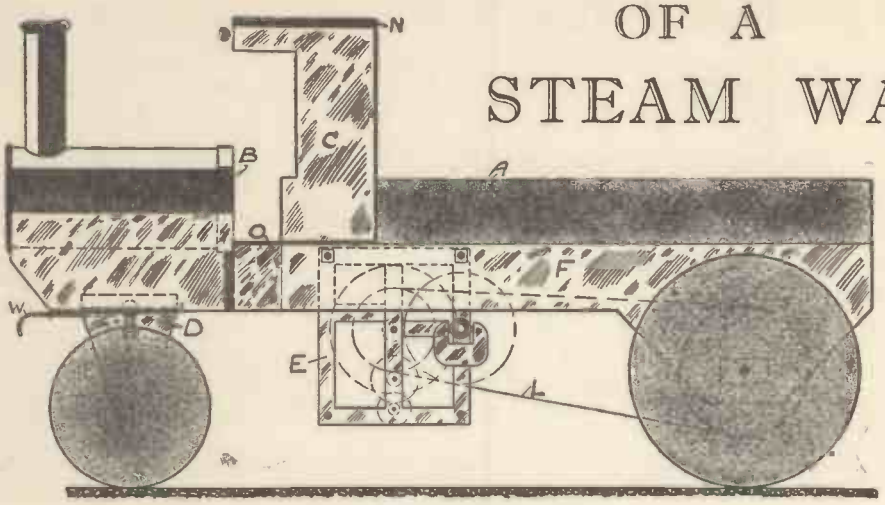


Fig. 1.—Side View of the Wagon.

WORKING models of steam wagons are rather rare, and a description of a clockwork-driven model may be interesting to readers in search of something novel in the way of model-making. Originally the model was intended to "steam," but, in the early stages of construction, it was decided to utilise the works of an old alarm-clock; the experiment proved so successful that the machine started off with a load of 15 lb.

Figs. 1 and 2 will give you some idea of the appearance of the completed model, whilst other particulars can be gleaned from the dimensioned sketches.

Frames.—The main frames A are cut from sheet tin; a little care should be exercised to avoid unnecessary twisting of the metal. After cutting out carefully, straighten by lightly hammering on a flat surface.

Next, clamp the frames together and true up with a file to the finished sizes; mark off and drill a hole through both frames before parting; this hole is to take the back axle. The frames are then bent as shown, one being left- and the other right-handed. Before the frames can be assembled, it will be necessary to cut out the cross members or stays (see Figs. 6, 7, 8, 9); the sketches are self-explanatory, but it should

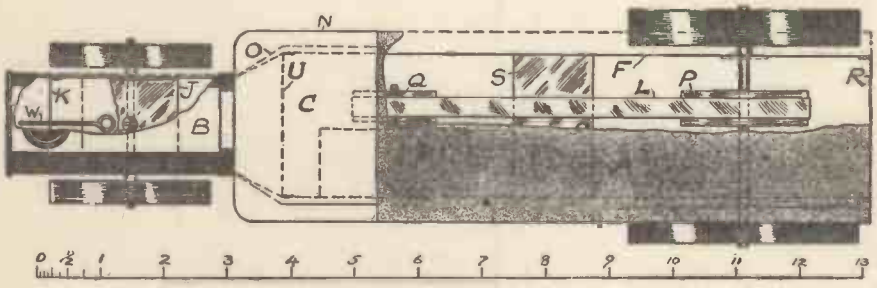


Fig. 2.—A Plan View.

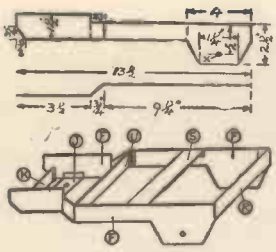


Fig. 3.—The Framework.

Fig. 4.—The Back Axle.

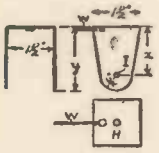


Fig. 5.—The Undercarriage.

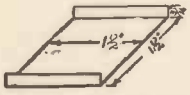


Fig. 6.—The Stay.

be noted that the ends of the stays are bent round to serve as soldering tags.

In building up the framework (Fig. 3), it will be found more convenient to turn the frames upside-down on a piece of flat board, allowing the front ends to overhang, then the stays may be soldered in their respective positions. The frames may be temporarily kept upright, and the correct distance apart, by driving a few nails into the board.

Back Axle and Wheels.—For the back axle a piece of $\frac{5}{32}$-in. steel rod will be required; the rod passes through the frames and protrudes on either side to take the wheels. For the latter, two lids from polish tins, etc., may be used; the lids can be stiffened up by soldering on the inside a disc of sheet tin (Fig. 4). Holes are drilled centrally through the lids to suit the $\frac{5}{32}$-in. rod.

The pulley P (Fig. 2) connected to the motor is readily obtained by selecting a small tin with a good-fitting lid, which should be soldered all round. Drill a hole in the centre of each side of the tin to suit the rod, and this will then complete the back axle. To prevent the wearing of the hole in the frames, a strip of brass (shown dotted in Fig. 2) may be sweated or bolted to the frames to carry the back axle. Do not solder the wheels on the back axle until everything is ready for final asssembly.

Front Wheels and Undercarriage.—Small tin lids or wheels may be used, the axle of which passes through an undercarriage (see Fig. 5). This item is bent up from a piece of sheet metal, and drilled as shown; the hole H is for attachment to the stay (Fig. 6) by a $\frac{5}{32}$-in. bolt and spring washer, thereby making provision for swivelling the wheels to enable the model to run on either a straight or curved course. The holes *I* will suit the rod used for the front axle. The dimensions *x* and *y* cannot be given, since they will be decided by the size of front wheel used; it is important to remember, irrespective of the size of wheel selected, that the framework should be kept level.

A piece of springy brass wire W is soldered to the undercarriage for locking the front wheels, the end of the wire dropping into one of the three notches cut in the stay, as shown in Fig. 7.

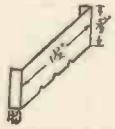


Fig. 7.—Three Notches should be cut in the Stay as shown.

Fig. 8.—The Cross Members.

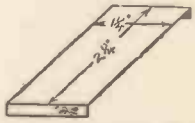


Fig. 9.—The Ends of the Stays and Cross Members should be bent as shown.

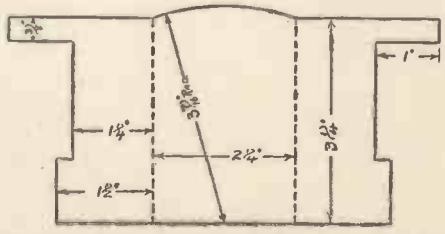


Fig. 10.—The Sides and Back of the Cab.

Cab and Foot-plate.—The sides and back of the cab (Fig. 10) are cut from light sheet metal, which is then bent round to shape. The roof (Fig. 11) is separate, and tacked in position by solder; the structure is then soldered to the foot-plate (Fig. 12) in readiness for soldering to the framework later.

A small tin B will be found ideal to represent the boiler, the choice and setting can be left to the taste of the builder. The funnel is best made from a piece of light brass tube, one end being filed to suit curvature of the "boiler," to which it is then soldered.

The body of the wagon is formed from a piece of tin, the sides and ends are bent at right angles to the sheet, and tacked with solder; when complete, the body is in turn soldered to the framework. The manner of proceeding with the job will be made clear by a glance at Fig. 13; the sides are bent about the dotted lines.

The Motor.—Procure from a local watchmaker the movement of an old alarm-clock or other clock; it is important, however, that the movement has a good strong spring. Remove the wheels of the alarm-train, also the "dial wheels" (those that drive the hands), and the "lever escapement." The "balance-wheel" might also have to be removed. On winding up the spring after the removal of these wheels it will be observed that the balance-wheel spins round at a great speed. It may be necessary to reduce the speed of the wheelwork by attaching a light vane or "fly" to this wheel, or to remove the balance-wheel and attach the fly to the wheel that runs at the highest speed in the train. Turn the frame of the movement so that the wheel comes at the bottom when the winder is on the outside; the long arbor on which the hands were mounted being on the inside—that is, between the frames.

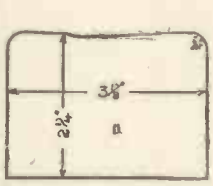


Fig. 11.—The Roof of the Cab.

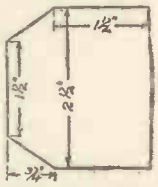


Fig. 12.—The Foot-Plate.

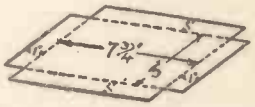


Fig. 13.—How to Mark out the Body of the Wagon.

Mounted on this arbor is a small pulley Q (a small tin will do) to transmit the driving power through a belt to the larger pulley P on the back axle. If preferred, "V" pulleys, to take a spring, may be used. It is important to mount the motor on that side of the framework that will allow the pulley Q to run forward, and so avoid the use of a crossed belt.

The motor may be attached to the frame by utilising the threaded ends of the two top pillars of the movement; the nuts are removed, and the ends of the pillars passed through a couple of holes drilled in the frame, the nuts being replaced will secure the movement in place. In winding up the motor, the highest driven wheel is held fast, or a simple braking device can be made to brake the wheel at will.

Assembly.—After placing the motor in position with its driving pulley attached to the arbor, the driven pulley P on the back axle can be set in line and secured by soldering.

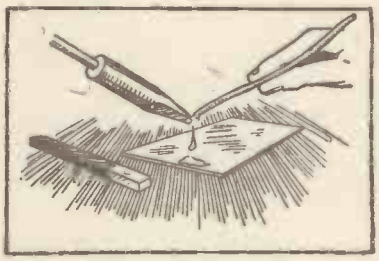
To maintain the axle in the correct position, small pieces of tube are slipped

on over the ends of the axle beyond the frames, after which the rear wheels are mounted on the back axle and soldered in position.

Having previously built up the cab with the foot-plate, the whole may now be set in place and soldered to the framework; likewise, the "boiler" can be set in front of the cab. All that now remains to be done is to procure a length of flat elastic for the belt.

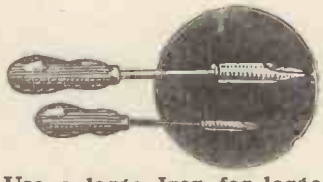
HOW TO SOLDER

PREPARATION.—A certain amount of preparation both of the soldering-iron and the work to be soldered is necessary before attempting to solder the parts together. The "iron" is really a copper bit, and the size of this bit is really decided by the class of work it is intended to solder. For example, it is no use trying to solder up a hole in a bucket with the small soldering-iron sold for wire-less purposes, because, owing to the bulk of the metal forming the bucket, both the solder and the bit rapidly become chilled, and the solder fails to adhere. For large work, therefore, use a large soldering bit, but for small work, such as soldering wires or sealing up a leaky boiler in a toy engine, use a small one.



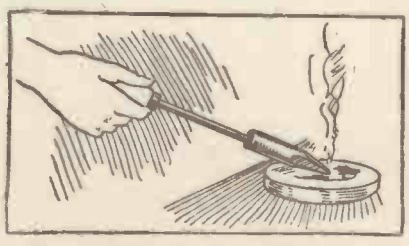
Tinning the Work.

In order to make a successful job of soldering, first clean the two parts which are to be soldered together. Even new metal must be cleaned in this way, and it should be done either with a fine file or a piece of emery-cloth. It is only necessary to clean those parts of the work to which the solder is to be applied. Having done this, heat the bit in the fire or over the gas, and when it is hot (do not allow it to get red-hot) quickly file the four faces of the tip of the bit bright, dip them in flux, melt a little solder on to the point of the bit, and then rub each face vigorously on a piece of bright tinplate, on which some of the flux has been applied.



Use a large Iron for large work and a small one for smaller jobs.

Tinning the Soldering Iron.—The tip of the bit will now be coated with a thin film of solder. After tinning, dip it in flux again, and hold a stick of solder against the point. It will be found that the solder will melt and hang on to the bit. Now drop a little of the flux on to the two parts which have previously been cleaned, and apply the point of the bit to the work. It will be found that the clean parts become tinned in the same way as the point of the soldering-iron. Having tinned the two parts of the work in this way, apply a little more flux, bring together the two parts to be soldered and apply the bit again, when it will be found that the solder will flow and securely hold them when it cools off.



How to tin the Soldering Iron.

Making a Pantagraph

AN INGENIOUS DEVICE FOR ENLARGING AND REDUCING DRAWINGS AND ILLUSTRATIONS

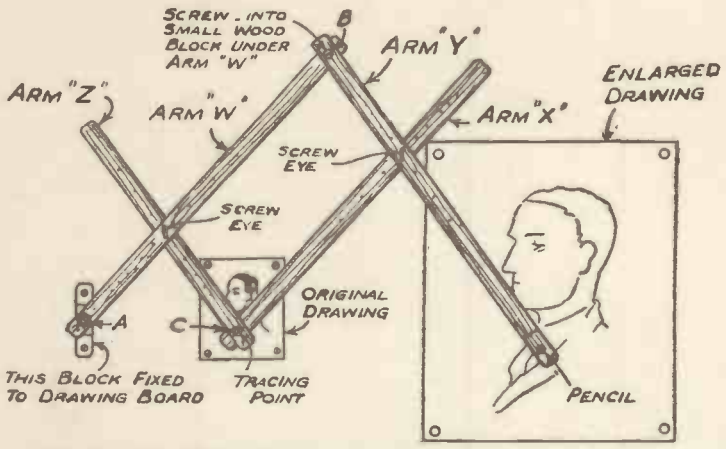


Fig. 1.—The Pantagraph completed. The assembling of the Parts is shown in this Diagram.

A PANTAGRAPH is a simple tool by means of which you may copy, enlarge, or reduce drawings and illustrations. The device shown in Fig. 1 consists of the various parts shown in Figs. 2 to 5. Use strips of oak $\frac{5}{8}$ in. wide and $\frac{1}{8}$ in. thick for the four arms, and carefully mark off the distances shown in Fig. 2. Drill the holes shown to accommodate the screw-eye illustrated in Fig. 5.

At the point A a little bar of wood is attached, as shown in Fig. 3, so that the end of the pantagraph can be screwed down to the drawing-board. The tracing point C consists of a nail with a washer soldered beneath the arm X to keep it in place; the nail should be filed up to a sharp point, and serves as the tracing point.

To accommodate the pencil a piece of wood is glued over the end of the arm Y, as indicated in Fig. 2, and a hole is drilled in it of a size to suit the diameter of the pencil. The other points are made from the drawings.

To enlarge a drawing to, say, three times its size, insert the screw-eyes into the holes marked 3, and upon tracing over the drawing with the tracing point the pencil will trace out the drawing three times the original size.

When it is required to reduce the size of a drawing, the positions of the pencil and tracing point must be reversed, and

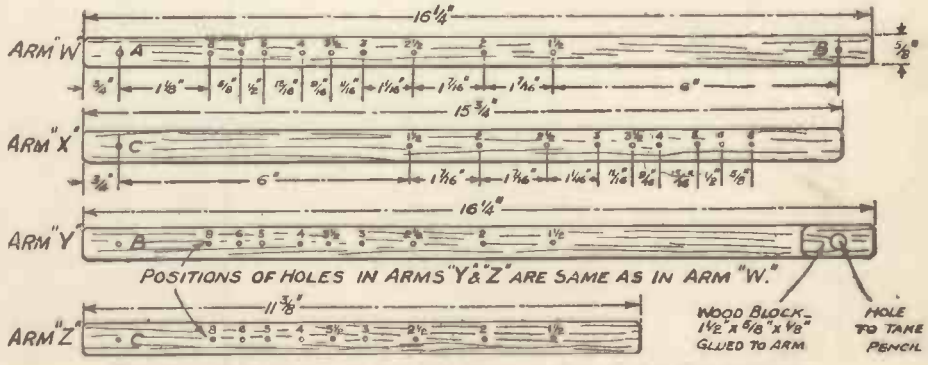


Fig. 2.—How to mark out the Four Arms of the Pantagraph.

for this purpose a short stumpy piece of pencil should be pushed over the tracing point, and a piece of round iron, pointed up at one end and of the same size as the pencil, should be pushed in the pencil hole. The various letters in Fig. 1 correspond to those shown in Fig. 2.

It is absolutely important, if accurate scale copying is to be done, that the distances of the holes from the points A, C, and B (Fig. 2) should be carefully marked out. To ensure this, place the arms W, Y, and Z together and scribe the three off at once with a square. Then place the point 8 on arm X level with the point 8 on arm W, and by means of the square scribe off the positions on arm W on to arm X. You will then be quite certain that the positions are correct.

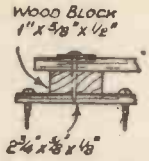


Fig. 3.—The Block for Clamping the Pantagraph to the Drawing Board.

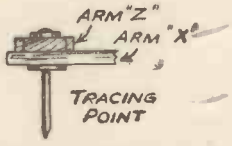


Fig. 4.—How the Tracing Point is made.

Fig. 5.—An ordinary Screw Eye is used where shown in Fig. 1.

In using the instrument let the left hand press on the tracing point and the right hand grasp the pencil. Now guide the tracing point over the drawing to be copied, and at the same time exert a slight pressure on the pencil. As the tracing point is moved over the drawing the pencil will draw out and enlarge the copy of the original. A little practice may be necessary to get the best results. You will probably find at first that the pencil lines are wavy, and this is because the pencil magnifies any false movement.

MAKING INVISIBLE INKS

HERE is a recipe for an ink which is visible only under water. When the paper is dry the writing is invisible. Prepare the ink by shaking together half a drachm of linseed oil, half an ounce of strong ammonia, and five ounces of water.

Fading Ink.—The curious property of this ink is that it completely fades away after a few days. Prepare a little starch mucilage, and add to it a few drops of tincture of iodine. The mucilage becomes almost black. This is due to the formation of starch iodide. Thin your "ink" to the right consistency and write a message with it. Leave the message in an envelope for a day or two, and then examine. The writing will have disappeared.

The Disappearing Writing.—A message written in ordinary writing-ink may be made to vanish by means of chlorine gas. Place a few crystals of potassium permanganate at the bottom of a jam jar, add a few drops of strong hydrochloric acid, and quickly cover the mouth of the jar with a lid. This precaution precludes the possibility of the choking fumes of chlorine drifting around the room. Now write a message on a piece of paper, wet it, and push it into a jar. The handwriting almost immediately disappears! Instead of using chlorine gas *free*, one may bleach writing-ink by the action of chlorine gas *in solution*. The handiest form of this is to be found in washing bleach, Milton, or some similar hypochlorite solution. It is necessary to merely paint this over the writing, which quickly vanishes.

AN AMUSING PERFORMING TOP

A Gyroscopic Toy

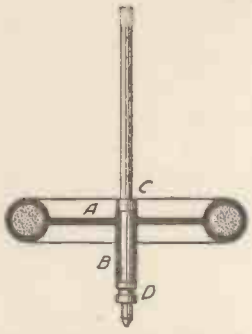


Fig. 1.—A Sectional View of the Top.

THE top shown in sectional view in Fig. 1 is made up from scrap without the use of a lathe. The small eye of a curtain ring to which the curtain hook is hitched is removed, and a $\frac{3}{16}$ in. hole drilled. The ring is then set upright in sand, and molten type metal should be poured into it until it is filled to overflowing.

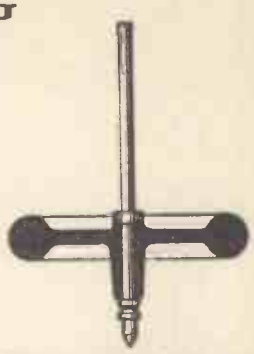


Fig. 2.—The Body of the Top can be made from a single Brass Casting.

The Disc.—The disc A is cut from stout sheet brass to fit closely inside the ring. The centre is drilled to take the short piece of stout brass tube B, which can be sweated into it, care being taken to set it truly square with the disc. The disc should then be fitted.

The Stem.—For the stem, obtain a length of $\frac{3}{16}$-in. silver steel rod, the bore of the tube being of that diameter. The collar C, made from a piece of the same tube as that used for the sleeve, is soldered in place and the stem inserted, after which the deeper collar D can be soldered to the stem, allowing a small amount of play up and down. Lastly, a groove is filed around this collar and the end of the stem brought to a neat conical point with a file.

Fig. 3.—The Top can be spun on a piece of String, as shown.

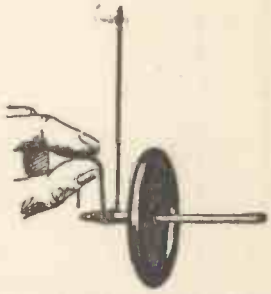


Fig. 4.—By holding the Top as shown it will climb up the String.

Those who possess a lathe might make the body of the top from a single brass casting, as shown in Fig. 2, tooling it all over and polishing it.

A Form of Gyroscope.—A good deal of entertainment may be had with a top of this type. It is in fact a form of the gyroscope, and may be spun and suspended from a looped cord with its axis horizontal (see Fig. 3); also, after a little practice, it may be made to mount a cord suspended from the ceiling.

Fig. 5.—Spinning a smaller Top by Contact.

A top like that described may be made to spin other smaller tops by contact (see Fig. 5). A few small tops having wooden discs, and stems pointed at each end, should be made for this purpose. The top is held lightly between finger and thumb.

The Cord.—There is nothing better than sea-fishing line. Use about a yard of it, and to avoid cutting the fingers fix a toggle at the end of the cord (see Fig. 6).

Fig. 6.—The Cord for spinning the Top.

One advantage of the form of top described is that it may be lifted by the stem without stopping the spin.

AN ELASTIC-DRIVEN MODEL BOAT

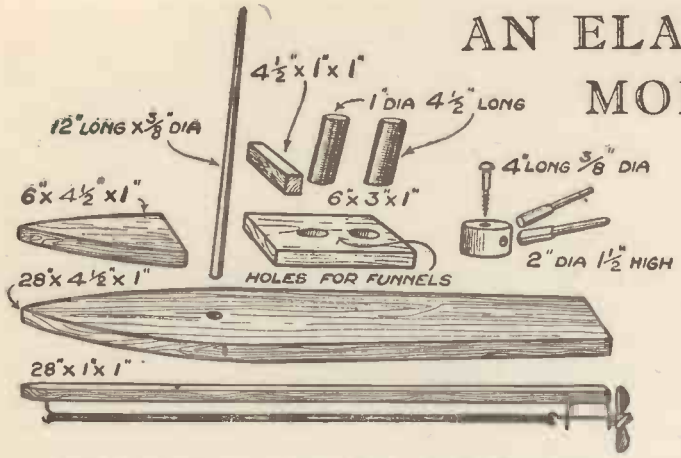


Fig. 2.—The Component Parts of the Battleship.

This boat will travel for over 100 yards

THIS model is very simple to make, and being very robust will stand any amount of rough usage. It is well suited for use at the seaside, for, being unsinkable, it can be sailed in rough water without coming to any harm when more elaborate boats might easily be pounded to pieces or sink and become lost.

Fig. 1 is a diagram of the complete ship, and Fig. 2 shows all the parts before assembly; in the case of the shaped pieces the dimensions given are the size of the wood before being cut to shape. The whole thing can be made out of 1 in. thick deal board.

The elastic motor shown at the bottom of Fig. 2 is simply screwed on to the centre line underneath the deck. An ordinary screw-dresser hook holds the front end of the elastic, and the two propeller bearings are made from a single strip of brass about $3\frac{1}{2}$ in. by $\frac{1}{2}$ in. by $\frac{1}{16}$ in. The propeller shaft is brass rod $\frac{5}{32}$ in. diameter by 4 in. long, bent to a hook at one end to hold the elastic.

The Propeller.—The propeller itself should be cut out from brass about 18 gauge with a fretsaw; it is 4 in. in diameter and has four wide blades, each bent through an angle of about 45 degrees. A $\frac{3}{16}$ in. hole should be drilled in one of the blades; this assists winding up considerably; you just carry a 3 in. nail in your pocket and stick the nail into the hole for winding purposes. Solder the propeller on to one face of a brass collar, and replace the tiny grub screw in the collar with a longer one, so that it can be screwed up very tightly.

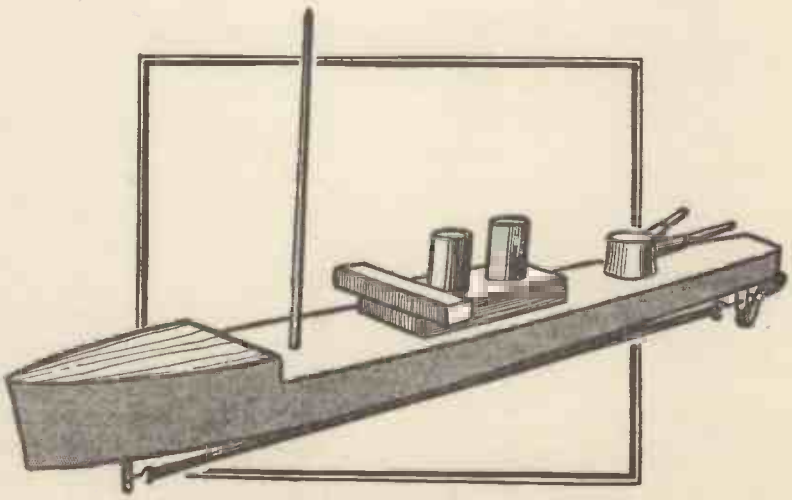


Fig. 1.—The Completed Model Boat.

MAKING A PRINTING PRESS

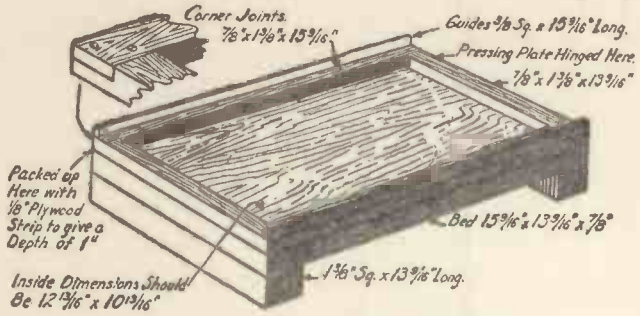


Fig. 1.—How to make the Press Bed.

Instructions for making a Practical Printing Press, on which you can print Club Magazines, Circulars, and Handbills, etc.

ONE of the most interesting of hobbies is printing. Its fascination appeals to all, and every boy at some time or other has tried, in some crude way, to devise some means whereby he can print something. The uses of such a hobby are too obvious to be explained. First, we want our readers to appreciate the fact that printing is an art, and, secondly, that the apparatus we intend to describe, although simple, easy, and not costly to make, is designed to produce real work, so that printing in this instance may be taken seriously. We first have to construct our press, which cannot claim to be elaborate, but which will perform its work just the same. We must remember that Caxton worked with a press which we would to-day term crude in every sense of the word, but his work was nevertheless good. We do not aim at speed; we have no use for that at the moment, the object is good work and how to produce it. Before we commence making the press it must be intimated that its construction, although simple, must be of first-class workmanship, for unless the press is accurately and truly made it will be of little use. Careful detail is given with this object.

The Bed.—The important part of every printing-press, even those wonderful, almost human, machines which turn out our daily newspapers, is the bed. In our case, this consists of a prepared wood base which *must* be perfectly true and flat. This, added to solidity and strength of construction, together with accurate workmanship, are its most essential factors. The entire section is made of oak, as this wood is strong and most suitable for the purpose. Be sure that the wood is well seasoned and dry, for new wood is quite useless as it will warp after assembly and render our efforts at accuracy of no avail. Concise details of this section are shown in the illustration, Fig. 1, and dimensions are also given. The press is designed

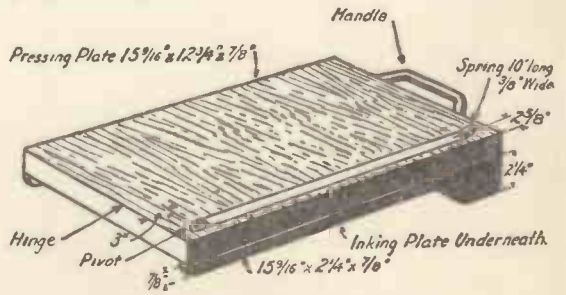


Fig. 2.—The Press Plate.

to print up to 8 in. by 6 in. size, which is as large as we are likely to require, while at the same time we can print anything smaller.

First, cut the actual bed-piece from one piece of oak, and see that the grain runs in the direction indicated. This is important. Finish the upper side with sandpaper until it is perfectly smooth and flat. Under this piece at each end is secured an oak runner. These serve two purposes—first, they prevent the bed-piece from warping across the grain, and, secondly, they serve to provide a level for the press. These are fitted by gluing and screwing at each end, the heads of the screws being countersunk. On the upper side of the bed-piece we fit a framed edge which allows for the *Chase* to be dropped in. This must be true and square, and the simple joinery at each corner is shown in the diagram. Finally, down the right and left sides of the frame we fit two guide-pieces which are glued and pinned in position, and these serve as a guide for the press-plate. This completes the *Bed*, which is of very simple construction, but once again, the work must be well done if disappointment is to be avoided.

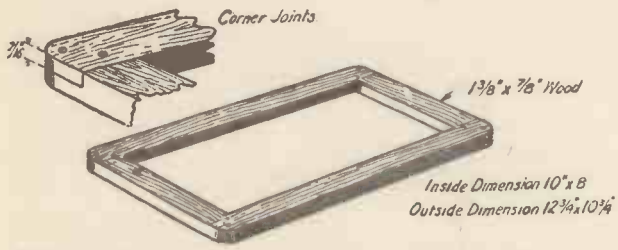


Fig. 3.—The Chase in which the Type is held or Set.

The Press-plate.—The next section of our press is the *Press-plate*. This is hinged to the back edge of the bed and serves also as an inker. The main wood-piece, which is of substantial oak, is cut to size first. The complete details of this section are shown in Fig. 2. The under face, which is to face the bed, must be finished quite smooth and flat, and the grain should be in the same direction as that of the bed as shown. The purpose of this is to balance any very minor inaccuracy. The sides of this piece must also be true and smooth and fit between the guide-pieces of the bed truly. At the front edge of the press-plate is fitted a metal handle which must be strong and firmly secured. Any handle will do for this purpose, and no doubt you will have such an item in the spare box, or it is quite easy to obtain one. At each side of the back of the press-plate are fitted side pieces as indicated, and these serve the combined purposes of maintaining the straightness of the plate, allowing plate to be dropped back level without straining the hinges, and enclosing the inker. The next item required is a strip of springy steel drilled at one end, which is fitted at the right side of the front of the press-plate, and this is to hold in position the paper to be printed with the addition of registering pins. The back of the plate is fitted with a piece of flat tin, or a stout piece of zinc is to be preferred, or, if possible, a steel plate. The press-plate is now hinged to the bed, and this part of the work must be very well

Fig. 4.—How the Type is Set in the Forme.

done, the hinges being recessed into the wood to give perfectly flat contact between the bed and plate. The only type of hinge which may be used is the long piano hinge, and this should be strong.

The chase, or forme as it is sometimes called, is a frame in which the type is set up. The construction of this must be just as true as the rest of the work, but it consists simply of a wood frame which must be perfectly square and flat. Details are given in Fig. 3, and from the dimensions it will be noticed that this is designed to drop into the bed of our machine, and that the space for type-setting allows for printing on quarto-size paper. This part is made of oak, and the corner joints if well made in the manner indicated, and glued in addition to screwing, will ensure a square setting. When screwing, by the way, a hole should be drilled and countersunk to suit the screw, in each instance in one piece. This will make the work of screwing much easier, avoid the possibility of the wood splitting, and ensure a firm grip between the two pieces. For all marking out of the wood use a steel square. The corners of the chase are rounded so that it is easy to drop it into the bed and to lift it out again, and the fit should be smooth, not tight.

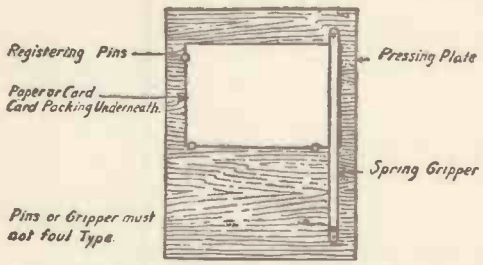


Fig. 5.—The Method of Registering the Position of the Type.

We have made our press, and now comes that part of the work which we are no doubt anxious to commence, namely, the actual printing. Your first efforts may not be a success, for, like other things, it is "not so easy as it looks." However, practice will make perfect, and if the instructions given herewith are carefully followed, the small skill required will soon be acquired. Once you are able to print a fair copy you will progress, and your work will improve until you find that you can tackle more ambitious things.

Type.—All type is made to standard size as regards height to paper. The letters themselves take various forms and sizes, and there are a number of styles to choose from. At the moment I will merely state that there are CAPS., that is, capitals, and "lower case," that is, the appropriate smalls. The matter of type can be gone into fully when you have mastered the art of printing something. Type can be obtained from any founder by the pound or by the font, which consists of a given style with all the caps., smalls, numerals, and signs, in appropriate quantities. For our use, to commence, we might get an assortment of discarded type, and classify it ourselves. This can usually be had from the local printer.

Setting Up.—Now we can consider the work of setting up, which amounts to setting up our type in the forme or chase. Remember that all the work is done backwards, and start on something simple as an address or visiting-card. Balance is the first thing to consider. The type must not be all over the place, but lined up at the edges with everything well proportioned. Then the ultimate work will look neat. Before we commence we shall need some furniture which consists of wood-packing pieces of standard size, reglets to use between the lines of type, and side-sticks, and quoins. To make all this clear I have shown in

Fig. 4 how the type is set, with packing-blocks, reglets, side-pieces, and quoins. A stock of these is required, the side-pieces and blocks being of one length to suit the chase. Starting from the top, we set our pieces, setting each line of type with blank type spacers between each word, and line spacers between each row, and finally pack up at the bottom, thus filling the chase. This must be done with the chase on a flat bed, and the bed of the press can be used for the purpose. All the furniture as required, by the way, can easily be made of oak wood.

Levelling.—This operation is a very important one. At the present stage the tapered quoins, which must all be cut to uniform and standard taper, should just hold the "set up" in position. The chase is in the bed of the machine. Now take a piece of good, flat oak wood, measuring 10 in. by 8 in., and place this over the type. Gently tap this in all positions with a wood mallet, and this will ensure that all the type is sitting perfectly on the bed of the machine. Tap the quoin-pieces to get a firm grip, and then level up again. Make sure that this is well done. The chase, by the way, should just fit in the bed if the dimensions given have been carefully followed, allowing $\frac{1}{32}$ in. clearance all round, and this should also be rigid. If not, it should be packed in with a strip of card at each side.

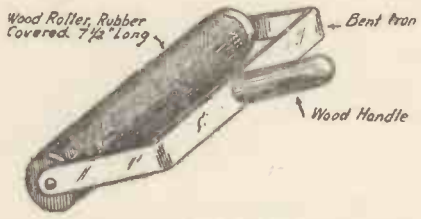


Fig. 6.—Roller for Inking the Type.

Making an Impression.—Before you attempt to take a number of pulls you must get a perfect specimen impression. First of all, register the position of the print on the pressing-plate. This is set by the simple expedient of using three drawing-pins, and the paper is set in position and held by the spring gripper. This part of the work is clearly indicated in Fig. 5. Do not, however, place your paper or card to be printed direct on the face of the pressing-plate. It must first be packed up with card, which must not measure more than 10 in. by 8 in. The cards should be thin and have a good surface. Try first using one card and add a card until the best impression is obtained. This is the art of getting just the right even pressure all over the type-setting; insufficient cards will make a poor impression, while too many cards will make an uneven impression. The packing must be just right, and the thickness of the print card or paper must be taken into consideration.

Printing.—At last we come to the printing. Assuming that you have set everything right, prepare your inking-plate. A small tin of ink will go a long way, and can be obtained either from a manufacturer or from your local printer. The ink should be dabbed on the plate evenly all over and then rolled in with a roller. Rollers such as photographers use will serve, if of suitable size, or, alternatively, you can easily make one. This item is shown in Fig. 6. The ink must be applied to the plate thinly and rolled perfectly even, otherwise you will get too much ink on your print in one place, and not enough in another. Now, close the press, run your roller over the plate, open the press, set your paper, run the roller evenly over the type with a swift movement, once forward and once back, close the press again, apply hand pressure, and open the press, and you have your impression. Before opening the second time, ink the roller ready for the next print.

As regards pressure, you will no doubt find this differs for the best results, and the amount to apply will come natural with practice. In many cases the weight of the pressing-plate alone will suffice. You are now free to take as many impressions as you like, and you will find that you will be able to do a considerable number in an hour, and once you have learned to do it properly you will be a real printer, and the work will be real, too, thus you can do all your own work—letter headings, cards, and so forth, and even school magazines.

There is still much more to consider, such as ornament, various aids to working, various composing-sticks, making your type cases, and so forth, but in the meantime, you will have much to do, and much to practice with, and you will have started on a really interesting hobby; one which is useful, instructive, and well worth studying.

Running your own Magazine.—The simplest form of magazine, and one suitable for a small school or club, is the folio type of magazine. First form a committee, and proceed to appoint editor and treasurer. The editor draws up a double list. The first column is headed Contributions, the second Readers. Any friend who has a desire to write, enters his name in the first column, the rest who, whilst interested, cannot be active in the business, put their names in the second column. This will ascertain the amount of support likely to be possible.

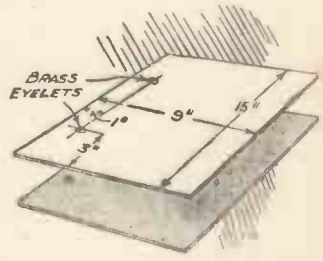


Fig. 7.—How to make the Cover.

Supposing the promoter thinks he has enough support to start the magazine, he next sees about the election of a committee drawn from the list of members shown in the columns. If both columns are fairly full, then it is a good plan to have two committeemen from each, making, with a chairman, five in all.

From these names are selected an editor and a treasurer.

Next fix the subscription, and with this form of magazine a merely nominal subscription is necessary. All work will be done voluntarily, and there is just the binder and paper to be bought.

Binding the Magazine.—To make the binder, take two pieces of limp cardboard, 15 in. by 9 in. (Fig. 7), and paste on the outside of them some imitation leather or, better still, some bookbinder's canvas. Two holes are bored in each, and brass eyelets inserted 3 in. from the top and bottom respectively and 1 in. from the margin. Then obtain a couple of dozen tags. They consist of two brass sections an inch long, joined by a silken cord, which varies in length according to the purpose which the purchaser has in mind. The double tags are now threaded through the eyeletted holes of the two covers of the binder, making it one (see Fig. 8). When sheets are added, the under part of the binder is slipped out of the tags, and the sheets of paper are threaded on, holes being punched or bored to correspond with those of the binder. On the front may be pasted the title of the magazine, etc., whilst on the inside of the binder, to face the first page, may be written or typed the rules and circulation list.


Fig. 8.—Attach the Covers by means of this form

A SWINGING PENDULUM BIRD

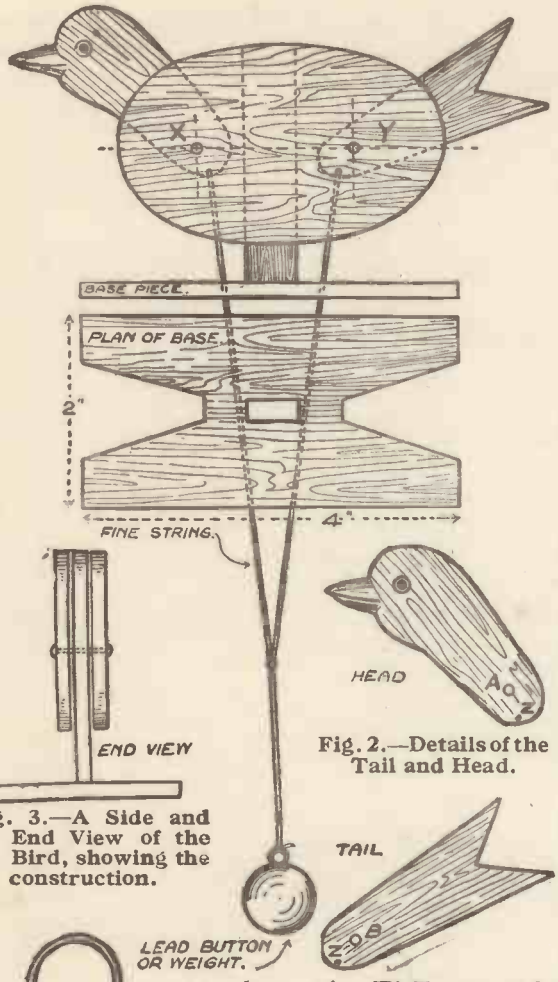


Fig. 3.—A Side and End View of the Bird, showing the construction.

