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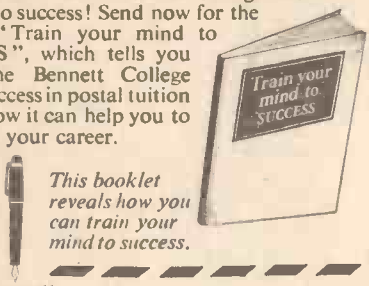

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Practical

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CONTENTS

CONTRIBUTIONS

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

FAIR COMMENT

PAST AND PRESENT

RECENTLY shown on television was an old film in which many of the scenes depicted a famous London Square in the year 1880. Slightly shrouded in fog, ornate gas lamps ghosting the darkness and hansom cabs moving gracefully along, everything seemed completely unhurried as if time was of no consequence whatever.

Today that same square closely resembles a race-track, a tearing mass of cars with would be Fangios behind the wheel: at night a blaze of sodium lamps, illuminated signs everywhere—KEEP LEFT, NO ENTRY, NO PARKING. This is the present—we call it progress, but where are we going in such a hurry and how do we use the precious time we save? This is a way of life we accept without second thought, yet it is strange how many of us enjoy a glimpse into the past, perhaps it helps to ease the tension of modern living.

FORWARD INTO SPACE

PRACTICAL MECHANICS, despite any diversities, must always be looking ahead, watching and reporting on new developments in the scientific and mechanical fields, and as we start this brand new year of 1962, what is in store for us in the months ahead?

Russia has already announced that they plan to orbit a man around the moon and bring him safely back to earth. Subsequently a rocket will be landed on the moon's surface, equipped with all the necessary instruments to send back comprehensive details of conditions that exist there. We take it for granted that Russia will take the initiative in these projects, therefore it only remains for us to await results. This is the situation today, the race to space between Nations is now virtually non-existent. We have become so keyed-up over the years by the probing and speculation of our scientists as to the possibility of life on other planets, the time is approaching to find the truth.

At one time this may have seemed frightening, but today we are more prepared, space has already been explored with some degree of safety and words like Satellite and Ionosphere are part of our everyday vocabulary. We no longer fear an invasion by fearsome little men with ray-guns at their hips. The news, when it comes, will be devoured with certain fascination and will generally be regarded as another wonderful scientific achievement. Let us hope that 1962 will see the complete conquest of the moon: the world's scientists, whatever their nationality, at least deserve this glory.

FIRST WITH THE NEWS

The leading article and cover illustration in our December issue described the Hover-rail as a future form of travel. We now learn that Hovercraft Development are working on this project which they hope may be built and operating within four years.

The February 1962, issue will be published on Jan. 31st, 1962. Order it now!

THE board (Fig. 1) is made from ex. $\frac{1}{2}$in. mahogany and is $8\frac{1}{2}$in. in diameter. Clean up both surfaces, and finish the top with finest glasspaper. Then, with soft pencil—say 3B—mark out the centres for the hollows, as shown in Fig. 3. Pencil the outlines of the outer diameter with compasses, also the edges of the outside groove. These will serve as a guide when cutting.

Fig. 1—The board being used.

Drilling the Holes

Punch each centre carefully and drill $\frac{1}{8}$in. holes $\frac{1}{8}$in. deep to ensure a steady setting for the countersinking bit (Fig. 2, right). Note that its angle is 45°. Countersink the holes until they measure $\frac{1}{2}$in. at the top. Do not countersink the centre hole at

J. E. describes MAKING A SOLITAIRE BOARD

this stage, it will later be used as a centre for cutting the outside diameter and the circular groove. Use the rasping tool (Fig. 2) in the drill chuck to round the sides and bottoms of the hollows so that they assume a nearly semi-circular shape as shown in the centre section Fig. 3.

Shaping the Board

Rounding the board and cutting the circular groove are the next jobs to be undertaken. The author used a bandsaw, disc sander and power drill but these are not absolute essentials. The centre hole is bored right through with a $\frac{9}{64}$in. drill allowing it to take a No. 6 wood screw which will be used as a pivot. Assuming that a bandsaw is available, the table is temporarily fitted with a wooden top large enough to enable the screw to be driven in it at a position $4\frac{1}{4}$in. from the near side of the bandsaw blade and at rightangles to it. The screw is then passed through the centre hole in the board and into the table and the former slowly rotated. In this way a perfect circle can be cut and the board, in turn, can similarly be fitted to the disc sander table and a really first class smooth and accurate finish accomplished. If a bandsaw is not available, the circle should be cut with a bow or fret saw—keeping just outside the cutting line—and carefully finished with glasspaper.

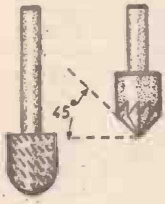
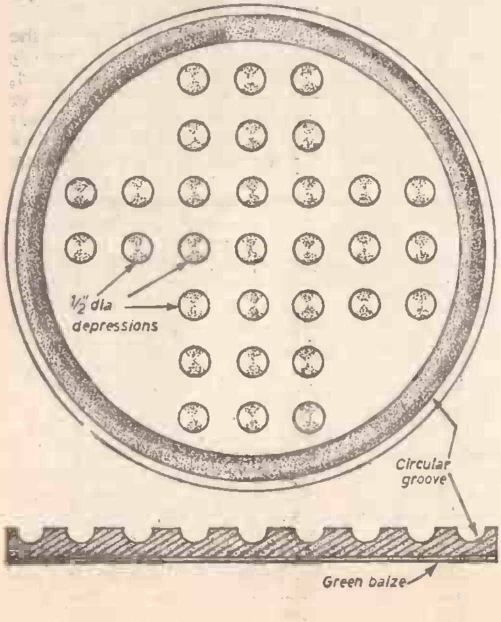


Fig. 2. (Far left)—The shaped rasping tool and (right) the high speed 45° counter-sinker.

Fig. 3. (Below)—Lay-out of the board and also showing a centre section.



The Groove

If a power drill cannot be used, resort will have to be made to the careful manipulation of a woodcarver's $\frac{1}{2}$in. gouge; also, an ordinary cutting gauge might be used to mark the outside limits of the groove—this will not only supply useful edge-guides but also prevent the wood from splitting or breaking away, particularly towards the outer edge. If, however, a power drill is available, the countersinking bit and shaped rasping tool are used in the chuck, the centre hole in the board being used as a pivot for fastening it to the drill table. The countersunk is operated at one point, with the board stationary, to a depth of not more than $\frac{1}{8}$in. and, contrary to usual practice, the *drill table* is brought up to keep the board in close contact with the bit. The work is then carefully rotated until the circle is complete. Again the bit is operated at one point, this time to a depth not exceeding $\frac{1}{4}$in., the drill table again raised, and the board rotated as before. Finally, the countersinker is again operated at one point until the top edge of the cutters reaches the top of the board, the table again raised, and rotation continued until a completely circular but triangular groove has been cut. The rasping tool is substituted; and the same procedure followed until the groove assumes semi-circular sides and bottom. This is for reception of the marbles as they are removed from the board.

Remove the board and finish off the centre hole to correspond with the other thirty-two and either polish or stain and wax polish. A final refinement is to stick a piece of green baize to the bottom.

Thirty-two ordinary glass marbles are all that is now required to complete the game.

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EVENING STAR

PART II.

PUT a $\frac{3}{16}$in. drill through the hole in crosshead and arm. Open out the hole in the arm, and the side of crosshead to which it is attached, with $\frac{7}{32}$in. drill and tap $\frac{1}{4}$in. × 40. File off the head of the 9B.A. screw, open out the hole at the bottom of the arm with $\frac{3}{16}$in. drill, and squeeze in a bronze bush. Don't forget that the crossheads should be right and left-handed! Owing to the limited clearance between crosshead and coupling rod, there must be no projection of the crosshead pin on the inside, so a special kind of pin, with the screwed part next to the head, must be used. Chuck a piece of $\frac{3}{8}$in. hexagon steel in the three-jaw, face the end, turn $\frac{1}{2}$in. length to $\frac{1}{4}$in. dia., further reduce $\frac{5}{16}$in. of the end to $\frac{3}{16}$in. dia. and screw the remnant of the $\frac{1}{4}$in. section $\frac{1}{4}$in. × 40. Part off at $\frac{1}{8}$in. from the shoulder, reverse in chuck, and chamfer the corners of the hexagon head.

Connecting-rods

If a milling machine is available, the table of which has a longitudinal movement of not less than 8in., the method described for milling coupling-rods can be used for the connecting-rods, except for a variation in the way of holding the blanks. If held direct in the machine vice on the table, the overhang at each end would be excessive, and the pressure of the cutter would spring the rods, or perhaps bend them. What I do, is to cut the lengths of steel for the rods about $1\frac{1}{2}$in. longer than specified, allowing for $\frac{3}{4}$in. overlap at each end. Instead of holding them direct in the machine-vice, they are laid on a piece of 1in. square steel bar, with a stout clip at each end to prevent any shifting under cut (Fig. 65). The bar is gripped tightly in the machine-vice, and the overhang at each end doesn't then matter, as the bar is stiff enough to stand up against the thrust of the cutter. As the connecting-rods have a slight taper, the supporting bar must be slightly tilted in the vice, so that the marked-out line of the connecting-rod is horizontal. This is only about a minute's work.

Put your scribing-block on the miller table and set the needle level with one end of the marked line, then shift it to the other end, and carefully adjust the bar until that end of the marked line is level with the needle point. Check the first end again to make certain that it hasn't shifted, then tighten up the vice and go ahead with the milling.

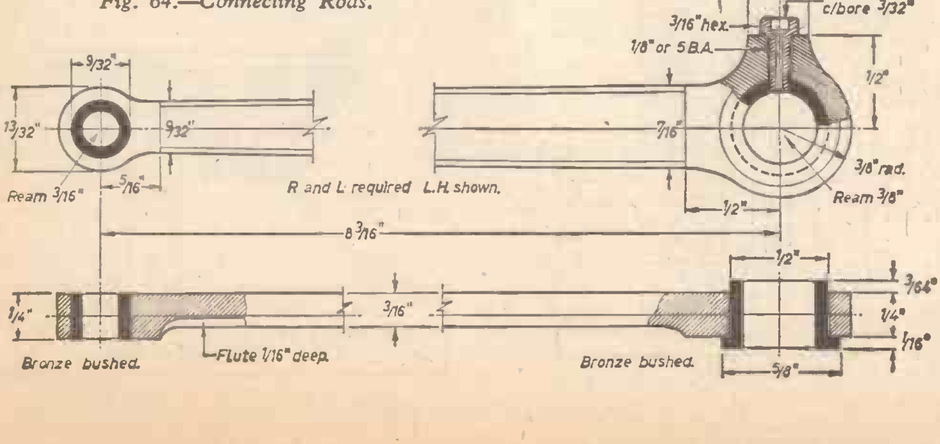
The recessing is done with each rod clamped down separately on the supporting bar. For the fluting, the big end of the rod blank is set slightly to one side, so that the cutter will run parallel to the side of the tapered rod. Use a cutter $\frac{3}{16}$in. wide on the arbor, and take the first cut about $\frac{3}{64}$in. away from the side of the rod. Reset the rod on the supporting bar so that the cutter will follow the other edge of the tapered rod, and take a second cut same distance from the edge, and same depth as the first one. The result should be a perfect tapered flute. As a matter of fact, it wouldn't be noticeable if the flute is the same width at both ends, in which case one traverse with a $\frac{1}{32}$in. cutter would do the trick; or the fluting may be omitted altogether—it doesn't affect the working of the engine, though it might offend Inspector Meticulous!

Alternative to Milling

Very few, if indeed any home-workshop lathes have slide-rests with a cross-traverse of 8in. so if the milling is done in the lathe as described for the coupling-rods, it will have to be a two-stage job. This entails exceedingly careful setting up on the second stage, so that the cut lines up with the first one. Personally I don't think it is worth the trouble, and would prefer to cut away the surplus metal with a hacksaw, holding the blanks in the bench vice and using the tops of the jaws to guide the saw blade. It is easy enough to saw along the full width of the vice-jaws, and then shift the blanks along so that the cut can be continued. A spot of careful filing afterwards would remove the saw marks.

The ends of the rods can be rounded off in the same way as the coupling-rod bosses after sawing off the overlaps. The little ends are bronze-bushed, the bushes being flush with the sides, like those in the middle of the coupling-rod. The big-end has a flanged bush, like the one at the trailing end of the coupling rod, but made to the dimensions given

Fig. 64.—Connecting Rods.



in Fig. 64. Note that it projects through $\frac{3}{64}$in. and forms a distance-piece between the coupling-rod boss and the big-end. The projection which represents the full-size oil box is drilled No. 40, tapped $\frac{1}{8}$in. or 5B.A. and furnished with a hexagon-headed brass screw, drilled through No. 55, the head being counterbored $\frac{3}{32}$in. This screw runs right into the big-end bush as shown in Fig. 64.

Assembly and Erection

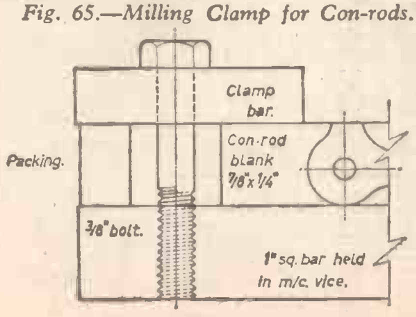
The position of the cylinders is shown on the frame drawing in dotted lines (see March issue). Put one of the cylinders in position shown, and hold it temporarily in place with a big cramp over cylinder and frame. Put a No. 30 drill into those of the flange holes that are directly accessible, and run it right through the frame plate. Put the end of a bent scriber into those you can't get the drill into, and mark little circles on the frame. Remove cylinder, centrepop the middle of each little circle, and drill No. 30. Replace cylinder, and fix it temporarily with a couple of $\frac{1}{8}$in. or 5B.A. bolts.

Remove one of the distance-pieces from a guide-bar assembly, slide the left-hand crosshead into it, replace distance-piece, and make sure the crosshead slides freely from end to end. Put the little end of the left-hand connecting-rod into the crosshead, and secure it with the crosshead pin. Put the big-end on the driving crankpin, hold the crosshead level with the piston-rod of the left-hand cylinder, and turn the wheels until the crankpin is on front dead centre; the piston-rod should enter the cross-head boss, and the crosshead should push in the piston-rod until the piston hits the front cover.

Next, put the left-hand bracket on the top guide bar at $1\frac{1}{8}$in. from the end of the bar, see Fig. 66. Temporarily clamp the bracket to both frame and bar, then turn the wheels and see if the crosshead slides freely from end to end, with no hard spots or binding of either crosshead or piston-rod. If there should be any, adjust the bracket until they disappear. When the required freedom is obtained, the bracket is set O.K. Run a No. 43 drill through the holes in the bracket where it rests on the bar, and make countersinks. Drill the frame No. 30 using the holes in the back of the brackets as guides. Remove bracket, drill the countersinks in the bar with No. 51 drill, tap 8B.A. and file off any burring, then fix the bar to the bracket with four 8BA screws, hexagon heads for preference. Fix bracket to frame with two $\frac{1}{8}$in. or 5B.A. bolts.

Take off the front cylinder cover, set the crank on front dead centre, and gently tap the piston until it is just $\frac{1}{16}$in. from the end of the bore. This will give $\frac{1}{32}$in. clearance between piston and cover at

Fig. 65.—Milling Clamp for Con-rods.



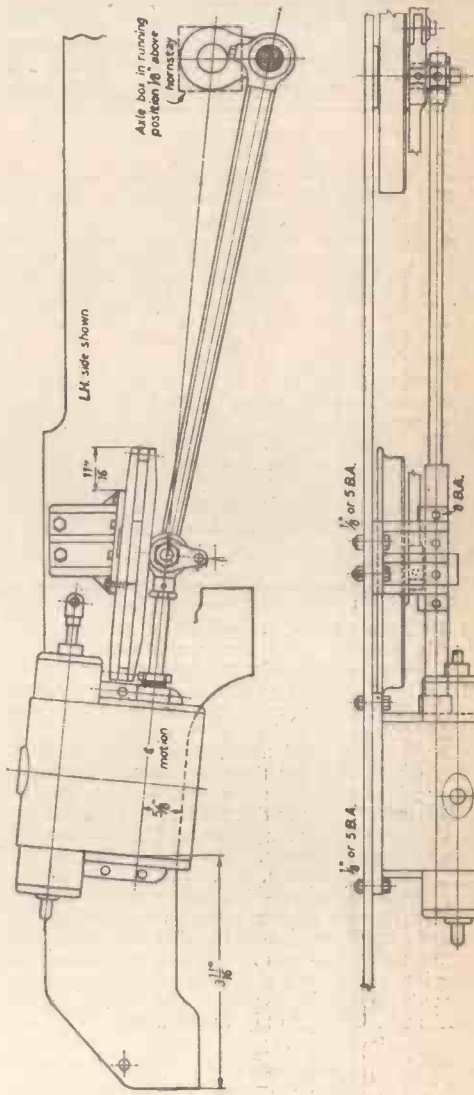


Fig. 66.—Driving Gear Erected.

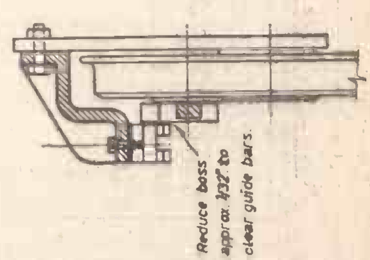


Fig. 67. — Section at Guide Bar Bracket.

APOLOGIES TO READERS FOLLOWING 'EVENING STAR' SERIES FOR A MISTAKE IN THE SEQUENCE OF THE PAGES IN THE DECEMBER ISSUE.

each end of the stroke. Drill a No. 43 hole through crosshead boss and piston-rod, and squeeze in a piece of $\frac{3}{32}$in. silver-steel, which should project about $\frac{1}{32}$in. each side. Replace cylinder cover, and repeat operations for the right-hand side, after which the wheels should turn and the whole bag of tricks work sweetly with no tight places anywhere.

Valve Gear

We now come to the job of making and erecting the valve gear; and in my long experience this seems to be the *pons asinorum* of not only all beginners in locomotive construction but quite a number of more experienced workers as well. I don't see any reason why this should be. There is no " witch-doctory " business about valve gears, as some folk would have us believe. Their function is simply (a) to operate the valve so that it admits steam to the cylinder, at the point where it can exert full pressure on the piston at the instant the crank passes dead centre; (b) to cut off steam at any desired point in the stroke; (c) to release the spent steam by the time the piston has reached the end of its stroke, avoiding back-pressure on the return stroke; (d) to reverse the movement of the engine. Over 150 different types of valve gears have been devised, some simple, some with weird and wonderful arrangements of rods and links; but of all the lot, the most extensively used have been the Stephenson link motion, and the Walschaerts radial gear. After those, the Joy radial gear, especially suitable for inside cylinders, and the American Baker gear, have been very popular. I have fitted many types of valve gears on the engines built during the past 60 years and more, so should know both good points and faults, and have found that simple gears are the best.

The valve gear on *Evening Star* is the simple straightforward Walschaerts. It differs from the usual arrangement by having the reversing shaft directly operated by the reversing screw, instead of the screw being in the cab, and connected to the gear by a long reach rod. The wheel in the cab, which is parallel with the cab side, turns a shaft like the propeller shaft of a motor-car, having a universal joint at each end, that at the front end being directly connected to the reversing screw. The latter is carried in an upward extension of the bracket carrying the expansion link on the left-hand side of the engine. On the full-size job, these brackets are fabricated, and I have had to simplify them considerably to make a suitable arrangement for 3½in. gauge; but they look just like those on big sister. One spot of bother was the supporting plate which is bolted to the frame. On the big engine, there is plenty of room for the plate to go between wheel and frame. On the little one there isn't, as you can see by the plan drawing (Fig. 69). I will explain how the small brackets can be built up, but if our advertisers can supply cast brackets—which will need a rather tricky bit of pattern-making — I strongly advise their use, as it will save much work. Some close fitting will be required, but there is nothing for the veriest tyro to worry about, as long as instructions are followed.