Fig. 2.—Details of the Tail and Head.

HERE is an amusing toy, the materials required for which are as follows: a small quantity of plywood, some thread, a small quantity of lead, a piece of flower wire, and two small panel pins.

The two bodies of the bird are cut from two pieces of three-ply wood tacked together, measuring 2½ in. by 4 in.; the oval is drawn on this, and then the two are cut together. Next the base piece, 4 in. by 2 in., is cut out, and the hole cut in the middle must allow the support (Fig. 1) to fit into it tightly. The head and tail (see Fig. 2) are drawn on a small piece of plywood and cut out with a fretsaw. At the end of the head and tail pierce a small hole, as shown at Z in Fig. 3. Half an inch from these pin-holes drill another hole. These holes are marked A and B. Again, in the figure showing the side shape, drill the same sized holes at X and Y as indicated, ½ in. from the end. Now, either cut a piece of lead or, better still, bore a ¾ in. hole ½ in. deep into an odd piece of wood 1 in. thick (see Fig. 4), and after inserting the ends of a twisted wire eye, as shown in Figs. 4 and 5, pour into the mould a small quantity of molten lead. The length of the two threads should each be 2ft.

Fig. 5.—The piece of wire for making the loop on the weight.

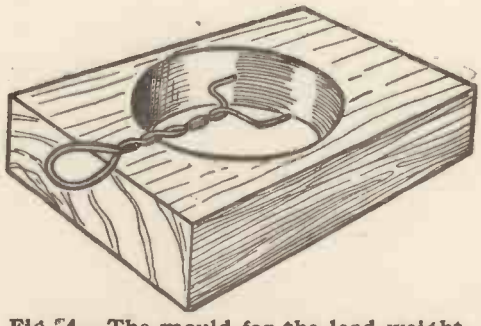


Fig. 4.—The mould for the lead weight.

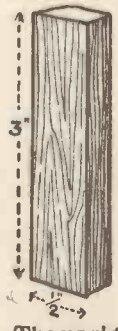


Fig. 1.—The upright support which should be a little thicker than the Head and Tail.

THREE SPLENDID MODEL GLIDERS

Excellent Fliers which cost almost nothing to make

BOYS can get much fun out of toy gliders. Usually they are launched from the hand, an elastic band being the propelling force. By this method, however, there is some uncertainty about the aim, which is important if a good flight is to ensue, as wind direction has to be taken into account.

A better plan is to use a catapult like that illustrated.

Figs. 1, 2, and 3 show how an efficient glider may be made from cardboard

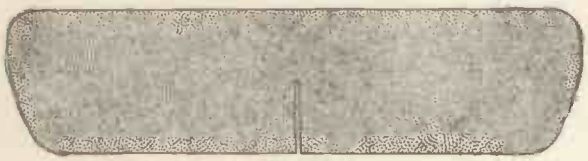


Fig. 1.

Fig. 3.

Fig. 2.

Figs. 1, 2, and 3.—The Various Parts of the Glider.

in three pieces. Fig. 1 is the wing, Fig. 2 the tail plane, and Fig. 3 the fuselage. Cut these from thin, stiff cardboard and unite them with glue, worked into the slots before they are interlocked. When the glue is set, the wings should be bent slightly upwards, each an equal amount.

How to Make the Catapult.—Fig. 4 shows the complete device in section, with the glider in place ready to be discharged. The body of the catapult is a

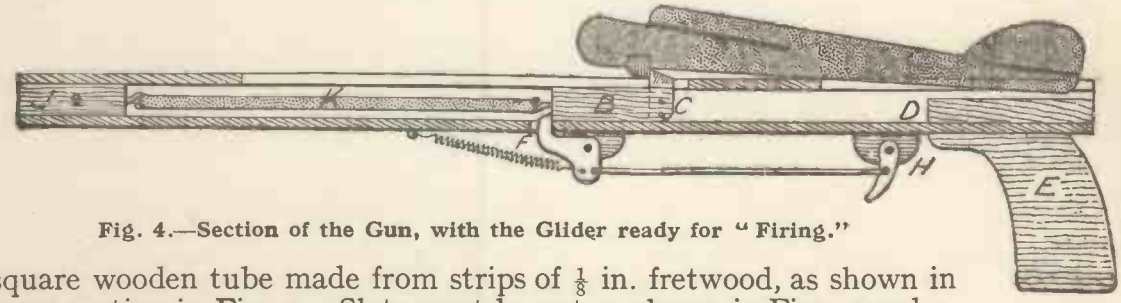


Fig. 4.—Section of the Gun, with the Glider ready for "Firing."

square wooden tube made from strips of $\frac{1}{8}$ in. fretwood, as shown in cross-section in Fig. 5. Slots must be cut as shown in Figs. 4 and 5. This is best done before adding the top to the tube. The block B, then, may be made and fitted so as to run freely through the tube. At its back end a saw-cut is made, into which the brass strip C is inserted and secured with two rivets. The projecting head of the strip must have a free run along the slot (see Fig. 4). At the back end of the tube a block D is glued in place to give a firm attachment for the pistol handle E.

Fig. 5.—The Trigger.

The trigger release F works through a slot in the lower side of the tube. It is cut from sheet brass. A spring, as shown, gives the return action.

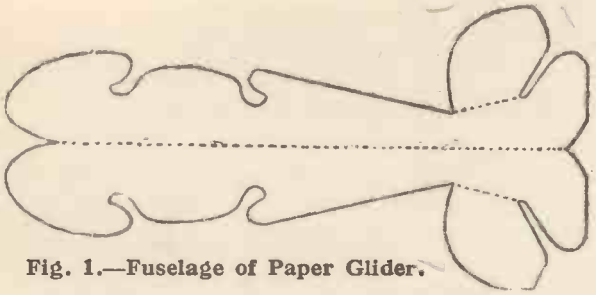


Fig. 1.—Fuselage of Paper Glider.

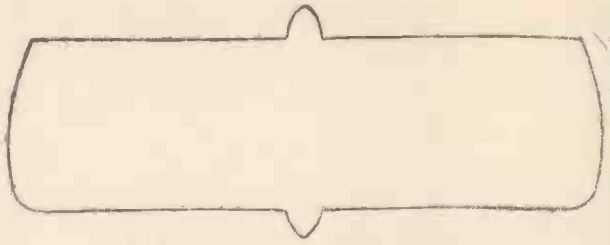


Fig. 2.—Mainplane of the Glider.

H is a supplementary trigger to enable the release to be worked with the forefinger of the hand holding the pistol grip.

The two triggers are pivoted in hard-wood bearings (see Fig. 5), and are connected by a length of wire working freely in holes in the triggers.

How it Works.—The fore end of the block B must be fitted with a wire hook, best made from a small brass screw eye. A similar hook must be fitted to the block J. This block is not a fixture, but is secured with a through pin of brass wire (see Fig. 5), which makes it easy to hitch the rubber banding K on to the two hooks.

The action of the catapult will be obvious. The block B is drawn back until its fore end engages with the trigger F, when the glider may be put into position and discharged.

The projecting piece on the fuselage should be reinforced by gluing pieces of veneer on each side of it, as shown by the shading on Fig. 3.

AN EFFICIENT LONG-FLYING GLIDER

QUITE a lot of instructive amusement can be gained from model gliders. These fascinating little devices can be very quickly made from cartridge paper and other ready-to-hand materials, although more elaborate ones, with fabric-covered wings, such as are used by members of model aeroplane clubs, need almost as much care in their construction as a power-driven model aeroplane. Some of these have remained in the air for nearly a minute, and an early experimenter (Weiss) obtained a flight of nearly a mile from a model glider.

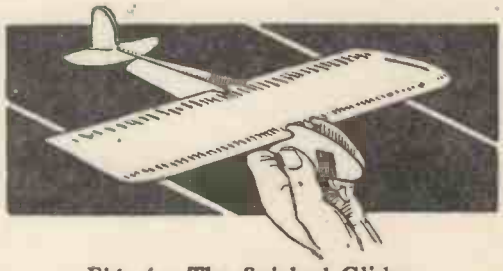


Fig. 4.—The finished Glider.

Gravity as a Propelling Force.—Gliders are frequently spoken of as powerless machines; this is not, of course, strictly speaking correct, for without some driving force the glider would not move. Gravity is the force from which a glider derives its motion, and the most efficient

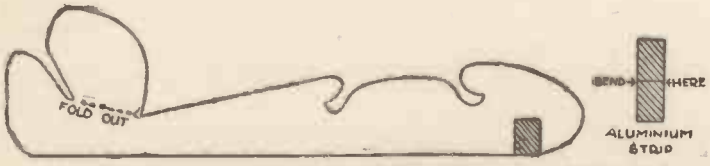


Fig. 3.—How the Fuselage of the Glider is folded, and (right) the Aluminium Loading Strip.

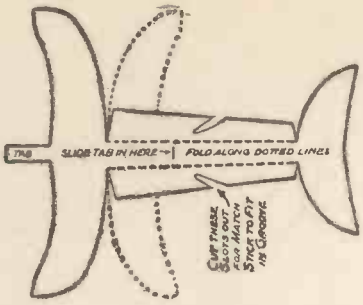


Fig. 5.—How to make a simple Catapult Glider.

glider is that which glides at the "flattest" angle—that is to say, the one that travels the farthest with the smallest loss of altitude. A glider that descends 1 ft. for every 6 ft. it travels is said to have a gliding angle of one in six, and if it is launched from a height of 6 ft. it would reach earth 36 ft. away.

You can make a glider perform many of the trick evolutions of the full-size aeroplane. For example, if you throw it into the air, instead of launching it at its correct speed, it will loop-the-loop, regain its balance, and then glide steadily to earth. Again, if you launch it steeply banked (heeling over to one side), it will side-slip, and then proceed to glide smoothly. All these little experiments are very fascinating, and they can be made indoors or out in the open.

A Simple Paper Glider.—On a thin piece of cardboard draw Figs. 1 and 2 and cut them out. Then fold through the centre of Fig. 1 and bend a strip of aluminium on to the front of the plane, as shown in Fig. 3, to weight it. With the thumb of the left hand spread the body sides apart, and with right hand insert the point of the front wing into the notch provided for it.

Next insert the rear part of the wing by bending it. Unfold the tail flaps at the dotted line as shown in Fig. 3 and bend until they are at right angles to the wing. The glider is then ready for flight (see Fig. 4); it is advisable to give it a coat of shellac to stiffen it.

If it tends to dive, cut off a piece of the aluminium, and if it flies in a series of swoops, add a piece.

A Miniature Catapult Glider.—The only materials you require for the miniature indoor catapult glider shown by Figs. 5 and 6 are a piece of thin cardboard, a length of elastic, and any suitably arranged platform, such as a drawing-board. Fig. 6 shows that the catapult is fixed down to the platform by means of drawing pins, and the looped end is placed into sloping slots in the side of the fuselage. When you pull the glider back and release it, it will be shot into the air at a high speed, and will glide for a considerable distance. Many little experiments can be carried out with it. You will be able to study the effect of varying the angles of the wing tips and tail, and it will thus help you to understand the principles of the aeroplane.

The wing span of this little glider is $4\frac{1}{2}$ in., the tail span $2\frac{1}{2}$ in., the width of the fuselage is $\frac{3}{8}$ in., the depth $\frac{1}{2}$ in., and the total length of the glider when folded is 4 in. You will be able to devise for yourself many other shapes of glider from the instructions given in this section.

Those who would like to pursue the subject of model aeroplane building and flying should obtain from the publishers of this Annual a copy of "Model Aeroplanes and Airships," by F. J. Camm. It costs 1s., or by post 1s. 2d.

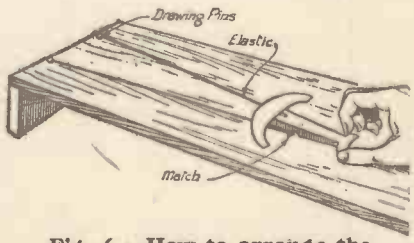


Fig. 6.—How to arrange the Catapult.

A FINE WORKING MODEL ANTI-AIRCRAFT GUN

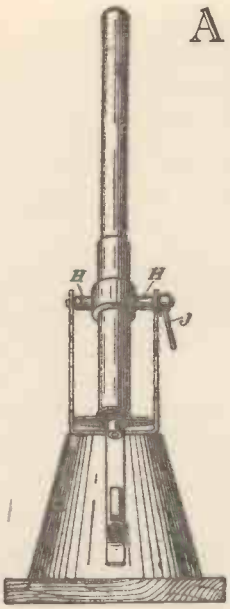


Fig. 1.—End View of the Model Anti-Aircraft Gun.

Made in an evening from ready-to-hand materials. It will expel dummy shells

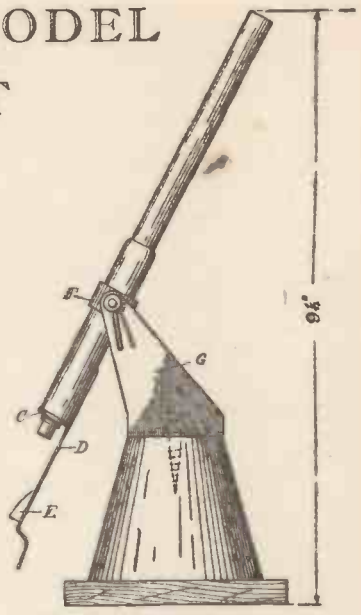


Fig. 2.—Side View of the Anti-Aircraft Gun.

HERE is an interesting toy which is not difficult to make if the instructions are carefully carried out. A slight knowledge of soldering will be necessary, and a few ordinary tools such as most amateurs possess.

Gun Barrel.—You will require two pieces of brass tubing for the barrel of the gun, one piece being 7 in. long and $\frac{3}{8}$ in. *outside* diameter, and the other piece 3 in. long and a little over $\frac{3}{8}$ in. *inside* diameter, so that it just fits nicely over the longer tube. For the latter, the plunger-tube of a discarded cycle-pump would answer the purpose quite well. Clean the two tubes with fine emery cloth, and, after slipping on the outer tube, neatly solder it, at the top and bottom, to the inner tube. Remove all superfluous solder with a small file, and see that the lower ends of the tubes are quite flush.

Fig. 4.—The Trigger-Plate.

Fig. 5.—The Trunnion Fitting.

Firing Mechanism.—The "firing" mechanism consists of spring, plunger, spring-rod, and trigger-plate. For the spring-rod a piece of brass or steel rod $\frac{1}{8}$ in. diameter and $4\frac{3}{4}$ in. long will be required, and on one end of this rod the plunger has to be soldered, as shown in Fig. 3. A brass collar about $\frac{3}{16}$ in. thick will do for the plunger, which must be an easy sliding fit in the barrel. The catchplate A can be fashioned to the shape shown out of an odd piece of sheet brass $\frac{1}{16}$ in. thick. A $\frac{1}{8}$-in. hole can be drilled in the middle of the plate so that it can be slipped on to the plunger-rod. The stop B may consist of a piece of brass tube about $\frac{1}{4}$ in. long, and this, together with the catch-plate, are to be soldered on to the end of the plunger-rod, after the other parts of the mechanism are assembled.

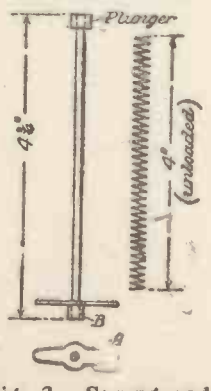


Fig. 3.—Spring-rod, Catch-plate, and Spring.

For the end-plate C of the gun barrel, a thick brass washer

can be used. This should be slightly larger than the outside diameter of the gun barrel, and the hole in the centre must be an easy fit to the spring-rod. The joint between this plate and the end of the barrel must be well soldered, and after this is done the end of the trigger-plate D can be soldered to the barrel, as indicated in Fig. 2. The trigger-plate can be bent to the shape shown from a strip of thin, springy sheet brass $\frac{1}{4}$ in. wide and $3\frac{1}{2}$ in. long.

A piece of steel or iron plate $\frac{1}{2}$ in. by $\frac{3}{16}$ in. by $\frac{1}{8}$ in. thick can now be filed to the shape shown at E for forming the stop for the catch-plate A. Solder the stop on to the catch-plate in the position indicated in Figs. 1 and 4.

Pass the spring-rod through the spring, and insert them in the gun barrel, then, with the aid of a round, wooden rod, push the plunger down till the end of the rod passes through the end C. Now slip on the catch-plate and the piece of tube B and solder them in position.

Trunnion Fitting.—The next part to be made is the trunnion fitting F, by means of which the gun is pivoted in the cradle G. A slightly enlarged view of the trunnion fitting is given in Fig. 5. A piece of thick brass tubing about $\frac{7}{16}$ in. long is required, having an inside diameter that just allows it to fit nicely over the outer gun barrel. A $\frac{1}{8}$-in. diameter hole can now be drilled through the piece of tube to take two pegs, which must come exactly opposite each other. Two pieces cut from a French nail of suitable size would answer very well for the pegs, one of which is $\frac{1}{2}$ in. and the other $\frac{5}{8}$ in. long. The longer peg should have a thread cut on one end to take the clamping-nut, as shown in Fig. 2. The thread can be cut by means of a small screw-plate, if one is available, or, failing that, a friend who has one can be approached in the matter. The pegs can now be pressed into the holes made to receive them, and well soldered in position; after which the complete trunnion fitting can be soldered to the gun barrel. Make sure before soldering that the pegs or trunnions are in the correct position in relation to the trigger-plate, and that the centres of the trunnions are about two inches from the end of the gun barrel. (See Fig. 1.)

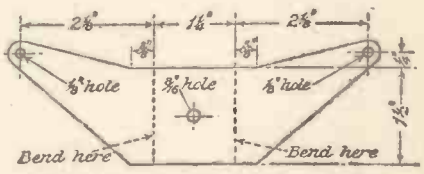


Fig. 6.—How to mark out the Cradle.

Gun Cradle.—For the cradle G we shall require a piece of sheet brass about $\frac{3}{64}$ in. thick, cut to the shape given in Fig. 6. After carefully marking out the shape on the piece of metal with the aid of a scriber or fine-pointed bradawl, drill the three holes to the sizes indicated.

We now have to cut the piece to the required outline, and for this purpose we use a hammer and chisel. Lay the metal plate on top of an ordinary flat-iron (this makes a good anvil) and cut all round the outside of the line with the chisel. When you have done this, the edge must be carefully filed down to the line, and the two ends bent up at right angles on the dotted lines.

Gun Mounting and Base.—It will be noticed upon reference to Fig. 1 that the gun cradle is mounted on a conical pedestal support. In our simple model this can be of wood, and could be turned in a small lathe to the shape shown. If a lathe is not available, this part will have to be shaped by hand with a carpenter's chisel, and finished with a rasp and glass-paper. The base is simply

Fig. 7.—The Wooden Shells.

a piece of $\frac{3}{8}$-in. wood $3\frac{1}{2}$ in. square, which can be fixed to the pedestal support by means of two screws driven in from underneath.

A brass screw, 1 in. long, and a washer, are used for fixing the cradle on top of the pedestal. The screw should not be screwed down too hard, but just sufficiently to permit of the cradle being turned easily.

In order to maintain the gun in a central position when mounted in the cradle, a piece of brass tubing about $\frac{1}{4}$ in. long can be slipped on each trunnion, as shown in Fig. 2. When placing the trunnions in their respective holes in the top of the cradle, press the longer trunnion in place first, then spring the opposite side of the cradle out slightly, and slip the other trunnion in position.

Clamping Device.—All that is now required to complete the gun is the clamping-nut and handle J. The latter may consist of a piece of French nail pressed into a hole drilled at an angle to receive it in the side of the nut, and then soldered. The end of the handle should be nicely rounded with a file.

How to Work the Gun.—To fire the gun, the spring-rod is pulled back till the catch-plate snaps behind the stop E, thus "cocking" the gun. A steel cycle ball is now dropped down the barrel, and the trigger-piece depressed, which releases the catch-plate and allows the spring to project the ball.

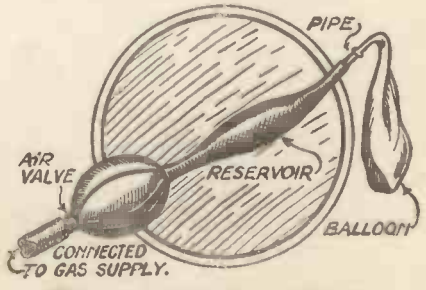
Ammunition.—In addition to cycle balls, "shells" could be used, made from a hardwood rod, pieces about $1\frac{1}{2}$ in. long being cut off and a hole drilled in each to take a round-headed screw. After inserting the screw, file the end of the wood, as shown in Fig. 7, so that the end of the "shell" comes flush with the head of the screw. Another kind of "shell" is also shown in Fig. 7. In this case the head of the screw is cut off with a hacksaw, and part of the stem is filed to a sharp point.

Some good fun may be had by getting a small toy balloon, tethering it about 4 ft. from the ground, and firing at it with the sharp-nosed "shells."

INFLATING BALLOONS FOR PARTIES

NO party would be complete without a number of gaily-coloured balloons. Anyone can, of course, fill them with air, but this sketch shows how to inflate them with gas with the minimum of apparatus or trouble. Balloons so filled are, of course, lighter than air, which makes them much more attractive.

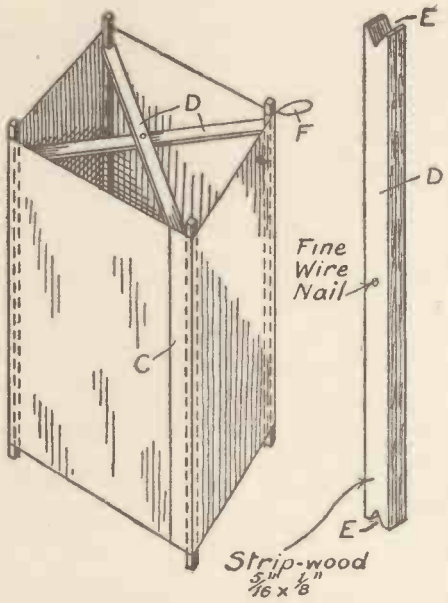
The simplest type of pump for the purpose is an ordinary rubber bellows, such as one finds on scent or similar sprays. The type shown in sketch, fitted with a reservoir for storing air, is the best and most suitable for the purpose in view. The procedure is very simple; besides the bellows, all you require is a short length of rubber tube of such a size as to fit fairly tightly over the air valve of the bellows, as shown in sketch, and a small piece of glass or metal tube for connecting to balloon.



How to Inflate Toy Balloons.

A Fine High-Flying Box Kite

MADE IN A FEW HOURS FOR 6d.

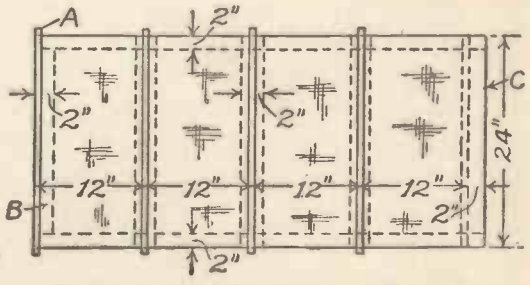


The completed Box Kite and (right) the Diagonal Stretchers.

ALL that is required to make this kite are a few lengths of stripwood and four sheets of coloured paper measuring at least 28 in. by 14 in.

From some $\frac{3}{16}$ in. square stripwood cut four pieces 25 in. long for the corner stiffening pieces. Take the four sheets of coloured paper, which must be cut to exactly the size mentioned, and with some strong glue stick them together, allowing an overlap of 2 in. as shown in the bottom diagram. Now turn over a 2 in. fold at the top and bottom and also on one side, and glue them down. Measuring from the edge of this folded side, mark the positions of the wood strips along the top and bottom fold of the paper. Glue one of the sticks to the paper level with the folded edge, as shown at A, with the ends projecting evenly. Glue the other sticks in place and see that they are parallel to each other with their centres 12 in. apart, as indicated in the diagram. When quite dry and the sticks secure, the edge C of the paper must be glued to the back of the other end of the paper at B.

For cross-struts D, cut four 16½ in. lengths of $\frac{5}{16}$ in. by $\frac{1}{8}$ in. stripwood, place two of them together, and drive a fine wire nail through the centre, turning the end of the nail up underneath. Treat the other two pieces in the same way. Notch the ends as at E, open out the struts, and fit them inside the kite, as shown in the first diagram.



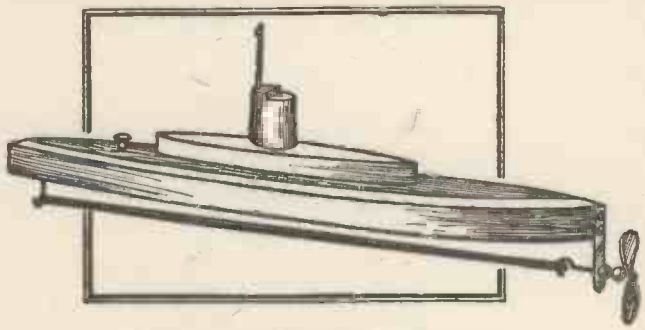
How to mount the Strips of Wood on to the Coloured Paper.

Securely tie a piece of string to the top of one of the sticks to form a loop F to which the line is attached. The line should be wound on a spool and "paid out" gradually; tow the kite against the wind, when it will quickly ascend to a great height.

HOW TO BUILD A MODEL SUBMARINE

THIS trim little submarine can easily be made in an hour or two from a few odds and ends. The hull and raised deck are of wood, and a cork forms the conning-tower, which is surmounted by a periscope, fashioned from part of an aluminium curtain-pin or a piece of tinned-iron wire.

The Hull.—For the hull, take a piece of wood 10 in. long by 1¾ in. wide, and ⅝ in. thick, and after planing it on both sides, mark a centre line on one side. With a pencil carefully set out the shape of the hull (A), and then saw away the parts not required, and finish the sides smooth with a chisel. Now chamfer or bevel the top edge of the hull all round, as shown in the accompanying sketches. This can be done with a small iron plane and a chisel.

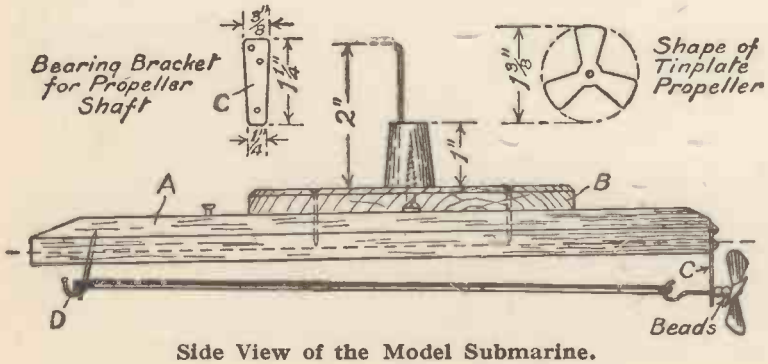


The Completed Model Submarine.

The Deck.—Cut the raised deck (B) from a piece of wood ⅜ in. thick, and in the middle of this screw on a cork, which serves for the conning-tower. Fix the raised deck to the hull with two ¾ in. nails. The lower end of the periscope is pointed, and is simply pushed in a hole made in the cork with a bradawl. For the bollard, seen just in front of the raised deck, cut off the top part of a French nail, file the end to a point, and hammer it into the hull, so that the head stands up about ¼ in.

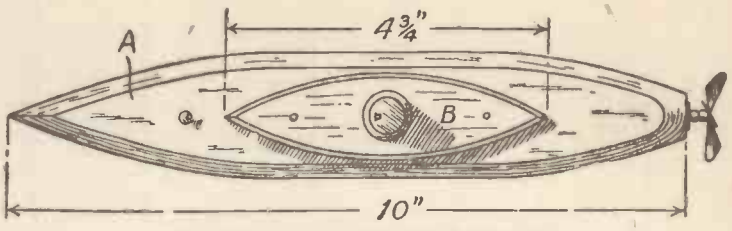
A piece of thin strip brass can be filed to shape to form the bearing-bracket (C), small holes being drilled as indicated. Two small brass screws fix this bracket to the stern of the boat.

The Propeller.—To make the propeller, obtain a flat piece of tinplate, and on it mark a circle 1⅜ in. diameter, and then set out the shape of the propeller blades. With a pair of old scissors cut away the metal not required. File the edges of the blades smooth with a file, and drill a tiny hole through the centre of the propeller to take the shaft. This consists of a 1½ in. length of plated wire taken from a thick bent-wire paper fastener. Lightly solder the propeller on to the end of the shaft, and then twist the blades so that the



Side View of the Model Submarine.

outer edge of each one makes an angle of about 45 degrees with the shaft when the propeller is viewed edgewise. Slip a couple of glass beads on the shaft, and with a pair of pliers bend the end to form a hook to take one end of the rubber "motor."



Plan View of the Model Submarine

Making the Hooks, etc.—The front hook (D) is made from a blanket-pin and is driven into a hole made in the hull. The rubber "motor" consists of 18 in. of $\frac{1}{16}$ in. square rubber strip, the two ends being bound together with strong thread. After placing the strands on the hooks, rub them over with a little lubricant as explained below. All the woodwork of the little craft can be given a coat of grey paint to finish it off.

On winding up the "motor" by means of the propeller, and placing the boat on the water, it will glide along quite realistically until the rubber strands become unwound. The boat rides nicely on the water and does not require a keel of any kind.

By an adaptation of the simple ideas contained in this section, you will be able to make quite a lot of little working models, for twisted elastic is a simple and inexpensive means of driving them.

By the way, for the best results you should lubricate the elastic with soft soap, to enable the strands to slide over one another easily, and also to prevent the edges of the strands cutting into one another. Soft soap enables more turns to be given to the elastic skein.

Small tubes of elastic lubricant may be purchased for a few pence from most manufacturers of model aeroplanes. If you decide to use soft soap, use the pure green sort, obtainable from the chemists. Do not use vaseline or oil, or you will speedily ruin the rubber.

A MUSICAL DOOR ALARM

A Musical Door Alarm.

HOLLOW out a block of wood about 1½ in. thick, and obtain some 30-gauge piano wire and tuning pins from any music shop. Screw four pins in the top of the block, and four opposite at the bottom. Next make four or eight notes by connecting the top and bottom pins with separate lengths of wire. Two strips of metal will serve as bridges for the strings to rest on. A pliable object, such as a pointed piece of soft rubber, can be fixed near the top of the door to catch the strings block, which is fixed endways on the door post, when a nice chord is played every time the door opens if the strings are tuned to the musical scale.

A WORKING MODEL ROAD CRANE

Only odd pieces of wood are needed to make this fine model

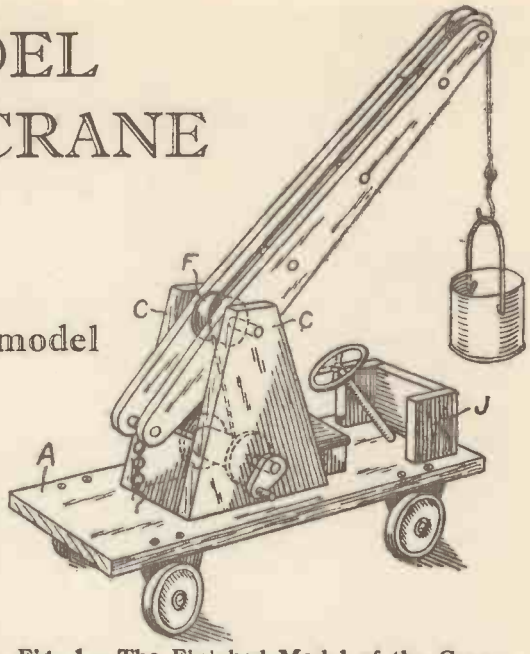


Fig. 1.—The Finished Model of the Crane.

THIS strong and instructive toy can easily be made with odd pieces of wood, a cotton-reel, and pieces of wooden knitting-needles. For the platform A saw a piece of $\frac{3}{8}$-in. wood 8 in. long by $3\frac{1}{2}$ in. wide. Plane it on both sides and around the edges. Cut out four pieces of $\frac{3}{8}$-in. wood to the sizes given at B, for the wheel bearings. These are screwed to the platform, as shown in Fig. 1, at a distance of $\frac{3}{4}$ in. from each end. Now saw the two side-pieces C C to the dimensions given in Fig. 2, and carefully smooth the edges with a chisel. On the centre line of each piece make two holes, as indicated, just large enough to allow a thick wooden knitting-needle to pass through.

Making the Jib.—To make the jib D, cut two pieces of $\frac{1}{4}$-in. wood to the shape shown in Fig. 3, and make the holes in each a tight fit for pieces of knitting-needle. Cut five pieces 1 in. long, and one piece $2\frac{1}{2}$ in. long. Glue the ends of the short pieces in the holes in the sides of the jib after slipping a boxwood pulley between the top ends of the jib. The long piece passes through the hole E in each side-piece, also through another pulley F, the rod projecting $\frac{3}{4}$ in. on each side. There should be a space of $\frac{1}{2}$ in. between the jib sides for the full length.

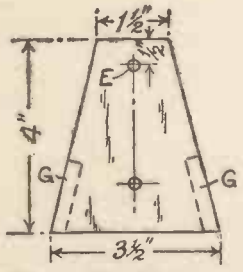


Fig. 2.—The Measurements of the Side Pieces, marked C C in the Finished Model.

The Winding Drum.—This consists of a deep-flanged cotton-reel just long enough to fit nicely between the side pieces C C, which are $1\frac{3}{4}$ in. apart when fixed to the platform. Now get a wooden rod or stout knitting-needle to fit the hole in the cotton-reel, and cut off a piece 3 in. long. Screw one side-piece to the platform from underneath, place the jib and winding drum in position, and then screw down the other side-piece. To strengthen the sides screw two pieces of wood G G between them at the front and back, and also to the platform. Make the little winding handle H out of wood $\frac{3}{16}$ in. thick, and fix one end on to the winding-drum shaft with a

small screw, and glue a short piece of round wood in the hole in the other end. The rear end of the jib can be held down by a short piece of chain and a small screw-hook. The front part J and the driver's seat can be made from pieces of ¼-in. wood, and are nailed or screwed in place. The steering wheel is simply an iron toy wheel, about 1½ in. diameter, screwed on to the end of a piece of dowel rod glued into a hole in the platform. The running wheels are wooden ones, 1½ in. in diameter, and are fixed to the bearing-brackets with round-headed screws and washers.

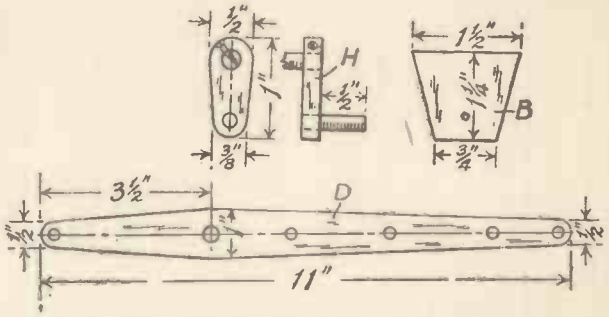


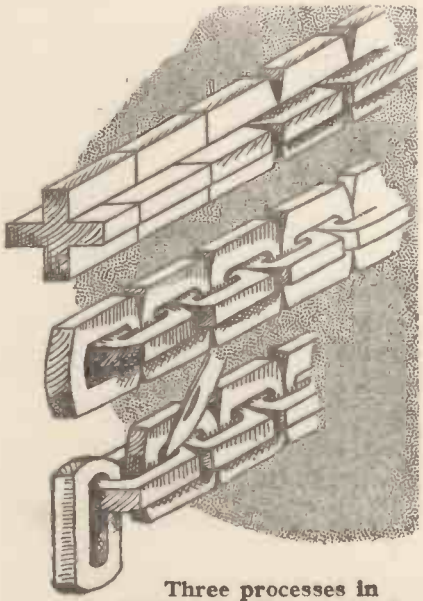
Fig. 3.—The Jib Winding Handle and Brackets for the Wheels.

The Finished Crane.—To complete the crane you will require 5 yds. or 6 yds. of thin twine, one end of which must be attached to the winding drum and wound up. The other end is passed over the two pulleys (see Fig. 1), and tied to a small hook, which you can bend to shape from a piece of thick wire. The little bucket can be made from a tin and a piece of bent wire.

The finished toy can be painted with enamel in one or two colours.

A CHAIN MADE OF WOOD

OBTAIN a straight-grained piece of wood about 1 in. square, and as long as you require the chain to be; any wood may be used that does not split too easily. Cut pieces out of the corners so as to give the wood a cross shape in section as shown in the top figure of the illustration; mark off the lengths of each link as shown (the marks on the horizontal arms of the cross being midway between those on the vertical arms), and cut notches at each mark like the far end of the top figure.



Three processes in carving the Wooden Chain.

How to make the Links.—Next cut out with a fretsaw as much of the inside of each link as you can get at, and at the same time separate each link from its neighbour in the same plane. The chain should then appear as in the central figure, the links being attached by a small piece of wood which cannot be reached by the fretsaw. Separate the links by nibbling these unwanted pieces away with a sharp-pointed penknife as shown in the lowest figure, and breaking them apart when nearly cut through. The rough ends can easily be trimmed after twisting the separated link to a suitable position, and the square corners rounded off to make the links look more like those of an ordinary iron chain.

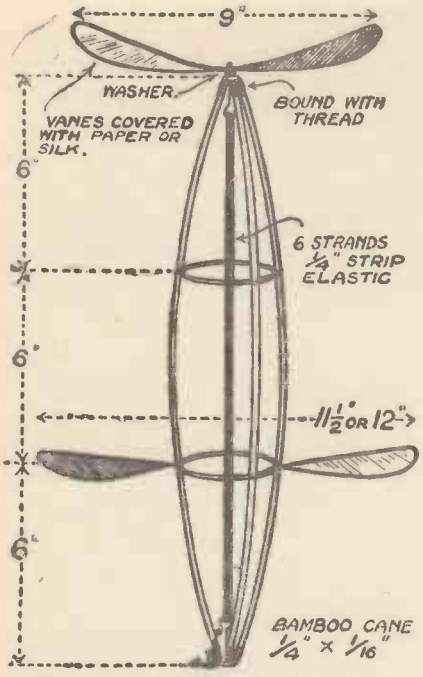


Fig. 3.—The Completed Model Helicopter.

A HIGH-FLYING MODEL HELICOPTER

This Model rises vertically into the Air to an Enormous Height

MODEL aeroplane makers will no doubt welcome a change from the orthodox model in the form of the model helicopter now described. Its construction is very simple, and it flies in a very fascinating manner, rising to a great height. Unlike a model aeroplane, which needs fairly calm conditions before it will fly satisfactorily, a model helicopter will fly in any wind.

The Fuselage.—This consists of three lengths of bamboo cane ¼ in. × 1/16 in. and 18 in. in length. Next cut two bearings from a piece of tin to the shape shown in Fig. 1—one for the propeller, the other for the hook. Two holes must then be drilled in the top bearing to allow the hook made from 20-S.W.G. steel wire to be soldered to it. The bottom bearing has only one hole in the centre to allow the propeller shaft to be passed through.

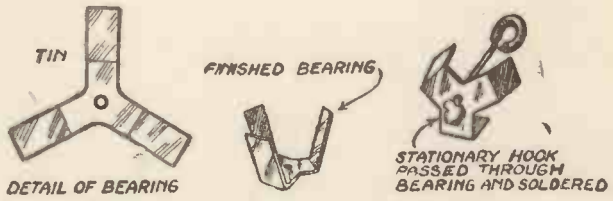


Fig. 1.—Details of the End Bearings.