Lap-and-lead movement

A desirable feature of the Walschaerts gear is the separate operation of the lap-and-lead movement by connection to the crosshead. The acceleration of the movement and rapid reversal of the valve at each end of its travel, ensures a quick release of exhaust steam, and a correspondingly quick opening of the steam port for the return stroke. You can tell a Walschaerts engine by its snappy exhaust bark; on my little ones it sounds like pulling a cork out of a bottle, when starting a tidy load. The parts required are valve crosshead, combination lever, and union link. To save unnecessary repetition, please note that all the forked joints in the valve gear can be made in the same way as those in the coupling-rods. Clamp the pieces to be slotted, in the slide-rest tool-holder, and run them up to a saw-type cutter mounted either on a stub arbor held in the chuck, or a longer arbor mounted between lathe centres. While a cutter the width of the required slot is desirable, it isn't essential, as a narrow cutter will cut any width of slot by taking two or more bites. Run the lathe at low speed, and use plenty of cutting oil.

For the valve crossheads, take a piece of $\frac{1}{4}$in. × $\frac{5}{16}$in. mild steel about 2in. long. At about $\frac{6}{32}$in. from each end, starting from the narrower side, drill a No. 32 hole right through the thickness,

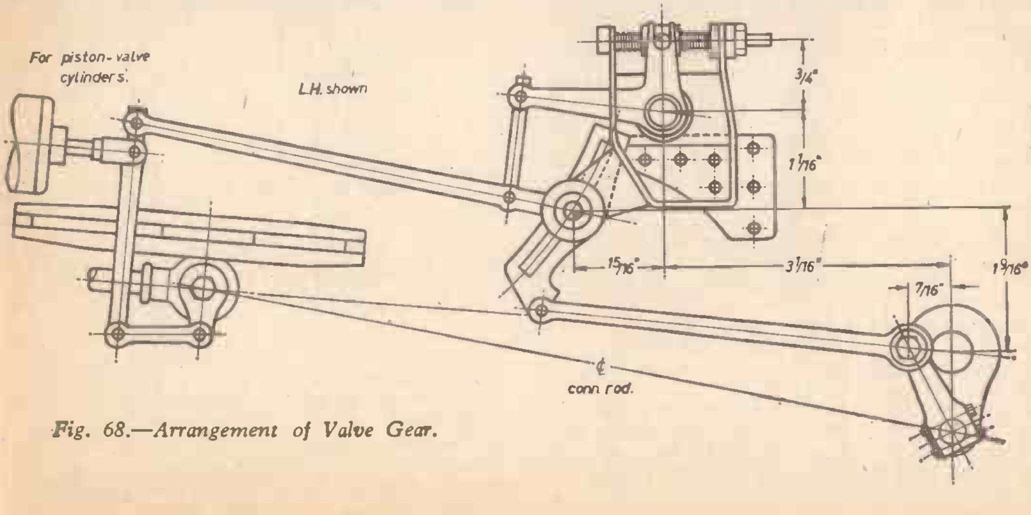


Fig. 68.—Arrangement of Valve Gear.

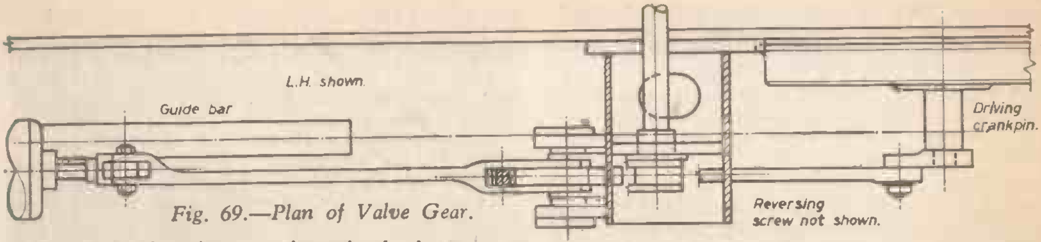


Fig. 69.—Plan of Valve Gear.

making sure that it goes through dead square. Next, slot each end as mentioned above, to a depth of $\frac{1}{4}$in. beyond the centre of each hole. Saw off each end about $\frac{1}{4}$in. past the end of the slot. Chuck truly in the four-jaw with the sawn end outwards, turn down to $\frac{7}{32}$in. dia. until within $\frac{1}{16}$in. of the slot, then face off the end until the turned boss is $\frac{3}{32}$in. long. Centre, drill No. 30, and tap $\frac{5}{32}$in. × 40. Finally, round off the slotted ends by judicious use of a fine file, and put a $\frac{1}{8}$in. parallel reamer through the holes. The crossheads should then look like Fig. 70.

Combination lever and union link

Each combination lever will need a piece of $\frac{1}{4}$in. × $\frac{3}{16}$in. mild steel 3in. long. Mark off one piece as shown in Fig. 71, drill the holes No. 32, use the drilled one as a jig to drill the other, then temporarily rivet them together with bits of $\frac{1}{8}$in. wire, and mill the sides to outline given, by any of the methods I gave for milling coupling rods. Knock out the rivets, and take $\frac{1}{32}$in. off each side of each lever, bringing the thickness down to $\frac{1}{8}$in. below the second hole. This can be done by clamping the lever to a supporting bar, as described for recessing the coupling-rods, and running it under a small diameter cutter on lathe or milling-machine. Saw off the superfluous metal at each end round off the bottom eye, file the top to outline shown, and ream the holes $\frac{1}{8}$in. The top of the full-size lever is hollowed out to form an oil box, but this isn't needed on the small engine, just drill a No. 55 hole down the top, and countersink it.

To reduce wear to minimum, the holes should be case-hardened. Heat the bosses to bright red, and plunge them into hardening powder, so that the holes are filled with it. Any good make is suitable, such as "Kasenit," "Pearlite," "Ecosite," and so on, sold in small tins at most engineers' supply stores. Repeat the heating and plunging, so that the hardening material penetrates well, then reheat until the yellow in the flame dies away, and plunge into clean cold water. Brush away any traces of hardening material, making sure that nothing is left in the holes, and clean up the bosses with fine emery cloth. They should be so hard that a file will not cut them. If all the pin holes in the valve gear are case-hardened, and silver-steel pins used, it will be a very long time indeed before any slackness develops, and the valve setting will remain accurate.

The union links are made from $1\frac{1}{4}$in. lengths of $\frac{1}{4}$in. × $\frac{3}{8}$in. mild steel. Mark out carefully, then drill the holes No. 32. It is always advisable to drill the pin holes in small forked joints before the slots are cut, as it ensures absolute alignment. If drilled after slotting, it frequently happens that the drill "wanders," and the holes will not only be out of line, but one will be bigger than the other. They can be milled to outline by aid of the side teeth of a small-diameter endmill held in the chuck, but anybody handy with a file will find it much quicker to file them to the shape shown in Fig. 72. Ream the hole $\frac{1}{8}$in.

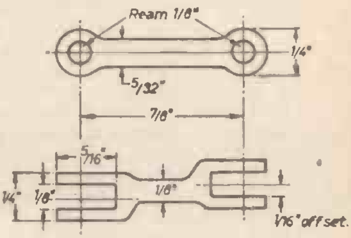


Fig. 72.—Union Links.

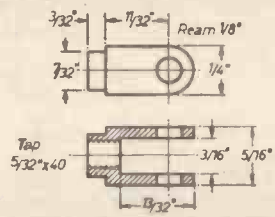


Fig. 70.—Valve Crossheads.

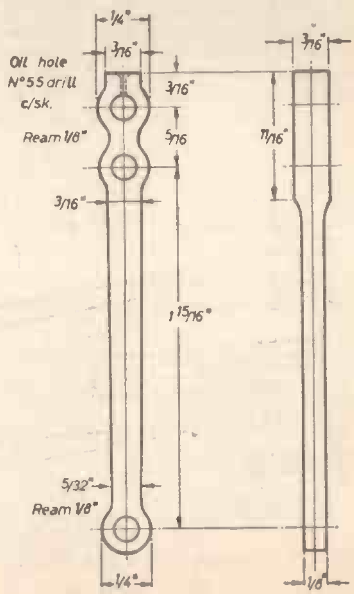


Fig. 71.—Combination Lever.

Materials required

- 5 1lb. Cadbury's drinking chocolate tins
- 1 piece of asbestos $2\frac{7}{8}$in. wide × 20in. long × $\frac{3}{16}$in. or $\frac{1}{4}$in. thick
- 2 pieces of $\frac{1}{8}$in. dia. wire 21in. long
- 2 pieces of mild steel strip $5\frac{1}{2}$in. long × $\frac{5}{8}$in. wide × $\frac{1}{8}$in. thick
- 1 porcelain connecting block with hole in centre
- 1 100W. spiral element and a rubber grommet
- 5 $\frac{1}{8}$in. Whit. nuts
- 1 $\frac{1}{8}$in. Whit. screw $1\frac{1}{4}$in. long

The Completed Heater.

Inserting the element.

THREE of the tins must have the bottom cut out to $2\frac{1}{4}$in. diameter with a pair of dividers or a tank cutter. All the open ends of the tins must have slots to take the asbestos as shown below. These are best cut with a very fine file. The $\frac{1}{8}$in. holes must also be drilled to take the tie rods.

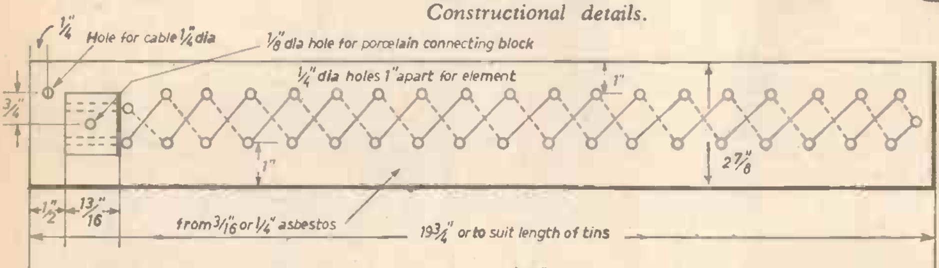
Thread string through asbestos former to find the correct length to which the element must be stretched.