The Fuselage Supports.—The supports are made from 20-S.W.G. wire, and consist of two rings 3 in. in diameter (see Fig. 2). When these are fitted inside the fuselage and the bearings placed at each end of the bamboo canes, the shape of the fuselage should be similar to that shown in Fig. 3. The two vanes attached to the top ring of the fuselage are made from 20-S.W.G. wire, and should be bent to the shape shown in Fig. 4. These can then be covered with silk or paper (see Fig. 5).

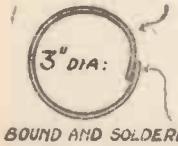


Fig. 2.—Make Two Fuselage Supports to this Shape.

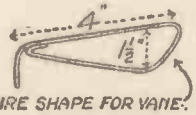


Fig. 4.—Construction of the Vane or Rotor.

The Propeller and Hook.—The propeller is made from one length of S.W.G. wire, as

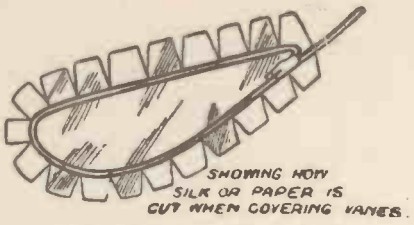


Fig. 5.—How to cover the Wire Propeller.

shown in Fig. 6, and the two ends are soldered into position. It should then be covered similar to the vanes. For the hook, a piece of wire is bent as in Fig. 7. It is then attached to the top bearing through the two holes already bored and soldered into position. A piece of elastic is now attached to the two hooks, and the vanes and propeller are twisted as shown in Fig. 3, and the model is now ready for a trial flight.

Testing the Model.—For the first flight give the propeller about 200 turns to the right or clockwise, and hold the helicopter as shown in Fig. 8, the propeller being held in the right hand, and the left hand is placed on top. When launching the model do not throw it into the air, as this will spoil the flight. Gently release both hands at once and the model will rise into the air in a vertical position to a height of about 100 ft. To obtain the best results, six strands of $\frac{1}{4}$-in. strip elastic should be used, and these should be well lubricated with pure soft soap. The elastic will then stand between 300 to 350 turns.

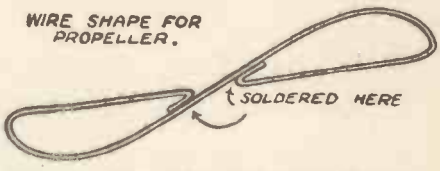


Fig. 6.—The Wire Propeller Frame.

It is important to note that a helicopter is not an autogiro. A helicopter can rise and descend vertically, whereas an autogiro needs a short run (about 20 yds.) before it will lift. It can, of course, descend vertically. There can be little doubt that the autogiro is the machine of the future, and it affords an example for interesting experiments by the keen model maker.

Fig. 7.—How to form the Hook on the Propeller Shaft.

It is possible, if such model helicopters are made extremely light, to make them ascend to an enormous altitude, and then to flutter about like some huge insect. Fortunately model helicopters may be made to fly much more easily than the average model aeroplane, and they provide members of model-flying clubs with a device which they may use at model aeroplane meetings when the weather is far too boisterous to permit of flights with the usual type of model aeroplane.

It is indeed a somewhat surprising fact that model aeroplane clubs do not hold competitions for model helicopters and flapping-wing models, bearing in mind that the limit in model aeroplane performances has probably been reached, unless one can devise a more efficient form of motive power than twisted elastic.

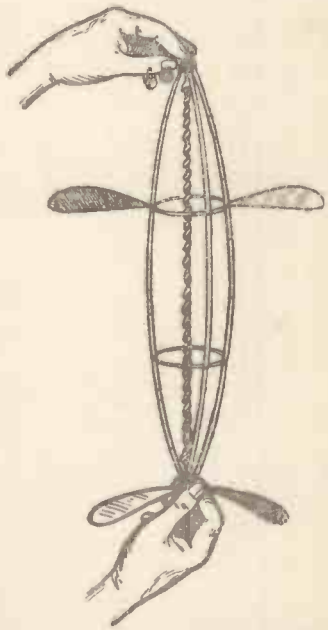


Fig. 8.—How to launch the Model Helicopter.

AN AMUSING TOY ACROBAT

By pressing the two bottom supports the Acrobat performs a number of tricks in very realistic fashion

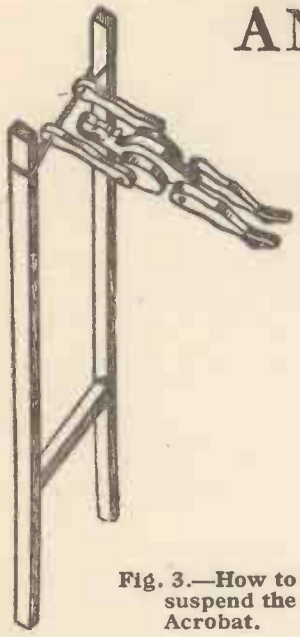


Fig. 3.—How to suspend the Acrobat.

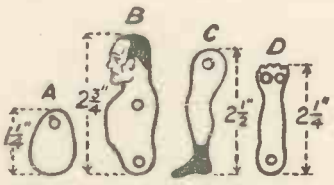


Fig. 1.—The Various Parts that make the Acrobat.

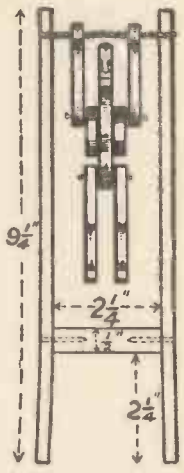


Fig. 2.—The Frame Measurements.

THE tumbling acrobat shown in the sketches above is a novel and entertaining toy and is quite easy to make, provided that you have a fret-saw. The arms and legs of the acrobat are hinged, and when you squeeze together the bottom ends of the frame, holding it in an upright position, the acrobat turns somersaults and can be made to perform all sorts of laughable tricks. First make the acrobat. Cut him out of three-ply wood, drawing the parts out from the outlines (Fig. 1). Cut two pieces of shape A, one of B, two of C, and two of D. Make the holes in each piece for the joints with a fretwork drill or a bradawl, and fasten the parts together by means of pieces of thin wire. A strong hair-pin can be utilised for this purpose. The ends of the wire are turned over, as you can see in Fig. 2. It is essential that the holes must be big enough to allow the wire to make a very loose fit, as the acrobat will not perform properly if his joints are at all stiff.

The Frame.—The frame in which the acrobat performs is made from strip-wood. The uprights are $9\frac{1}{4}$ in. long by $\frac{1}{2}$ in. by $\frac{1}{4}$ in. The cross-piece is $2\frac{1}{4}$ in. long by $\frac{1}{2}$ in. square. They are fastened together with two wire nails, as illustrated in Fig. 2. Cut a notch in the side of each upright, near the top, for the string to pass over.

The acrobat is suspended in his cage by standing him on his head and threading strong string as shown in Fig. 3. The acrobat must stand on his head when this is being done, or he will not be able to perform properly. Note that in Fig. 3 there are no twists of the string between the sides of the frame and the acrobat's hands, but the string is twisted three or four times between his hands. The correct tension of the string between the uprights is best found by experiment.

A SPLENDID MODEL SAILING BOAT

You can make it for a few pence in an evening

THE little model sailing-boat illustrated in the sketch overleaf (Fig. 5) has the advantage that its construction does not depend on the accurate and careful carving out of a relatively large chunk of sound pine wood.

To eliminate the carving, a boat hull can, of course, be made up with the orthodox ribs and planks. This construction certainly can be made to provide a boat with first-class lines, but the novice with no fine wood-working experience is likely to find this system even more arduous. He will, therefore, obtain quite a good result by adopting the six-plank built-up hull, the parts for which are shown in detail in Fig. 4.

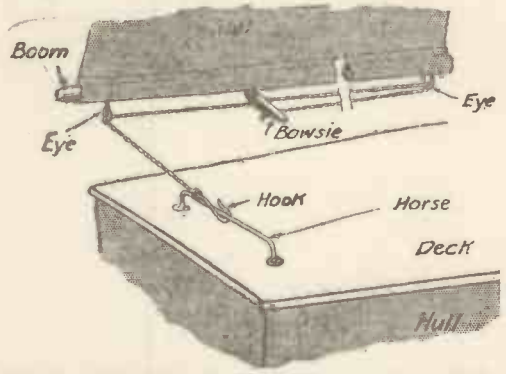


Fig. 1.—The Main Sail must swing from side to side to an extent governed by the cord called the Main Sheet.

Fig. 2.—The "Gaff" is secured as shown.

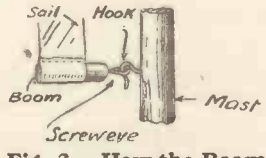


Fig. 3.—How the Boom is secured.

The Hull.—The boat is really a "sharpie" design, and is sloop-rigged. It has a proper fin keel and the same as is just fitted to many full-size sailing-boats of small tonnage. To make the hull, a piece of fretwood, $\frac{1}{8}$ in. thickness, 11 in. wide, and 36 in. long, is ample. But if thin cardboard templates or paper patterns are cut out before going to the Hobbies depot to purchase the wood, it may be found less expensive to obtain it in smaller pieces exactly to require- ments. Wide pieces of wood are always more expensive than narrower strips.

Care should be taken in marking out the templates to be used in finally shaping the pieces, more particularly in setting out the curves of the deck and bottom planks of the hull. A centre line should be drawn on the curve as a basis at the outset. Either by accurate setting out on both sides of this centre line, or by making a half template in paper, marking out one side first and then turning it over to do the same for the other side, perfect symmetry of shape can be assured.

The deck piece must be made $\frac{1}{8}$ in. larger all round to allow it to overhang the sides of the boat, to form a coaming.

The Sides.—These are not quite straight at the deck line, but have about $\frac{1}{8}$ in. camber in the whole length, as shown by the dotted line. The deepest portion of the sides is also a little nearer to the bow end of the boat than to the stern.

Having planed up the edges of the wood to the required shape, the triangular piece of wood shown in Fig. 4, forming the stem of the boat, should be made.

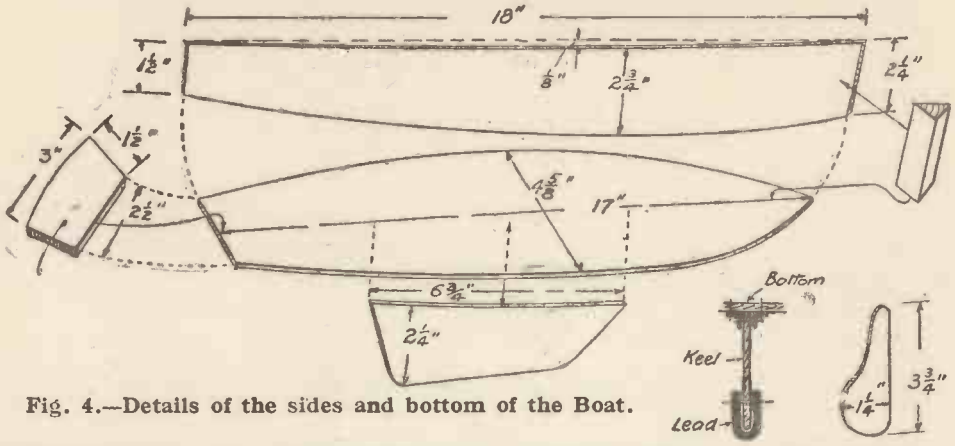


Fig. 4.—Details of the sides and bottom of the Boat.

The Transom.—The stern piece, or transom (Fig. 4), should be made of thicker stuff than the rest of the hull—say $\frac{5}{16}$ in. thickness wood of close grain—and be very slightly carved on the top line. The stern end of the sides will require planing at an angle so that they meet without a gap when fixed up to the stem piece.

Building Up.—When the stern joint is secured, a series of blocks, into which the bow of the boat may be forced, should be nailed down to the bench (or to a building-board on the bench), or drawing board. The bottom plank can then be panel-pinned to the sides, drawing the latter to the correct deck plan curve, and bending the bottom board down simultaneously, as the nailing-up proceeds. As soon as the building process reaches the stern end of the hull, the transom piece (Fig. 4) may be inserted, and, except for fixing the deck and the keel, the main part of the hull is completed. Another method would be to secure the sides to the stern transom, after the stern end is finished, by screws only. Then, by making temporary cross-pieces out of odd pieces of wood, the sides are bulged out to the required shape. This shape can be judged by trying the job, deck edge downwards, on to the bottom plank. The work then proceeds as already described. When the bottom plank is fixed, see Fig. 4, the transom can be temporarily removed to secure it by glue as well as the screws.

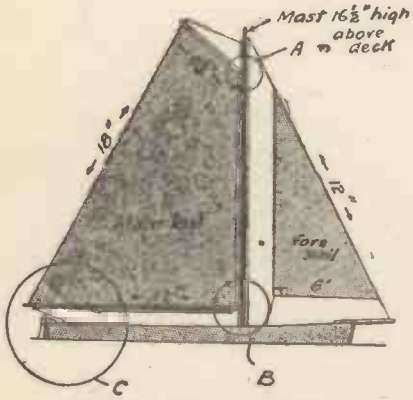


Fig. 5.—The Sail Plan.

Fixing the Deck.—The deck is fixed in the same way as the bottom, care being taken to obtain an even amount of coaming overhang. To ensure this, three or four small strips of ¼ in. by ¼ in. wood might be battened across the inside of the deck, their respective lengths being accurately measured and cut to just fit inside the side-pieces. These battens will strengthen the deck considerably, without adding much weight.

The Keel.—This should be accurately placed exactly over the centre line drawn on the bottom piece. If desired, the keel may be made of sheet metal and attached to the bottom by two $\frac{1}{4}$ in. by $\frac{1}{4}$ in. brass angles. Of course, such angles might be employed to fix a wooden keel, in which case this part may be fixed down after the deck is in place.

Painting the Hull.—When the hull is finished, the work may be sandpapered quite clean and smooth, and it will be ready for painting. The first coat should be a priming coat of red-lead paint, and when thoroughly dry this may be rubbed down with sandpaper, and two coats of the required colour applied.

Rudder and Mast.—The shape of the rudder (made out of $\frac{1}{8}$-in. wood) is shown in Fig. 4. All edges should be glass-papered to a rounded shape. It is attached to the hull by a small brass hinge. The hinge should be let in, to a slight extent, into the side of the rudder, so that the rudder will swing an equal amount in both directions. The tiller is made of brass wire pushed into a hole in the head of the rudder.

A round stick of $\frac{5}{16}$-in. dowel wood is required for the mast. This should be carefully tapered off from the deck line to the mast-head by planing or scraping, and then sandpapering to a finish. The bowsprit is made in a similar manner and screwed down to the deck at the stem end of the boat.

To fix the mast a hole should be drilled in the deck, and by means of a steel knitting-needle another hole, for a small wood screw, should be forced through the bottom board. This small screw should be driven up into the mast.

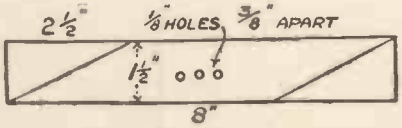
The Sails.—These should be cut out of as fine a calico material as can be obtained, the cutting-out sizes being indicated on the sail plan, Fig. 5. The mainsail has a wooden "boom" at the bottom and a "gaff" at the top to which it is fixed by a hem, as illustrated in Figs. 1, 2, and 3. The rigging is fixed to the boom and gaff, the latter being carried from the mast by a gaff jaw made of bent hard-drawn brass wire.

A SIMPLE FLYING TOY

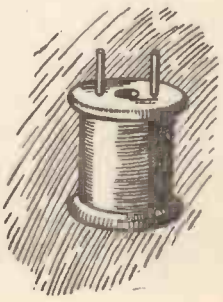
THE chief part of this toy is a strip of fairly stout tin, and this should be cut to the dimensions shown in the sketch. Three holes must be drilled in the positions shown, about $\frac{1}{8}$ in. diameter.

An empty cotton reel and a bradawl will now be required; also two wire nails 1 in. long; these latter are driven in the reel to the depth of $\frac{1}{2}$ in. The heads are removed. Before the toy can be worked, the corners of the strip have to be bent slightly.

The Toy ready for use.



A piece of tin should be cut to the above dimensions and bent according to the flight required.



Two nails with their heads filed off are driven in to a cotton reel as shown.

A Model Steam Engine and Boiler

A SPLENDID WORKING MODEL WHICH MAY BE MADE FROM CHEAP FITTINGS

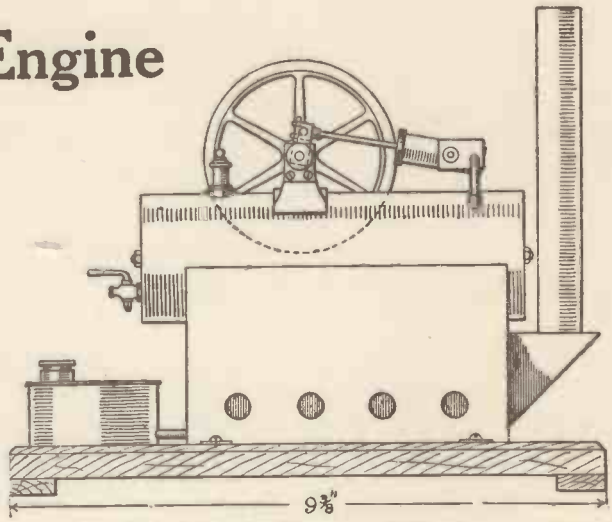


Fig. 1.—The Completed Engine.

THIS small steam plant is of very simple construction and will work at a high speed. No lathe is necessary, as the turned parts can be purchased at any model makers' supply stores. It will be noticed, by referring to Figs. 1 and 2, that the model is very compact, and only occupies a comparatively small amount of space. The engine, of the single-acting oscillating type, is mounted on top of the boiler, and this is supported by a firebox, which acts as a flame-guard for the spirit lamp.

To build the model as illustrated, the following raw material and fittings will be required :

(*a*) 6 in. length of 2 in. outside diameter brass tubing, No. 20 gauge (for boiler barrel).

(*b*) Piece of sheet brass, 5½ in. by 2¼ in. by $\frac{3}{32}$ in. thick (for boiler ends, crank webs, and bearing plates).

(*c*) 4 in. length of No. 19 gauge strip brass, $\frac{7}{8}$ in. wide (for saddle bracket).

(*d*) One single-acting oscillating cylinder, $\frac{3}{8}$ in. or $\frac{7}{16}$ in. bore by $\frac{3}{4}$ in. stroke, two test cocks, and a small spring safety valve.

(*e*) 2¼ in. of light brass tubing, $\frac{7}{16}$ in. diameter, for the wick tubes of lamp, and 6½ in. of ⅛ in. diameter brass tubing for the lamp supply pipe and steam-pipe.

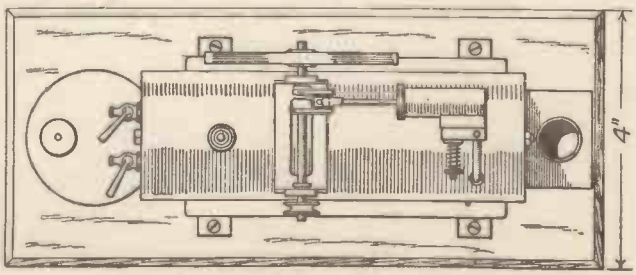


Fig. 2.—Top View of the Engine.

(*f*) One flywheel, $2\frac{3}{4}$ in. or 3 in. diameter, and about $\frac{3}{16}$ in. across the rim; and a small pulley wheel, $\frac{1}{2}$ in. diameter.
(*g*) $6\frac{1}{2}$ in. length of $\frac{1}{8}$ in. diameter brass rod (for the boiler stay).
(*h*) Piece of tinplate, $15\frac{1}{2}$ in. long and $3\frac{1}{8}$ in. wide (for firebox).
(*i*) 5 in. length of $\frac{5}{8}$ in. diameter thin brass tubing (for chimney).

The remaining two or three small pieces of metal required can, no doubt, be requisitioned from the scrap box.

Boiler Construction.—Having procured the necessary materials and fittings, the construction of the boiler can be proceeded with. It will no doubt be found that the ends of the piece of tube for the boiler barrel will require truing up. As you have to reckon without a lathe, careful filing will have to be resorted to. To act as a guide for filing, scribe a line as near one end of the tube as possible. A thin, stiff piece of cardboard with a straight edge, wrapped round the tube, will form a guide for the scriber, and will enable the line to be marked round sufficiently accurate for your purpose. After marking one line, measure off a distance of 6 in. and scribe another line. The two ends of the tube have now to be filed down to these lines. To test the squareness of the ends, apply a steel square at different positions round the tube while the filing is being proceeded with. After the boiler barrel is satisfactorily trued up, mark the position, and drill the hole to take the safety-valve bush, which can then be soldered in place. Now take the piece of $\frac{3}{32}$-in. sheet brass, and with a pair of dividers scribe on it two circles (for the boiler ends) of a diameter equal to that of the inside of the boiler. The two bearings and crank webs can also be marked out on the same piece of brass plate.

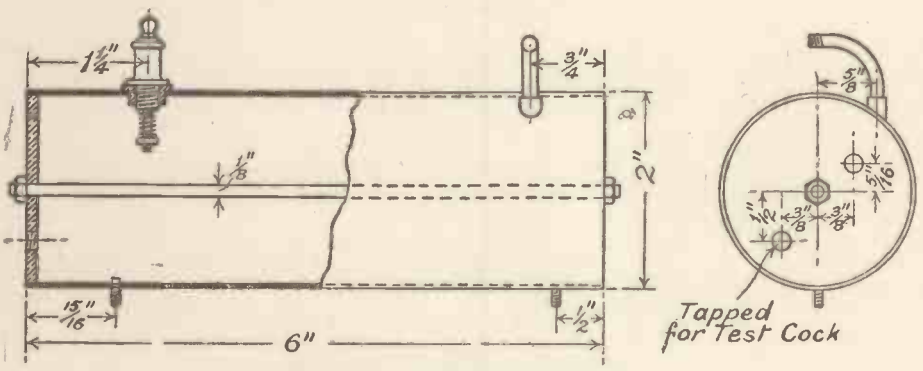


Fig. 3.—How the Boiler is made.

At least $\frac{1}{8}$ in. should be allowed between the marked-out parts, as the metal has to be sawn through with a hacksaw to separate the parts. The two centre holes for the stay may be drilled $\frac{1}{8}$ in. diameter, and the two holes in one end for the test cocks should be drilled and tapped out to suit the screwed ends of the latter. Now separate

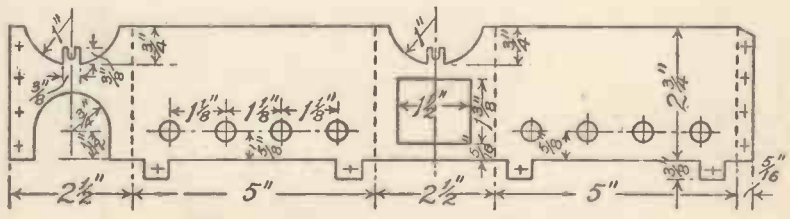


Fig. 4.—How to mark out the Firebox.

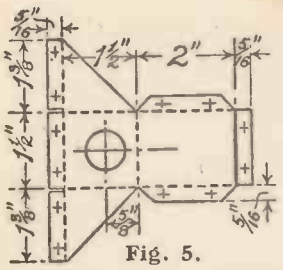


Fig. 5.

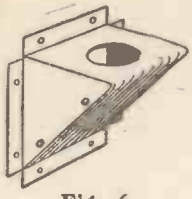


Fig. 6.

Figs. 5 and 6.—How to mark out and assemble the Chimney Support.

the two pieces as above mentioned, and with a hammer and cold chisel chip away the superfluous metal, taking care to keep on the outside of the scribed circular line. Now hold one disc in the vice and carefully file the periphery down to the line, leaving the edge as square as possible, so that the end is a tight fit in the boiler tube. Treat the other end in the same way, and then, with a piece of fine emery cloth, well clean the inside of the boiler at both ends and press the discs in place (see Fig. 3).

After the ends are pressed in place, about $\frac{1}{32}$ in. of the boiler tube should be left projecting so as to assist the solder to flow round the joint. When the ends are adjusted so that they are quite square with the boiler barrel, the soldering can be done and the joint well sweated. Having treated both ends satisfactorily in this way, the projecting edges of the boiler barrel can be carefully filed down flush with the face of the ends, as shown in Fig. 3.

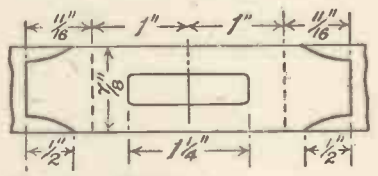


Fig. 7.—Showing Bearing-Bracket marked out and bent to shape.

The next thing to do is to fix the stay rod which runs through the centre of the boiler. Take the piece of ⅛-in. diameter brass rod, and after cutting a thread on each end a distance of ⅜ in., push the rod through the centre holes in the boiler ends and screw on two brass nuts so that they clamp the ends fairly tightly. The nuts can now be soldered to the boiler ends so as to make steam-tight joints. After removing any superfluous solder, file down the ends of the stays till they are nearly level with the faces of the nuts.

Firebox.—Take the piece of tinplate and carefully mark it out to the dimensions given in Fig. 4. Drill the ventilation holes, and cut away the other parts with a small cold chisel and hammer. Finish the edges down to the scribed lines with a file and then drill $\frac{1}{16}$-in. rivet holes along each end where indicated. In each bottom lug drill a ⅛-in. hole. Bend the firebox to shape on the dotted lines and then rivet the overlapping edges together with copper-wire rivets. The four fixing lugs at the bottom can be bent outwards and the two lugs at the top, where the boiler rests, are to be bent inwards. For the chimney support, cut out a blank from a piece of tinplate to the shape and sizes given in Fig. 5 and drill $\frac{1}{16}$-in. rivet holes at the points indicated. Bend to shape on the dotted lines, and rivet together with short pieces of copper wire. Push the chimney support in place from inside the firebox,

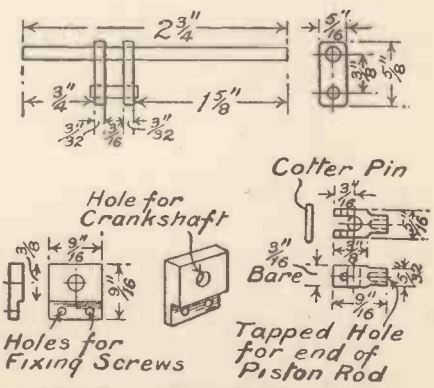


Fig. 8.—Details of Crankshaft, Bearings, and Piston Rod Head.

mark the position of the eight rivet holes in the firebox front, and rivet in position. The base of the chimney can be neatly soldered in the hole in the chimney support.

Bearing-Bracket.—This can be marked out on the piece of $\frac{7}{8}$-in. wide strip brass to the dimensions given in Fig. 7. After chipping away the four corners with hammer and chisel, file the curved parts to shape with a half-round file, and then drill and file out the rectangular hole in the middle. Now bend the bracket to shape so that it fits on the boiler shell nicely and the turned-up ends are quite parallel with each other. The bracket can now be soldered in position on top of the boiler after making sure that the turned-up ends are quite vertical when the boiler is placed in position on the firebox.

The Crank-shaft.—For this we shall require a piece of iron or steel rod $\frac{1}{8}$ in. diameter and $2\frac{3}{4}$ in. long, and a short piece $\frac{7}{16}$ in. long and $\frac{3}{32}$ in. diameter for the crank-pin. A piece of a straight French nail will answer very well for the latter. Now take the piece of metal on which the crank-webs have already been marked out, and separate these from the bearing-plates. File the webs down to the scribed line, leaving the edges as square as possible. One face of each can now be "tinned" by coating with a thin film of solder, after which they can be clamped together so that the edges register and held over a Bunsen burner or gas-ring till they become sweated together. Care should be taken to have the face of the web with the centre-punch marks on the outside. The holes for the shaft and crank-pin can now be drilled through squarely, one $\frac{1}{8}$ in. diameter, and the other $\frac{3}{32}$ in. diameter, after which hold the parts over the gas flame to separate. Having removed the solder and cleaned up both faces, slip the webs on to the shaft in the position indicated in Fig. 8, leaving a space of $\frac{3}{16}$ in. between them. Next press the crank-pin in place, and sweat the whole together, allowing the solder to run well into the four joints. The projecting ends of the crank-pin can be filed down flush, and the part of the shaft between the webs must be removed with a hacksaw, and the ends filed flush with the inside faces of the webs. This completes the crank-shaft, which may be cleaned up with fine emery cloth. If the flywheel is provided with a screwed hole in the boss, the end of the crank-shaft must be screwed for a distance of $\frac{3}{8}$ in., but if a plain hole is provided it can be fixed with a grub screw.

Fixing and Bearing-Plates.—The two bearing-plates can be cut out and filed to shape after drilling the two $\frac{1}{8}$-in. holes for the crank-shaft and four $\frac{3}{32}$-in. diameter holes for the fixing screws. Each plate has now to be filed down a distance of $\frac{3}{16}$ in. from the bottom, an amount equal to the thickness of the bearing-bracket, as shown in Fig. 8. After these parts are filed away hold one plate in position on the bearing-bracket, as shown in Fig. 2, and carefully mark on the latter the position of the two holes for the fixing screws. These can be $\frac{3}{32}$-in. round-headed screws, and the holes in the bracket can be drilled and tapped to receive them, the bearing-plate being then screwed in position. Before fixing the other plate the crank-shaft must be slipped in position in the bearings after putting on two small brass washers (see Fig. 2). See that the shaft is maintained in an easy running position before marking out the holes for the fixing screws in the second plate. Having screwed both plates in position the sides of

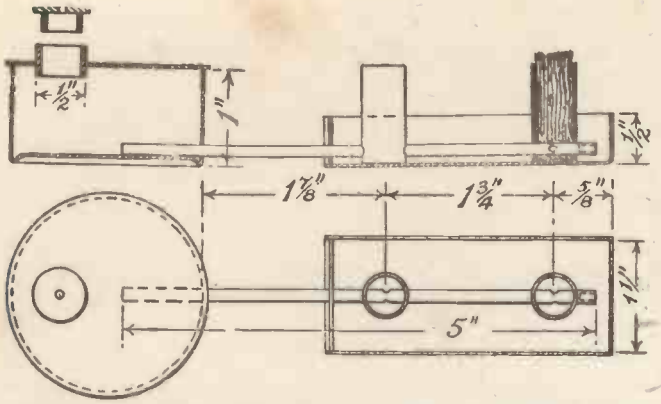


Fig. 9.—Sectional Elevation and Plan of Spirit Lamp.

these, together with the edges of the bracket, can be neatly filed flush as indicated in Fig. 1.

Cylinder and Steam-Pipe.—The latter consists of a 1¼ in. length of brass tubing screwed at each end, and bent as shown in Fig. 3. One end is arranged to screw into a socket soldered into the boiler barrel in the position indicated in the drawings. This socket can be made from a piece of $\frac{3}{16}$-in. diameter brass tubing, $\frac{3}{8}$ in. long, tapped with a thread to suit one end of the steam-pipe. On the other end of the pipe the steam-block is arranged to be screwed, as shown. The working face of this block must be quite vertical, and must be in such a position that when the cylinder is in place the piston rod is in line with the centre of the crank. The position of the block can be adjusted in this respect by giving it a turn one way or the other on the end of the steam-pipe. When the necessary adjustments are made the steam-pipe can be neatly soldered to the socket. The piston-rod head, shown in Fig. 8, can be fashioned out of a small piece of stick brass, the slot to take the crank-pin being first drilled and then cut out with a hacksaw and finished with a small file. The hole for the cotter pin, which is simply a $\frac{3}{4}$ in. length of No. 16 gauge hard brass wire, must be drilled so that when the pin is in position the crank-pin is free to turn freely without any shake or rattle. A new piston rod will no doubt have to be fitted, as the one supplied with the cylinder may be too short. This is easily made from a piece of steel rod of the required diameter, and should have a thread cut on each end for screwing into the piston and piston-rod head.

Baseboard.—For the baseboard a piece of deal $\frac{1}{2}$ in. thick can be used, measuring $9\frac{3}{8}$ in. by 4 in., chamfered along the top edges as indicated in Figs. 1 and 2. Two strips, $\frac{3}{4}$ in. by $\frac{1}{4}$ in., can be nailed on underneath to act as feet, running the whole width of the board.

Before screwing down the firebox, the boiler must be clamped in position. For this purpose two short pins should be screwed and soldered into the bottom of the boiler in the positions indicated in Fig. 3. These pins engage with the slotted lugs in the top curved parts of the firebox, a nut is then slipped on each pin and tightened up, so holding the boiler firmly in position.

The Spirit Lamp.—The construction of the spirit lamp is clearly shown in Fig. 9. The reservoir, it will be noticed, is circular in shape, and can be made from a cocoa or other round tin cut down to the required height. The top consists of a circular piece of tinplate in which the hole for the filler is drilled, the latter being a short piece of brass tubing soldered in. This top part should not be soldered on till the rest of the lamp is completed. To make the cap, a short piece of tubing is required which slips easily into the filler tube, a circular piece of

brass being soldered on, and a vent hole $\frac{1}{16}$ in. diameter drilled in the middle. The wick tubes may be cut off a little over an inch long, and the ends squared up. A $\frac{1}{8}$-in. diameter hole has now to be drilled through each piece of tubing so that the edge of the hole comes within just $\frac{1}{16}$ in. of the bottom of the tube. Now take the brass tube for the supply pipe, and at the points indicated make nicks on each side of the tube with a small round file. The holes so made should be about $\frac{1}{16}$ in. in diameter, and must be arranged sideways of the pipe when the latter is in position in the wick tubes. Having slipped these on the pipe, see that the little nicks come about the middle of them, and then solder in position. Two discs of brass or tinplate will now be required, which have to be soldered into the bottoms of the tubes. At the same time stop the end of the pipe up with a plug of brass wire and solder in place.

With regard to the drip tray, the bottom and three sides can be formed of one piece of tinplate cut out as shown in Fig. 10, and bent to shape. The end is a separate piece, a hole being drilled to take the supply pipe, which can be slipped through and soldered in place, after adjusting the wick tubes to the proper position. Now drill an $\frac{1}{8}$-in. hole near the bottom of the reservoir, so that when the supply pipe is pushed through the wick tubes are in line with the filler. Solder the joint where the pipe passes through, and also on the inside of the reservoir where it touches the bottom. This being done, the top of the reservoir can be soldered in place. The best material to use for the wicks is what is known as asbestos yarn. Purchase a yard of this about the thickness of ordinary string and cut off two lengths sufficient to fill the wick tubes, allowing about $\frac{1}{8}$ in. to project so as to give a good flame.

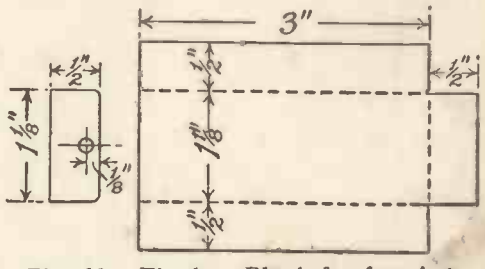


Fig. 10.—Tinplate Blank for forming Drip Tray of Lamp.

In conclusion, keep the flames of the lamp well under control when running the engine, and do not let them get too high. It is also important that the level of the water in the boiler should not be allowed to get below the bottom test cock while the lamp is burning.

A BOOMERANG

YOU require a piece of hard wood, such as oak or teak, about 2 ft. 6 in. in length, and 1½ in. wide. The thickness should be ½ in. One side should be left flat and the other rounded, as shown in Fig. 1—the greatest thickness of this curved part to be $\frac{4}{10}$ in.—and by steaming the wood, carefully bend to an angle of 120 degrees (see Fig. 2).

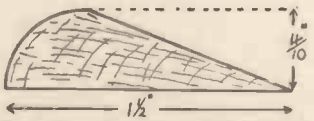


Fig. 1.—One side of the wood should be rounded, and the other tapered off as shown.

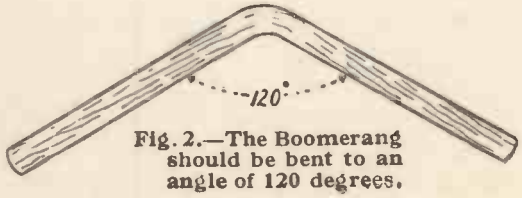


Fig. 2.—The Boomerang should be bent to an angle of 120 degrees.

Launch the boomerang into the air, holding one tip in the hand, with the curved face upwards, giving it a spinning motion.

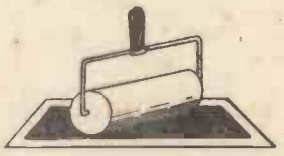
How to use a Jelly Hectograph.

HOW TO MAKE A JELLY HECTOGRAPH

A useful and interesting device for copying written matter

A HECTOGRAPH provides a simple and ready means of producing club and school magazines, circulars, and similar announcements when only a few copies are required. A good jelly hectograph is capable of producing two hundred fair copies from one original. To make a suitable solution, soak in cold water 2 oz. of pale gelatine glue, and stir it until it has the appearance of a thick jelly. Then place it in a piece of fine muslin and squeeze away any surplus water that has not been taken up by the glue. Next, put the jelly in a thick earthenware vessel with ½ pint of glycerine. Place it in an oven and let it simmer, stirring it at intervals to prevent it caking on the bottom of the vessel. After thoroughly mixing it in this way, add a few drops of oil of cloves to preserve the preparation.

Making Copies of Written Matter.—Now obtain a cheap metal tray about 12 in. square with sides about 1 in. high. Pour the solution into this and place it aside to cool. It takes four hours to set, and it is then ready to receive the copy matter which must be written with the special ink described later. Before using the hectograph, rub the surface of the pad with a damp sponge, then place the written matter gently on the pad face downwards. The paper should be gently rubbed and allowed to remain for a few minutes. On removing the paper a perfect impression of the written matter will be found on the pad. By simply placing a blank sheet of paper on the pad and lightly drawing the hand over the back, upon pulling the paper off there will be found an exact facsimile of the original copy. When sufficient impressions have been taken from the pad, the surface should be washed with a sponge until the ink has disappeared. The pad should then be re-melted over a slow fire.



An ordinary Photographic Roller will enable you to get a good impression on the Paper.

Hectograph Ink.—The ink for use in connection with the hectograph is made from ¼ oz. of aniline black, 2 oz. methylated spirit, 2 oz. water, and 4 oz. glycerine. These are heated until the aniline black is properly dissolved. Colour inks may be made simply by varying the colour of the aniline dye.

Hectograph ink, by the way, can be purchased from the stationers in a variety of colours. By using these it is possible to make multi-coloured impressions. Another hectograph may be made by using ordinary putty. This will tend to harden, but it may be rendered usable again by moistening it with linseed oil.

A SIMPLE ELECTRIC MOTOR

Easily made and ideal for driving small models

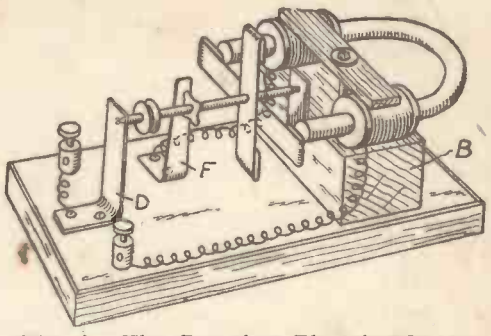
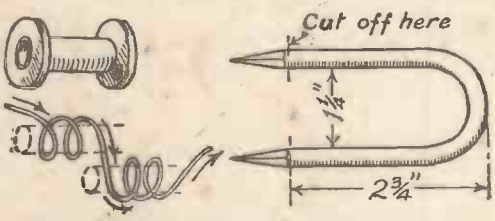


Fig. 1.—The Complete Electric Motor.

THIS little motor, made of extremely simple materials, will work very satisfactorily if the various parts are carefully put together. It consists of an electro-magnet, at the ends of which an armature, in the form of a cross, is caused to rotate. By means of a contact-breaker on the armature shaft, the circuit is broken at the right moments, so that the armature revolves continuously and at a rapid rate while connected to the battery. It will drive your models, too.