Fit a rubber grommet in the end tin next to the connecting block to take the cable. Thread the ends of the $\frac{1}{8}$in. wire tie rods $\frac{1}{8}$in. Whitworth $\frac{1}{2}$in. each end.

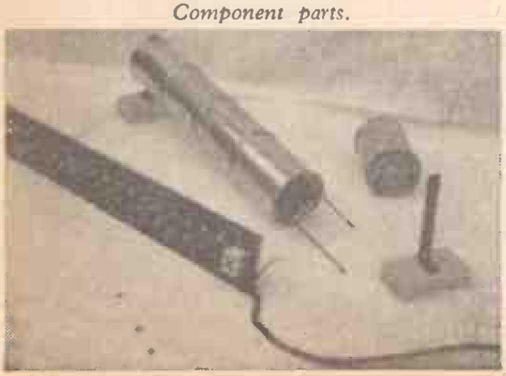
Use 3-core cable to connect the heater and earth the green cable to the tie rod nut.

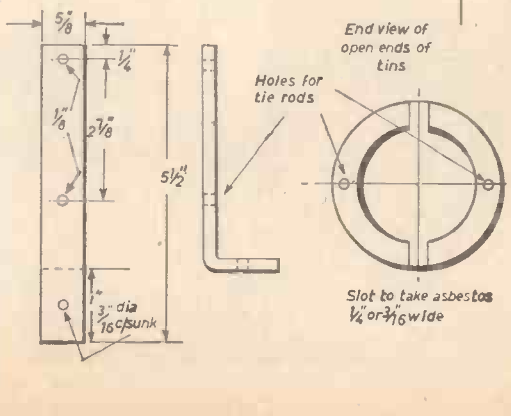
A TUBULAR HEATER *for* 2/6

Constructional details.



Component parts.





By Eric Hawkesworth

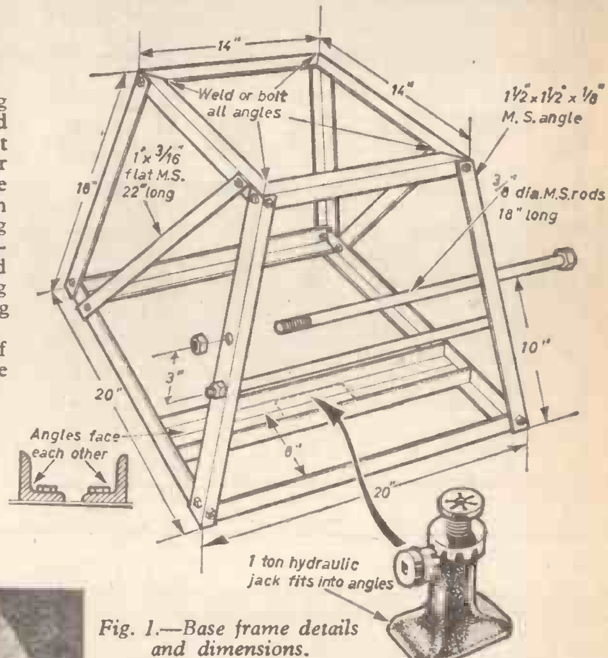


Fig. 1.—Base frame details and dimensions.

THE Flying Sorcerer is an original floating lady illusion using lightweight and portable, easy-to-build apparatus that retains all the mystery and effect of similar tricks that can only be performed on the professional stage with elaborate winch equipment. A small hydraulic car-type lifting jack having a 5in. lift at 1 ton capacity provides the levitation power for the trick and this lift is multiplied three times in the lifting link arms to give a vertical rise to the floating platform of nearly 15in.

A dummy drape fixed to the rear edge of the platform hides the elevator tube in the UP position, allowing the performer to move away from the rear of the apparatus and walk round at will. Apparent absence of connecting wires, etc., can be proved by passing a large sized hula hoop or similar ring over the girl and platform by a double move manipulation that allows the ring to be placed over the flying sorcerer's feet and removed past her head. This move can be repeated several times. Elevation and depression of the platform is smooth and even—operation of the lifting jack being effected via a long rod through a backcloth curtain drape.

Fig. 2. — Lifting links project through rear of base and are bolted to the elevator tube.

Floating Lady Base Frame

Material for both the base frame and lifting arms is mainly 1½in. x 1½in. x ⅛in. mild steel angle. The base frame (Fig. 1) comprises two square frames of 20in. and 14in. joined by four inward slanting corner angles each 18in. long. Method of assembly is by bolting or welding; bolts are ¼in. B.S.F. with nuts on the inside of the frame. When bolting up, tighten progressively to ensure a symmetrical frame. Fit the two flat-strip cross bars and the pair of angles to hold the lifting jack. The centre line of the jack is 8in. from adjacent frame side.

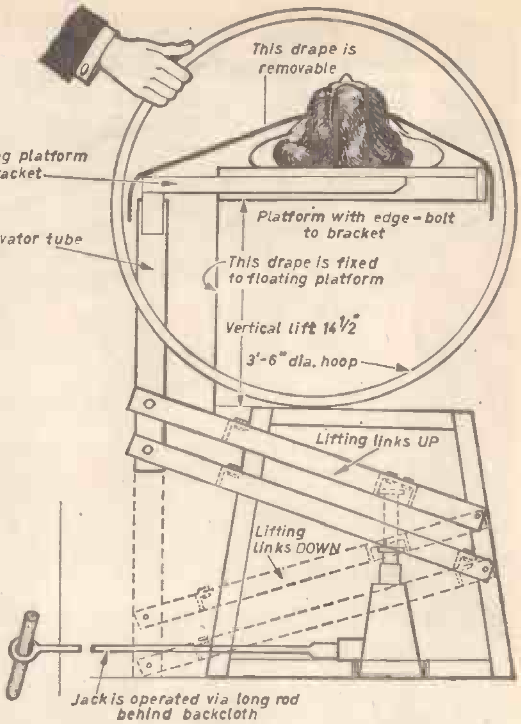


Fig. 5.—(Above) End view of assembled illusion.

Fig. 6.—(Below) Lifting arms and bracket.

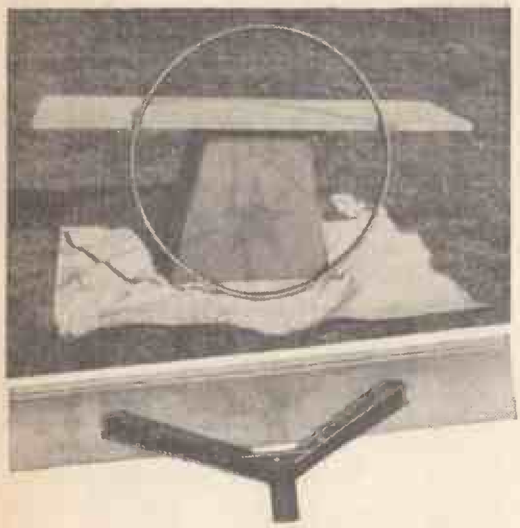
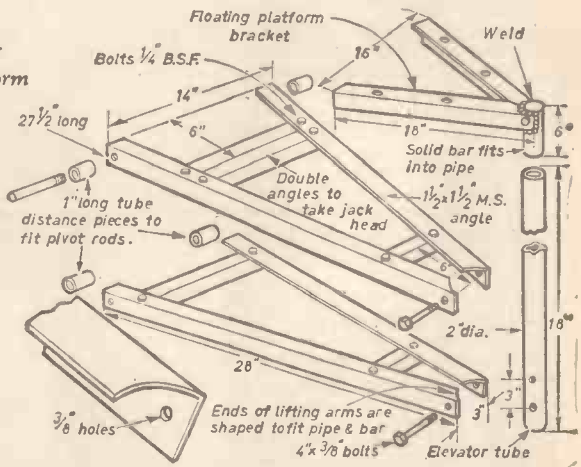


Fig. 3.—(Top) The completed apparatus.

Fig. 4.—(Above) Underside view of the platform showing the 'V' angle and mounting stub.



Drill the holes for the pivot rods ⅜in. dia. Upper holes are marked off 10in. from the floor and the lower holes at 3in. centres below. Thread two 18in. lengths of M.S. rod and fix them temporarily into position through the holes with nuts. The jack should be a tight fit in the angles with the operating shaft pointing to the rear.

The upper lifting arm has side angles 27½in. long (Fig. 6) and there are a set of double angles to take the head of the jack. A second cross brace is set 6in. from the nose end of the arm and both the angle irons are shaped to fit round the elevator tube as shown in the detail sketch. ⅜in. holes are drilled at both ends of the arm to receive the radius rods and elevator tube mounting bolts.

The lower lifting arm is similar except for ½in. longer side angles (28in.) and single cross brace angles front and rear. Both lifting link arms should measure 14in. across the pivot end and taper to 2½in. for a snug and easy fit round the elevator tube. Assemble the arms into the base frame after fitting short tube distance pieces over the pivot rods.

The elevator tube is an 18in. length of 2in. dia. pipe drilled with ⅜in. holes at 3in. centres to accommodate the cross bolts of the lifting arms. With the jack in position, the tube should rise and fall vertically from floor level to maximum height. Adjust the screw neck of the jack piston to give contact with the angles of the upper arm when the piston is at lowest stroke.