The Electro-Magnet.—First of all obtain a stout iron staple such as can be purchased from an ironmonger's shop for about twopence. Get one about 3¼ in. long and 1¼ in. wide, so that when the points are cut off with a hacksaw the magnet will have the dimensions given in Fig. 3. The ends of the magnet must be filed smooth and square.

You will notice, on referring to Fig. 1, that the magnet has two coils of wire, one on each limb. The wire is wound on bobbins, which are made by wrapping a strip of thin brown paper, 1 in. wide, round each magnet limb and sticking the edges down with glue so as to form two paper tubes. Now make four washers of stiff cardboard or thin fretwood, and glue one of these on to each end of the tubes. One of the finished bobbins is shown in Fig. 2, which also indicates the direction of winding.



Figs. 2 and 3.—The Magnet and Coils.

Winding the Coils.—After the glue has set, proceed to wind the magnet coils, using No. 26-gauge double cotton-covered copper wire. About 6 yds. of wire will be required for each coil. Wind on the wire as closely and evenly as possible, and when half the wire has been wound on one bobbin, tie a piece of strong thread round the last two turns to keep the wire from unwinding. Now cross the wire over and wind in the reverse direction on the other bobbin. Leave about 8 in. of free wire at each end for connecting-up purposes. You will see by Fig. 2 how the wire is crossed over from one coil to the other. Make sure of this.

Armature and Spindle.—The armature can be made next, and for this cut two strips of thick tinplate (A, Fig. 4) and round the ends with a file. In the

middle of each strip drill a small hole, bend over the ends, and pinch together with pliers.

Now prepare the armature spindle, which may conveniently consist of a 2-in. length of ordinary steel knitting-needle with the ends filed conical, as shown in Fig. 1. Press the armature arms on to the spindle at ½ in. from one end and at right angles to each other. Adjust them carefully at right angles to the spindle and solder them in position.

The little contact-breaker E can be filed to shape from a piece of sheet brass ⅜ in. square, a hole being drilled in the centre a tight fit to the spindle. Round the corners carefully with a fine file, and then press the contact-breaker on the spindle about ¼ in. from the back of the armature, firmly soldering it into place.

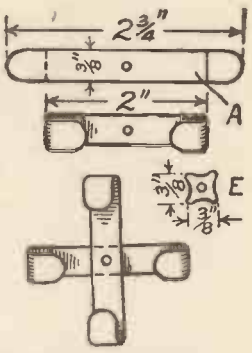


Fig. 4.—How to make the Armature.

Baseboard and Bearing-Plates.—At this stage it will be as well to prepare the baseboard. Plane a piece of wood 5 in. long by 2¾ in. wide and ⅜ in. thick, and bevel the top edge all round. A rectangular block of wood B can also be made for supporting the magnet. This block, which is 2 in. long by 1¼ in. by ⅞ in., can be fixed by two screws driven in from underneath the baseboard.

From a strip of thin sheet brass, ⅜ in. wide and 3¼ in. long, cut off a piece 1 in. long. In this piece drill two holes, as shown at C, Fig. 5, and near the top edge make a deep centre-punch mark. One end of the other brass strip D can be bent at right angles on the dotted line after the two holes are drilled in the lower part, as indicated. A deep centre-punch mark should also be made near the top end of this plate on the opposite side to that on which the bent foot projects (see Fig. 1).

Assembling the Parts.—Having got so far, we can now begin to assemble the other parts of the motor. Clamp the electro-magnet firmly in place on top of the block B by means of a thin strip of wood and a stout screw, allowing about ½ in. of the ends of the magnet to project beyond the face of the block B.

The two bearing-plates C and D can be screwed in position and adjusted so that the spindle runs quite freely and is parallel to the baseboard. When the spindle is revolving, the bent-over parts of the armature should clear the ends of the magnet by a bare $\frac{1}{16}$ in., and the magnet can be finally adjusted to bring this right by slightly turning the holding-down screw.

We shall now require a strip of very thin, springy brass about ⅜ in. wide and 2 in. long for the contact-brush F which should be cut to a slight taper, as in Fig. 1. Bend the bottom part at right angles, drill the two small holes, and then screw it down to the baseboard opposite the little contact-breaker, so that it presses lightly against the rounded corners of the latter when it revolves. Take care to see that the corners are quite smooth and that they all make contact with the brass brush.

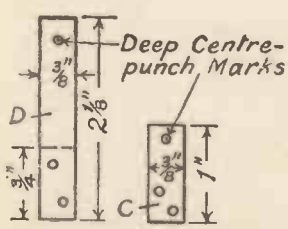


Fig. 5.—The Bearing Supports.

Making the Connections.—After screwing two terminals in the baseboard, we connect up the wire from the magnet coils. The end of the wire from one coil is clamped

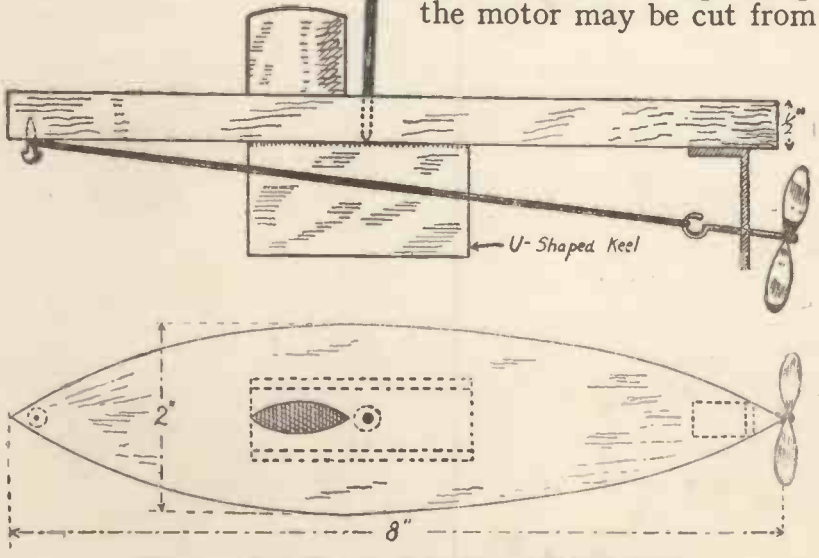
down under the head of one of the screws which fix the brush to the baseboard ; while the end of the wire from the other coil is screwed down under one of the terminals, as shown in Fig. 1. The other terminal is connected to one of the fixing screws of the bearing bracket D.

The little motor is now ready for connecting up to a battery, and this may consist of two small bichromate cells. After giving the armature a turn to start it, it should revolve at a rapid rate, if the contact-breaker is carefully adjusted so that it is just breaking contact with the brush when either of the two arms are directly opposite the ends of the magnet.

When the correct position is found, fix the contact-breaker with a touch of solder. If required, a small pulley-wheel can be fixed on the shaft for working a light toy model by means of a driving band of thin string or cotton.

A SIMPLE DIVING SUBMARINE

THE hull is made of any wood about ½ in. thick, cut to the shape shown, noting that it is symmetrical both ways. A piece of sheet steel, as thick as possible, is obtained, about 2 in. by 3 in., and bent into a U-shape, this being fastened about half-way down the centre line to form the keel. A bracket is now made for the propeller shaft from sheet brass or iron, and a screw provided at the nose for the rubber motor. The propeller is made from sheet tin and soldered to its shaft. A small bush is made from tin to take the thrust. A conning-tower can be made from wood or cork, and a large nail will serve as a periscope. The rubber used for the motor may be cut from an old cycle tube. The model will have to be weighted until it just floats, and this can be done by putting washers over the "periscope." When wound up in the usual way, and placed in the water, the model will first run on the surface for a second or two, and then dive realistically until the power has run out, this being due to the slope of the propeller lifting the stern.



Side and Top Views of the Model Submarine.

MAKING A JAPANESE ONE-STRING FIDDLE

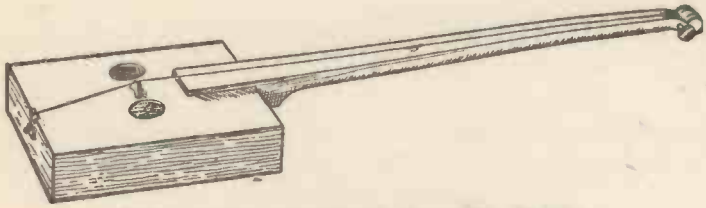


Fig. 1.—The completed Japanese Fiddle.

YOU CAN MAKE IT FROM A CIGAR-BOX IN AN EVENING!

FOR the body of the fiddle you will need a cedar cigar-box, measuring approximately 8½ in. by 4⅞ in. by 2¼ in. Tear off as much as possible of the paper decoration and binding, and take the box to pieces carefully. Clean off the remainder of the paper, inside and outside, with glass-paper. On no account should the wood be damped to help this, or the pieces are sure to warp.

Making the Body.—Before you begin to work on the body you will find that the bottom of the box will eventually be the "belly" or upper surface of the fiddle, and the lid will be the back or bottom. With a sharp centre-bit or a fret-saw cut two holes, 1 in. wide and 1½ in. apart, in the belly. Then in one of the end pieces cut a square hole measuring ½ in. by ½ in. and ¾ in. from the upper edge. In the other piece cut a hole ½ in. by ⅜ in. and ⅞ in. from the edge, as shown at Figs. 1 and 2. The fingerboard is next made, as follows, from a straight-grained

Fig. 2.—How the Holes are cut in the Ends of the Cigar-box.

Figs. 3 and 4.—Top and Side Views of the Fingerboard.

piece of wood planed to 2 ft. 5 in. by 1⅞ in. by 1¼ in. Any wood will serve, but a hardwood such as mahogany, walnut, or oak will be best.

The Fingerboard of the Fiddle.—Two views of the fingerboard are shown at Figs. 3 and 4, with an enlarged detail at Fig. 5. Set out the fingerboard as described below and shown in the diagrams. Mark one of the narrow sides as the "face-side" (the upper surface), and one wide side as the "face-edge." Across the face-side, 6¾ in. from the end, make a clean saw-cut $\frac{3}{16}$ in. deep. Now gauge a line $\frac{3}{16}$ in. from the face-side but 8¾ in. long, and another below it and 1⅜ in. from the face-side. With a fine handsaw cut

Fig. 5.—Enlarged View of the Fingerboard.

along these lines and then remove the wood between them. Turn the fingerboard face-side downwards and, gauging two lines $\frac{3}{8}$ in. from each edge and $8\frac{1}{2}$ in. long, saw along them and cut away the outside pieces. The remaining portion is the rod, which passes through the cigar-box, and where it passes through the far end of the box it needs stepping back $\frac{1}{4}$ in. to make a shoulder on two sides. The hole to receive it has been cut to $\frac{1}{2}$ in. by $\frac{3}{8}$ in. The upper portion of the fingerboard (Fig. 5) needs to be tapered, and this is marked out as follows :

From a point $9\frac{3}{4}$ in. from the lower end of the fingerboard, plane the sides of the wood equally, so that it tapers to $\frac{3}{4}$ in. at the top.

Making the Under-side.—The under-side should be cut away, as shown in Fig. 5, so that the fingerboard is $\frac{3}{4}$ in. square at the end. Now mark out and cut the tenon, the centre-piece at the top, which measures $\frac{3}{8}$ in. wide and $1\frac{1}{2}$ in. long. For the cheeks of the scroll, the part which takes the peg, take two pieces of $\frac{3}{16}$-in. fretwood $4\frac{1}{2}$ in. by $1\frac{1}{2}$ in.

These two pieces are now glued and screwed to the sides of the tenon, and a small piece of wood $\frac{3}{8}$ in. thick is sandwiched between them to fill up the space. This should be glued in and pressure applied, so that it sets quite solid. Now bore a hole $\frac{1}{4}$ in. in diameter through the cheeks for the string peg. It is probably best to buy a violin peg from a music-dealer's. When all is ready for assembling, fit the box end with the larger hole on to the centre-post, gluing it in position. A couple of fine screws should be put through it into the shoulders of the fingerboard. Fit the other end in the same way, and then fasten on the sides, top, and bottom in that order.

Tuning the Fiddle.—The string (a violin " E ") is looped over a small round-head screw which is inserted in the projecting end of the post and, passing over the bridge placed midway between the holes in the belly, is then taken through the hole in the peg. The bridge is easily cut from a piece of $\frac{3}{16}$-in. fretwood. It should be about 1 in. wide at the base and $\frac{1}{4}$ in. at the top. The height should be such that the string stands $\frac{1}{8}$ in. above the surface of the fingerboard. Tune the string to middle C on the piano. The situation of the other notes can be found by placing the finger in position, plucking the string to ascertain the correct note, and marking the point in pencil. These places can be marked permanently by making shallow saw-cuts across the fingerboard and filling in with strips of banding inlay or plastic wood. A good plan is to stain the fingerboard black before making the saw-cuts, and then the inlaid bands will show up clearly. When the fiddle has been cleaned up and smoothed with glass-paper, give it a coat of glue-size and, when this has dried, give two coats of best copal varnish. To prevent the string cutting into the wood, a small piece of tin or brass should be bent and inserted under the string on the edge of the box.

The instructions given in this section relate to a very simple type of one-stringed fiddle. In later pages we explain how to make a more elaborate musical instrument of this sort. It is possible after a little practice to obtain quite tuneful results from these instruments. It is important to draw the bow across the string at right-angles to it, to keep the bow well resined, and to mellow the notes by means of the " close shake " ; this consists of pressing the index finger of the left-hand on the finger board and waggling the other fingers in the air.

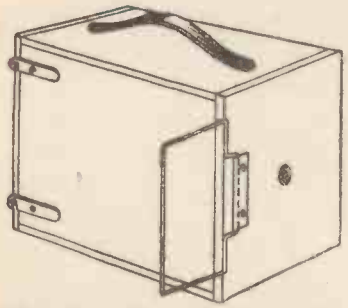


Fig. 1. — Showing how the View-Finder is attached.

AN EASILY MADE SNAPSHOT CAMERA

It takes standard plates and excellent photographs

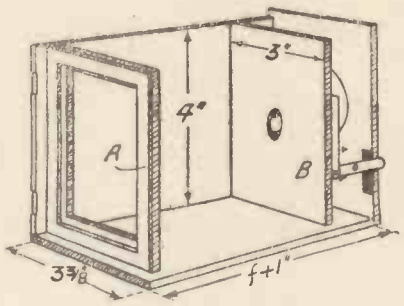


Fig. 2.—Details for fixing the Lens Board.

THE efficient little camera shown at Fig. 1 takes plates 3½ in. by 2½ in., and is quite simple to make. First obtain a small magnifying-glass and measure its focus. If you hold it in front of a white card so as to get a sharp image, the distance between lens and card is its focus.

In Fig. 2 the length is given as "$f+1$ in." This means the focus of your lens plus 1 in. Thus, if your lens focus measures 4 in., make your camera body 5 in. long, and so on. For the body (and elsewhere, except otherwise specified) use $\frac{3}{16}$ in. fretwood, and in fitting it together take great care that the joints are light-tight. Use glue and very small nails, drilling holes first to prevent the wood splitting.

To make the plate carrier A (Fig. 2), cut a piece of wood 3 in. by 4 in. and in this cut an opening 2¼ in. by 3¼ in. Cut a second piece from $\frac{1}{16}$ in. wood to the same size, and in it make an opening a shade larger than 2½ in. by 3½ in. Glue the two pieces together, thus forming a frame with a rebate into which a plate fits neatly. Glue it in the camera body $\frac{3}{16}$ in. from the end (see Fig. 2).

Fixing the Lens.—Next make the lens board B (Fig. 2). A hole is cut in the centre into which the lens fits tightly, being secured by a touch of glue. To find its exact position in the camera, make a temporary focusing screen by gumming a piece of thin white paper in the rebate in the plate carrier; then, having glued the edges of the lens board, push it into the camera until the image on the screen is sharply focused.

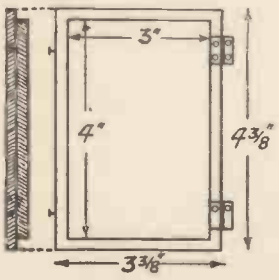


Fig. 3.—The Back of the Camera.

The back is shown at Fig. 3, and consists of two pieces glued together and covered on the inside with black velvet. Attach it to the camera by two small hinges.

The Shutter.—The front and shutter are shown complete at Fig. 4. A ⅜ in. hole is cut in the centre around which is glued a ring of velvet, as shown by the dotted lines. The shutter parts are shown at Fig. 3. Cut the disc A from tin. Drill a small hole in the centre, and below it cut an opening ⅜ in. in diameter. Slightly to the right of the centre drill another small hole. Cut the strip B from

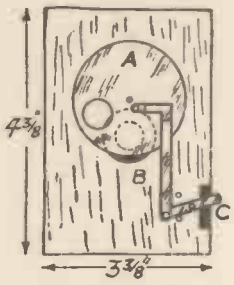


Fig. 4.—Method of fixing the Shutter.

sheet brass, drill the two ends, and then rivet the upper end loosely to the second hole made in disc A. For a rivet use a small nail nipped off close below the head. Lastly, make the lever C from stout brass, drill it as shown, and rivet it to the end of strip B (see Fig. 4).

Pass a small nail through the centre of disc A, put on a small washer, then nail it to the camera front so that the openings in the disc and front correspond. Glue a strip of velvet under lever C, to act as a light-trap, then attach it with a screw through the centre hole. It will be seen that, upon depressing the end of lever C, strip B moves up and causes disc A to rotate, and thus make the exposure. Two small nails limit the movement of lever C.

The whole interior of the camera should now be given a coat of dead black, which may be purchased from any photographic dealer. Then attach the front, making a slight, velvet-lined recess in the side of the camera to clear the shutter lever.

Two small brass catches D (Fig. 5) engage with two nails in the edge of the camera back. The view-finder is a wire rectangle $3\frac{1}{2}$ in. by $2\frac{1}{2}$ in. Bend a piece of brass around it and attach it to the camera by two small screws (see Fig. 1). A leather handle cut from a strap and secured to the top by two screws completes the camera (see Fig. 6).

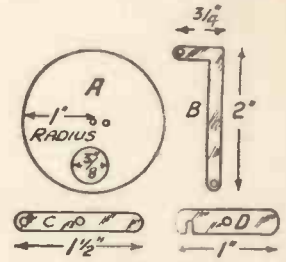


Fig. 5.—The various Fittings.

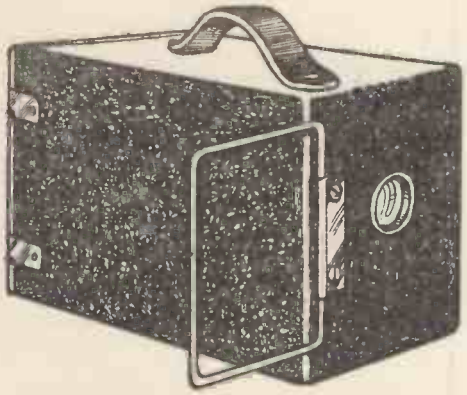


Fig. 6.—The finished Snapshot Camera.

shutter. This may take the form of a flat piece of wood screwed near the lens so that it may slide over the aperture, completely covering it.

Another and simpler shutter can be made out of a cardboard pill box, in the bottom of which a large hole should be cut. Next glue the box over the tinfoil.

Pinhole Cameras (Fig. 6 shows the completed camera).—An even simpler camera than the one described is that known as a Pinhole Camera. In its simplest form such a camera consists of a light-proof box with a very small pinhole at one end (see Fig. 7). A ready-made box for your pinhole camera consists of a cigar-box. In one of the end pieces bore a hole about $\frac{1}{2}$ in. in diameter; on the inner side glue a small piece of tinfoil which will entirely cover the hole. With the finest needle obtainable pierce a hole in the exact centre of the tinfoil strip; this hole constitutes the lens. The next operation is the construction of the

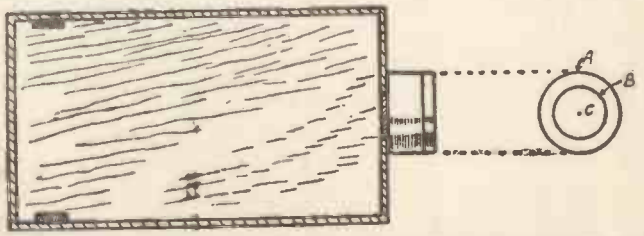


Fig. 7.—A sectional view of the Camera. A is the rim of a pill-box; B, tin-foil lens; and C, small pin-hole.

A QUICKLY MADE SHADOW SHOW

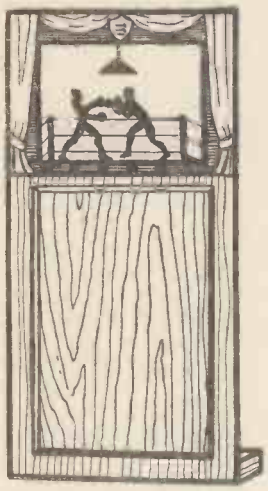


Fig. 1.—The Finished Show.

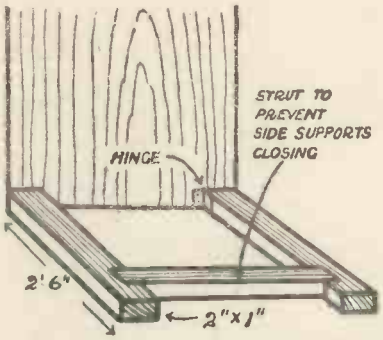


Fig. 2.—The Supports for the Front.

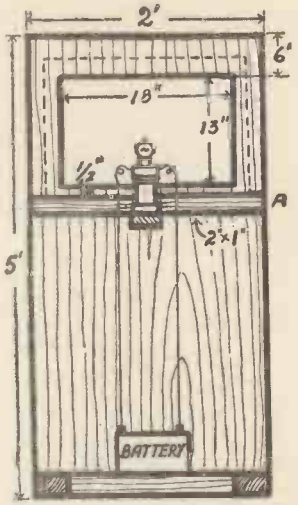


Fig. 3. — The Measurements for cutting the Stage Opening.

THE novel and amusing shadow show shown in Fig. 1 will prove very popular at parties, etc. It is quite simple to make, and no doubt the reader will be able to think out one or two short plays with which to entertain his friends. To commence the construction, obtain a piece of three-ply wood 5 ft. by 2 ft., and two pieces of wood 2 ft. 6 in. by 2 in. by 1 in. to support the front. The supports are fastened to the front by means of two 1-in. hinges, so that they can be pressed inwards (not outwards). To prevent the supports from slipping while the show is in progress, fix a strut of wood between them as shown in Fig. 2. When fixing the strips make sure that the front does not topple forward.

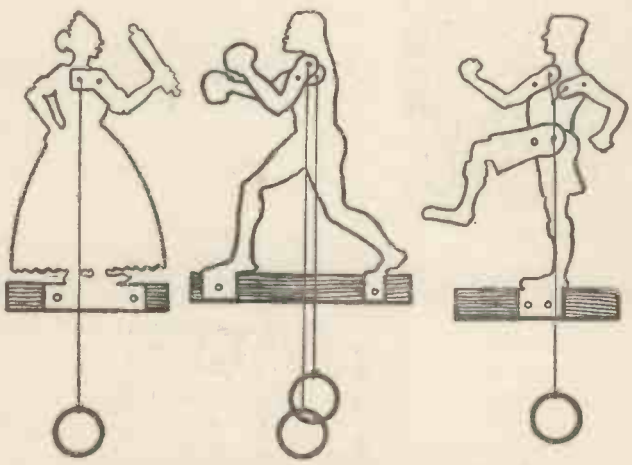


Fig. 4.—Details for making the Figures.

The Stage Opening. — An opening 18 in. by 13 in. is now cut for the stage front, about 6 in. from the top (see Fig. 3), and a piece of damp grease paper, 22 in. by 17 in., is glued over it. It will be found that when the paper dries, it will stretch, giving the paper screen a smooth surface. A strip of wood (A, Fig. 3), 2 ft. by 2 in. by 1 in., is now fixed ½ in. below the opening level. This, of course, is fixed at the back.

The Figures.—The model is now complete, and should be given a coat of paint—brown, red, or blue preferably. If desired, a curtain can be fitted in the opening. The characters can be made to move by means of wires with rings attached. The fingers are inserted in the rings, and are moved about at the discretion of the operator. The figures are made as shown in Fig. 4. They should be attached to ½-inch blocks, which fix in the stage ½ in. below the opening level (Figs. 3 and 5).

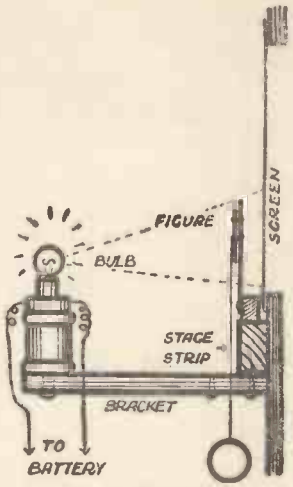


Fig. 5. —The Lighting Arrangement.

The Lighting Effect.—The method of fixing the electric bulb is shown in Figs. 3 and 5. Place the battery at the base of the model (Fig. 3), and connect the bulb to it. Never have a row of lights. You may think it will make the screen brighter, but you will find it produces several shadows to each figure. The words "Shadow Royal" can be painted on the front of the theatre if so desired. The "camera" when fitted up, is moved about behind the screen, with a sheet of tracing paper held on the glass plate. When the shadow image on the screen is in focus, you have found the correct position for working. The room should, of course, be partially or, better, entirely darkened. It is an advantage also to arrange a curtain around the screen, so that no direct rays fall on the operator, and the "camera" is hidden from the public.


Fig. 6. —A Finished Shadowette.

HOW TO MAKE SHADOWETTES

THE silhouette pictures of our great-grandparents are now highly prized, even more than photographs. The art of making them is a very old and difficult one. The silhouettist snipped out the side-view portrait from black paper with a pair of scissors, and unless you are particularly gifted with your fingers, you are not likely to be able to produce good results. The "shadowette" system described here will enable you to make perfect silhouettes, and even to make a great deal of money for your next bazaar. The principle is a very simple one, and most hobbyists will find all the requirements lying about their workshop.

How Shadowettes are made.—The "victim" sits in a chair so that his shadow may be thrown upon a ground-glass or paper screen (Fig. 8). He must be so arranged that he sits as close to the screen as possible, in order to obtain a sharp edge to the shadow. He will not have to sit still very long, because a shadowette outline can be made in ten seconds, and a very small movement on his part will not matter. It will be found that a sharp shadow will be thrown by a strong light when the light is at a great distance; but as this is not usually practicable, a "magic-lantern"

or spotlight may be used. A good source of illumination is a 100-watt electric lamp, with a small filament, at a distance of 10 ft. from the "sitter." A condenser lens will concentrate the light. Or, on the other hand, an electric cycle or motor-car lamp, with a parabolic reflector, will project a suitable beam.

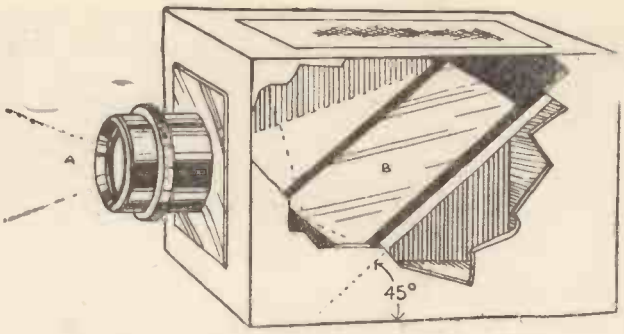


Fig. 7.—The Recording Apparatus.

The Recording Apparatus.—And now for the "recording" apparatus. You will require a camera lens of from 4 to 7 in. in focal length, a plane mirror about 4 in. square, a piece of glass about 6 in.square, and when you have made several experiments with these objects, a box of the right size. We cannot lay down any exact dimensions for this box, because a great deal depends upon the focal length of your lens. This may easily be found by focusing some distant object, such as a window in the room, upon a sheet of paper. The distance from the centre of the lens to the paper is the approximate focal length (see Fig. 7).

The Lens.—The lens is mounted on the front of the box, as shown in the diagram. Most lenses have a mount which may be screwed in position over an aperture in the box: but failing a mount, the lens may be clipped in position by a couple of brass or steel strips. The mirror is arranged in the box at an angle of 45 degrees to the lens, and this is important—the dimensions of the box must be such that the distance from the centre of the mirror to the mid-point of the lens is approximately equal to the focal length of the lens. The glass plate is let into the top of the box, or, if you wish, the whole top of the box may be of glass, the plate being simply glued in position. It is essential that the glass be larger than your tracing paper, so that a good working surface is obtained when making the drawing.

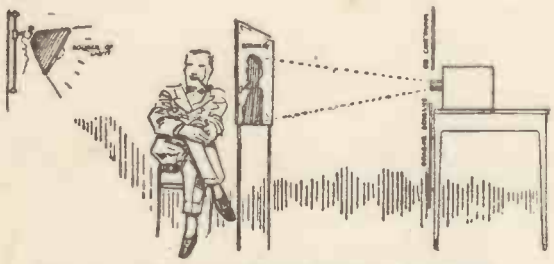
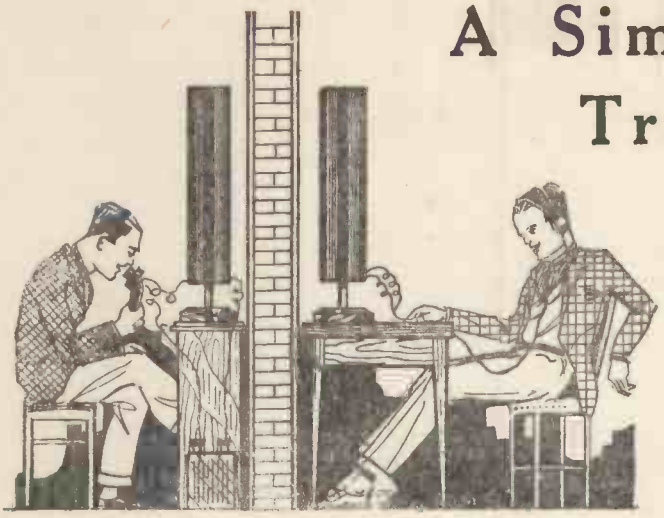


Fig. 8.—How the Shadowettes are made.

The Finished Silhouette.—When the subject is sitting in the required position before the screen, the operator quickly but carefully traces the outline of his features on the tracing paper with a sharp pencil. With practice a few seconds will suffice. The pencil outline is then inked over and filled in with a brush and Indian ink. The silhouette picture may be mounted on card or in a white paper folder. If you are working at a bazaar, then time means money, and it is better to organise the work so that one operator makes the pencil outline, another goes over it in ink, and a third fills it in.

By the way, in selecting the tracing paper, obtain that sort which has the greatest degree of transparency. If you use tracing cloth, remember there are two sorts—blue and white. Use blue if possible, because this is more transparent.

A Simple Wireless Transmitter



BY MEANS OF THIS SIMPLE PIECE OF APPARATUS YOU WILL BE ABLE TO TRANSMIT AND RECEIVE MESSAGES OVER SHORT DISTANCES

THE apparatus about to be described might be called a wireless telephone. As in wireless, there is no connection between transmitter and receiver, but unlike radio it is much simpler to construct. The range is, of course, limited, but it will give clear, undistorted speech over short distances.

The principle is that of induction. A current is sent round a coil of wire, wound round a frame. This produces a magnetic field round the wire. Now if a microphone is introduced in this circuit, and you speak into it, the current rises and falls according to your speech. This in turn causes a fluctuation in the magnetic field. By bringing another coil of wire near the first, that is, within the fluctuating magnetic field, currents similar to those passing round the first coil are set up in this second one. Since the first currents are varying according to your speech, it only requires a pair of headphones connected to the second to hear that speech. (See Fig. 1.)

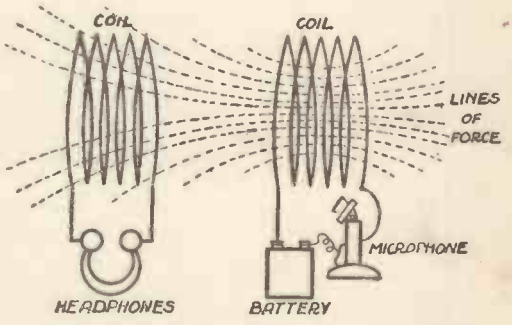


Fig. 1.—The Principle on which the Telephone works.

In constructing the telephone, all that is needed is a pair of ordinary wireless headphones, a microphone button, an accumulator, a few yards of insulated wire, and some wood to make the two frame aerials.

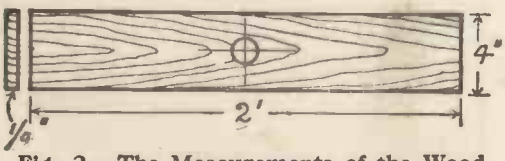


Fig. 2.—The Measurements of the Wood for the Frame Aerial.

The Frame Aerials. — These latter should be constructed first. They are each composed of four strips of wood, 2 ft. by 4 in. by $\frac{1}{4}$ in. One of these strips must have

a hole bored in the centre, making a push-fit for a piece of broom-handle or dowelling (Fig. 2). The four strips are now assembled as in Fig. 3 the corners being glued, bradded, and blocked. The whole frame is supported by a length of small-gauge broom-handle, which passes up through the hole in the bottom, and is screwed in position at the top. (See Fig. 4.) It is 2 ft. 3 in. long, and fitted with a wooden base. This latter is $1\frac{1}{4}$ in. thick and 6 in. square, with a hole in the centre to take the broom-handle. The handle should be a push-fit in the hole, or may be glued in position. In drilling the hole, make sure that it is dead upright, or the frame will not stand level. A better appearance is obtained by chamfering the top edges of the base.

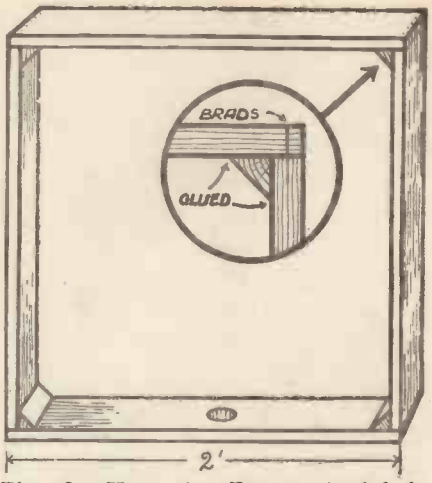


Fig. 3.—How the Frame Aerial is assembled. Inset gives details of the Corner Joints.

The next job is to wind the coils. The number of turns of wire depends largely on the resistance of your headphones and the microphone, and also on the voltage of the battery. If a pair of wireless headphones of the usual 2000 ohms resistance are to be used, then about 200 turns of 28 gauge enamelled copper wire should be wound on the receiver aerial as in Fig. 4. Although it is not necessary to wind the wire evenly from the point of view of efficiency, it looks better if the job is done neatly, rather than having one turn jumbled over the other. The ends of the coil should be bared, and connected to two 'phone terminals.

The Transmitting Aerial.—This is wound in a similar manner but with thicker wire, say 22 gauge, enamelled or D.C.C. wire. The actual number of turns will depend on the resistance of your microphone button and voltage of the battery. With a 4-volt accumulator, 30 turns might be used to start with, whereas with a 6-volt accumulator, as many as 50 or 60 turns will probably give the greatest range. It is not advisable to pass too much current through the microphone, otherwise "arcing" will occur between the carbon particles, with the result that the speech will come through mingled with crackling noises like atmospherics. If this happens, cut down the voltage, or better still, wind some more turns on the transmitting aerial, which will increase the range.

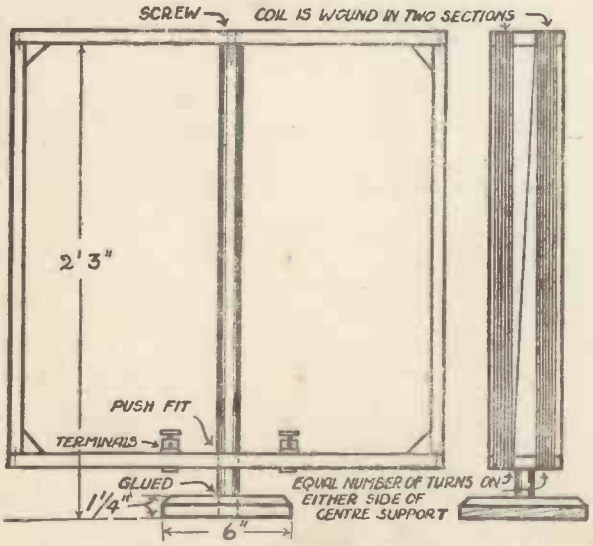


Fig. 4.—The whole Frame is supported by a length of Small-gauge Broom-handle.

Remember, that the greater the number of turns carrying a STRONG modulated current, the more powerful will be your transmitter; therefore it

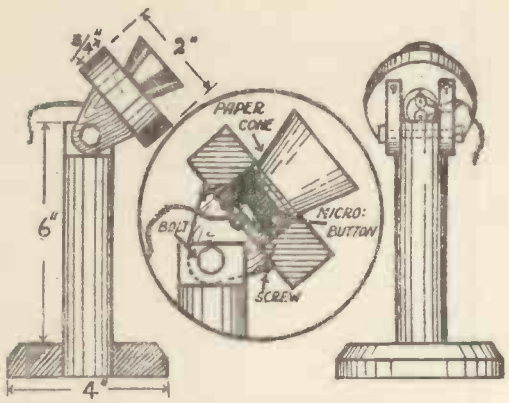


Fig. 5.—The Stand for the Microphone.

is useless to use a large number of turns with a low voltage, since the resistance of the coil will cut down the current.

When the frames are complete, the telephone is ready for use, but before it is tried out it is best to make some kind of stand for the microphone. A suggested design is shown in Fig. 5.

Testing the Apparatus.—Now for the initial test. Start with the frames facing one another, about 6 ft. apart. Connect the microphone and battery in series with the transmitting frame. Connect the 'phones to the receiver. Now speak into the " mike," getting a friend to put on the receiving 'phones. Every word should come through clearly at this distance. Then try moving the receiver further away. Of course, the greatest fun can be had by putting the transmitter and receiver in adjoining rooms. Speech will pass right through an ordinary wall. If you have a friend living next door, get him to put the transmitter against the wall in his house, and get the receiver exactly opposite in your house. He will then be able to speak to you through the wall.

Various interesting experiments will suggest themselves, such as trying two-way communication by fixing a battery, microphone, and headphones in series with each frame, or transmitting morse by substituting a buzzer and tapping key for the microphone as in Fig. 6. You might test the resistance offered by various types of wall. A wooden partition, for instance, will be found to absorb scarcely any of the radiation, whereas an iron fence will cut off communication completely.

NOTE.—As the strength of the signals in the receiver is entirely dependent on the power radiated from the transmitter, some form of amplifier is a great asset. Those readers possessing valve sets will be able to fix up a very effective one, simply by connecting one end of the receiving aerial to the grid of the detector valve of their set, the other end being joined to the earth terminal. No other alteration to the set is necessary, and no interference is caused to other sets in the neighbourhood.

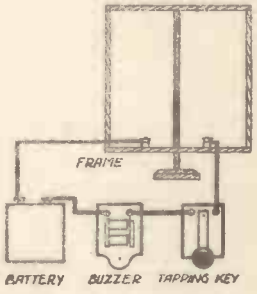


Fig. 6.—Substituting a Buzzer and Tapping Key for the Microphone.

It is not suggested that this apparatus is capable of transmitting over long distances, nor can it be considered as a wireless transmitter properly so described. It is claimed, however, that it will efficiently transmit over fairly short distances. The more efficiently it is made the greater will be the distance through which one can transmit. With it it is possible to carry out quite a number of interesting experiments, as well as to indulge in instructive amusement. Readers will find in a 1s. handbook (obtainable for 1s. 2d. by post from the publishers of this Annual), entitled "Simple Electrical Apparatus," a description of quite a number of pieces of electrical apparatus as simple and as effective as this induction transmitter.

MODELS WORKED BY SAND

Simple Models made from Cardboard and Cigar Boxes which work for over a quarter of an hour

The Grindstone.

The Acrobats.

The Water-Mill.

THESE easily constructed toys afford much interest and amusement to both young and old. The most popular model is that in which an acrobat performs upon a trapeze, but there is scope for ingenuity in devising other models, two of which are shown above, namely, the water-mill and the man at the grindstone.

The mechanism is very simple, as will be seen from Fig. 1. A neatly fashioned box of thin wood is the first essential. It may measure 12 in. by 9 in., with a depth of 2½ in.

A sheet of glass will be required to close in the front. This may be secured at the edges with passe-partout strip. When finished, the whole thing must be sand-tight.

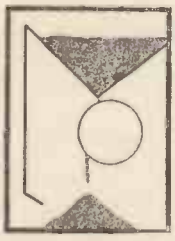


Fig. 1.—The Sand Reservoir.

Fig. 2.—A Sectional View of the Box for holding the Sand.

Fig. 2 shows the box in sectional view. A narrow fillet is run round the inside at about the middle of its depth to carry the sheet of stout card on which the background is painted, and in which the forward primal of the wheel works.

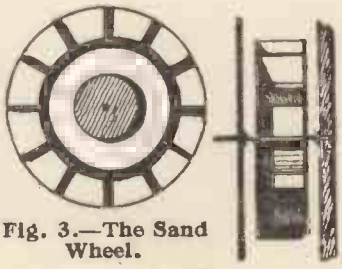


Fig. 3.—The Sand Wheel.

The Sand Reservoir.—Referring to Fig. 1, it will be seen that the sand reservoir is made from a strip of cardboard, and that this strip is continued downwards

to make the channel through which the reservoir is refilled when empty, by turning the box round anti-clockwise. This piece of card must have a width exactly equal to that of the space between the back of the box and the cardboard background, so that when the latter is glued in place a glue joint may be made also between it and the reservoir.

A small hole must be made in the centre of the angle that forms the bottom of the reservoir, to allow of a fine stream of sand falling upon the wheel.

After piercing, the hole should be made clean with a hot wire, or it may have fitted in it a short length of small brass tube.

The Sand Wheel.—Fig. 3 shows how the wheel is constructed from cardboard. The left-hand view is as it would appear with one face removed. In the centre is a wooden disc to afford a good fixing for the wire shaft.

The right-hand view shows the bearings and the collars on the shaft to prevent lateral movement. A small brass plate is let into the wooden back, drilled to take the end of the shaft.

A small amount of lateral play may be allowed to guard against jamming.

As to the figures, these should be copied on to stout Bristol-board, and cut out neatly. They may then be coloured to taste.

The Figures.—The acrobat (Fig. 4) should consist of five pieces—the trunk and four limbs. The joints are made with sewing cotton knotted on each side. As the hands have to be separated, a short tube should be made by rolling pasted paper around a piece of the same wire as that used for the shaft. This tube may be $\frac{3}{8}$ in. long. After the figure has been jointed, insert the tube between the hands, pass a wire through hands and tube, glue the ends of the tube, and force all together. When dry the wire may be removed. When mounted on its shaft there will be sufficient friction to hold the figure securely to it.

Fig. 4.—The Acrobat.

For the stationary figure the same outline may be used, but reversed, rearranging the arms and legs. When drawn as it has to appear, the figure may be cut out in one piece. It should be fixed with small wooden blocks so as to stand about midway between the background and the glass.

A round notch (see A, Fig. 4) should be cut in the instep of one foot of the movable figure. This hitches on to the trapeze from time to time and varies the figure's evolutions.

Fig. 5.—How to make the Man who turns the Grindstone.

The man (Fig. 5) also should consist of five separate pieces—the trunk, the right arm, the left arm in two pieces, and the two legs in one piece, the joint being at the hips.

The right hand connects with the crank of the grindstone, and the left hand is fixed at a point where a tool would be held.

In this case the shaft must be long enough to admit of its fore-end being bent to form the grindstone crank-handle.

The man's feet may have a strip of ground attached, as shown in the half-tone illustration.

The running of the sand-wheel must be tested, in all cases, before the background is glued in place, as, unless quite free, it may jam with a grain of sand.

The Water-Wheel and Grindstone.—The water-wheel, which, it should be noted, is undershot, and the grindstone, b th must rotate clockwise, so that in arranging the internal mechanism the sand-wheel must be set more to the left than shown on p. 82, to allow the stream of sand to impinge on its right-hand side.

Build up the water-wheel from cardboard with floats complete, and set forward that part of the foreground that comes in front of it, to allow the necessary space for the wheel.

Before closing in, fill the reservoir with clean silver sand that has been passed through fine wire gauze or muslin to exclude all large particles.

If the outside of the box be covered with cloth, the material may be brought forward at the front and turned over to secure the glass.

MAKING A PERISCOPE

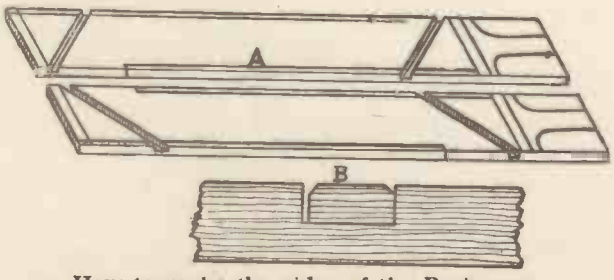
FIRST obtain two mirrors measuring 3 in. square. Next prepare two sides of planed wood 22 in. by $2\frac{3}{4}$ in. by $\frac{3}{8}$ in., and two pieces for the ends, $2\frac{3}{4}$ in. by $2\frac{5}{8}$ in. by $\frac{1}{2}$ in. Two thin pieces are required for the back and front, and these measure $15\frac{1}{8}$ in. by $3\frac{1}{2}$ in.

The two sides require to be grooved to take the mirrors, and these are shown in the sketch A. Mark the two pieces "in pair," so that the grooves slope in the same direction on the opposite pieces.

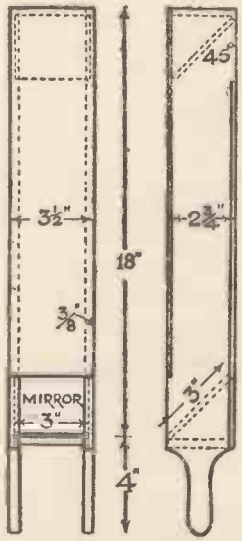
The best method of cutting the grooves is shown in the enlarged detail at B. Mark the lines in pencil exactly the same distance apart as the glass is thick, and then cut the lines in with the point of a knife. With a chisel make a shallow cut to meet the knife cut, and so form a trench. Mark the depth of the groove on both edges, and saw down to the line as shown at the left side. Repeat the saw cut at the right, and then the wood between the saw cuts is easily removed.

Next shape the lower ends of the side pieces to form the handles. Cut back the edges of the side pieces to receive the front and back pieces. To assemble the periscope, nail or screw one of the side pieces to the end pieces, and fix the mirrors in position. The other side piece is now placed in position and fastened to the end pieces with nails or fine screws.

The finished Periscope.



How to make the sides of the Periscope.



This diagram shows how to assemble the various Parts.

A SMALL GARDEN WINDMILL

The Sails spin round and the Vane indicates the direction of the wind

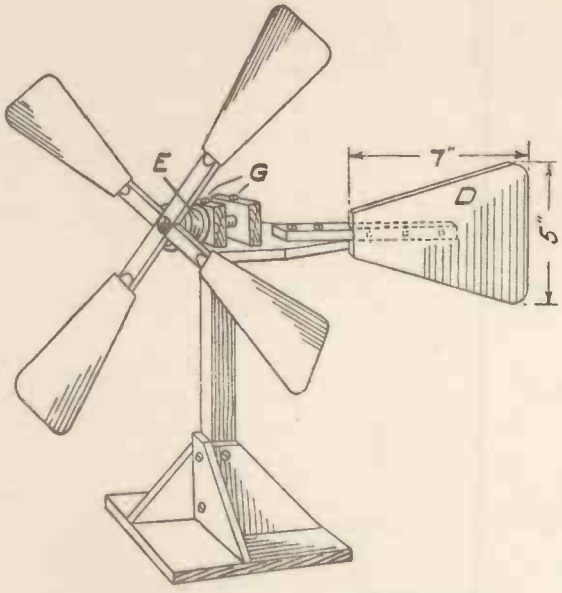


Fig. 1.—A View of the finished Garden Windmill.

THE making of this simple windmill will provide several half-hours of interesting work, and when finished it can be mounted on top of a summer-house or other suitable place in the garden.

For the arms which carry the sails, take two 12-in. lengths of $\frac{1}{2}$ in. by $\frac{3}{8}$ in. stripwood, and with a chisel pare away one edge at each end, as shown at AA (Fig. 2). The bottom edge is removed on the left, and the top edge on the right of each arm. At the back of one arm, in the centre, cut a slot $\frac{1}{2}$ in. wide by $\frac{3}{16}$ in. deep. Make a similar slot in the other arm from the front, as at B.

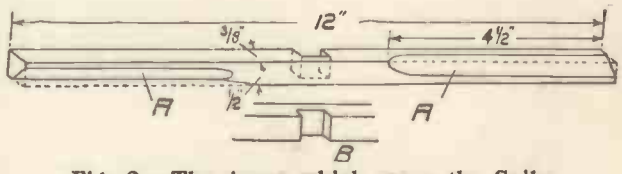


Fig. 2.—The Arms which carry the Sails.

The Sails.—To make the sails, cut out with a fretsaw four pieces of thin wood to the sizes given at C (Fig. 3), and round off the two corners at the wide end. Pieces of $\frac{1}{8}$-in. fretwood can be used for the sails and the tail-piece, D. Each sail is fixed to a bevelled part of an arm by three brass screws. The arms can now be pressed together at the centre joint and then screwed to the end of a cotton reel, which forms the hub, E (Fig. 4). The hole in the reel is continued through the centre of the arms to take a thick wooden knitting-needle, about $\frac{1}{4}$ in. diameter. This forms the windmill shaft on which the hub revolves.

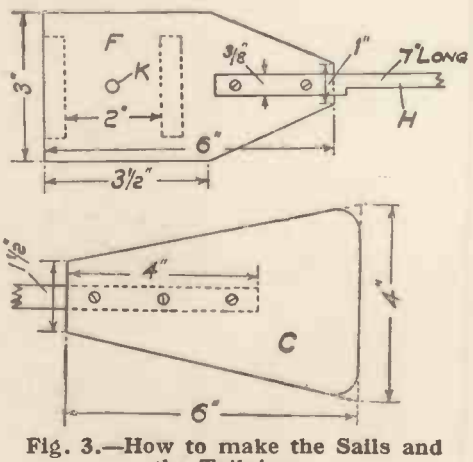


Fig. 3.—How to make the Sails and the Tailpiece.

The Base-Piece.—Cut the base-piece, F (Fig. 3), out of wood $\frac{1}{4}$ in. thick, and screw

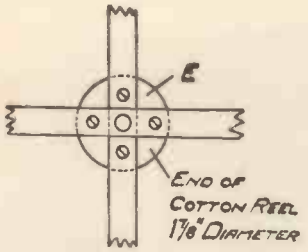


Fig. 4.—A Cotton Reel is used, as shown here, to form the Hub.

on to this from underneath two pieces of ½-inch wood 2 in. wide and 1½ in. high, in the positions indicated by the dotted lines. Make a hole through the middle of each piece of wood to take the shaft, which is held firmly in place by two screws, G (Fig. 1). The wooden head of the knitting-needle keeps the arms and the hub from slipping off the shaft.

The tail-rod, H, is a 7-in. length of ⅜-in. stripwood, cut away for part of its length to take the tail-piece, D, which is cut to the shape and dimensions given in Fig. 1, and then fixed in place by three countersunk screws. The other end of the tail-rod is fixed to the base with two screws.

Mounting.—To mount the windmill ready for working, make a hole, K (Fig. 3), in the base-piece to take a stout round-headed screw, which can be driven into the top of a long post in the garden, after slipping on a large washer under the head of the screw. This screw, which forms the pivot, must be driven just sufficient to allow the base of the windmill to turn easily. Another way is to use a short post about 12 in. long, supported by wooden angle-pieces on a baseboard, as shown in Fig. 1. The baseboard can then be fixed in place on the top of a shed or outhouse.

A NOVEL PENCIL-BOX

HERE is a little pencil-box fashioned after the mystic castle of the fairy-tale book. Three pieces of wood only are required to make the box, and they should be cut to the outline shown in Fig. 1. One piece, ¼ in. thick, will form the bottom, and to this will be glued a ½ in. piece, which will have its centre cut away to form a recess for the pencils and pens. A small recess will also be formed at the top, wherein may be kept indiarubber or nibs. The lid is cut from a piece of ¼ in. stuff, and is fastened to the box by means of a round-headed brass screw as shown. The simple design must be drawn on the wood and coloured up and lined in in black. To secure a close fit between the lid and box, and to prevent the former working loose with constant use, a thin felt washer is placed under the head of the screw, and when necessary this may be tightened.

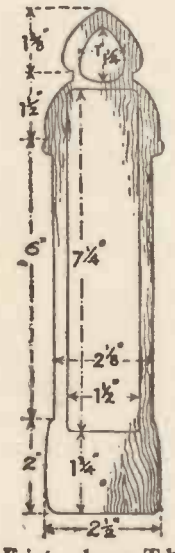


Fig. 1. — The measurements of the Pencil-Box.

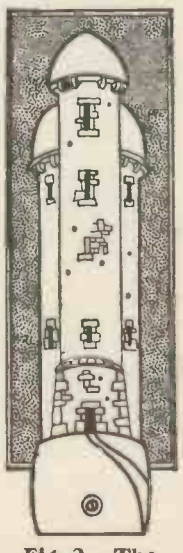


Fig. 2.—The finished Pencil-Box.

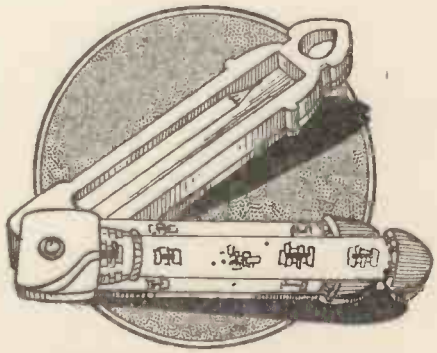


Fig. 3.—How the Pencil-Box opens.

Two Novel Money-Boxes

THE "BEGGING DOG" AND THE "COTTAGE"

HERE are two novelties for the nursery which will help young folk to save their pennies. As may be seen by the sketches, the "Begging Dog" and the little "Cottage" money-boxes are quite simple to make from odd pieces of wood.

The "Begging Dog" Box.—Commence by cutting the floor, a plain rectangular piece measuring $3\frac{1}{2}$ in. long by 2 in. wide, $\frac{1}{4}$ in. thick. In the centre of this will be cut a slot $1\frac{1}{2}$ in. long, 1 in. wide, $\frac{3}{8}$ in. from the front and back edges. (Fig. 2 shows this clearly, and the back and one end in place.) The slot is for extracting the money; the piece cut out should be replaced, and a piece of stout brown paper pasted over the whole underside of floor to keep it in place. When one wishes to empty the box, just sever the paper with a penknife and the centrepiece will come away.

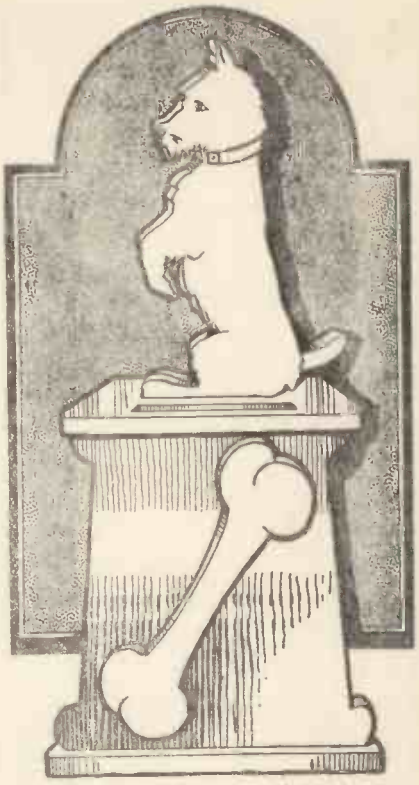


Fig. 1.—The "Begging Dog" Money-box.

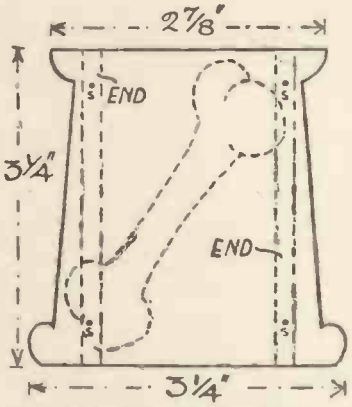


Fig. 3.—The Front of the Money-box.

Fig. 2.—Details of the Floor.

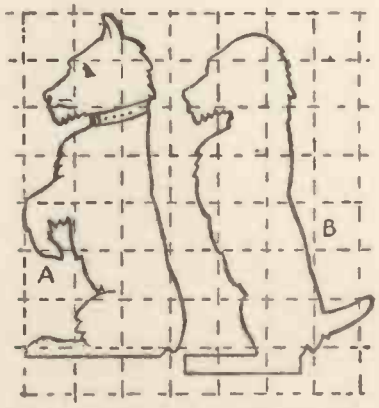


Fig. 4.—How to draw and cut out the Dog.

The Front and Back.—Next the front and back are cut, exactly alike, to the shape and dimensions shown in Fig. 3, $\frac{3}{16}$ in. thick. The dotted lines show the position to screw the ends and the bone overlay, which is to be glued on the front.

The two ends are just plain pieces, measuring $3\frac{1}{4}$ in. high by $1\frac{1}{4}$ in. wide, $\frac{3}{16}$ in. thick. Having cut all the parts mentioned, screw the two ends to the front and back, and the whole to the floor.

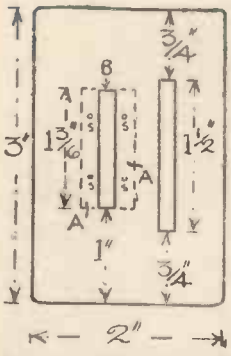


Fig. 5.—The Top of the Box, showing the Position of the Dog and Money Slot.

The parts for the dog will need to be enlarged from the ones shown in Fig. 4. Mark out the ½-inch squares as shown, and carefully draw the portions shown in each square. You will require two pieces cut to the shape of A for the outside, and one of B for the centre; these parts will all be $\frac{3}{16}$ in. thick. Glue the centre part to the outside parts; the tenon on the centre of the dog is for fixing it to the top. Cut the top as shown in Fig. 5; the slot B is $1\frac{3}{16}$ in. long, $\frac{3}{16}$ in. wide, 1 in. from each end, and ¾ in. from the back edge. The measurements for the slot for the money are shown quite clearly. Glue the tenon on the dog into the mortise B; the dotted lines show the position of the parts A, and indicate where screws should be placed. Finally screw the top on to the box. The box would look very attractive if stained dark brown and polished. The bone overlay is to be drawn as shown in Fig. 6, and cut in $\frac{3}{16}$ in. thick wood, and painted white, making a good contrast with the dark box. Glue the bone to the front of the box in the position indicated.

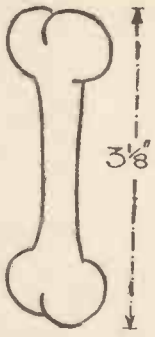


Fig. 6.—The Bone for the Begging Dog.

List of Wood required for the "Dog" Money-box.—Floor, one piece required, $3\frac{1}{2}$ in. long by 2 in. wide, ¼ in. thick. Top, one piece required, 3 in. long by 2 in. wide, $\frac{3}{16}$ in. thick. Front, one piece required, $3\frac{1}{4}$ in. high by $3\frac{1}{4}$ in. wide, $\frac{3}{16}$ in. thick. Back, one piece required, $3\frac{1}{4}$ in. high by $3\frac{1}{4}$ in. wide, $\frac{3}{16}$ in. thick. Dog, three pieces required, $3\frac{3}{4}$ in. high by 2 in. wide, $\frac{3}{16}$ in. thick. Bone, one piece required, $3\frac{1}{8}$ in. high by $1\frac{1}{4}$ in. wide, $\frac{1}{16}$ in. thick.

"The Cottage" Money-Box.—"The Cottage" money-box is also very simple to make. Commence with the base, $4\frac{1}{2}$ in. long by $2\frac{1}{4}$ in. wide, ¼ in. thick, as in Fig. 7; the dotted lines show the position to screw the back, front, and ends. Cut the two ends as shown, also the back; these parts are $\frac{3}{16}$ in. thick. The top edge of the back must be chamfered to the same slope as the ends, to take the roof; also a door for extracting the pennies, cut ½ in. from the bottom edge, ¾ in. from each side, and 3 in. high, hinged as shown, and a small lock fitted as indicated, cutting a hole for the key in the position required. A slot for the pennies is cut ½ in. from the top edge 1 in. from each side, $\frac{3}{16}$ in. wide and 2 in. long. The front of the cottage is shown quite clearly in Fig. 8, is $\frac{3}{16}$ in. thick, also having the top edge chamfered the same slope as the ends. Mark out the windows and doors as shown, ready for painting later. Having cut all the parts mentioned, screw the ends to the front and the base. The roof is just a plain piece

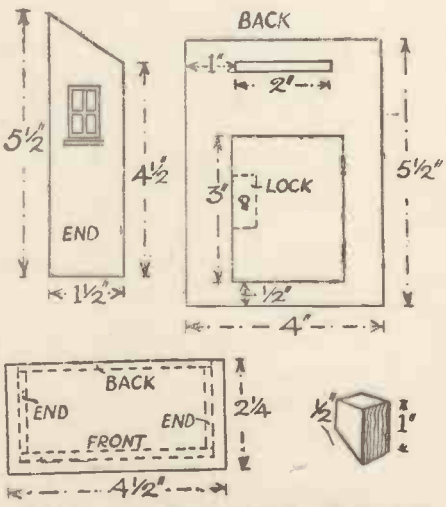


Fig. 7.—The Base of "the Cottage" Money-box.

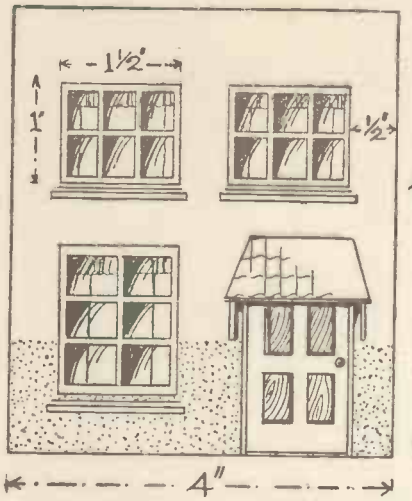


Fig. 8.—The Front of the Cottage.

measuring 4½ in. long by 3 in. wide, $\frac{3}{16}$ in. thick; screw this to the front, back, and ends. The chimney is a piece of ¾ in. by ¾ in. stripwood, cut to the shape and dimensions shown in Fig. 7, with a piece of 1 in. wood, ⅛ in. thick, glued on the top to form the capping. Screw the chimney to the roof, and the cottage is complete.

Suggested Colouring.—We suggest colouring as follows: Roof and porch, red; house, cream; windows and dotted portion, brown; doors, brown with cream panels. The effect of glass in the windows may be obtained by first painting them white and flashing with blue. A green shrub could be painted on the end of the cottage, which would add greatly to the effect.

List of Wood required for "The Cottage" Money-Box.—Base, one piece 4½ in. long by 2¼ in. wide, ¼ in. thick. Front, one piece 4½ in. high by 4 in. wide, $\frac{3}{16}$ in. thick. Back, one piece 5½ in. high by 4 in. wide, $\frac{3}{16}$ in. thick. Ends, two pieces 5½ in. high by 1½ in. wide, $\frac{3}{16}$ in. thick. Roof, one piece 4½ in. long by 3 in. wide, $\frac{3}{16}$ in. thick. Chimney, one piece ¾ in. by ¾ in. stripwood, 1 in. long. Capping to chimney, one piece 1 in. by 1 in., ⅛ in. thick.

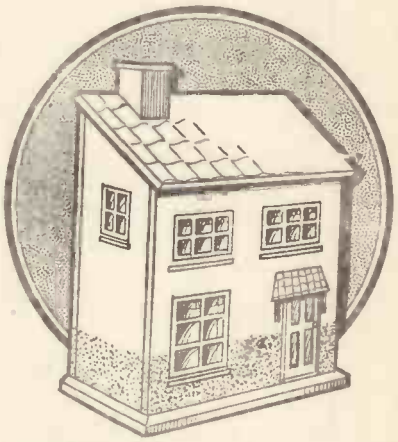
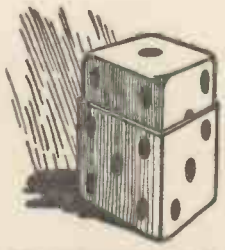


Fig. 9.—The Cottage Money-box.

THE HAT AND DICE TRICK

TO perform this trick you require a prepared dice and box. The dice is composed of a real dice and a false shell, which fits over it. When the box is placed over the shell and gripped tightly, the shell will remain fixed inside the box, and when it is lifted it will appear empty. By carefully studying the illustration you will perhaps get a better idea of how the dice works. If you cannot make them, the dice and box can be bought at your local conjuring store for a few pence. Borrow a bowler hat from a friend, remove the cover of the dice, and place the true and false dice into the hat. Now tell your friends you will remove the dice, but in reality you only take out the false dice, leaving the true one in the hat. Now place a book or board over the hat, and place the false dice upon it. You then tell your friends you will command the dice to pass through the cover into the hat. To do this, place the box over the false dice and grip tightly, lift the box, and show them that the dice has apparently vanished. Now turn the hat upside down and allow the real dice to fall out.


The Dice and Shell.

AN EXCELLENT SHOCKING COIL

An amusing electrical instrument which any amateur can make. It is quite harmless

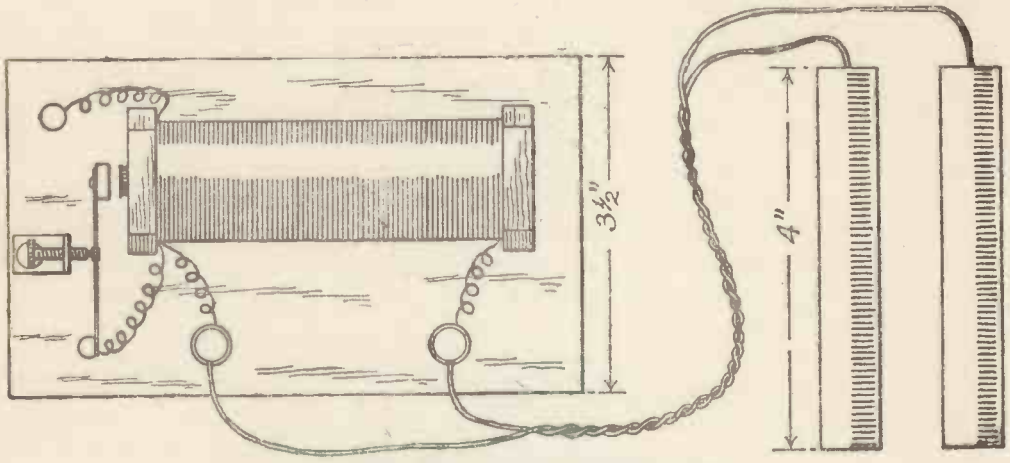


Fig. 1.—Plan View of the Shocking Coil.

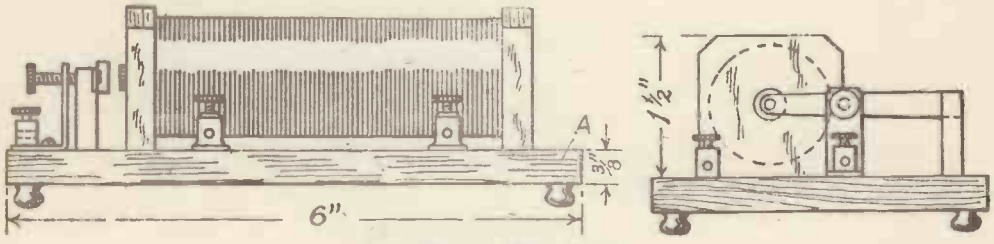


Fig. 1a.—A Side View.

THE construction of a small shocking coil is a job that any amateur can tackle, and, when finished, such a coil will provide endless amusement. The one herein described can be made quite cheaply, and will work well when connected up to a 2-cell bichromate battery or a 4-volt accumulator.

Principle of Working.—In the first place, it may be as well to briefly explain the principle on which a shocking coil works. A shocking coil, which is really an induction coil of simple form, depends for its action upon the peculiar property of electricity, by virtue of which, when one coil of insulated wire through which an intermittent current of electricity is caused to flow is placed within another coil, a current of electricity is induced in the outer coil. The inner coil in this case is called the primary coil, and the outer one the secondary coil. In order that the electromotive force or pressure of the induced current shall be sufficiently high

to cause a shock, the primary coil is wound round a laminated iron core, while the secondary coil consists of a much larger number of turns than the primary winding. An intermittent current is caused to flow in the primary coil by means of a rapid make-and-break device which will de described later. It is on the rapidity of the make-and-break action that the strength of the shock depends.

Details of Construction.—The first part to take in hand is the baseboard A (Fig. 1A), and for this a piece of wood 6 in. long, 3½ in. wide, and ⅜ in. thick will be required. Ordinary deal will answer quite well, and this can afterwards be stained and polished. Two pieces of wood, 1½ in. square and $\frac{5}{16}$ in. thick, will also be required for the end cheeks, as shown at B (Fig. 2), which support the core and windings.

With a $\frac{5}{16}$ in. centre-bit make a hole in the middle of each cheek to allow the ends of the core to pass through. Chisel off the top corners and well rub the sides and edges of the cheeks and baseboard with fine glass-paper.

For the core, obtain a coil of florists' soft iron wire and, without undoing the coil, cut out a portion 4¼ in. long. The part to be cut out must be bound round tightly with another piece of wire to prevent the strands coming loose when severed. The best way to cut the wire is to use a sharp-edged cold chisel and hammer. The bundle of wire can now be straightened out and the jagged ends filed square. To facilitate this operation, apply some flux to the ends of the wire, and dip them in molten solder. It will now be found that it is quite an easy matter to square up the ends with a file.

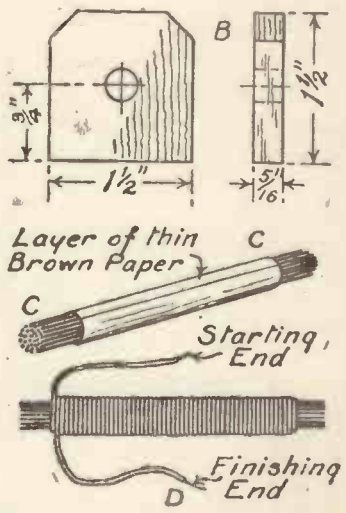


Fig. 2.—How to Wind the Coil.

Now take the core and proceed to cover it with a layer of thin brown paper, the edges of which overlap ¼ in., and are stuck down with a little glue or seccotine. This paper wrapping should be 3¾ in. wide, so as to allow ¼ in. of the core to be bare at each end, as indicated at CC (Fig. 2).

Winding the Coils.—We shall now require 5 yards of No. 22 cotton-covered copper wire for the primary winding, and 26 yards of No. 28 wire (also cotton-covered) for the secondary winding. Take the paper-covered core and proceed to wind on the primary wire, leaving a free end of at least 6 in. to start with, the same amount being left at the finishing end, as shown at D (Fig. 2). The last one or two turns must be bound round tightly with thread to prevent the coil from unwinding. Apply a coating of shellac varnish and cover the coil with thin brown paper. When dry, wind on the secondary wire, leaving about 6 in. at each end for connecting-up purposes. After binding the last two turns with thread, another application of shellac varnish can be given and allowed to dry.

Mounting the Coils.—The coils are now ready for their casing, consisting of a cardboard tube covered with a piece of velvet, which gives the completed coil a pleasing finish. Obtain an ordinary postal tube, about 1¼ in. outside dia-

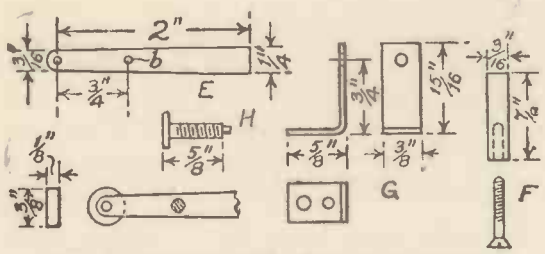


Fig. 3.—Details of the Contact Screw and Bracket.

meter, and cut off a piece $3\frac{5}{8}$ in. long, keeping the ends as square as possible. Cut a piece of velvet to just cover the tube, and glue the edges down to the cardboard. Now place the coils in the tube, make little nicks in the ends of the tube for the connecting wires to pass through, and then glue on the wooden cheeks. One end of the iron core should project about $\frac{1}{16}$ in. past the face of one cheek as depicted in Fig. 1. Fix the coil in position on the baseboard by two screws driven into each cheek from underneath.

Contact Breaker.—This consists of an armature spring, supporting piece, contact screw, and bracket. For the armature spring cut out a piece of thin springy sheet brass, about No. 35 gauge, to the shape shown at E (Fig. 3). The little armature is a soft iron disc $\frac{3}{8}$ in. diameter and $\frac{1}{8}$ in. thick. A hole should be drilled through the centre of it so that it can either be screwed or riveted to the end of the spring.

The contact piece on the spring is of silver, and for this a link from an old silver watch chain can be used. Straighten the link out, and, after cutting off a piece $\frac{1}{8}$ in. long, insert it in the hole made at *b*, and burr it over on both sides of the spring by tapping with a light hammer till a flat surface of silver is formed about $\frac{1}{8}$ in. diameter, as indicated in Fig. 3.

A piece of brass rod $\frac{3}{16}$ in. diameter and $\frac{7}{8}$ in. long will now be required, and this should have a hole drilled and tapped in one end to take the stem of a countersunk screw, as shown at F. At the top end a flat can be filed sufficient to take the width of the armature spring, which can then be neatly soldered to the pillar, as shown in Fig. 1.

The bracket G, for the contact screw, can be bent to shape from a piece of sheet brass about $\frac{1}{16}$ in. thick after drilling the two holes near one end for the fixing screw and terminal stem, and drilling and tapping the hole near the other end for the contact screw. For the latter, obtain a brass screw, with a milled head if possible, and in the end drill a small hole and solder in a short piece of silver wire from the watch-chain link, leaving about $\frac{1}{16}$ in. projecting, as depicted at H (Fig. 3). Fix the bracket to the baseboard with a small round-headed brass screw and terminal, as shown in Fig. 1A. See that the end of the silver wire on the contact screw touches the centre of the silver contact piece on the armature spring when the latter is in its normal position. Screw another terminal into the baseboard in the position indicated in Fig. 1.

Making the Connections.—First of all, each piece of free wire from the coil should be formed into a spiral, as shown

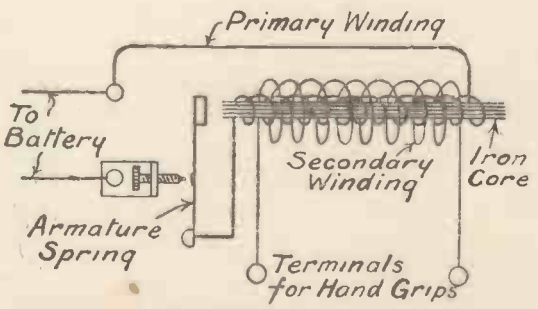


Fig. 4.—The Coil should be Tested by connecting up to a Dry Cell.

in Fig. 1. This is done by winding the wire round a smooth rod of either wood or metal about $\frac{1}{8}$ in. diameter.

Bare each end of the covered wire by scraping with a penknife. Fix one end under the terminal near the corner of the baseboard, and clamp the other end of the primary under the brass pillar which supports the armature spring (see Fig. 1). Clamp the ends of the secondary wire under the two terminals which are arranged to take the ends of the flexible wire attached to the hand grips.

The coil can now be tested by connecting up to a single dry cell, the leads from the latter being connected to the two terminals at the ends of the primary winding, as shown in Fig. 4.

On adjusting the contact screw so that the silver point presses lightly against the contact piece on the spring, the latter should begin to vibrate at a rapid rate and continue to do so while the current is flowing. This shows that the primary winding is all right. Now place the tip of a finger of each hand lightly on the two terminals attached to the secondary winding, when a shock will be felt.

For the hand-grips two pieces of thin brass tubing about 4 in. long and $\frac{5}{8}$ in. diameter will be required. A piece of ordinary twin flex-wire, about 3 ft. long, serves for the connecting leads. The wire is opened out at each end, two of the ends being soldered to the grips.

A MODEL OF A ROMAN CATAPULTA

THIS model is a simplified reproduction of a type used by the Romans about the time of Julius Cæsar, and will form an interesting model. The sketches illustrated show the general proportions of the model. The absolute dimensions may safely be left to the judgment of the constructor. Details of construction need not be given, as the sketches explain themselves. In securing the striking board to the upright, a thin band of metal is needed, as shown shaded in Fig. 2, for if the striking-board is pierced by a screw there is a great tendency for it to split. The winding drum and spindle are made of hard wood, its bearings of eyelet-headed screws, and the wheels cut from fretwood and fixed to the frame by means of nails or screws.

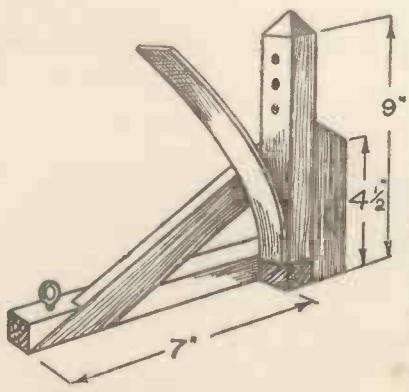


Fig. 2. Diagram explaining the construction.

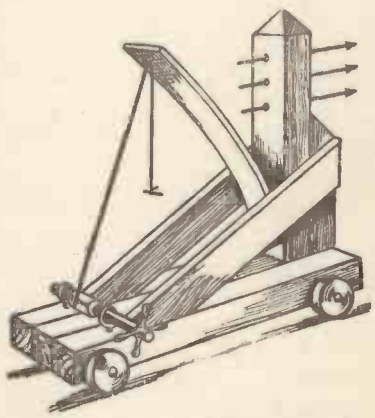


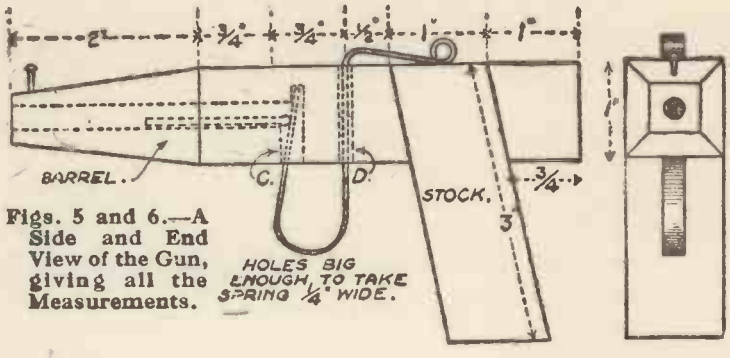
Fig. 1.—The finished Catapulta.

To charge the model, wind back the striker as in Fig. 1, and insert the spears in the holes drilled for them (they must fit loosely in the holes), then pull the trigger cord and release the striker, which will drive the spears forward.

The striking board is made of ash, $\frac{1}{16}$ in. by 1 in.

A TOY PISTOL:

Powerful Yet Harmless



Figs. 5 and 6.—A Side and End View of the Gun, giving all the Measurements.