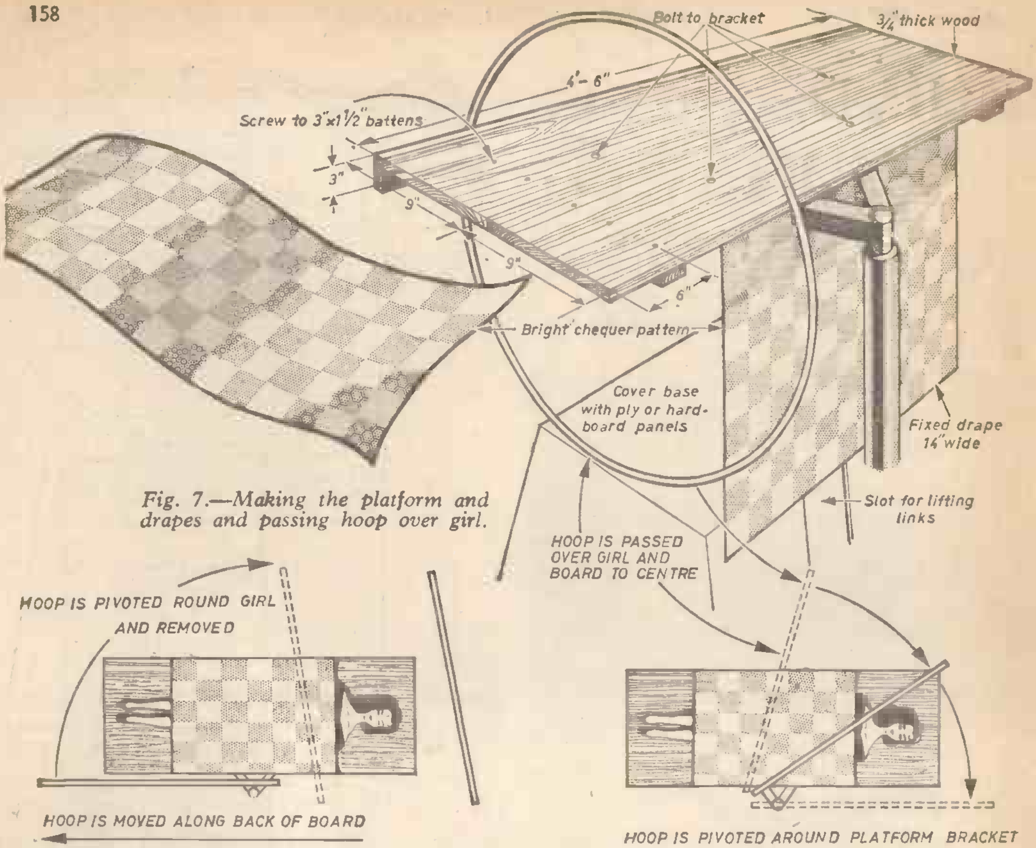


Fig. 7.—Making the platform and drapes and passing hoop over girl.

Floating Platform Bracket

A sturdy steel bracket to carry the platform is made from two $1\frac{1}{2}$in. × $1\frac{1}{2}$in × $\frac{1}{8}$in. angles each 18in. long. Inward ends of these angles are shaped to fit a solid bar stub, 6in. long and an easy fit in the elevator tube bore, and are welded and cross bolted to its head. Widest points of the bracket angles are 16in. apart. Fig. 3 shows a side view of the completed apparatus with lifting link arms in two positions. The jack handle is sawn in half and an extra length welded between to give a new overall length of 6ft. This handle works the jack with a rocking action to lift and a press-and-turn to release.

The actual platform is built of two 4ft. 6in. long boards of 9in. x $\frac{3}{4}$in. timber. A pair of 3in. x $1\frac{1}{2}$in. cross battens are screwed across the boards 6in. from each end and a 3in. deep edge strip is fastened along the front of the platform—screwing to board edge and batten front. See Fig. 4.

Bolt the platform board to the bracket using $\frac{1}{4}$in. coachbolts with the nuts underneath. In the DOWN position, the edge strip of the platform should slide in from the base frame to mask and hide the angles of the bracket. The platform is, of course, mounted centrally across the arms of the lifting angles.

There are two drapes and each serves a purpose. The permanently attached drape is 14in. wide and 17in. deep and is fixed to the rear edge of the platform board after cutting slits for the bracket angles. This drape rises and falls with the platform and is concealed by the base frame in the DOWN position. Fig. 7.

The loose drape is 18in. wide and 2ft. 6in. long and it is draped across the girl assistant as she lies on the platform. This cover hangs over the front edge of the platform to a depth of 4in. and is pulled back and behind the elevator tube out of the way. In the UP position, both drapes seem as one and the elevator tube remains effectively concealed.

The base frame is covered with plywood or hardboard panels bolted on with small round-headed screws. Leave a slot in the rear panel for the lifting links to operate through. Decorate the base with yellow stars or question marks on a red background and paint all the metalwork black after priming with a suitable undercoat. Paint the platform red and choose a bright multi-coloured chequered design for the drapes.

The hoop may be a hula hoop or one manufactured from a length of plastic garden hosepipe with a joining plug. Make it 4ft. dia. in this case. Also, a loop of white rope can be used in lieu of a solid hoop—the effect is just the same.

Performing the Illusion

Your Flying Sorcerer is introduced to the audience, and, after hypnotising, is commanded to lie on the platform. The apparatus can be sited in front of a draped doorway with the jack operator behind the scenes. The magician lays the removable drape across the girl and directs her to rise.

(Concluded on page 183)

BUILD YOUR OWN FOUNDRY

by John Waller

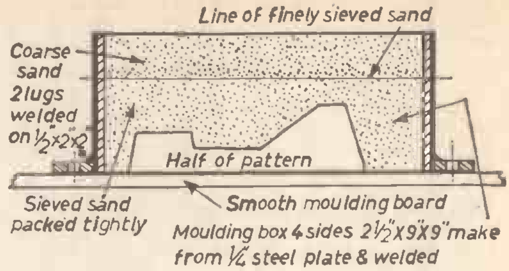


Fig. 1.—First stage in the preparation of a mould.

Part 2—Concluding details

BEFORE moulding can commence, an adequate supply of the correct sand is necessary. The small quantity you will need may be obtained from your local foundry. Provided you are prepared to collect it yourself there will probably only be a charge of a shilling or so. Also buy a quantity of parting sand as it is known; half a sack of this is sufficient, but keep this separate from the other material.

Assuming you have the necessary pattern—and you can cast almost anything, though it may need special attention if holes are present—lay the pattern on the large board and place over it a moulding box as depicted at Fig. 1. For the purpose of this example we will assume the pattern is flat and made in two halves, and after covering it with a preliminary layer of fine moulding sand the remainder of the box is filled without troubling to pass it through the sieve, and rammed reasonably tight. Various tools used in the moulding process are shown at Fig. 2.

The box is now turned over; if the sand is tight enough it will not fall out. Sprinkle a thin layer of parting sand over the complete surface of the mould; whereupon you can now place the second box on top and locate it with the aid of the two pins. Place the other half of the pattern, the runner and risers in position—the latter are used to obtain a head of metal to allow the escape of gas—and then carry out the same procedure as before. Incidentally, the pattern will have two pins in order to position each piece in relation to each other. Tap the runner and riser gently and withdraw them.

Separating the Boxes

Now separate the two boxes, and if care is taken the pattern will also separate without damaging the sand. Drive a spike or nail for a short distance into the pattern and lift each from the sand, and then cut a channel in the bottom box from the spot where the runner meets the sand to the cavity left by the pattern. A reference to the drawing at Fig. 3 shows this clearly. Before again reassembling the boxes, scrape some of the sand from the top of the runner to make it easier to pour the metal, and

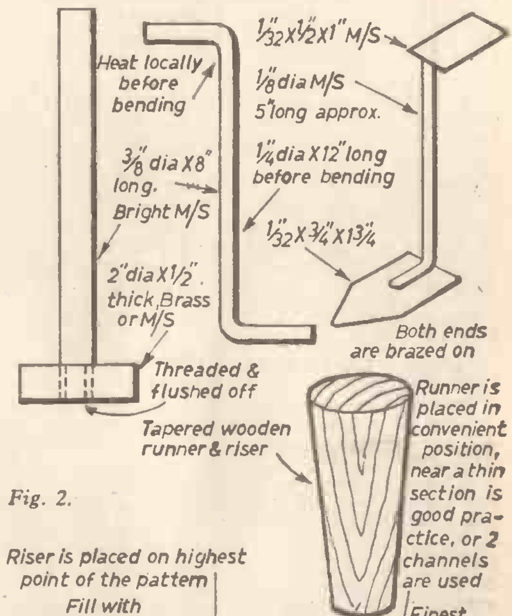


Fig. 2.

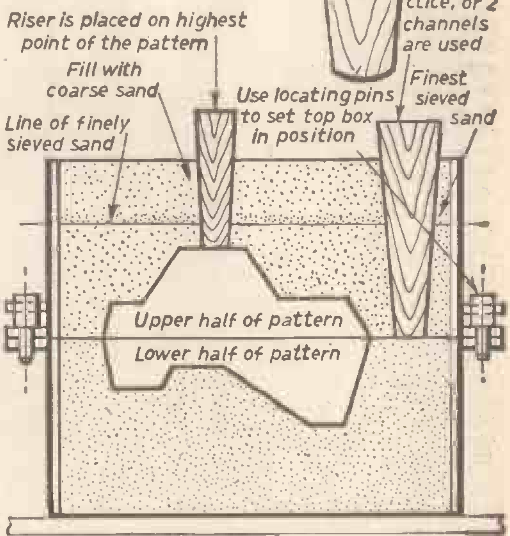


Fig. 3.

Fig. 2.—The most popular moulding tools.

Fig. 3.—The second stage, showing the runner and riser in position.

then carefully set the lower box on a bed of moulding sand. Locate the top member and you are ready for the pouring. Fig. 4 illustrates the mould assembled on the foundry floor ready for the running of the metal.

For casting hollow articles a core is required, and the easiest article which can be used by way of explanation, is the cast iron drawn pipe used for carrying away rain water.

Fig. 5 illustrates a typical pattern for such a hollow article—the length is immaterial and the reader will observe that two projections are present, which as known in foundry colloquy, as prints. Obviously when this pattern is treated in the manner described above, these prints leave their impressions in the sand and these impressions are used to locate the core. This latter item is merely a cylinder of sand suitably reinforced with rods, of the appropriate length, and when this is fitted into position it "fills up" the mould as shown at Fig. 6, leaving a space round which the molten metal can flow to form a cylinder.

A few remarks concerning the texture of this moulding sand is essential, and a water can with a fine rose is ideal for sprinkling it until it becomes just damp enough so that when a handful is squeezed it clings together in a ball while the hand remains dry. The presence of too much water is bad practice and will result in defective castings, so always try the moulding sand in this manner and see that it is thoroughly mixed after adding the water.

Fettling

This is the name given to the trimming process and the runners and risers are cut off with a hacksaw to be used the next time a cast is made, but try and be a little selective with the material you will use for casting, as the iron for the drain pipes mentioned above is not likely to produce really fine iron castings. Car pistons are useful, but try and use one make if you can, and as there are a a variety of brasses, here again use metal from a particular source, otherwise in large batches you may find the colour varies slightly due to the lack of copper in some material.