YOU will require some 1-inch square wood, 12 in. long, an old clock spring about ¼ in. wide, and a pin to make this simple and cheap gun. The bullets are ordinary matchsticks, and can be fired a considerable distance. You will notice that the gun consists of two main parts ; they are called the stock or handle, and the barrel or tube through which the matchsticks are fired. When making these parts remember the first thing to do is to bore a hole down the middle, then fit the handle on. All this is shown in Figs. 1 and 2. You can then shape the nozzle end, as shown in Figs. 3 and 4. The measurements are shown in Figs. 5 and 6.

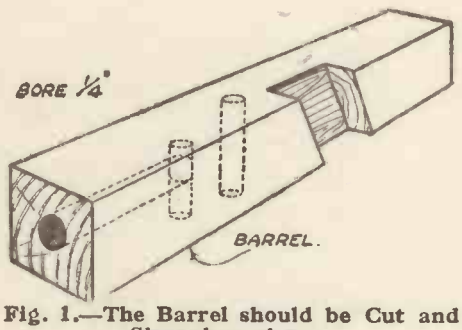


Fig. 1.—The Barrel should be Cut and Shaped as shown.

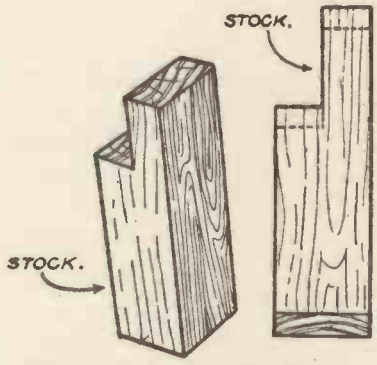
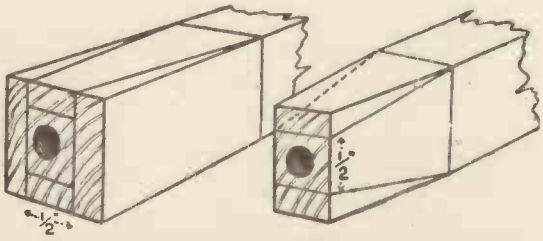


Fig. 2.—Details of the Stock.

Fixing the Spring.—When fixing the spring, first bend the top pieces by heating (see Fig. 7), and insert it at the top. Press the top of the spring down, and bend the bottom round so that it is sprung into position in hole C. The end



Figs. 3 and 4.—How to Shape the Front of the Barrel.

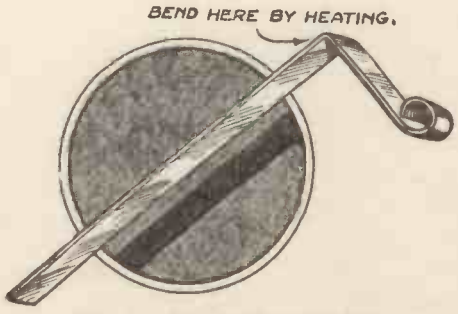


Fig. 7.—The Firing Spring.

engages a firing step, showing that the mechanism is quite simple. Place a match down the nozzle, you can put it in whichever way you like, and then choose the best way by experiment.

The Foresight.—Aiming is the next problem. For this we have to fix in the nozzle on top, the pin or foresight. Take a three-cornered file and carefully file a sharp " V " in the spring. To aim the gun : sight the object in the " V " of the spring, and then sight the pinhead between them. To fire : when ready, pull the loop of the spring slowly back.

The gun can be stained and varnished, when it will give added pleasure in using.

A POWERFUL CROSS-BOW

THE weapon about to be described here employs a stretched rubber cord as the propelling agent, thus resembling the catapult. The stock may be cut from a piece of straight-grained deal, 1 in. thick, to the pattern shown in Fig. 1.

The top surface must be grooved half round, as in Fig. 2, to a full $\frac{5}{16}$ in. radius, so as to provide a channel for the bolt, which is made from $\frac{3}{8}$ in. dowelling. This groove should be well smoothed with glass-paper.

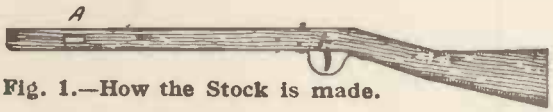


Fig. 1.—How the Stock is made.

If no suitable plane is available, use a small gouge, and even the surface with a rat-tail file before glass-papering. Cut the slot shown at A 1 in. by $\frac{1}{4}$ in., and fit to it the cross-member, as shown in Fig. 3. This should be tapered in width to $\frac{1}{2}$ in. at each end, as shown. We have now to consider the lock. Make a vertical slot centrally as shown in Fig. 4, $\frac{1}{8}$ in. wide, and long enough to house the lock mechanism.

The trigger C, Fig. 4, may be cut from thick brass sheet. It is secured with a screw, taking care that it pivots on the plain part of the screw. Its turned-up point D must stand above the upper surface $\frac{1}{4}$ in., for a $\frac{1}{4}$ in. diameter cord. When the adjustment is made a screw should be driven through the stock at E.

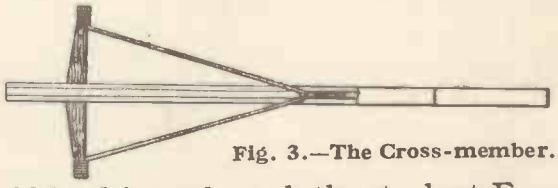


Fig. 3.—The Cross-member.

A lock spring is used to give the return action to the trigger, fixed in place by the two screws F and G. It only remains to attach the rubber. Wrap the ends with a strip cut from a piece of old kid glove, and bind them firmly with thin copper or brass wire to the cross-member. The length of the cord must be ascertained by experiment. It should be sufficient to admit of hitching it over the trigger head when stretched to nearly its limit. The bolts may be 8 in. long, cut from $\frac{3}{8}$ in. dowelling. A wire nail is driven into one end, and the " feathers " may be cut from thin celluloid in one piece and glued into a saw-cut made from the back-end of the bolt. There is no need to put a notch in the end (see Fig. 5).

Fig. 2.—The top surface of the Barrel is grooved as shown here.

Fig. 5.—A piece of dowelling made up as shown can be used for the Bolts.

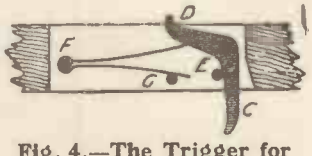


Fig. 4.—The Trigger for releasing the Bolt.

A Splendid Cigar-Box Crystal Set

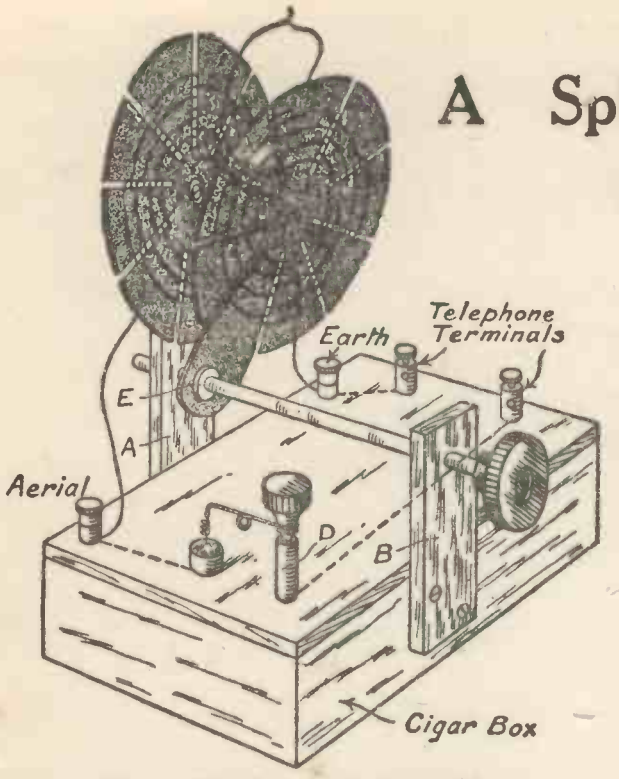


Fig. 1.—The Completed Crystal Set.

IT WILL RECEIVE THE BROADCAST ON THE PHONES WITHIN A RADIUS OF 20 MILES FROM A BROADCASTING STATION ON WAVE-LENGTHS UP TO 500 METRES

THIS simple wireless receiver can be made in an evening, and will give very satisfactory results on broadcast wavelengths up to about 500 metres, using an ordinary outside aerial. The base consists of a small cigar-box measuring 5½ in. by 3½ in. by 1¼ in. deep. Remove the lid of the box, and from it cut two strips 1 in. wide, one being 4½ in. long and the other 3 in., for the supporting pieces A and B respectively. Both pieces have a hole bored through on the centre line 1¾ in. from the bottom, to take an ordinary wooden knitting-needle a good sliding fit. Screw these pieces to the long side of the box opposite each other, so that the wooden rod, when in position, is parallel with the bottom of the box.

Tuning Coils.—The tuning inductance consists of two basket coils, the winding of which is joined in series to form a variometer. From a piece of stiff cardboard, about $\frac{1}{16}$ in. thick, cut out a disc 3¼ in. in diameter, and another piece the same diameter, but with a projecting lug C, as shown in Fig. 2. Draw a circle 1 in. in diameter in the centre of each disc, and then mark out the nine slots in each former, and cut them with the aid of a sharp penknife and a ruler. Wind each cardboard former with sixteen turns of No. 26 gauge D.C.C. copper wire, and leave about 4 in. of free wire at the starting and finishing ends for connecting-up purposes. Mark out the position of the

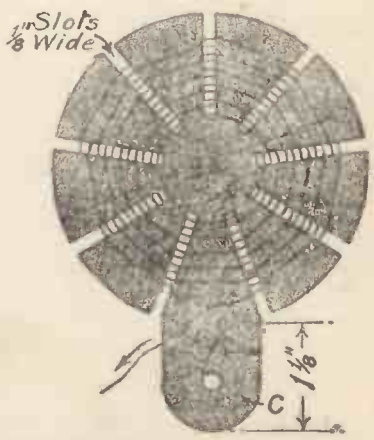


Fig. 2.—How the Basket Coils are made.

terminals and detector fittings, and at these points drill ⅛ in. holes through the bottom of the box. Push the stems of the terminals through the holes, and screw on the back-nuts.

The Crystal Detector.—The detector post D consists of a valve-leg socket, which is clamped in position by means of nut and washer. The adjusting knob is a wander plug, the prongs of which fit fairly tightly in the hole of the socket. The spring arm is part of a domestic safety-pin, to the end of which is soldered the "cat's whisker" of No. 32-gauge copper wire. Any form of crystal cup with a screw stem can be used.

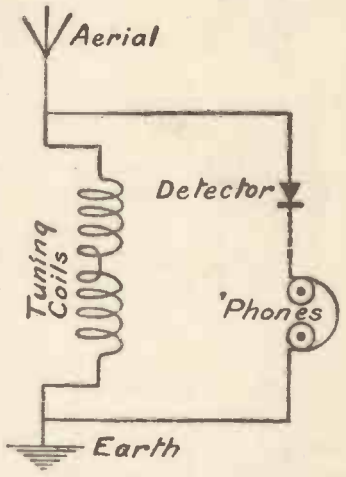
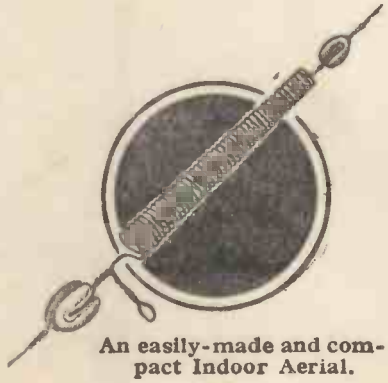


Fig. 3.—The Circuit diagram.

Connections.—For making the connections underneath the baseboard (see Fig. 3), a similar wire can be used to that with which the coils are wound. The aerial terminal is connected to the crystal cup, the detector post D to one of the 'phone terminals, and the other 'phone terminal to the earth terminal. The tuning coils are mounted as shown in Fig. 1, a central hole being made in the fixed coil former, which is fixed to the upright A with a brass screw and nut. The moving coil former is pushed on to the wooden spindle, and glued on after the spindle is pushed through the holes in the wooden uprights. A cardboard washer E can be glued to each side of the former, and also to the spindle, in order to ensure a strong joint. The finishing end of the winding of the fixed coil is joined to the aerial terminal, and the starting end of the other coil to the earth terminal. The other free ends of each coil are then joined together, leaving sufficient length of wire between to enable the moving coil to move sideways. A knob can be screwed on to the end of the wooden spindle as shown in Fig. 1. Tuning is accomplished by turning the knob slowly to the left or right till the station required is heard clearly in the 'phones. If a good piece of crystal is used, this simple set will give quite good results with an ordinary pair of headphones.

A COMPACT INDOOR AERIAL


An easily-made and compact Indoor Aerial.

PROCURE about 30 ft. of bare copper wire, and wind it closely round a broom handle; now slide it off the stick and twist one end into a loop, as shown in the sketch. Attach two insulators of the egg type to each end, and stretch the coiled wire out to the required length, fixing it by means of cord to the wall. The lead-in can next be soldered to the loop in the wire, and then carried down to the set. Although not extremely efficient, this aerial will give results on a good set.

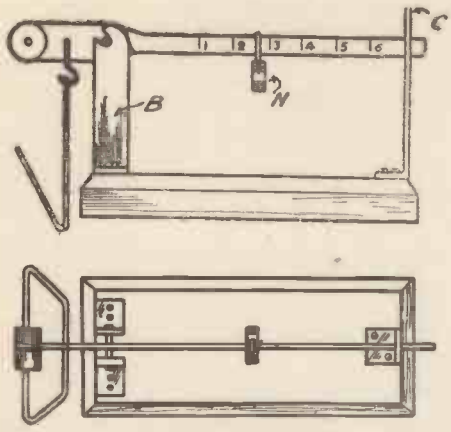


Fig. 1.—A Side and Plan View of the Letter Balance.

A LETTER BALANCE MADE FROM ODDS AND ENDS

Simple and accurate, this Balance will be found useful for chemistry, photography, and model making

HERE is a simple letter balance. First make the base; use a hard wood such as oak, size 8 in. by 3 in. by 1 in., plane it so that it measures when finished 8 in. by $2\frac{3}{4}$ in. by $\frac{7}{8}$ in., with a $\frac{1}{4}$ in. chamfer along the top edges.

The supports for the beam are now needed. Piece C is shown in Fig 1 and Fig. 2, pieces B are shown in Fig. 1 and Fig. 5. All these three pieces are $1\frac{3}{4}$ in. high, 1 in. at the bottom, and $\frac{3}{4}$ in. wide, made of brass. Pieces B have a hole drilled in them $1\frac{1}{2}$ in. above the angle bend at the bottom, $\frac{3}{8}$ in. in diameter. Make sure that you drill the two pieces together to be certain they are in alignment, file a point at the bottom of the hole to take the knife edge of the fulcrum; to do this use a small three-cornered file. Now file a slant cut to the holes at an angle of 45 degrees, to permit the fulcrum to be placed in position. Piece C is the same size as the other pieces, but it has a slot in it $\frac{3}{4}$ in. long and $\frac{1}{4}$ in. wide instead of a hole, the centre of the slot being 1 in. above the angle at the bottom.

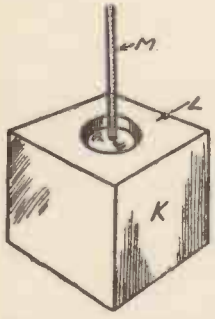


Fig. 4.—The Mould for the Counterpoise Weight.

Fig. 2.—The Support for the Beam.

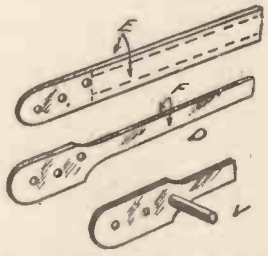


Fig. 3.—Details of the Cross Beam.

The Beam.—The beam consists of strip mild steel $8\frac{1}{2}$ in. by $\frac{1}{2}$ in. by $\frac{1}{16}$ in., shaped as at D in Fig. 3. First draw a centre line along strip and square a line across $1\frac{3}{4}$ in. from the end. This will position the centre for the hole that takes the fulcrum V (Fig. 3). Now mark off a distance of 1 in. each side the centre of the fulcrum. The one on the right will give the first division mark, that on the left the position for the hole on which the wire holder for the letters is hung. The hole at V is just above the centre line, the others are on the centre line; they are all $\frac{1}{8}$ in.

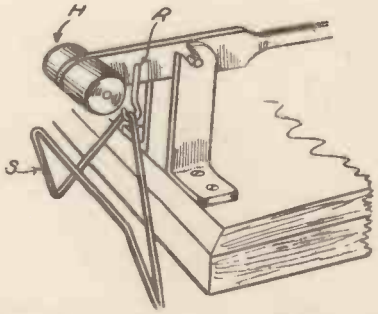


Fig. 5.—How the Letter-Holder is made.

diameter. The long edges are now marked $\frac{1}{4}$ in. down as at E, Fig. 3, and then filed to F, Fig. 3, leaving this part of the beam only $\frac{1}{4}$ in. wide. The fulcrum is made of a short piece of steel $\frac{1}{8}$ in. diameter, making a tight fit. Now correct balance of the beam. This is done by first supporting the beam by a silk thread slipped round the fulcrum, and adding weights until a true balance is obtained.

Make a letter holder as at S in Fig. 5. This can be made of $\frac{1}{16}$ in. brass diameter. The counterpoise weights are made of lead cast in plaster of Paris, as shown in K (Fig. 4), with a centre hole formed by a wire core pin. The two discs are $\frac{1}{4}$ in. wide, but in the first place cast them $\frac{3}{8}$ in. thick, and file them down to the correct weight. When you have done this, make the moving weight N by casting it to a diameter of $\frac{3}{4}$ in. in plaster of Paris as at Fig. 6. The loop is made from a hairpin. When cast, file it to weigh 1 oz. Next mark off divisions, slightly notching the top of the beam, borrow some weights, 1, 2, and 4 oz., hang these on the letter holder, and then slide weight N along beam until balance is obtained, and repeat the process until you have secured your positions.

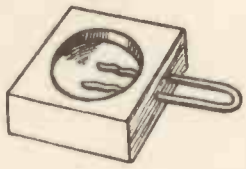
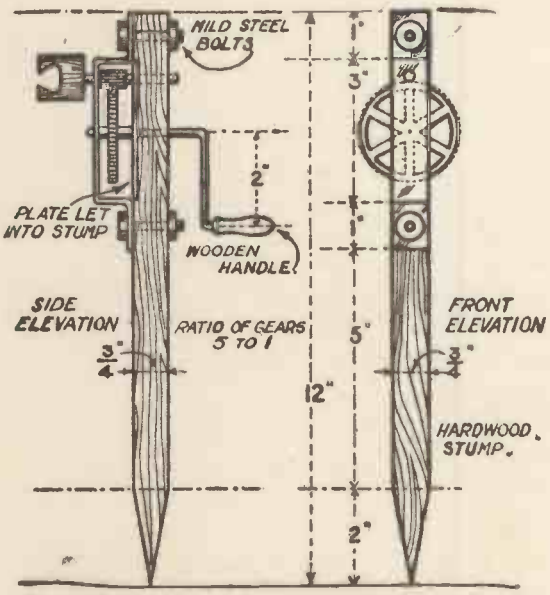


Fig. 6.—The Loop for the Moving Weight is made from a Hairpin.

A WINDER FOR MODEL AEROPLANES

IT is always a tedious job winding up the propeller of a model aeroplane. You can considerably speed up the process by making the simple piece of apparatus shown in the diagrams. It consists of a stump of wood, to which a simple winding crank, gear-wheel, and pinion have been secured. A wooden chuck is driven on to the shaft of the pinion to grip the propeller, and if suitable gears are selected, one turn of the handle will turn the propeller five or more times. In use, the winder is pushed into the ground, the left hand supporting the propeller in the chuck, whilst the right hand turns the handle. It is important to remember that if the elastic skein is to be wound five hundred times, the handle must be turned a correspondingly smaller number of times, according to the ratio between the teeth of the pinion and the teeth on the gear. Lubricate the gears with vaseline. If you do not wish to go to the trouble of making up this special winder, you can improvise one from a hand-drill.



This simple model Aeroplane Winder may be made quite easily. It certainly speeds up an otherwise tedious process.

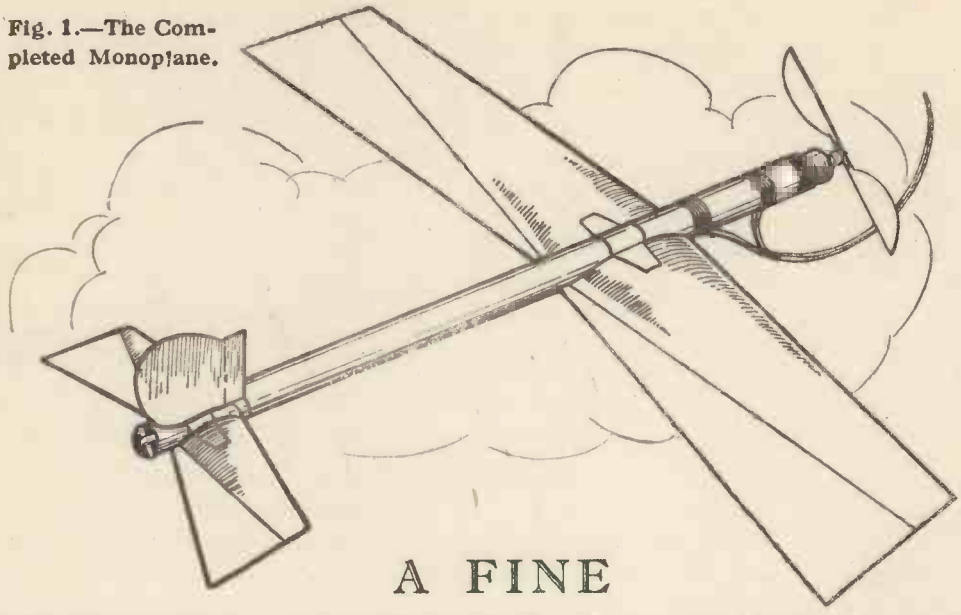


Fig. 1.—The Completed Monoplane.

A FINE HAND-LAUNCHED MONOPLANE

This Tractor Monoplane is a ripping flier and costs only a few pence to make

THERE are a great number of different kinds of model aeroplanes that the amateur can build. Quite a number of them are expensive, especially when the first few crashes take place. Here is one which costs very little, and you can afford to make a few spares quite easily. You will find it a good flyer, but take care to adhere to the given measurements. It is strong and, combined with lightness, will stand a fair amount of legitimate use. You will notice there are no wheels, and the weight of the model is well under 2 oz.

The Body.—The body is tubular, and is made from stiff drawing paper. Obtain a round rod $\frac{3}{8}$ in. in diameter, and roll round it the piece of drawing paper, size as illustrated in Fig. 2. Do not withdraw the rod until the model is finished. A good gum is essential. Use a wooden rod much longer than the body. Next with some strong thread bind the ends and fix with gum.

The Wings and Tail.—In Figs. 3, 4, 5, and 6 respectively are given the

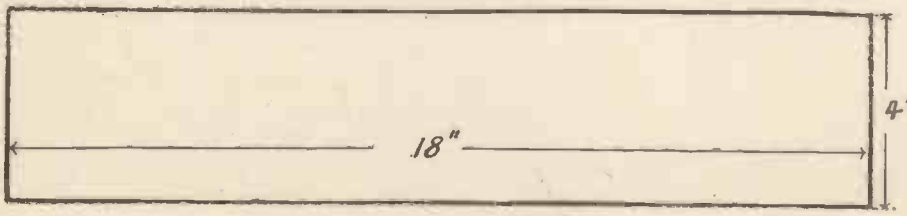
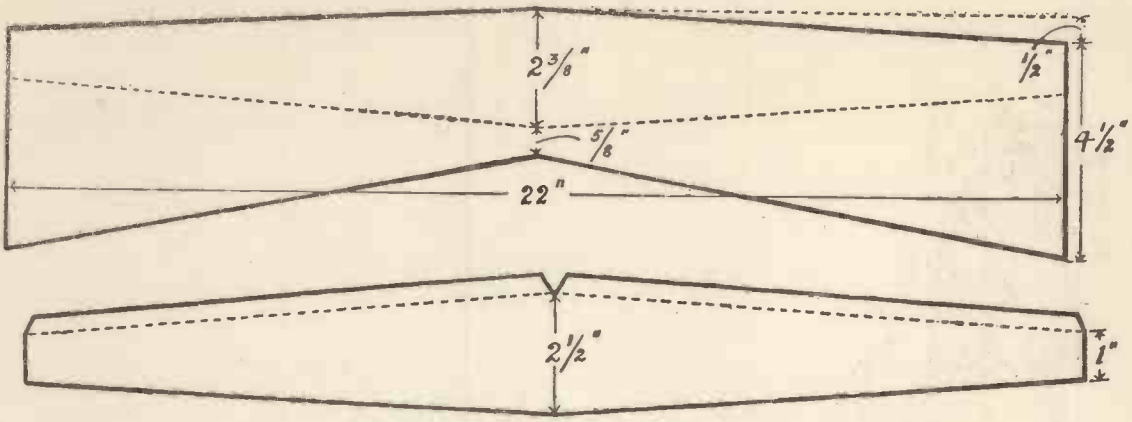


Fig. 2.—The Paper for making the Body.



Figs. 3 and 4.—Details of the Wings.

measurements for making the wings and elevator. The same drawing paper is used, and each wing is built up of two parts. Fig. 4 and Fig. 6 are fixed on top of Fig. 3 and Fig. 5 respectively, the edges of Fig. 4 and Fig. 6 being glued to the underside of the main plane surface and the rest rolled over to give camber or thickness to the wing. They are left to dry after gluing, and the camber part only is pierced to let the body fit and slide in tightly, allowing 5½ in. of the front end of the spar to protrude from the leading edge of the wing. The tail plane is treated in the same way, and then the rudder is mounted across the spar straddle fashion.

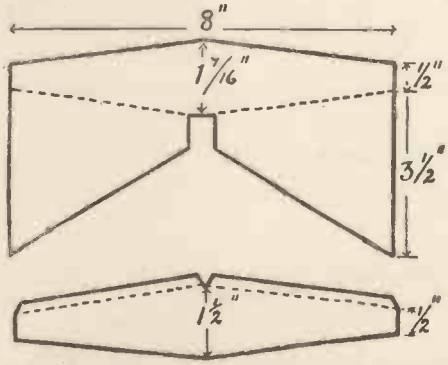
The Skid and Screw.—A piece of cane 7 in. long is employed in making the air-screw, and one side of the cane is flat. The blades are fixed to this, and when dry they are twisted at an angle of 45 degrees.

A hairpin will do for the shaft ; bearings are easily secured by using two beads, and the whole fitting is carried by a cork that fits tightly into the tube end.

The elastic motor is of the small strand variety, and its tail end is held firmly by a piece of cane, which fits neatly into two small slots in the spar.

At the front is mounted a protecting skid of cane held in position by a small compression bar, and secured to the spar and cane by gummed thread.

Adjustment for flying purposes is obtained by raising or lowering the rear edge of the front plane.



Figs. 5 and 6.—How to make the Tail.

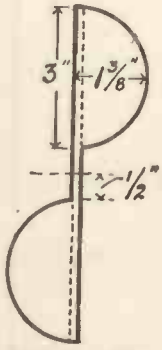


Fig. 7.—The Propeller.

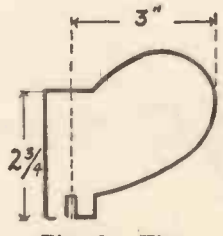


Fig. 8.—The Rudder.

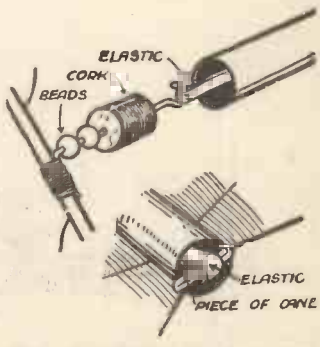
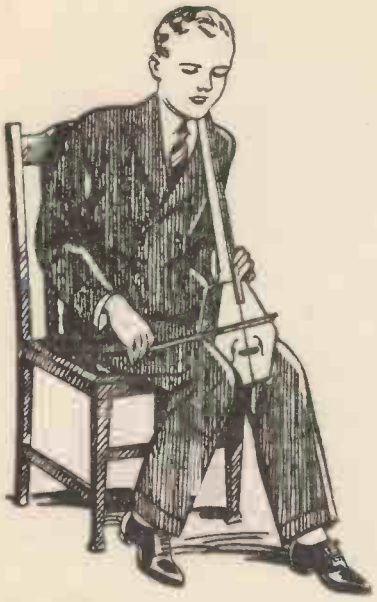


Fig. 9.—How to fix the Elastic in the Tube.

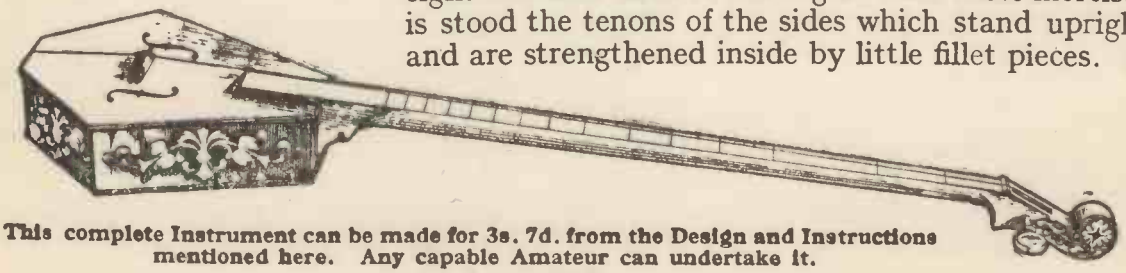


HOW TO MAKE A ONE-STRING FIDDLE

THOSE who have a few fretwork tools can make the one-stringed fiddle illustrated, and their work is very much lightened by a large design sheet on which all the necessary patterns are clearly printed ready to paste down on the wood. The neck is, of course, the main work involved, but this is really quite straightforward. The wood for it is 1 in. thick and the shaping of this is best done with a fret machine, although the experienced user of a hand-frame can get on quite well. The fiddle is a real full-sized musical instrument played with a bow, but with the body of the fiddle held between the knees instead of on the shoulder, as in the case of a violin. It is, of course, essential to get correctly seasoned and attuned wood, and special instrument pine has to be used for the breast of all stringed instruments. The difficulty of obtaining it is removed by the supply of a suitable parcel by Hobbies Ltd., not only for this, but for the neck, the design and wood in the string, peg, etc. Get by taking the patterns of front of you and start work down to the wood for that the neck and pasting them two pieces on the design, part. They are shown in clearly indicated. The but are fitted together as the wood will look as shown pattern for the side on has been cut out with the at Fig. 1, whilst when it will be as Fig. 2. The fretsaw and shaped up it small plane, and finished shaping is done with a until a nicely rounded effect off with fine sandpaper away towards either end. is obtained. The curve dies In the top of the neck a curve has to be cut through the head, and a hole bored across to take the key (Fig. 3).

A Special design chart of all the necessary parts (Fiddle No. 768) costs only 4d. A special parcel of wood, planed ready to cut and shape is 2/6. A suitable book teaching you how to play is obtainable for 2/. The string, peg, and a suitable bow are 5/3.

The body is an hexagonal-sided box. The back is cut from $\frac{1}{8}$-in. wood with eight mortises close to the edge. Into these mortises is stood the tenons of the sides which stand upright and are strengthened inside by little fillet pieces. A



This complete Instrument can be made for 3s. 7d. from the Design and Instructions mentioned here. Any capable Amateur can undertake it.

central aperture is cut in the two ends of these upright sides to allow a portion of the neck to pass through at the letters A and B. The top or breast is cut from

Fig. 1.—The Pattern of the two parts of the Neck are pasted on the wood like this, to make one complete Length.

$\frac{3}{32}$-in. pine and has two *f*-shaped openings. The tail of the neck is inserted in the body and glued firmly in place. Minor parts to be added are the bridge, which is

Fig. 2.—This is how the Neck will look when Cut and Shaped out according to the Design.

tapered to a point at the top as shown by the section, and a small piece of $\frac{1}{8}$-in square hardwood which is let into a groove across the head of the neck to raise the strings above the surface of the wood. The bridge is movable, but the hardwood is glued in (see Z). The design includes seven fretted overlays—one on the back and the others on the sides of the instrument. They are cut from $\frac{1}{16}$-in. wood with a fine fretsaw and glued finally in place.

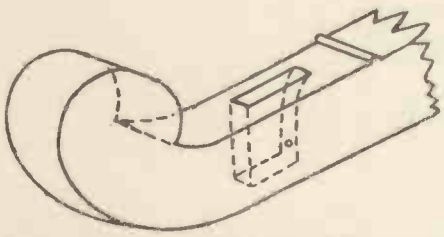
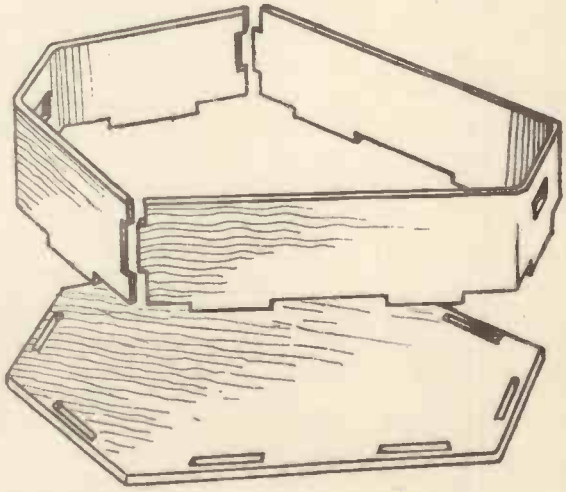


Fig. 3.—A Hole is cut downwards through the Neck to take the Key through the little Hole.

The whole of the work can be stained deep mahogany with a coat of clear varnish over.

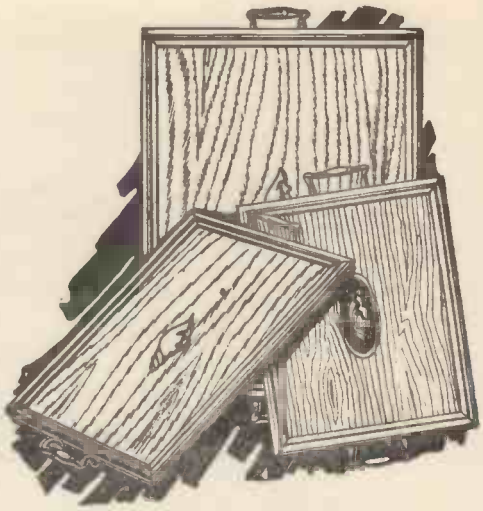
For playing, fix one end of the string to the tail of the neck, pass it over the bridge along the flat of the neck and round the key at the top. The position of the notes is indicated by running a tenon saw or a fretsaw lightly across the neck at the proper places. To find the position of these marks, it is necessary to tune the string to D in the base by means of a piano. The next note will be D♯, and its position on the string must be tuned in according to the note on the piano. By shifting the finger up and down, the various notes are obtained and can be permanently marked in as indicated.



A General View of the Body work, with the two parts forming the Sides.

TRAY MAKING

IS QUITE EASY



It's quite easy to make Trays, and the handyman will find it an interesting as well as a profitable job.

EVERY home needs trays, and few homes have all they need. They grow in sizes selected for their usefulness, from the baby one for the early morning cup of tea, to the big fellow which carries all the dirty "crocks" away after a meal. This variety is helpful to the worker who has decided to make them up, for he can cut his work according to his cloth—or wood in this case. All you need is a piece of plywood for the base, the shaped moulding for the edges, a transfer to decorate the bottom, and a couple of handles for the ends. Fortunately all these parts are now obtainable quite cheaply by the amateur woodworker, and only a few of the ordinary carpentry tools are needed. To make matters even more simple, complete sets of all parts required for making trays of popular sizes are supplied by Hobbies Ltd., and they will be pleased to send full particulars to any reader.

The base of a tray is usually of $\frac{1}{4}$-in. material, and in order to make it strong as well as cheap, plywood is usually used. Whilst a cheap quality may serve the purpose, it is better to obtain a good class of plywood which has one side of it faced with oak or mahogany, thus the base is in keeping with the moulded edging, and the whole thing can be finished with polish as a complete mahogany or oak tray. The actual size is immaterial and can be made according to individual taste. The board requires nothing further than a light rubbing of sandpaper to make it ready for the moulding edge. A piece of this moulding is illustrated herewith (Fig. 1) and stands on the tray bottom. The moulding has to be cut the required length of the sides of the tray, and it is a wise plan to keep it a little inwards from the actual edge of the base. This provides greater hold for the screws when they are driven up underneath, and makes it less likely for them to split the board. The ends must be cut at an angle of 45 degrees, so when the four parts are put together they make a correct framework.

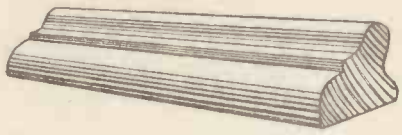
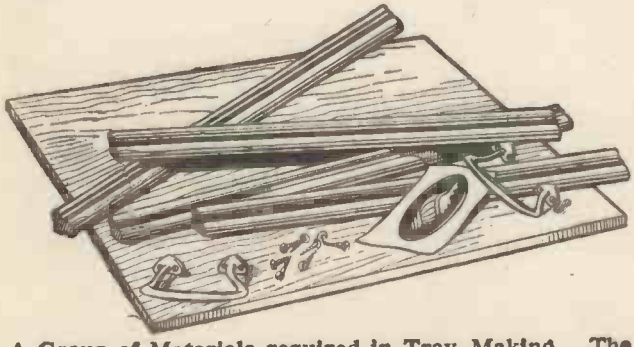


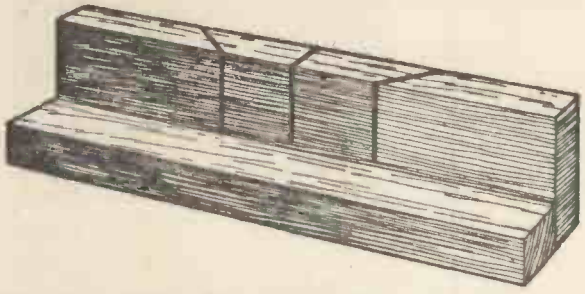
Fig. 1.—This is the Moulded Edge you buy in Strips to form the Tray Sides.



A Group of Materials required in Tray Making. The article tells you how to put them together.

One must remember to mark the length of moulding on the outside top edge, and to see that the mitre is cut

inwards from here. The diagram at Fig. 2 illustrates quite plainly how much difference is made if one measures and cuts from the wrong side. The mitring must be done on a proper block in order to ensure a correct corner joint, and a cheap and useful one is illustrated. Having cut the moulding and tested it for length, glue it to the baseboard so that a little of its edge projects beyond the back of the moulding. Put glue in the corners also to hold the moulding there. Then turn the whole thing over and drive in three or four ½-in. flat-headed screws along each side. Suitable handles are obtainable in various shapes. They are screwed under the baseboard and sunk into a shaped recess, cut with a chisel. Some are also made so they screw to the back of the moulding by ½-in. round-headed brass screws. The position of both kinds is illustrated at Fig. 3.



This is the Mitre Tool used to guide the Saw at the right angle in cutting the Strips.

If the tray is to be left with the wood in its natural state, it is now complete, but many prefer to stain and polish it. This largely depends on the use to which the tray is to be put, for if it is just for ordinary general purposes a polished surface would soon get spoiled, whilst anything hot, such as a teapot or hot water jug, would immediately blister the polish. Trays certainly look better and more saleable if polished, and as this is now a simple process with Lightning Polish, the handyman is well advised to finish it this way. When the polishing has been completed except for the last rubbing, the transfer is added in the usual way.

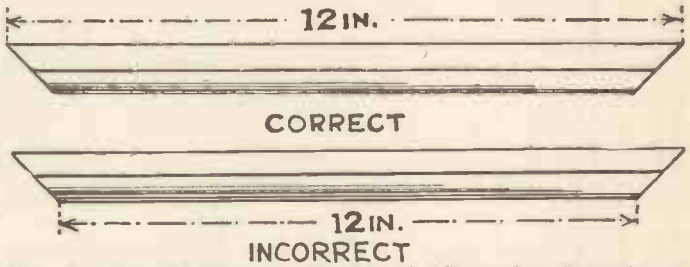


Fig. 2.—The Right and Wrong of Measuring Lengths of Moulding for the Edges.