A pattern which does not possess a flat surface is treated in rather a different manner to that described above, and Fig. 7 shows the details of such a mould. The pattern is placed on the board and sand sieved over it and rammed into position—care is necessary if the pattern is fragile, but gently placing the sand with the fingers overcomes any tendency to break it. Now cut away and push back the sand to give a joint line which will allow the removal of a pattern of this type to be lifted from the box, but do not at this stage remove it from the sand. Next, sprinkle a thin layer of parting sand over the surface and proceed as before, only on this occasion you must exercise extra care when separating the two halves. Repair broken portions of the sand by gently lifting them back into place and pressing them home with the aid of a trowel. Sometimes a brush ½in. wide, dipped in water, is useful for smoothing off the replaced sand, but do not overdo this as a really damp mould can cause faulty castings. Incidentally, this latter method is known as oddside moulding and is applied extensively in foundries when several castings are required from a single pattern, only then the moulder will make one oddside—the name given to the lower half of the two boxes—and use this as a base member for the other attempts. He thus has a sand "board" in which to lay his pattern every time and needs only to briefly dress the joint line on each occasion.

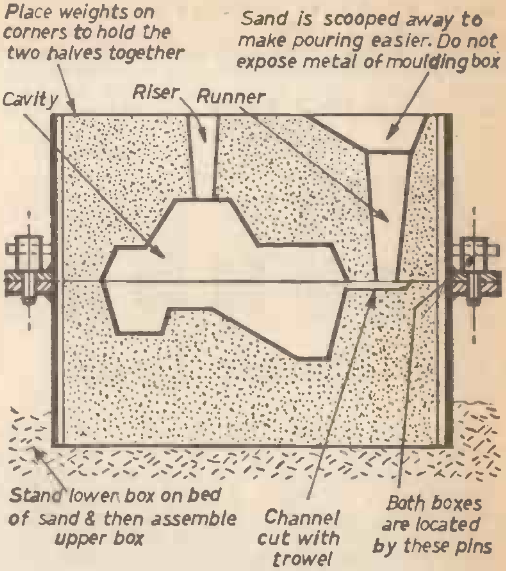


Fig. 4.—The mould finally assembled ready for pouring.

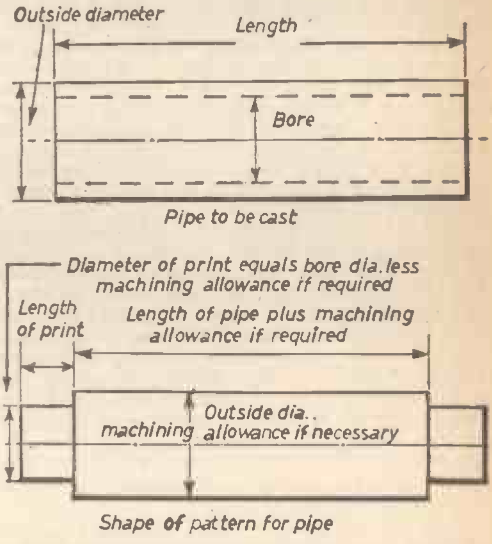


Fig. 5.—Details of casting hollow articles.

Handling Molten Metal

A few remarks regarding the handling of molten metal is essential as a safety precaution—there is no real danger in moulding if you always remember

BUILD YOUR OWN FOUNDRY Contd.

these rules, but I must emphasise that you are dealing with material which is in a condition at a much higher temperature than boiling water—so see that these precautions are observed every time you prepare a mould and handle the metal.

The preparation of the sand is important; if the sand is too wet it will produce faulty castings, and in extreme cases it could cause the metal to splutter when it enters the mould, so mix the sand carefully, using only a little water at a time, until the correct texture is obtained. If you do produce a mixture which is too wet, then dry the mould as most foundrymen do, with the aid of a large piece of red hot coke held close up to the cavity by a pair of tongs.

Weighting

You will note that it is indicated on the drawings that large weights placed on the corners of the top box are an asset because they tend to hold both halves together as the metal is poured. However, remember that these weights are of cold metal and if the molten metal comes up the riser too fast and contacts these cold details, then it will spatter and is liable to cause severe burns. Incidentally, the making of these weights can be your first attempt, because by using a house brick as a pattern you can cast these from scrap iron. Again, during the pouring process make sure the metal does not contact the sides of the boxes as an identical condition will occur. If metal does run out the sides of the boxes during pouring—this is a sign they have not been assembled correctly—go on pouring, but have an assistant throw a shovel full of sand against the leaking metal and stop it in this manner. This is orthodox foundry practice and does no harm if the sand is not wet. Keep your feet away from the sides of a box during the casting process as this leaking of the metal can obviously cause a burn. Very occasionally you will find it necessary to vent the mould to allow gases to escape, and this is easily done with a cycle spoke or similar article, but never make the holes too large and again never place a weight over a hole as even a slight amount of hot metal rising and running over the top surface of a mould could be dangerous. Work steadily and carefully, and the moulding of metal can introduce many new and interesting items to the home and workshop.

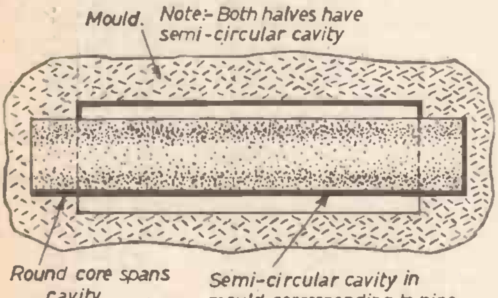


Fig. 6.—Plan of the mould for the pipe shown in Fig. 5.

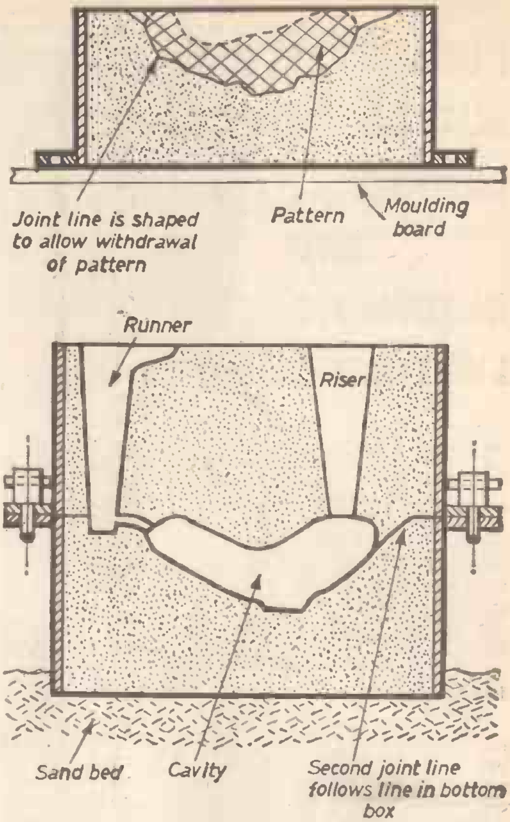
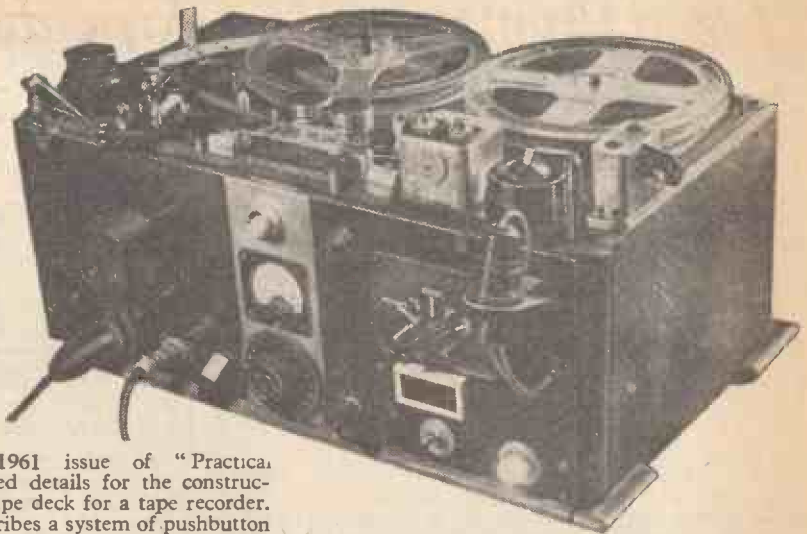


Fig. 7.—Moulding irregular shaped articles.

PUSH BUTTON CONTROL AND AUTOMATIC SWITCHING



THE September 1961 issue of "Practical Mechanics" carried details for the construction of a simple tape deck for a tape recorder. The present article describes a system of pushbutton switching which can be added to this deck, including a device for stopping the machine when the end of the tape has been reached.

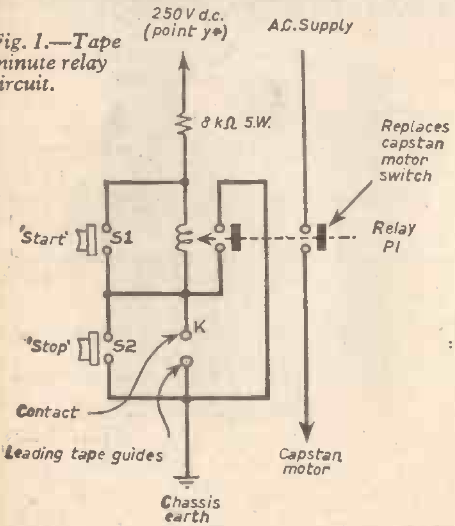
The system actually comprises two quite separate schemes: a tape "Run/Stop" control and a "Record/Playback" control; either or both of which can be included as desired.

The "Run/Stop" Controls and End-of-Tape Switch

The end-of-tape switch makes use of the stop foil to be found on most makes of recording tape. The standard form of stop foil is a thin layer of aluminium, about 4in. long, bonded to the inner (active) surface of the tape at each of the points where the two ends of the tape meet the leader and trailer strips (or about a yard from the extreme ends of the tape). Although some tapes do not have this device, a few seconds work with gum, scissors and (say) the foil from a cigarette pack can remedy this.