To further ornament the tray, some of the simple marquetry transfers obtainable for 1d or 2d. should be added. A simple shell pattern such as seen in the picture of the finished trays, or even an effective little corner piece, adds a pleasing touch to the finished article. These transfers are printed in bright colours and are quite simple to apply.

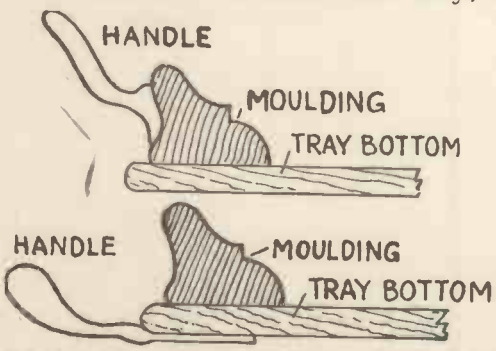
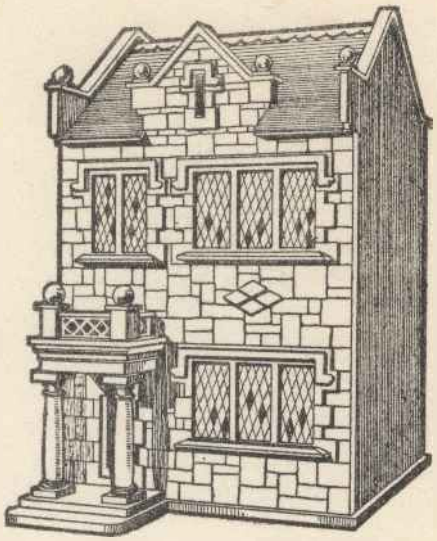


Fig. 3.—The manner of fixing the Handles is shown above. One is to the Moulding, and the other is under the Tray.

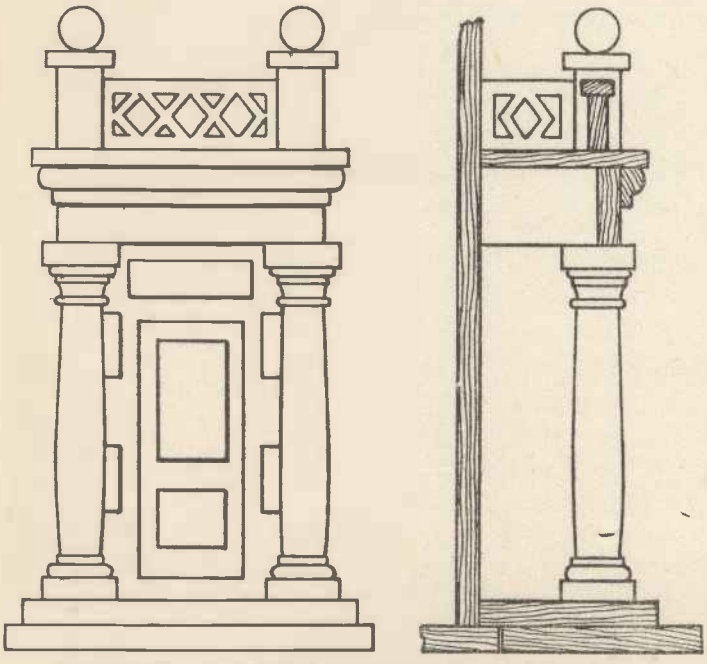
These are two of the Popular Colour Transfers suitable to fix to the centre of Trays.

AN EASILY-BUILT DOLL'S HOUSE



This splendid model House stands 16½ ins. high and 10½ ins. wide, is easily built, and looks quite realistic. Full-size patterns are available in a special design Chart

A DOLL'S HOUSE is always a popular piece of work for the amateur to make up, and the artistic house we illustrate here can easily be completed by any handyman with a few fretwork tools and some wood. The completed house is very realistic, with diamond-leaded windows, porch and balcony, etc. It is 16½ in. high, 10½ in. wide, and 8 in. deep, and the front is hinged on as a complete part, so that it provides access to the whole of the interior for furnishing, lighting, etc. It is, of course, impossible to give all particulars of such a house here, and the full-size patterns are obtainable on a special design sheet as shown below. On this the parts are all set out in full, so that they can be easily pasted down to the wood and cut out without further bother. Moreover, a special parcel of all the materials necessary is supplied by Hobbies Ltd. for 9s. 4d. The design number is 157 Spcl. and the following article is written assuming that the worker has the patterns in front of him and is ready to begin. The actual wood supplied in the parcel is cut the sizes required in boards of mahogany for the house itself, and whitewood for the overlays.



This Front and Side View of the Porch is helpful in building that portion of the House.

The base is a plain piece of wood, ¼ in. thick and 10½ in. by 8 in. Upon this is glued and screwed the two sides and the back, which make the walls. The two roof slopes are cut to outline; in one piece—the front slope—there is a recess

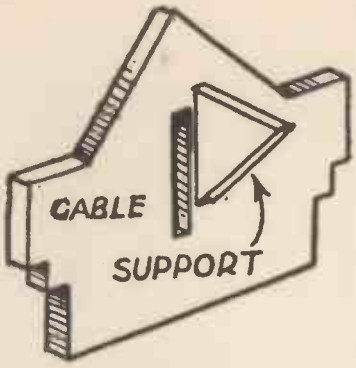


Fig. 1.—A Back View of the way the Gable is stiffened up.

to allow the gable front to be added. Screw to each other, and overlap as a butt joint, the back portion being under the front. They can be screwed from the outside of the walls as well as from the top.

The top edges of the walls are then fitted with the coping, which has to be chamfered as indicated by the sections on the

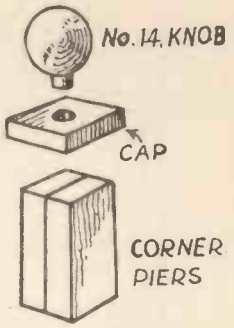


Fig. 4.—The Corner Posts of the Porch are made like this.

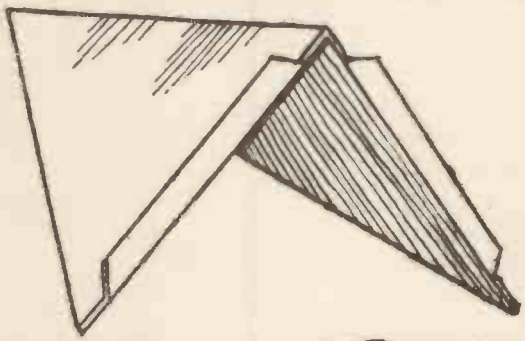


Fig. 2.—The False Roof to the Gable.

parts. Above these at the small bases which hold the Next glue and screw in the upper rooms. This part is neath the eaves, chamfered front, and a slight recess cut, can screw the gable front.

respective front are the round knobs. ceiling to the fitted just beback and into which we This gable the recess, and rigid by the port at the back (Fig. 1). It the design part of the front back support is put one side the window, and is glued on hold the whole piece firmly.

front is fixed in held a little more right-angle supwill be noted from gable that this of the aperture of three edges to

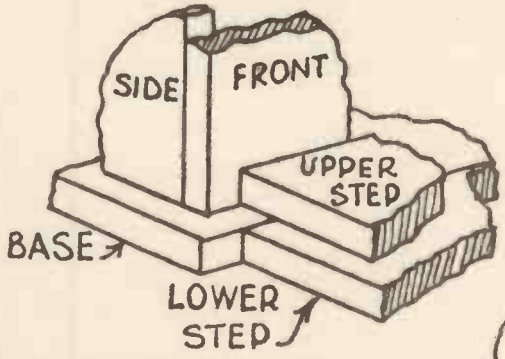


Fig. 3.—A Detail of the Front Corner of the House.

The roof behind the front made in stiff cardboard, and on the design sheet an outline is drawn to the actual size required. Two projecting tabs are provided, and these are bent upwards and glued to the back of the gable front (see Fig. 2). The final additions to the gable are the coping pieces, the window overlay and bead moulding over it. The large piece which forms the front is cut from $\frac{1}{4}$-in. wood, with three openings for the windows, one for the door and one for the small fanlight. Cut the overlays in $\frac{1}{16}$-in. wood, and glue them in place to form the windows. Over these again are the narrow bead mouldings and the sills beneath and above each window. These sills have the upper front edge planed to the section indicated, and each end returned in a similar manner.

gable is actually

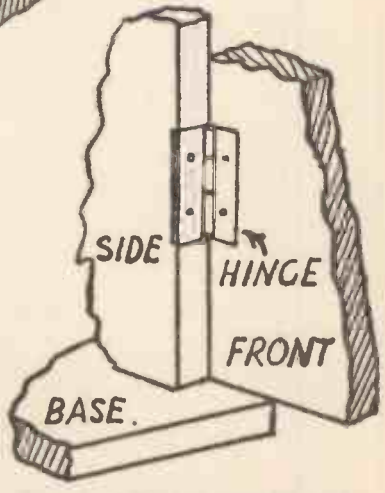
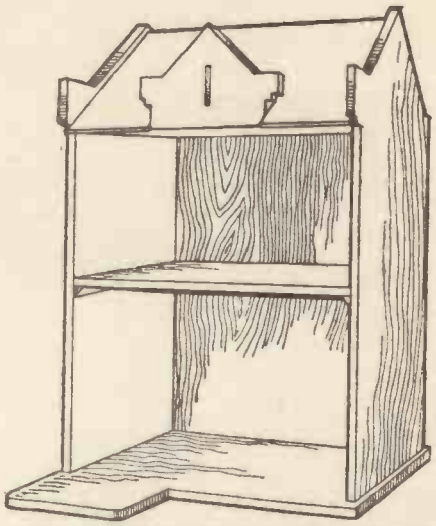


Fig. 5.—The way the Hinged Front is Fitted on.

The steps of the porch are made up in two pieces ; the upper is glued to the front of the house, but the lower is glued on to the upper only, and $\frac{3}{8}$ in. inwards. This is to form a stop, and come to rest when the door is closed against the front edge of the base (see Fig. 3). Now cut out the rest of the parts which form the porch. There is a small base and cap at the bottom and top of each column, and the front and sides, which are plain rectangular pieces, glued to the top and to the front of the house. Above these is the roof, and in the right angle beneath is glued the three short pieces of moulding.

The corner pillar for the verandah is made up of two pieces of $\frac{1}{4}$-in. wood, a cap, and a knob (Fig. 4). The balustrade and small capping parts are glued wherever possible to the adjoining pieces —the whole porch being glued to the front of the house.

The door is fixed with two tiny hinges, and above it is put in the small strip of glass to form the fanlight. The front of the house is now completed, with the exception of the addition of the small diamond overlay on the front. The windows themselves are the leaded light variety, as plainly indicated in the illustration of the finished house. This effect is obtained by drawing upon the actual glass the lines of the lead in Indian ink. The glass is put behind the overlays and a strip of $\frac{1}{16}$-in. wood fitted to hold them. The completed house has its front hinged on as a door with a little catch on the other side to hold it closed (see Fig. 5).



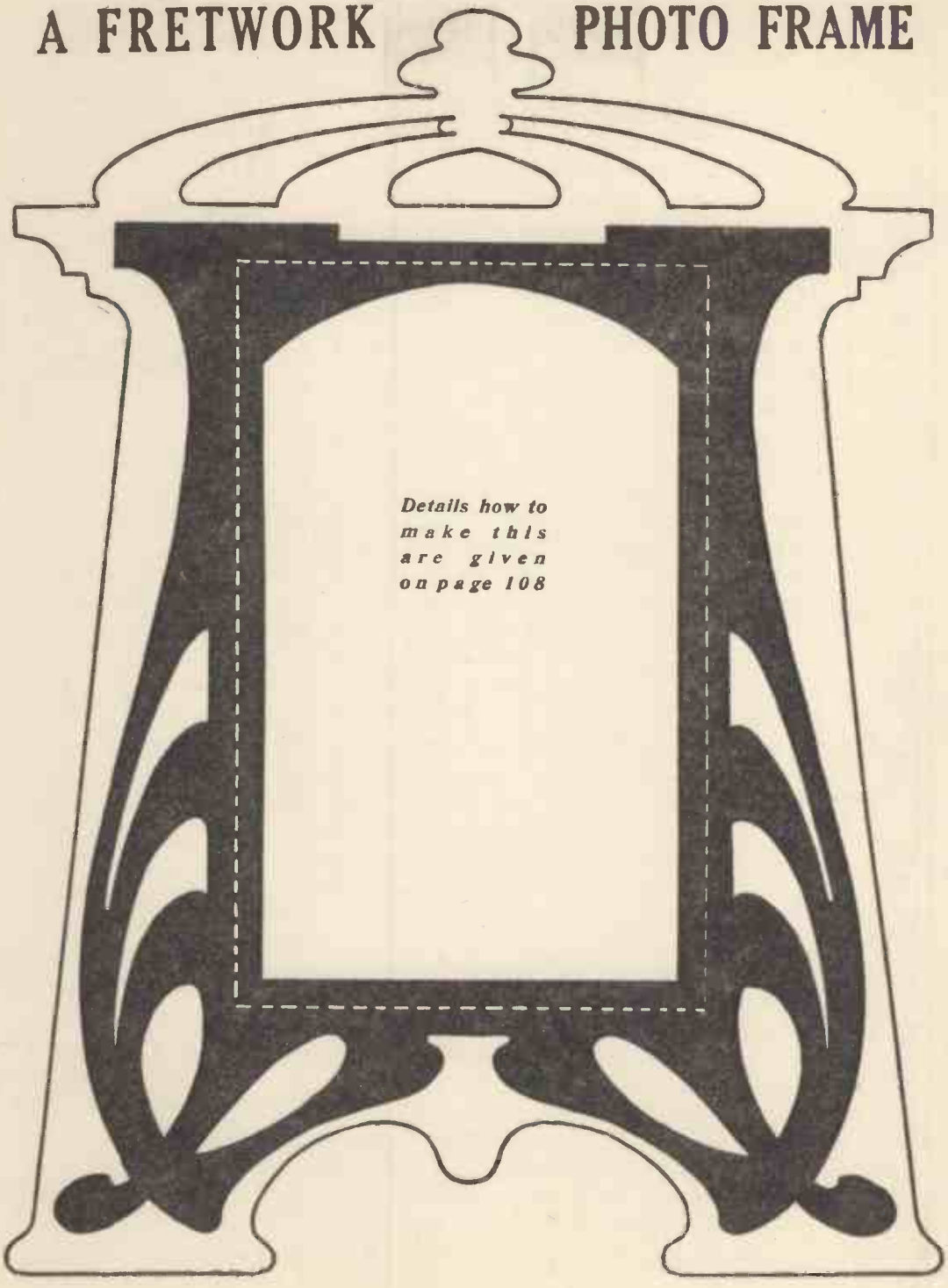
A Picture of the Skeleton Framework without the Door, to show the General Construction.

A complete Chart of all parts is supplied by Hobbies Ltd.—Doll's House No. 157 Special—for 9d., or 10d. post free. Wood for all the parts, with moulding, knobs, etc., is supplied for 8s. 6d. (postage 9d.), and the hinges, window glass, door knobs, etc., complete for 10d., or 1s. post free. By obtaining this parcel the whole House can be built without further trouble.

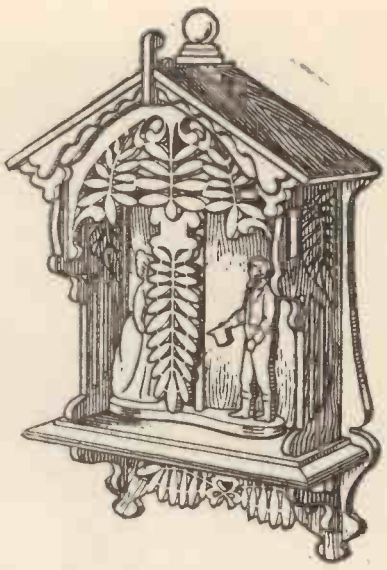
A SIMPLE PHOTO FRAME

The design shown on page 109 is for Fretwork Photo Frame which is easily cut from two pieces of wood. Trace off the patterns shown as two pieces. The background of the frame is traced to the outline, and to the three fret at the top, whilst an interior opening has to be cut to the dotted lines to take the glass. The piece printed solid black is also traced off, and cut out from another piece of wood. The larger board should be $\frac{1}{16}$ in. thick, and the overlay—the smaller one—$\frac{1}{8}$ in. Any common fretwork will do, such as satin walnut, mahogany or whitewood. The overlay will stand up more if cut in a different wood from the backboard. Cut out with the fretsaw, clean up both parts, and glue together. Put the glass behind the overlay, then the picture, and then a piece of cardboard or blotting paper to fill up the remainder of the recess. A piece of brown paper, or photo clips, will hold the backing in place, and a strut of wood, or the special metal ones supplied should be fixed to make the photo frame stand sloping slightly backwards.

A FRETWORK PHOTO FRAME



HOW TO MAKE A HYGROSCOPIC WEATHERHOUSE



MOST of us are fascinated by those quaint little houses where the lady or the gentleman appears at the front door according to the state of the weather. These mysterious happenings are only due to atmospheric differences affecting the workings inside the house. This is known as hygroscopic—which is the name for anything which is sensitive to moisture. One of these houses is illustrated herewith, and readers can make it for themselves in fretwood from full-size patterns printed and design No. 1529, obtainable for 4d. from Hobbies Ltd. The finished drawing on this page shows the style which the house takes when the design is completed, and the polite gentleman having raised his hat, can be seen just emerging from his side of the door. If the house is properly constructed, the advent of the man beyond his door is a sign of damp weather or rain; if the lady emerges, then the reverse is the case, and dry weather may be expected. A number of our younger readers may be entirely mystified as to the working of the novel barometer. In reality it is perfectly simple, the entire mechanism being a short piece of gut which holds the figures on a central pivot suspended from the centre of the roof. Gut is quickly affected by atmospheric changes; at the slightest suspicion of dampness it will expand, whilst if dryness or heat is in the air it immediately contracts. In doing this, it must, of course, turn slightly, and by hanging to the gut a horizontal floor upon which the figures stand, the turn is accentuated so that the figures move over quite a wide angle.

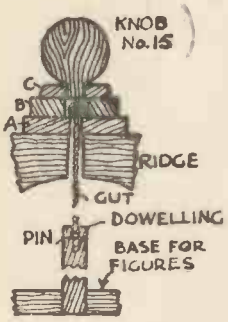


Fig. 1.

The only tools needed are a fretwork handframe, a cutting table, a drill, sandpaper, glue, and a few nails and screws. The kind of wood to use is immaterial, but the design gives all particulars as to thickness, etc. To save trouble, however, Hobbies supply a special parcel in which all the boards are supplied the correct thickness and planed ready to use.

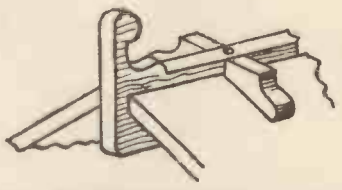


Fig. 2.—The Front End of the Roof.

The construction of the house is a simple matter, and when complete it is 8 in. wide, 12½ in. high, and 3¾ in. from back to front. The two figures stand on a base fixed to a vertical piece of dowelling, hidden behind the drop centre design. The base upon which the figures stand is lifted ¼ in. from the floor of the house in order to allow the movement of swinging.

Before beginning the actual cutting, understand how the gut is fixed through the roof to the knob above. A useful and helpful diagram is shown at Fig. 1. A hole is drilled in the top end of the ¼-in. dowelling to pass down the centre about ½ in. A pin is then put through into the gut and out again into the wood. In this way one end of the gut is fixed to the centre of the dowelling and allowed to swing evenly. At the other end it must pass through the ridge piece. This part is ¼ in. thick, and a hole in the correct position is given on the design. A wide drill-bit must be used so that the gut passes through loosely and without any friction against the edges of the hole. From there it passes through the largest washer (A). The exact height required is now found with the base ¼ in. from the floor of the house, and a knot tied to prevent the top end of the gut passing back through the washer A. This knot is hidden by the other two washers, B and C, and it is into the latter which the circular knob fits.

The General Construction of the House.

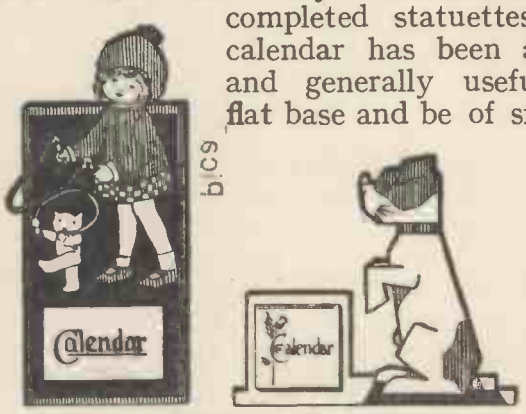
Paste all the parts down on their respective pieces of wood principally ¼ in. thick. The main back is in one piece, and it is upon this that the two side walls and the two-part base is screwed. Be sure to get the edges of these parts absolutely straight, because they must butt cleanly against the back, there to be glued and screwed as indicated. The top edge of each side is chamfered to allow for the sloping roof to be level upon it, whilst the bottom edge rests upon part No. 2 of the shelf. The two parts of this shelf or base are cut in ¼-in. and ⅛-in. wood. The former piece is rounded along three sides before it is glued to the plain rectangular piece above it (No. 2).

Before finally screwing on the two upper sides, remember to complete the front and the hanging piece at the back of it. These two are glued together with the long drooping laurel decoration passing down the centre to hide the dowelling of the figures. The complete front has to be mortised and tenoned into the two sides at G.

The roof consists of two rectangular parts placed up to a centre ridge. In order that the roof slopes should lie flat against the ridge, one edge has to be chamfered, and the angle is shown by the section on the design. The ridge is fixed into an open halving joint at K, in the back, and again on the front at H. The roof and edge are flush with the back, and screwed down to the upper edge thereof, as well as glued to the front and to the two sides. This will make a projection for the front of nearly an inch, which allows two parts, technically known as barge boards, to the gables, which drop below and hide the plain front.

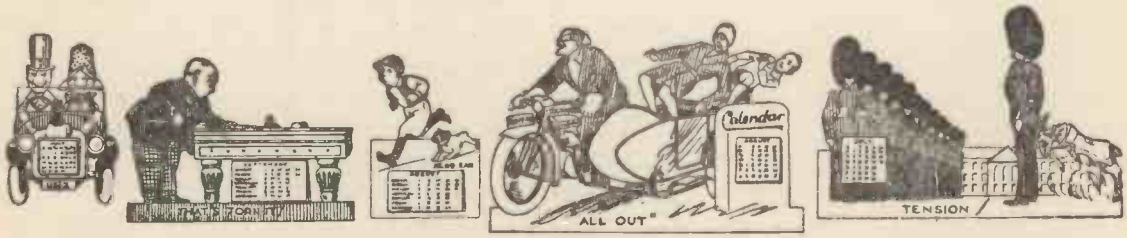
CUT-OUT CALENDARS MADE WITH A FRETSAW

HAVE you ever tried making little statuette figures by cutting them out on wood with your fretsaw? It is quite simple and interesting, and produces an excellent little novelty. All sorts of pictures can be used, and they are simply pasted on to a piece of wood cut round to their outline and fixed to some sort of base which will hold them upright. Suitable photographs can be made into lifelike pictures in the form of these statuettes, whilst a large number of coloured fronts from magazines can be used in the same way. The illustrations herewith give a good idea of what the completed statuettes look like, but in each instance here a calendar has been added to make the article more novel and generally useful. The picture, of course, must have a flat base and be of simple outline suitable for cutting with the fretsaw. A large range is obtainable from Hobbies Ltd., all of which have been specially selected for the purpose. They are quaint and novel, and in these a special place has been made for a suitable calendar date pad which is also obtainable from the same source. The pictures are cut out in paper with scissors, and pasted down to a piece of fretwood or plywood $\frac{1}{8}$ in. or $\frac{3}{16}$ in. thick — the former being preferable. Cut round the outline in the ordinary way with a sharp fretsaw which does not pull the paper off the wood. The picture, of course, is left on.



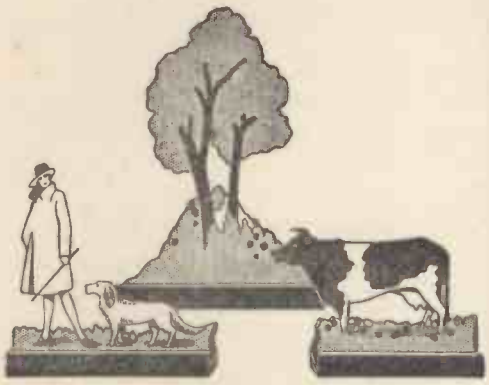
This class of Picture makes a first-rate Statuette Calendar Subject.

There are two or three methods of making the picture stand, and these are



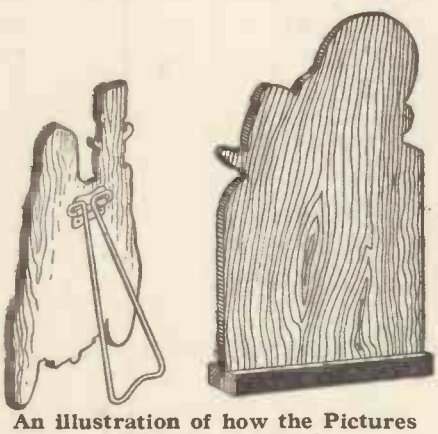
These are some Special Pictures produced for Calendar Statuettes and forming pleasing gifts made for a few pence.

illustrated herewith. The bottom edge of the picture must always be straight if a base strip is to be added. This strip can be a length of wood ½ in. square, glued level with the bottom edge behind the picture. Or a special moulding is obtainable which has a groove cut in it to take the picture board and serve as a base. This is also illustrated. When a tall upright picture has been cut, an ordinary base is liable to be insufficient to hold, and a photo strut either of wood or the special shaped metal ones obtainable should be used. These are screwed on behind so that the picture slopes slightly backwards. Special hinges and wire supports are obtainable for one penny or twopence each, which serve this purpose. They are fixed with small nails just long enough to hold, but not long enough to go through the wood and show on the picture.



By collecting suitable Pictures a complete Farmyard Set can be made up.

The edge of the wood should be painted jet black, and the baseboard treated in the same way. This is easily done with the special preparation known as Eggshell Black, and if a bright glossy surface is required, varnish or polish can be added to the black so that both are put on together, or the varnish can be applied over the black after a first coat has been brushed on. The position of the calendar is given in the pictures, which are bought for the purpose, but if the worker makes his own and uses some from magazine covers, he must remember to allow a suitable space for these calendar pads.

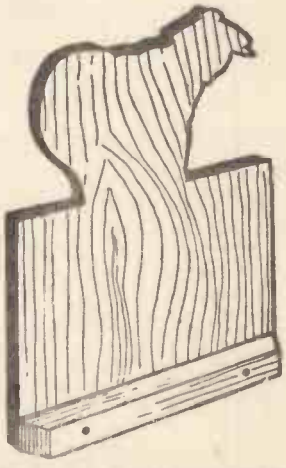


An illustration of how the Pictures are made to stand.

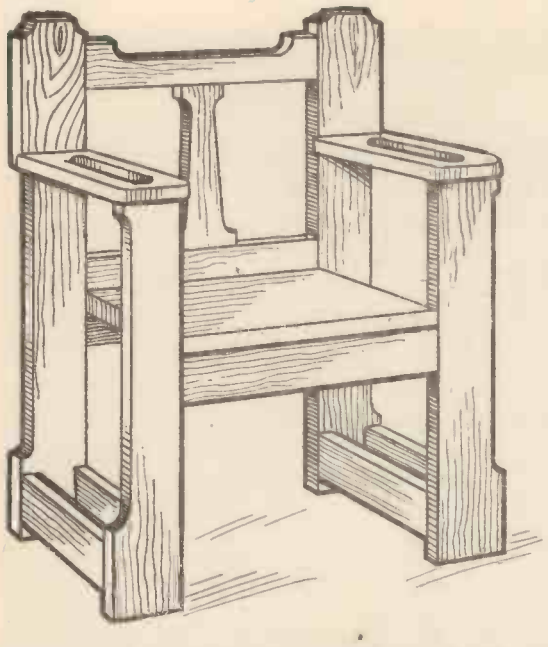
A pastime like this offers no end of jolly amusement. Go through old newspapers or good class magazines and find pictures suitable for using. You can make up a complete farmyard, or a zoo, or a fleet of cars in this way, by mounting and cutting out as described. Magazine covers printed in colours are particularly good for the work, and even picture postcards or cigarette cards can be used. Remember in every case to have the bottom edge straight or level, so that the finished statuette may stand.

Photographs of full-length figures, of yourself, or your house, are quite suitable if taken at the right angle and view.

This is a Special strip supplied with a groove ready to take the Picture.



Here the Base is merely a strip of wood glued and nailed along the back.



AN EASILY MADE HALL SEAT

THE fellow who owns a set of carpentry tools can make himself handy by cutting out this striking hall seat and umbrella stand. It can be completed in ¾-inch oak or Spanish chestnut, and the various parts can be shaped, as shown, with a fretsaw or bowsaw. Briefly described, the article consists of a framed back and a framed front, elevations of which are shown in outline by Figs. 1 and 2, connected together by arms, seat, and bottom rails. Suitable dimensions are given on the elevations, and also on the plan (Fig. 3). The positions occupied by the arms, seat, and bottom rails are indicated by dotted lines on Fig. 1.

It will be found most convenient to make the back framing first. For this, the following will be required: two uprights, 3 ft. long by 4½ in. wide; top rail, 2 ft. long by 3 in. wide; bottom rail, 2 ft. long by 4½ in. wide; centre upright, 1 ft. long by 4½ in. wide, diminishing to 3 in. wide at the top end. The members are mortised and tenoned together, the rails entering the outside uprights to a depth of 2½ in., and the centre upright entering the rails to a distance of ¾ in. The mortises and tenons should be worked before fretsawing the members as shown. If the tenons are well fitted and well glued no other fixing should be necessary; but for additional strength, fine screws may be driven in from the back.

For the front framing, two uprights 2 ft. 4½ in. long by 4½ in. wide, and seat rail, 2 ft. long by 3 in. wide, will be required. The construction is similar to that of the back framing, except that the seat rail should be planed down to ¾ in. in thickness and set in ⅛ in. from the face of the uprights. The purpose of this is to "break the joint" with the seat, which finishes flush with the face of the uprights. It will be noticed (see Fig. 2) that stub-tenons are sawn on the top ends of the uprights; these enter mortises, worked in the underside of the arms.

The arms should next be prepared. For

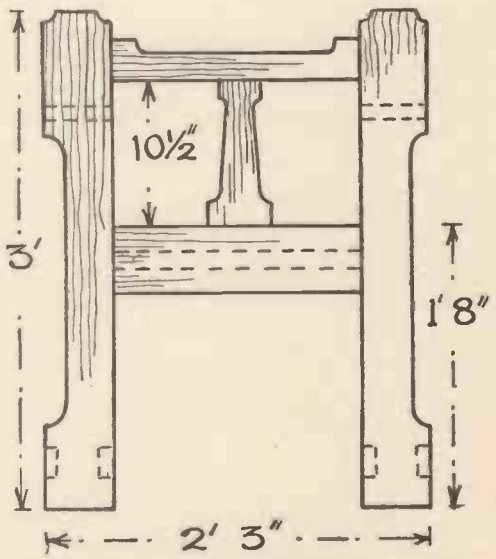


Fig. 1.—An Elevation of the back of the Chair, with useful Dimensions.

these, material 6 in. wide will be required. It will be seen that a slot is fretsawn in the centre of the arms to take the walking sticks and umbrellas. It should be a simple matter to make out the geometrical shape of the arms and slots by reference to the dimensions given on Fig. 3. The arms are connected to the back framing by stub-tenons similar to those shown on the uprights at Fig. 2.

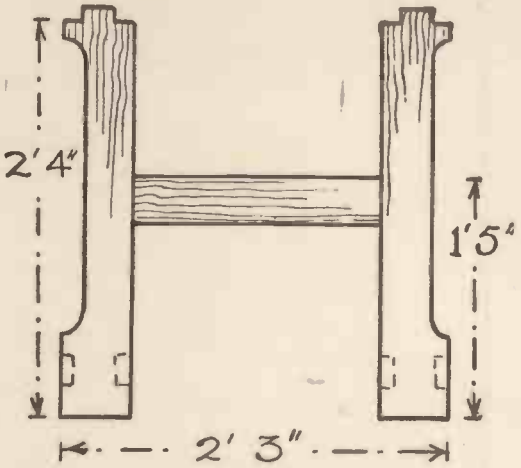


Fig. 2.—An Elevation of the Chair front.

A suitable width for the bottom rails is $2\frac{1}{2}$ in., and these are bare-faced tenoned into the back and front uprights in the positions indicated by dotted lines on Fig. 1. It will be seen by this figure, and by the general illustration, that two rails are provided at each side—on the assumption that the worker is capable of soldering up two stout zinc trays so made as to be supported between these rails. An alternative method would be to dispense with the outer rails and to buy two enamelled iron receptacles (made specially for taking the drip from umbrellas) provided with slotted

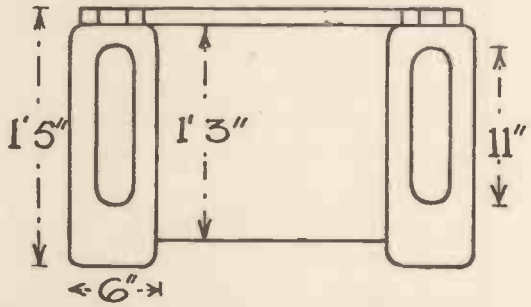


Fig. 3.—Looking down at the Seat and Arms.

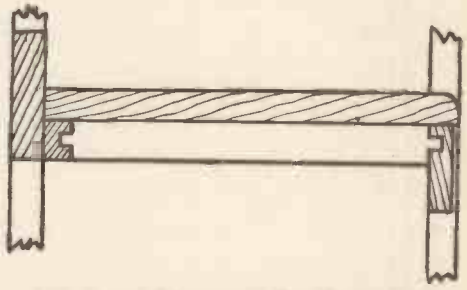


Fig. 4.—A Section of the Chair from back to front.

screw holes, by means of which they could be fixed to single rails fixed at the inner edges of the uprights.

The dimensions of the seat are 1 ft. 6 in. long by 1 ft. 3 in. wide. There is no reason why two or three widths should not be glue-jointed together to form this, as the glue joints will be strengthened by the cross-bearers by which the seat is carried. A section through the seat from back to front is shown at Fig. 4, and a section through the seat from side to side is shown at Fig. 5. The sharp edge at the front of the seat should be slightly rounded off with glasspaper.

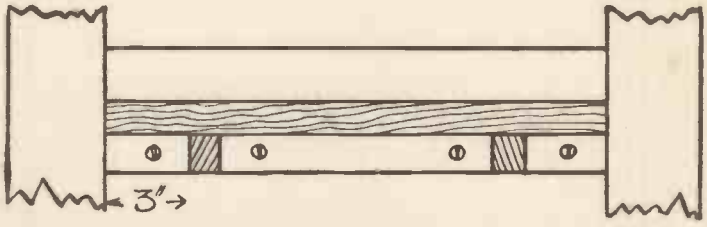
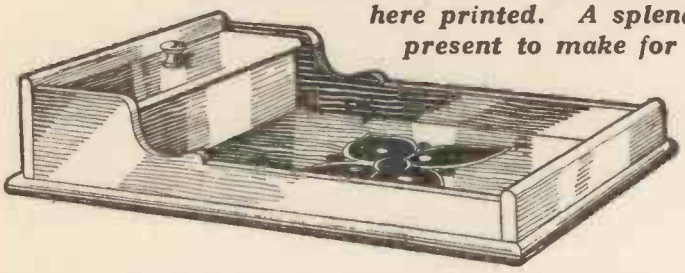
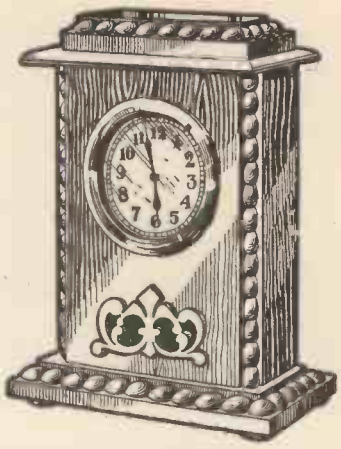


Fig. 5—Another Section—this time from side to side.

A DRESSING-TABLE CLOCK AND TRAY

Easily cut out in fretwood from full-size patterns provided and the particulars here printed. A splendid present to make for a friend





FRETWORK, of course, at one time merely consisted of seeing how many holes could be cut inside one piece of wood or from one pattern. Now popular taste has altered a good deal, and a more severe and less intricate design seems to be in greater demand. Although the clock and tray illustrated can be cut with a fretsaw, there is only one actual piece of fretwork—a small overlay on the front of the clock. Both the articles are useful as well as simple, and are built up without any tiresome joints. All the parts have straight edges and mainly consist of plain rectangles.

The clock will look best if completed in mahogany, and a parcel of wood is obtainable, as shown elsewhere. So far as the parts to be cut are concerned, it is necessary to obtain from Hobbies Ltd. the large chart which contains patterns for the pieces to be cut. This saves a lot of marking and measuring, for the paper patterns are merely pasted down to the wood and cut out in the usual way with a fretsaw.

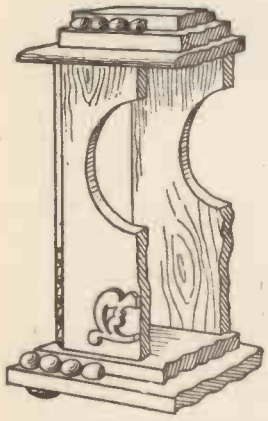


Fig. 1.—The Case broken through to show the General C onstruction.

The completed clock stands $6\frac{1}{2}$ in. high and $4\frac{3}{4}$ in. wide, and its construction is indicated by the sectional drawing given at Fig. 1. This picture is a side view of the clock cut right through the centre, and the position of the various parts can be clearly seen. The first part to be made is the framework, and here we have four pieces fixed together by $\frac{1}{2}$-in. angle fillets in the corners. This is illustrated at Fig. 2, where a picture of three sides is shown with the back omitted. Take the back and front first, cut off the angle fillets supplied the same length, and then glue the triangular pieces so that the right angle will fix right into the corner. Glue a length of fillet to each of the long edges of the back and the front. Make sure to get the fillet true, and

MATERIALS YOU REQUIRE

The design chart of all the parts ready to paste to the wood is No. 1758 and costs 4d. (postage ½d.). A special parcel of mahogany, beading, toes, etc. is supplied for 2/2 (postage 6d.). The clock to fit (No. 5306) costs only 3/3, and a small knob 1½d. Postage is 4d. extra.

then leave it until the glue is set. Then we can add the two narrow sides by gluing to the projecting edges of the fillet, and so make up a framework similar to that which is shown in Fig. 3. This completed framework is then glued to the upper base, and has screws passed in from the underside. At the other end the main top is then glued on from above.

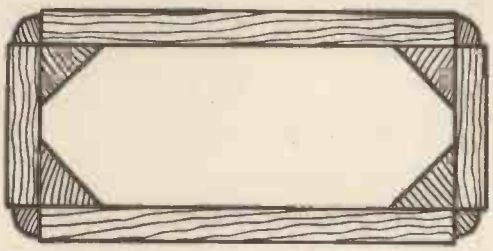


Fig. 3.—A Section through the body of the Clock showing the Corner Blocking Pieces.

The main base is glued beneath the lower one, whilst the top of the clock is made up by a further two pieces (top A and B) glued nearer to the back than the front. Their exact position can be seen in the detail at Fig. 1. In the angle of the base and of the top, the quarter round beading supplied has to be glued, and upright strips are also fixed into the right-angle joints of the framework of the clock itself. In cutting the lengths for the base and top, see that the corners are mitred so that the quarter ball carries round evenly as far as possible. The cloth is completed by the addition of a simple overlay in $\frac{1}{16}$-in. wood (glued immediately beneath the clock face), and the addition of four toes, one at each corner below the base. The clock movement is put in through the front after the wide rim back has been taken off. This back is replaced behind the wood of the clock-case, and there screwed up tightly in position.

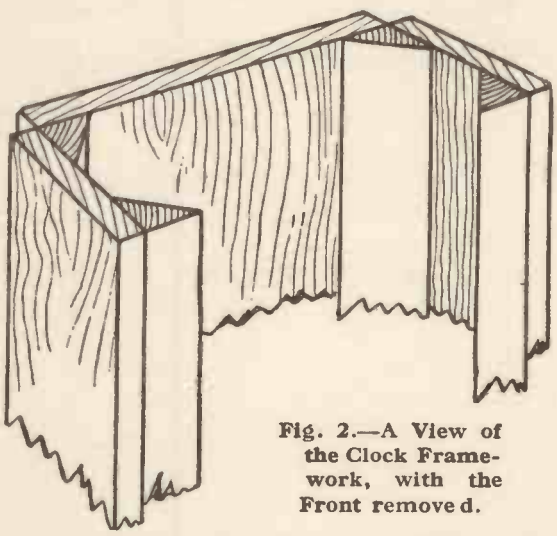


Fig. 2.—A View of the Clock Framework, with the Front removed.

The tray, like the clock, is quite a simple affair. On a plain rectangular base there are two sides and two ends built. The two sides are glued between the two ends, with the top considerably higher than the bottom. The fourth side of the box is provided by a front glued between the two sides. All these positions should be marked out on the base by screw holes and a centre pencil line, in order that when the various pieces are fitted together, they may be put in position true.

The lid of the box is not hinged, but fits into the recess of the box itself, and is held by a fillet under the front edge. These fillets are taken from $\frac{1}{4}$-in. wood $\frac{1}{4}$ in. wide. One fillet is glued along the back edge of the box the same height as the front. The lid is then cut, and a fillet is put in on the underside so that it forms a tight fit against the inner face of the front of the box. The detail at Fig. 4 shows the box with the lid by the side of it.

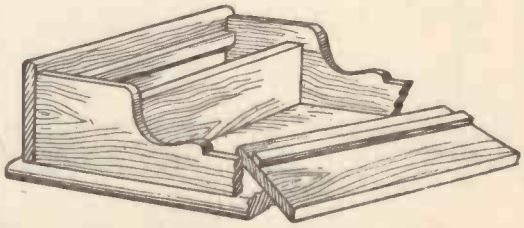


Fig. 4. A detail of the Box fitted into the end of the Tray. The lid is shown away.

A Fine Model Railway Station

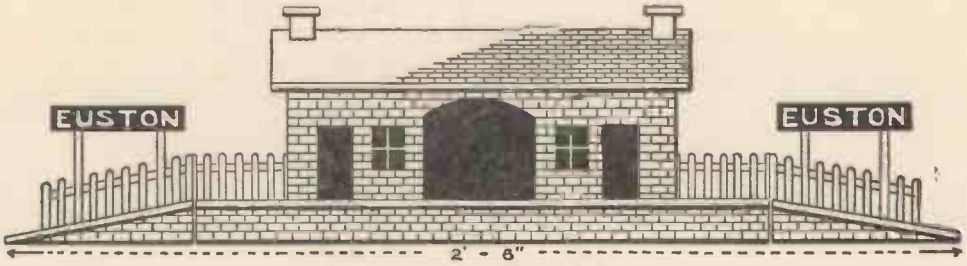


Fig. 1.—An Elevation View.

MANY readers of this Annual possess model railways; it may only be an inexpensive clockwork model, or on the other hand it may be an expensive electric outfit. These toys are very popular with boys of all ages, but a railway of any kind demands a really good station, and while boys may not be able to construct the railway itself, they can quite easily make a station. That shown in the elevation and plan, Figs. 1 and 2, is made almost entirely of plywood.

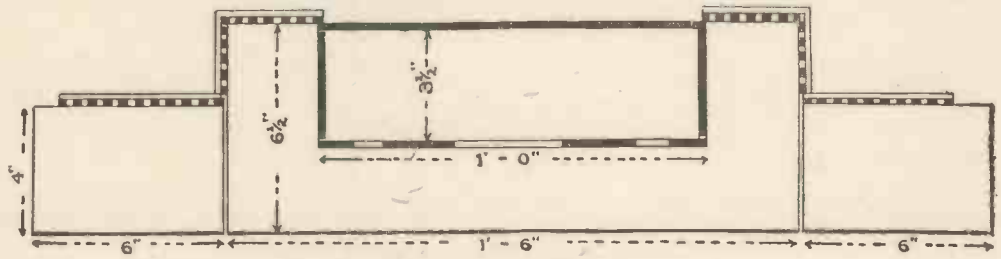


Fig. 2.—A Plan View of the Station.

The work is of such a simple character that any intelligent boy will be able to carry it out with few tools. As shown, the station is 2 ft. 6 in. long by 6½ in. wide by 9 in. high, and is made in three parts. This station is a very useful size for most railways, except the very small models, for which the dimensions could all be reduced proportionately. The three parts of the station are the main portion of the platform and the station buildings in one piece, and the two end sloping portions of the platform in two separate pieces.

Materials Required.—Plywood is the most suitable material to use in making models of this kind; a cheap panel, measuring about 30 in. by 48 in. by $\frac{3}{16}$ in. thick may be bought for about 2s. 6d. There is no need to use expensive wood, because when the station is finished, it may be covered with red brick and slate

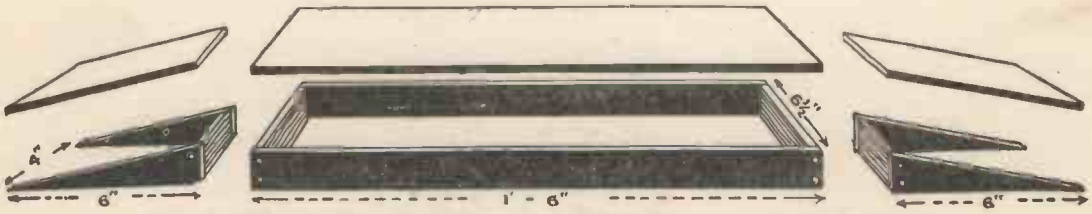


Fig. 3.—The method of making the Three Portions of the Platform.

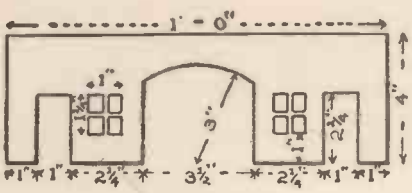


Fig. 4.—The Front of the Station.

Fig. 5.—The size and shape of the Ends.

Fig. 6.—The Front and Back nailed and glued to the Sides.

roofing papers, which are sold in sheets quite cheaply. The way to make the three portions of the platform is shown at Fig. 3. For the main portion, cut two sides, 1 ft. 6 in. long by 1 in. high, and two ends, $6\frac{1}{8}$ in. long by 1 in. high, and fit the sides to the ends. For the two end sloping portions, cut four tapering sides 6 in. long by 1 in. high, and two ends $3\frac{5}{8}$ in. long by 1 in. high, and glue and nail the sides to the ends. The main portion of the platform is covered with a piece of wood 1 ft. 6 in. long by $6\frac{5}{8}$ in. wide, and the two end portions with pieces of wood $6\frac{1}{4}$ in. long by $4\frac{1}{8}$ in. wide, glued and nailed to the sides and ends to overhang $\frac{1}{8}$ in. at the front.

The Front and Back.—The station building is made with a front cut to the size and shape shown at Fig. 4, a back of similar size, but without the door and window openings, and two ends cut to the size and shape shown at Fig. 5. The front and back are glued and nailed to the ends, as shown at Fig. 6, and the roof is covered with two pieces of wood, 1 ft. 2 in. long by $2\frac{3}{4}$ in. wide. Two chimneys are fitted to the building, the stacks being cut from $\frac{3}{4}$ in. wood to the shape shown at Fig. 7, and the capping pieces are of plywood $1\frac{1}{4}$ in. long by 1 in. wide. The capping pieces should be glued and nailed to the stacks, and the latter are glued and nailed through the roof. The building is glued and nailed through the platform. The fence around the back of the platform is made with $\frac{1}{8}$ in. by $\frac{1}{4}$ in. stripwood, fixed as shown at Fig. 8. The fence on the main portion of the platform should be made first, the uprights being $2\frac{1}{4}$ in. long, glued and pinned to the back and ends to stand $1\frac{1}{2}$ in. above the platform. The uprights are joined at the back with horizontal strips. The fence on the end portion of the platform is made in a similar way, only two of the uprights should be long enough to carry the name board, which is 4 in. long by $\frac{3}{4}$ in. wide. On completion, the station building and the front of the platform could be papered as suggested. The platform and fence could be painted, and any name desired written on the name boards.

Fig. 7.—How to make the Stacks for the Chimneys.

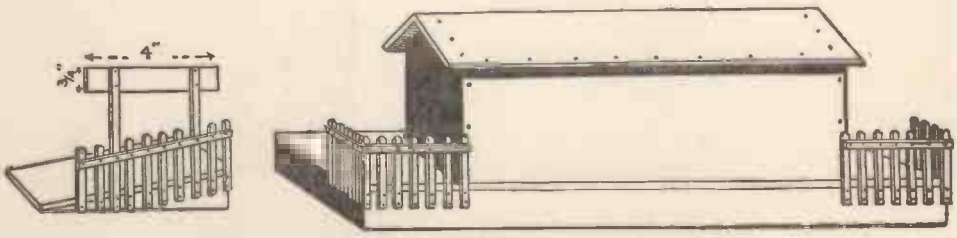
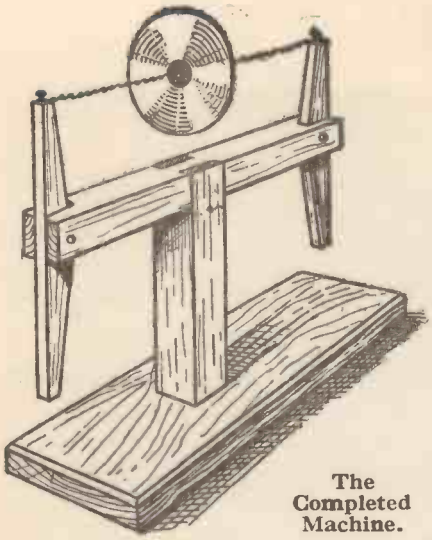


Fig. 8.—The Fence round the back of the Platform.

A Machine for Spinning Coloured Wheels



The Completed Machine.

MOST tops and spinning wheels have to be continuously wound up to make them run. Below is described a simple spinning machine on which you can mount your own colour wheels and spin them for as long as you like without stopping.

A basepiece of wood, 10 in. by 3 in. by $\frac{3}{4}$ in., with a mortise hole $\frac{3}{4}$ in. square cut through it in the centre, to take an upright bar $\frac{3}{4}$ in. square (see Fig. 1). The upright bar, $5\frac{1}{4}$ in. by $\frac{3}{4}$ in. by $\frac{3}{4}$ in., has at the top end a finger-joint cut, as in Fig. 2. The crossbar measures 8 in. by $\frac{3}{4}$ in. by $\frac{3}{4}$ in., and is cut in the centre as shown in Fig. 3; this fits on the top of the upright bar. At the ends of the cross-bar make the same finger-joint as in Fig. 2. Next come the two levers, which measure 7 in. by $\frac{3}{4}$ in. by $\frac{1}{4}$ in. each, and are shaped as in Fig. 4. From one end of each a hole 3 in. in diameter is drilled to take a panel pin or wire round nail. This same hole is drilled through the finger-joints at the end of the crossbar $\frac{3}{8}$ in. from each end, and act as a bearing for the spindle or nail. On top of the levers a pin is fixed to receive the loop ends of the strong thread which rotates the wheel.

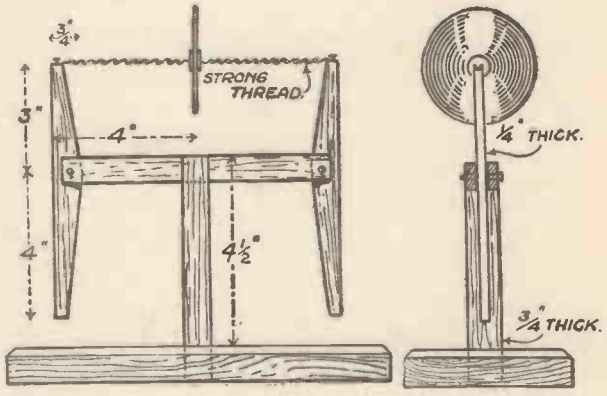


Fig. 4.—A Front and Side View of the Machine.

The machine will comfortably take 4 in. discs, and when making them strengthen the centre by fixing a card washer on either side (see Fig. 5). To put the machine in motion, first rotate the edge of the wheel until there is sufficient twist on the thread to set the wheel going. Having done this, slowly press the bottom of the levers towards the centre upright bar. The wheel spins two ways, so you will be alternately pressing and releasing pressure on the levers as and when the thread demands. As long as you apply this principle of alternative pressure the disc will spin.

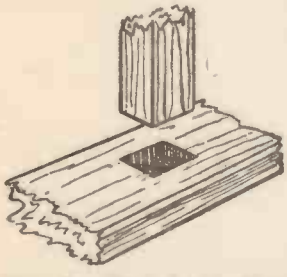


Fig. 1.—The Base with hole cut to take the upright.

Fig. 2.—Details of the finger-joints.

Fig. 3.—The cross-piece should be jointed in the middle as shown.

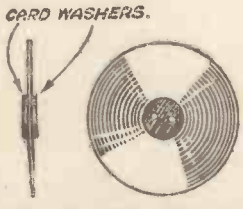


Fig. 5.—The Wheel with cardboard discs attached to strengthen it.

HOW TO MAKE A CHILD'S SCOOTER

You can make this splendid Scooter in a few hours. It is stronger even than the purchased Article

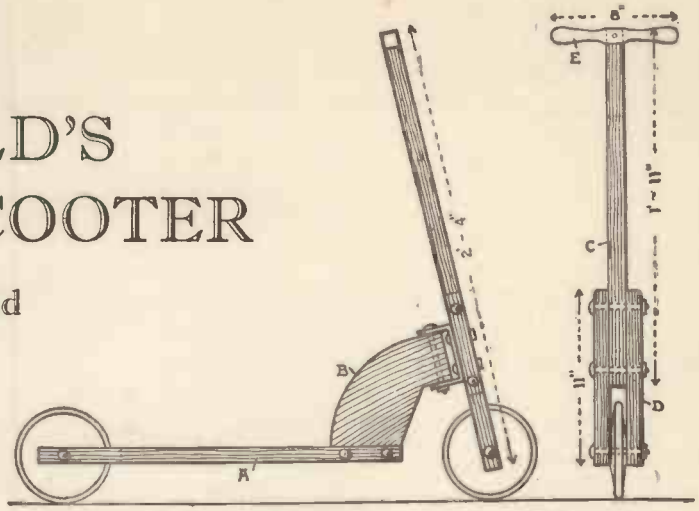


Fig. 1.—A Side and Front Elevation of the Scooter.

A SCOOTER is so easy and cheap to make that every boy should possess one. The work of making that shown here will come within the scope of elder boys, who are able to use ordinary woodworking tools, and those who are too young should find no difficulty in persuading their fathers or brothers to lend their aid. It is an interesting piece of work, and is really not difficult, as the parts only need to be cut out and bolted together.

Material and Method of Construction.—For a toy of this kind hardwood is essential, and suitable kinds are birch, elm, ash, or oak, not less than 1 in. thick. The scooter, side and front elevations of which are shown at Fig. 1, is made with a running-board (A), to the front end of which a neck piece (B) is fitted. The steering-handle and front fork is made with a centre shaft (C), the fork for the front wheel being formed by bolting two extension pieces (D), one on each side of the centre shaft at the bottom end, and the steering-handle (E) is mortised to the top end. The steering-handle and fork is pivoted to the neck piece by means of an iron jaw piece and long bolt, the jaw piece being bolted to the handle and fork, and the long bolt passes through the neck piece. The back wheel has a slot cut for it in the running-board, and the front wheel fits between the forks, both being fixed with bolts.

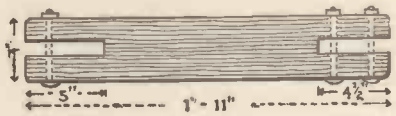
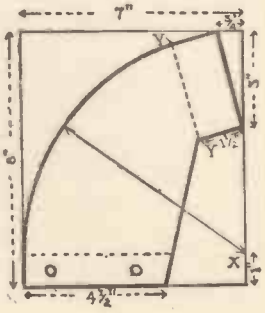


Fig. 2.—The Running Board.

The Running-Board and Neck Piece.—The running-board is shown at Fig. 2. It is 1 ft. 11 in. long by 4 in. wide, with a slot 4½ in. long by 1 in. wide cut at the front end for the neck piece, and a slot 5 in. long by 1 in. wide at the back end for the back wheel. The neck piece will require a piece of wood 7 in.



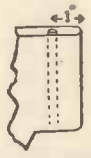


Fig. 3.—The details of the Neck Piece.

long by 8 in. wide, the method of setting out being shown at Fig. 3. First mark off the bottom 4½ in. long, then mark the depth of 3 in. from the front top end for the portion over which the iron jaw piece will fit. Set the top edge of this back ¾ in., and mark the width of 1½ in. at the bottom. Join up these points to form the outline of the neck piece, and mark out the shape at the back with a pair of compasses set at the point X. Cut out the neck piece with a keyhole saw, and bore a ¼ in. hole for the long bolt at the front end. The neck piece is now fitted in the slot at the front end of the running board, to which it is fixed with two ¼ in. bolts.

The Handle and Fork.—The centre shaft of the handle is 1 ft. 11 in. long by 1 in. square, and the two extension pieces, which are bolted one on each side of the centre shaft, are 11 in. long by 1 in. square. The steering-handle is 8 in. long by 1 in. square, with the ends rounded down with a spokeshave to give a good grip to the hands. A tenon is cut at the top end of the centre shaft, and a corresponding mortise is cut in the handle for fitting the two together, as shown at Fig. 4, the joint being fixed by boring a small wood pin through it.

Fitting the Steering Gear and Wheels.—The iron jaw piece is formed from a piece of 1 in. by ¼ in. iron 7 in. long. The ends of the iron should be rounded

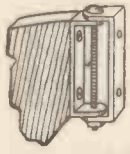


Fig. 6.—Another method of fixing the Steering.

Fig. 4.—How to fix the Handle.

Fig. 5.—One method of fixing the Steering Gear.

¼ in. holes to receive the long bolt are bored or punched ½ in. in from the ends, and two other ¼ in. bolt holes are also necessary for bolting the iron to the steering-handle. When the holes have been bored, the iron should be heated and bent to the shape shown at Fig. 5. This may be easily done if the iron is held in a vice with 2 in. of the end projecting above the vice jaws, the projecting end being bent over at right angles with a hammer. The iron jaw is now bolted to the steering-handle, after which the jaw is fitted over the neck piece and the long bolt is fitted, as shown at Fig. 1.

Another method of fitting the steering-gear is to provide two iron jaw pieces, one fitting within the other, as shown at Fig. 6, and pivoted with a long bolt. The front jaw piece is bolted through the steering-handle, and the back jaw is screwed to the neck piece, which, if this method is adopted, will be shaped at the front as shown by the dotted line Y–Y in Fig. 3, and the grain of the wood will run perpendicularly instead of horizontally.

The wheels should be 4 in. diameter by 1 in. thick, and they may be of the solid wood kind, or, better still, wood wheels fitted with rubber tyres. Bolts and nuts are used to fit the wheels, and both the wheels and steering-gear should be well greased or lubricated to make the working easy.

The scooter should be either painted or varnished on completion.

A FASCINATING AND EASILY-MADE WIRE PUZZLE

Make this Teaser to try on your Friends

Fig. 1. Wire rod attached to Curtain Ring.

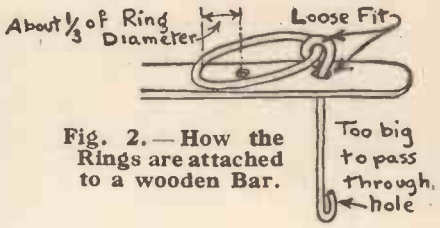


Fig. 2.—How the Rings are attached to a wooden Bar.

WHETHER this puzzle really originated in China seems a doubtful question, but there is no doubt at all that it is one of the best puzzles ever made. It can be made with any number of rings, but the usual amounts are from six to ten. The six-ring puzzle can be done in about one minute (when you know *how* to do it !), but each added ring makes the puzzle take about twice as long to solve, so a little mental arithmetic will indicate that a ten-ring puzzle should take about a quarter of an hour. Working such a puzzle is rather like knitting ; you " knit " away for a quarter of an hour, more or less, and eventually the two pieces of the puzzle separate.

The Construction of the Puzzle.—First get six curtain rings about 1 in.

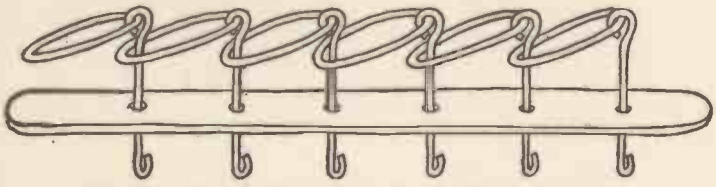


Fig. 3.—The Puzzle with all the Rings attached.

diameter, and some brass wire about 16-gauge, then form an eye in the end of a piece of wire, say 3 in. long, so that the eye holds a ring, as shown in Fig. 1. Make six parts like this. Next get a piece of wood or metal, or any other material that suggests itself to you, say 6 in. long, $\frac{3}{4}$ in. wide, and about $\frac{1}{16}$ in. or $\frac{1}{8}$ in. thick. Drill a hole 1 in. in one end, large enough to take the wire freely, put a wire (with ring attached) through the hole, and bend over the bottom end of the wire, as shown in Fig. 2. Then drill a second hole about one-third across the first ring (see Fig. 2), and insert a second wire and ring. Repeat this procedure until all the wires and rings are fixed, and the puzzle should look like the sketch (Fig. 3).

The Loop to Complete the Puzzle.—A length of about 18 in. of 16-gauge

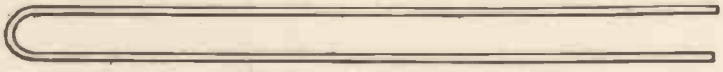


Fig. 4.—The open-ended loop of wire.

wire is cut off and bent in the middle to form an open-ended loop (see Fig. 4). Thread this loop through the rings and twist the ends together as shown in Fig. 5, and the puzzle will be complete. The problem is to remove the loop.

How it is Solved.—To solve the puzzle, take hold of the loop by the twisted end in the right hand, with the rounded end pointing to your left ; the puzzle then appears to you as Fig. 5. Let the rings and the base hang down from the loop, and manipulate the rings with the left hand. For ease of reference, let us number the rings 1 to 6, that on the left being No. 1, the others being numbered

consecutively towards the right. Draw the loop through the rings towards the right as far as it will go, lift rings 1 and 2 together over the end of the loop, then push the loop back to the left and drop the rings through as shown in Fig. 6. This illustration shows the rings nearly half-way through the loop, but they will

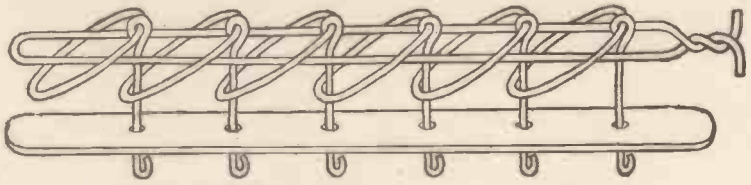


Fig. 5.—The First Move in solving the Puzzle.

fall right down and rest on the base. Now the secret of the whole thing is that the second ring from the left-hand end of the loop can always be removed.

After removing 1 and 2 as just described, the ring at the left-hand end of the loop is No. 3, and the second from the end No. 4 ; No. 4, then, is the next ring to come off. It is removed by drawing the loop as far as possible to the right, lifting 4 up over the end of the loop, pushing the loop back to the left,and dropping the ring through in the same way as you did 1 and 2. (See Fig. 6.)

Removing the Three Remaining Rings.—You now remove No. 3, and to do this put Nos. 1 and 2 on again by reversing the process for taking them off, *i.e.*, push rings 1 and 2 up through the loop as in Fig. 6, draw the loop to the right and allow the rings to drop below the rounded end of the loop. Now draw the

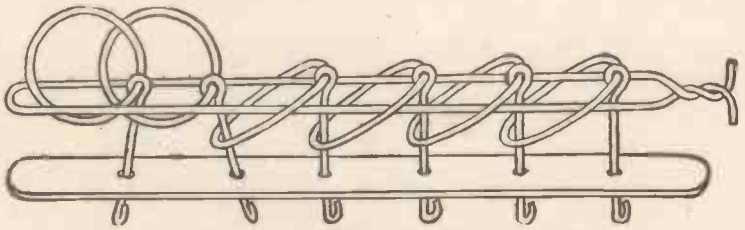


Fig. 6.—The Second Move in solving the Puzzle.

loop to the right, lift up No. 1 only, push loop to the left, and drop No. 1 through. No. 3 then becomes the second from the end, and can be removed in the usual manner. To remove No. 2, put No. 1 on the loop again (by passing it up from below in the same manner that you put 1 and 2 on together), then remove 1 and 2 together as before. Now 5 and 6 only are on the loop, and No. 6 being second from the end, can be removed. Then proceed as follows :

Put on 1 and 2 together. Remove 1. Put on 3. Put on 1. Take off 1 and 2 together. Put on 4. Put on 1 and 2. This leaves 1, 2, 3, 4 and 5 all on the loop, and the only result so far has been to get No. 6 off. To proceed : Take off 1. Take off 3. Put on 1. Take off 1 and 2. Take off 5. Put on 1 and 2. Take off 1. Put on 3. Put on 1. Nos. 1, 2, 3 and 4 are now on, and 5 and 6 are off. Take off 1 and 2. Take off 4. Put on 1 and 2. Take off 1. Take off 3. Put on 1. Take off 1 and 2, and the puzzle is done ! There is, of course, exactly as much work to be done in replacing the loop. There is no need to describe the method in detail, for you just work through the instructions.

MOULDS FOR CASTING LEAD TOYS

THE process of duplicating existing lead models may be undertaken with ease by any amateur, provided he is willing to take a reasonable amount of care. Let us assume that the model to be duplicated is 1½ in. high by ½ in. broad ; a model stationmaster, for instance. The first article to be constructed is the box stop. Cut out a piece of cardboard to the dimensions and shape shown at Fig. 1, score along the dotted lines, and bend up the flaps to form a lidless box, placing an elastic band round it to hold it together.

Making the Mould.—Obtain two-pennyworth of plaster of Paris (sufficient for several moulds). Carefully cover the model with oil, and then mix a tablespoonful of plaster with sufficient water to make a thin paste ; place this mixture in the box, so as to fill this half-way up the sides, and level up the surface. Allow the mixture to become " tacky," and then sink the model evenly in it, face downwards, until it is half immersed. Leave the plaster to set, and then carefully remove the model with a pair of pliers. If it has been thoroughly oiled, it should come away from the plaster without breakage. Slip off the elastic band, bend down the sides of the box, and remove the mould ; the edges of this half of the mould should now be bevelled with a penknife (Fig. 2).

Replace the mould in the box, re-oil the model, and also the surfaces of the plaster, and insert the model in its original position. Mix some more plaster, and place this in the box, filling up flush with the surface, removing all air-bubbles by pressing down the wet plaster with the end of a pencil. Allow it to dry thoroughly, and then remove from the box ; the two halves on the mould may now be separated, and should come apart easily if oil has been applied freely. A small channel should be cut in the plaster from the base of the model to the edge of the mould, through which to pour the lead. The mould is now ready for use.

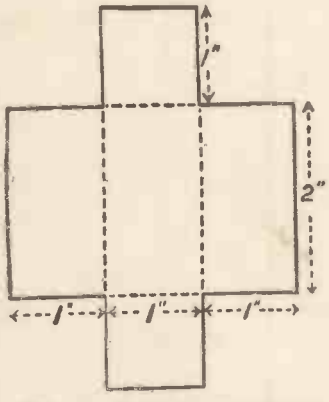


Fig. 1.—How to make the Mould.

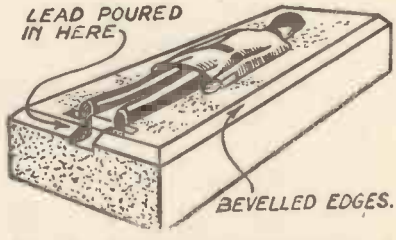
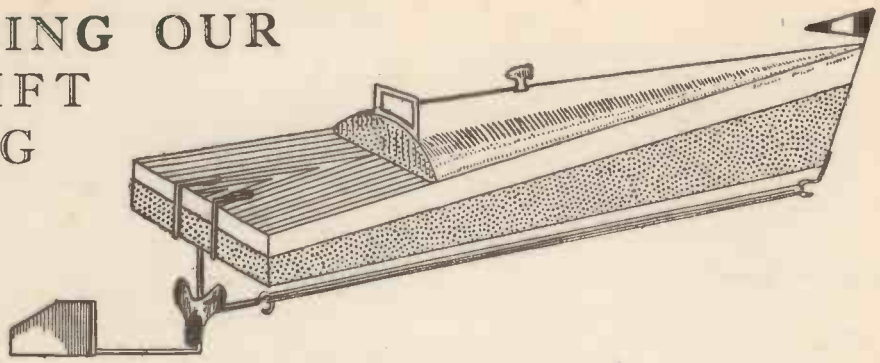


Fig. 2.—Taking an impression of a toy stationmaster in the plaster Mould.

Warm up some scrap lead in a tin, place the mould on a piece of wood, and grip the two halves together with two more pieces of wood. Pour in the lead—keeping the head well back to avoid splutterings—and allow a few seconds for cooling ; separate the half-moulds, and remove the " casting " with pliers ; it may then be trimmed, filed, and afterwards painted to suit personal tastes.

ASSEMBLING OUR FREE GIFT WORKING MODELS

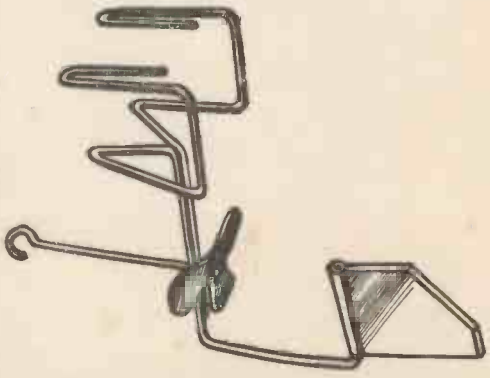
All of the parts will be found in an envelope at the back of this Annual



The finished Model Speed Boat.

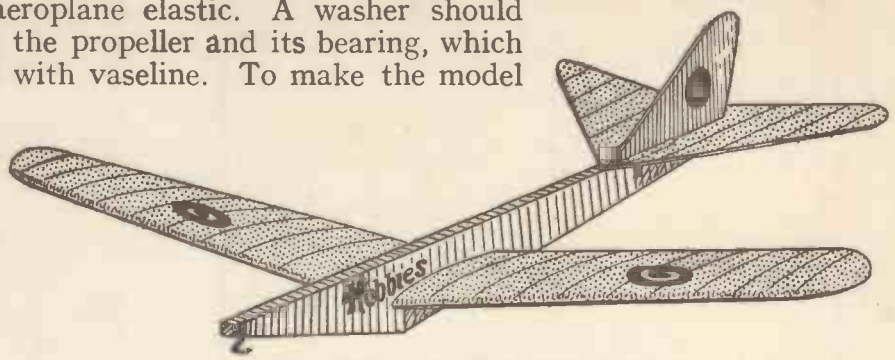
IN an envelope at the back of this volume will be found six sheets of cards, numbered 1 to 6. Sheets 1 and 2 are for making the ripping model speed boat shown in the sketch at the top of this page; sheets 3 and 4 make up a fine catapult glider, and sheets 5 and 6 make a working model windmill which is operated by sand. (See page 127.) Carefully examine the instructions given on each sheet before cutting out the parts. The only tools you will require are a ruler, a pocket-knife, pair of scissors, and a tube of glue.

Assembling the Model Boat.—Now take sheet 1 and cut out the hull of the boat (Fig. 1). This when glued together will form a hull, triangular in shape, but having a semi-rounded bottom. The stern is formed by folding the corners diagonally as shown by a dotted line. Crease also along the line marked X. Fig. 10 indicates how the folding should be done. Next cut out the deck (Fig. 2, sheet 2), and then the cowled hood or turtle back (Fig. 3), gluing this over the deck, and tucking the tabs inside out of sight. On top of the turtle back glue the ventilators (Fig. 6), sticking the two parts of this together. At the rear of the turtle back glue the end of the hood (Fig. 7), and above it the windscreen (Fig. 8). Fig. 4 shows a strip which should be folded down its centre and glued over the bow to make the hull watertight. Fig. 5 is a pennant, and the front part should be curled round a long wire extending down the bow and having a hook formed at its lower end to embrace the elastic. Fig. 11 shows the sealing strip and pennant in place. The diagram at the foot of this page shows how to form from 18-gauge wire the clip which carries the rudder and the propeller. The propeller should be made 1¼ in. in diameter, and it should be cut from the tin securing the top of a cigarette tin. The rudder should be cut from the same material. It need not necessarily be of the shape drawn. You may



This diagram shows how to make the clip for the Rudder and the Propeller.

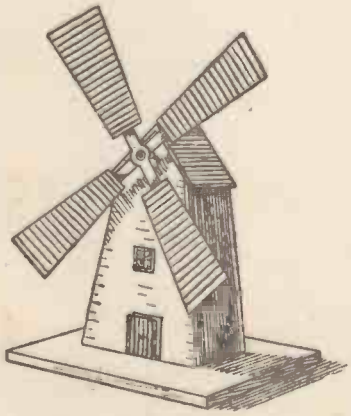
use Fig. 9 on sheet 2 as a template. When satisfied that the model is true, connect the propeller shaft hook to the hook at the bow with about four strands of $\frac{1}{8}$ in. by $\frac{1}{32}$ in. model aeroplane elastic. A washer should be placed between the propeller and its bearing, which should be smeared with vaseline. To make the model absolutely waterproof, it should be varnished or painted with a cellulose paint.



The finished Catapult Glider.

Assembling the Model Glider.—It will not take you many minutes to assemble the model glider. First cut out and assemble the fuselage (Fig. 19, sheet 4), carefully cutting the slots C and D (see Fig. 23) to receive the tail (Fig. 13, sheet 3). Before gluing the fuselage together cut a wooden nose-piece to the dimensions shown in Fig. 21, and smear glue all over it so that it remains firmly in place inside the fuselage.

Fig. 20 shows a section of the fuselage after it is assembled. Slots for the wings are cut in each side of the fuselage, and the wing (Fig. 12) is pushed through, bearing in mind that the sloping edges of the wing are the front edges. Fig. 17 shows a section of the wing which will take on this curve, and it is pushed through the fuselage. Bend the wing up on each side about $\frac{3}{4}$ in., as shown in Fig. 18. Next glue the rudder to the tail (Fig. 14), spreading the two tabs in opposite directions, as shown in the small detail A. Cut out the rudder disc (Fig. 15), and glue this directly opposite to the disc printed on the rudder by holding the latter up to the light. Screw a small picture hook into the nose of the fuselage, as shown in Fig. 22, and then make up from a piece of strong elastic the catapult shown in Fig. 16. It may be necessary to give a slight upward bend to the tail flaps should the machine tend to nose-dive.



The finished Windmill.

Assembling the Model Windmill.—The parts for this are on sheets 5 and 6. It is best to mount this up on a wooden baseboard, although a piece of cardboard will do almost as well. First cut out the two sides, Figs. 24 and 25, and glue on the front and back, Figs. 32 and 33. Next assemble the sand-wheel by folding up the core of the wheel (Fig. 30) round a piece of $1\frac{1}{2}$ in. diameter broom-handle, and passing the tabs (five on each side) through the slots of the sides of the wheel (Fig. 29). Glue these tabs down to the side. Now glue the blades of the wheel (Figs. 31 and 32) into place on the core, as shown by dotted lines, and pass the tabs on each through the slots already cut in the sides of the wheel (see Fig. 29). The diagrams

on this page show the general method of assembling. Next fit in the hopper (Fig. 34) in the position shown here. From a wooden knitting-needle cut off pieces sufficiently long to pass through the sides at the points indicated by small circles on the sides (Figs. 24 and 25), and pass these through, one through the sand-wheel and the other through the top. Glue a small cardboard washer

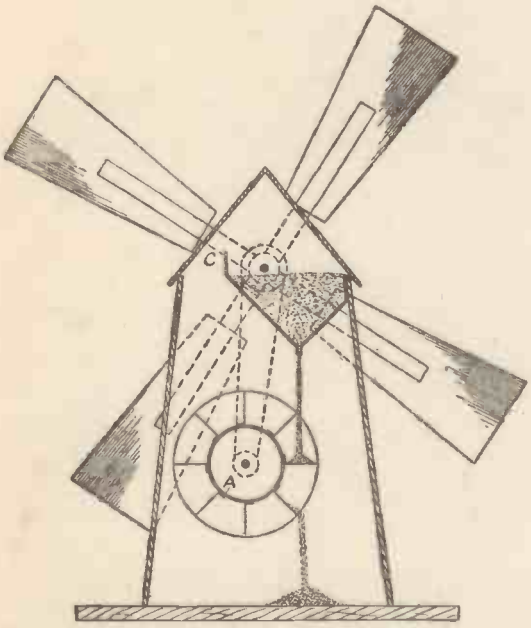
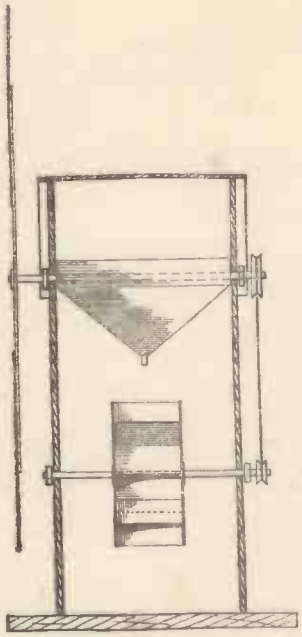
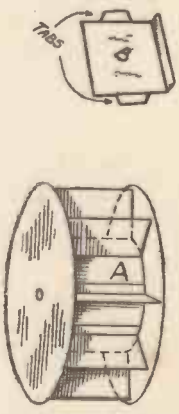


Diagram showing how the various parts of the Windmill fit together.



The Hopper and Sand-wheel Mechanism.



Assemble the Sand-wheel in the manner shown here, (A) the Core, and (B) one of the Blades.

on each to prevent the spindle pulling through, and also a small driving pulley as shown in the side view on this page. Fix the sand-wheel to its spindle by a touch of glue. Now assemble the sails (Figs. 26 and 27) on to the end of the top spindle, and fill the hopper with very fine silver sand, finally gluing on the roof (Fig. 28). To get the sand back again into the hopper turn the windmill slowly upside down so that the sand falls into the roof through the slot C.

Use the very finest silver sand available. As purchased this sand is damp, and it must be carefully dried before use by spreading it out on a piece of tin and placing it over the fire. If used wet the sand will refuse to run, and the moisture in it would cause the glued joints of the hopper to come apart.

A slight touch of oil on those parts of the spindles which pass through the sides of the windmill will make the windmill run more smoothly. By attaching other devices, such as a jointed cardboard acrobat, direct to the hopper spindle the model can be converted to other forms of toy.

The vanes of the windmill are stuck on to the arms quite flat, so that they offer a minimum of resistance. You will notice that the pulley on the windmill spindle is about twice the diameter of the pulley on the hopper spindle.

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