The winding of relay P1 is energised from the line carrying 250V D.C. to the bias oscillator. The other end of this winding is taken to contact "K" which bears against the tape at a point close to where it enters the leading tape guide. This latter must be earthed. As the stop foil is drawn past this point, the circuit to the relay winding is completed, the relay closes and stops the recorder. At the same time a pair of contacts on the relay short-circuit the gap between "K" and earth so that the relay remains closed even when the foil is not present. In order to re-start the recorder, it is necessary to de-energise the relay and this is done by means of pushbutton S1. A second pushbutton (S2) enables the recorder to be stopped manually. When pressed, it momentarily shorts "K" to earth (Fig. 1).

Fig. 1.—Tape minute relay circuit.



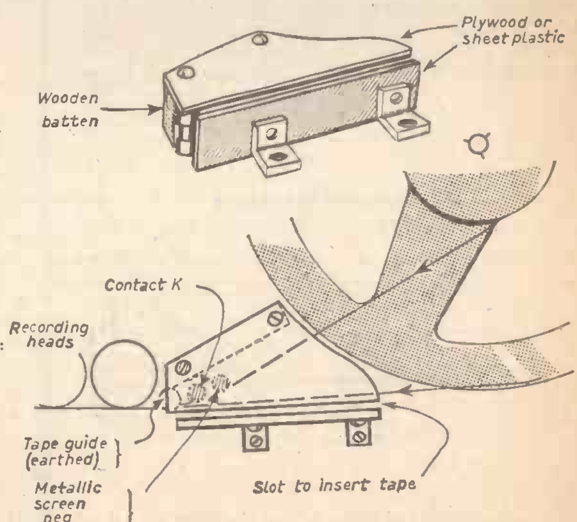


Fig. 2.—Contact shield.

for a home made Tape-deck

By J. H. GOULD

With this scheme, the tape will be driven immediately the deck is switched on, unless the "Stop" button is held down.

Contact "K" projects above the motor board and, when the tape is running, it carries a potential of about 250V above earth. Although this voltage would not normally be present when the tape is being loaded or changed, it still represents a danger. The "Grand Piano" type of shield of Fig. 2 is one answer to this problem and an advantage of this layout is that the tape will stop against the foil at the end of the tape but not at the beginning.

Where a clockwise driven feed spool motor is in use, the shield will need to be a mirror image of that shown.

COMPONENTS REQUIRED

(i) Tape "Run/Stop" Circuit:

- One: **Telephone-type Relay** (P1), 2,000 or 2,500 Ohm winding, 2 normally-open contacts.
- One: Vitreous-enamel, wirewound **Resistor**, 8,000 Ohms, 5 Watts.
- Two: **Pushbutton Switches.** Control keys or panel-mounting microswitches, 250V, 1 normally-open contact pair, 0.3A D.C.

(ii) "Record/Playback" Circuit:

- One: **Relay** (P2), as relay P1.
- One: **Telephone-type Relay** (P3), 2,000 or 2,500 Ohm winding, 4 normally-open and 4 normally-closed contacts.
- One: **Resistor**, as previously.
- Two: **Pushbuttons**, as previously.

The "Record/Playback" Controls

To save power (and the life of the valve), the oscillator is not left on "standby" when the recorder is switched to playback. This means that a ten-second delay must be expected after selecting "Record" and before the deck is in a condition to accept a recording. In the circuit described here the indicator lamp does not light until this time has elapsed (Fig. 3).

When the mains switch is closed, the deck will automatically assume the playback condition; this greatly reduces the possibility of a recording being accidentally erased. If the "Record" button is now pressed, relay P2 will operate and its sealing contacts will close to hold it in when the button is released (which also switches the H.T. to the oscillator). In addition, this operation energises the valve heater. As the valve heats up, relay P3 (whose winding is in the H.T. circuit) will close and seal, switching the deck to record and lighting the indicator lamp. A contact on this relay now opens to release relay P2 thus relieving the H.T. supply of any surplus load.

To replay a recording, the "Playback" button is pressed, short-circuiting the winding of relay P3. Relay P3 releases, bringing the circuit to the replay condition. It cannot reclose as no H.T. circuit now exists.

To avoid the possibility of feedback, relay P3 should be mounted as near to the "R" and "P" sockets as possible.

Where a balanced recording input is used (push-pull), three poles were necessary on the original record/playback switch. In this case, the contact pair in series with the indicating lamp will have to be foregone. This will provide a set of changeover contacts to replace S 3/3. The only effect this will have on the operation of the deck will be to cause the indicator lamp to light immediately the "Record" button is pressed.

Fig. 3.—"Record/Playback" circuit.

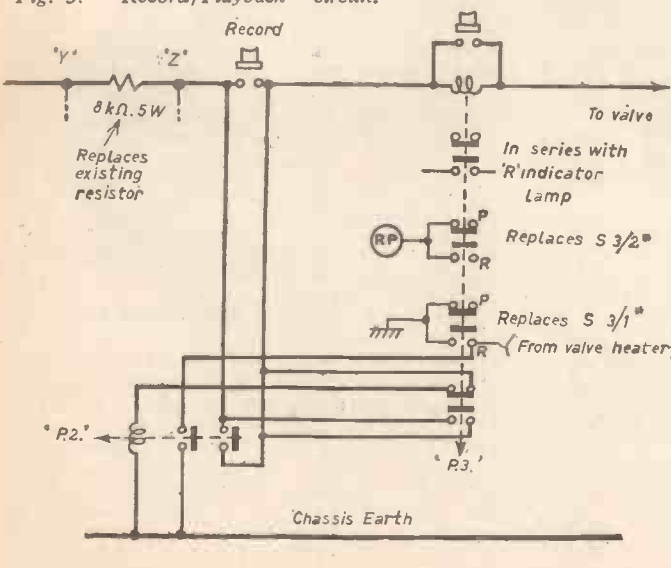
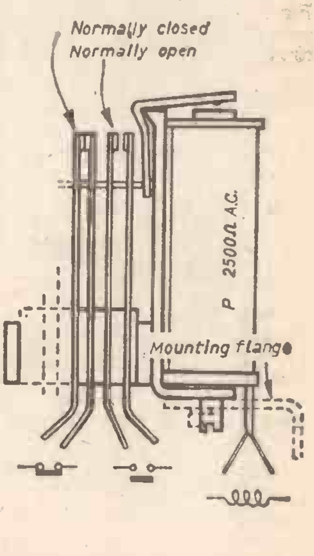


Fig. 4.—The telephone type relay.

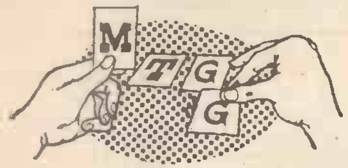


Twenty Teezers for Tricksters

PRACTISE THESE TO AMUSE YOUR FRIENDS

By Alan E. Ward

CAN you tear a pig out of newspaper, tie a knot in a handkerchief without letting go of the ends, or spell the word "expediency" with only five letters? The spelling stunt is easy and it is a pity that all spelling could not be abbreviated so logically. You only have to write: XPDNC. Try describing a hungry horse in just four letters of the alphabet. Just say: MTGG! Easy isn't it? What are the coldest letters of the alphabet?



The trick spelling.

The answer is IC and the reason should be obvious.

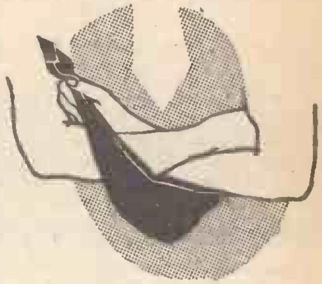
Have you tied that knot yet? The handkerchief should be twisted to form a "rope," then you can accomplish the task by folding your arms before gripping the ends of the handkerchief and pulling your arms apart. Suspend a ring from a piece of string tied to a chair back and try to cut the string without letting the ring fall. Are you baffled? The secret is to tie a loop in the string and then to cut through the loop.

Cutting Cotton

Imagine that you have a corked bottle inside of which a ring is suspended upon a cotton thread. A nice little problem is to find a method of severing the thread and letting the ring fall, without touching the bottle either directly or indirectly. To succeed in this clever stunt you will need to stand the bottle in sunlight before commencing. Take a powerful magnifying lens and use it to focus the sun's rays, through the glass, on to the cotton and wait until the thread gets hot and burns.

The 'dry' water trick.

Can you show something that has never before been seen and will never be seen again? To do this you produce a nut, crack the shell, extract the kernel and hold it up for everyone to see, and then eat it. Next, eat a lump of sugar and offer to bring the devoured sugar-lump beneath any one of two hats your friends may choose. Suspecting sleight of hand, your watchful audience will be really fooled when you casually place the selected hat upon your head.



The 'Knotty' problem.

Waterproof?

If you begin by secretly rubbing Lycopodium powder well into your hands, you can plunge the hand into water without wetting your flesh, but can you think of another way of doing this? Well, it's not difficult if your hand is protected by a rubber glove! Now, how can you completely enclose your breath in water without letting air escape? Are you completely foxed this time? The catch is to blow bubbles.

Perhaps you already know how to float a steel needle on water by slowly lowering the needle into the water upon a little strip of blotting paper. The soaked paper will sink, leaving the needle supported upon the "skin" of tense water molecules which covers the surface. Use a dry needle and non-greasy water.

Sweet deception.

There is an old stunt with paper which has been called "A camel through the eye of a needle." Cut a hole the size of a sixpence in a sheet of paper and provide yourself with a halfpenny. The coin is the camel and the needle is represented by the paper. Can you pass the halfpenny through the hole, without tearing the paper or bending the coin? The method employed is to crease the paper

" across " the hole, to lodge the coin in the hole between the folded " leaves " of paper and then to gently pull the lower corners of the folded paper upwards. The coin will now fall through the hole quite freely.

Card Tricks

"And now, ladies and gentlemen, I am going to cut a lady in half and put her together again." As you say this, take a pair of scissors and cut an old Queen of Hearts in half and immediately proceed to stick her two halves together again with a strip of Sellotape. While we are on the subject of playing cards, examine the four Kings and suggest why one of them would be sure to fail a military medical examination. You will observe that the King of Diamonds is, unfortunately, minus one of his eyes.

The one-eyed king.

A pencil and a book rest upon the table. How can you put the pencil under the book without actually touching either article ? The pencil should be resting upon a sheet of paper. To solve this teaser you must pick up the pencil by lifting the paper and then hold the pencil and paper underneath the table.

Bend a wooden match to form a V and place it upon a bottle top. Put a sixpence upon the wooden support. You are required to cause the coin to fall into the bottle without touching any of the apparatus. A drop of water will do the trick. Let the water fall upon the bend in the match. The water will soak into the wood, causing the fibres to swell and make the stick begin to straighten. As if by magic, the coin will be seen to slip through the opening V and fall with a loud "clink" into the bottle.

The litter lout.

Brain Twisters

How many grooves has a 45 rpm 7in. EP gramophone record ? Can you take one letter away from a six-letter word and leave 12? How can two fully-grown persons stand upon a copy of a magazine roughly 8in. × 11in., without touching each other, or even being able to see one another. These people should face each other and must not be blindfolded or hypnotised.

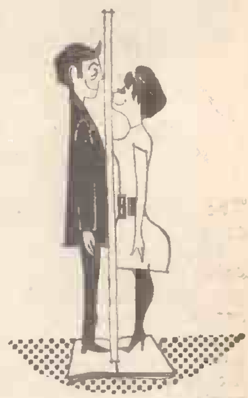
There will always be only one groove in any kind of gramophone record; and the mystery word required is " dozen." The stunt with the magazine is performed by opening out both covers and then placing the paper between two rooms. When the door is closed two persons will easily be able to stand upon the magazine while complying with the necessary conditions. Have you found time yet to tear out a paper pig? We can do even better. We shall tear our paper into many little bits—and make a litter! !

Sawing a lady in half.

Feeling for the Aces

Only the delicate fingertips of a magician are sufficiently sensitive to locate the aces by touch in a shuffled pack of cards held behind his back, or so it would appear to an audience watching this minor miracle. No skill at handling the cards is necessary, but the experiment will be doubly interesting if you take the trouble to convince your audience that you really have developed a remarkable sense of touch.

Remove the four aces and fasten them together with a paper clip to which a small safety-pin has been attached. Memorise the order of the aces and bend aside one of the prongs of the paper-clip to indicate which of the aces is at the top of the bundle. Open the safety-pin and use it to suspend the little packet, out of sight, beneath the back of your coat. Now you are ready to perform.



Two in one.

Give the pack to a spectator and ask him to give the cards a thorough shuffle. While he is doing this, keep your audience entertained by describing how usually, when a card is printed, the minute quantity of ink used up raises the surface of the card a tiny fraction of an inch. Say that you have been experimenting for many months and that, at last, you have acquired the skill of being able to feel the aces by touch.

Ask your assistant to hand you the shuffled cards behind your back. Face your audience and quickly retrieve the four aces and put them on top of the pack. Think as you do this and make sure, by feeling for the bent prong on the paper-clip, that the aces are added, face downwards, upon the face down cards in the pack. Aim to look somewhat tense as you feel the cards one at a time.

Bring out the first two aces and throw them upon the table. Now, keeping a careful check on the whereabouts of the remaining two aces, actually permit your audience to see your hands exploring the faces of the cards. Hesitate a moment, as if in some doubt, before holding up the third ace and endeavour to make the feat seem tremendously difficult as you find the final ace. Practice your bluff well and this very simple trick will be a huge success.

LATHE GADGETS

by L. C. MASON

Part 1

EASIER TOOL HOLDING

INNUMERABLE home workshops, garages and small firms feature a lathe as part of the equipment. Probably one of the most popular medium size general purpose lathes is the Myford ML 7, which has a range of additions and accessories available for it from the makers.

However, many model engineers, and others whose lathes are called upon to tackle a wide range of operations, can make use of a series of simple items which greatly facilitate the operation of the lathe on ordinary jobs, and in several cases make possible an operation for which no accessory is commercially available.

The first of these is an improved toolpost. Considerable time can be wasted when setting the tool to correct height in searching for odd strips of packing of various thicknesses. The toolholder described allows of any tool to be adjusted for height instantly with a finger screw, permits it to be slewed round to any angle, and does not bruise the topslide surface as does the jackscrew of the normal clamp plate toolholder. Furthermore, as the holder is retained by the standard stud and nut, the original arrangement can be restored by undoing the one nut.

The holder proper is mounted on a short stubby column, clamped tightly on the topslide by the normal stud and nut. Its dimensions are not critical—which applies to all the dimensions given—so that while the sizes shown have proved completely satisfactory in service, any slight variations are unlikely to affect its use. The main requirements for the column are that it should be truly cylindrical and have nicely flat and squarely faced ends. Drill the column centrally down the middle to an easy fit over the stud.

The main part of the holder is machined from a mild steel or wrought-iron block. First machine all the faces square with each other, which can be done in the four-jaw chuck. Then mark out for the hole which fits the column. Remount the piece in the four-jaw with the centre for the hole running true, drill with successively larger drills, finally boring out to size. Make it an easy fit on the column, as when the block is split to complete the clamp, there is every likelihood of the piece springing in a trifle, closing the hole slightly. With the hole bored, mark out for the clamping stud, the height adjustment screw hole and the line of the slit. Drill the stud hole to full depth tapping size for $\frac{3}{8}$in. B.S.F. (letter 0 drill) and follow up with $\frac{25}{64}$in. for stud clearance down to the level of the slit line. Tap the bottom half of the hole $\frac{3}{8}$in. B.S.F. (See Fig. 1.)

If preferred, the block can be left square without cutting back the face for the nut. This saves work, but letting the nut into the level of the side can be useful at times in getting the holder close up to a job. The piece was sawn out by hand, then the surfaces cleaned up by end-milling. Slitting the piece, which comes next, can either be done by hand or with a slitting saw mounted on an arbor in the chuck or running between centres. Hand sawing, taking care to keep to a straight line, makes quite a satisfactory job. Any irregularities at the ends of a hand-sawn slit can be neatened afterwards by chamfering lightly with a triangular file.

Thread a piece of $\frac{3}{8}$in. mild steel rod of suitable length at both ends for the stud, leaving it a little long on what will be the outer end. Run the stud tightly into the hole with a couple of locknuts, remove the nuts, fit a small washer and replace one nut. Any excess length of stud outside the nut can be cut off and the end of the stud shaped up by filing. A nut one size smaller outside than standard makes a neat fitting here, and sometimes makes it easier to get the smaller spanner to it when the holder is set to an awkward angle. For the small nut, drill out a $\frac{5}{16}$in. nut and retap it $\frac{3}{8}$in. B.S.F. Only a light spanner pressure on the clamp nut is required to provide a rigidly solid lock, and the holder is completely free on the column in half a turn of the nut.

Drill now for the height adjusting screw, tapping size for $\frac{1}{4}$in. Whit. (No. 11 drill.) The screw is a plain turning and screwing job out of $\frac{3}{8}$in. rod, with the head knurled for finger grip. Make the thread on the screw a very easy fit in the hole in the block, as possibly greasy fingers need to be able to turn the small screw head easily when the screw is lifting the weight of the holder up the column. Drilling the top half of the hole in the block ¼in. clearance helps in this respect, too.

Completing the clamping features first enables the slot for the tool to be machined with the holder mounted on its own column, as for use in turning. The slot dimensions given are for ⅜in. square tool bits, the size adopted as standard on the writer's ML 7. The holder is slipped on to its column, the height adjusted by the screw to bring the middle of the slot to centre height, set square to the faceplate, and clamped up tight on the column. The slot is then end-milled to depth. To save wear and tear on the end-mill, the bulk of the metal can be removed from the slot by drilling from one end and sawing out a strip.

With the slot machined out, there remains only the tool clamp screws. These should be Whitworth thread; the coarse pitch of this thread, compared with B.S.F., gives a slightly quicker release to the tool on slackening off, and ample grip is available with a very moderate spanner pressure. Two screws only are normally used as shown, but a third hole between the end ones is provided to be able to make use of very short tool bits. If commercial Whitworth bolts are used, obtain a pair of H.T. ones, or if special bolts are being made for the job with the conventional square heads as are often seen for this purpose, turn them out of sliver steel or something harder than mild steel. In either case, turn away the end two or three threads to produce a "dog point" on the screw. If this is not done, continued intermittent pressure on the end of the screws will spread the ends, so that in time it will be found impossible to unscrew them right out of the holder.

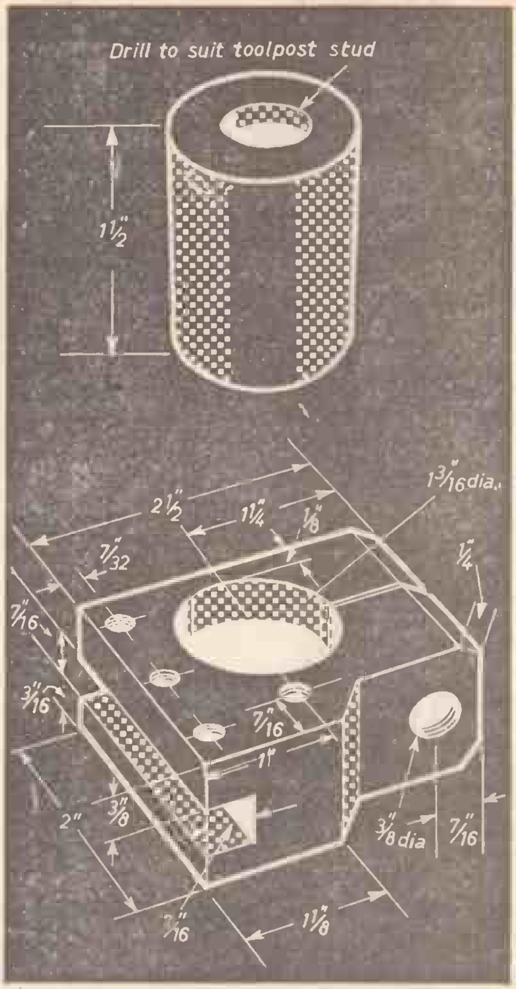
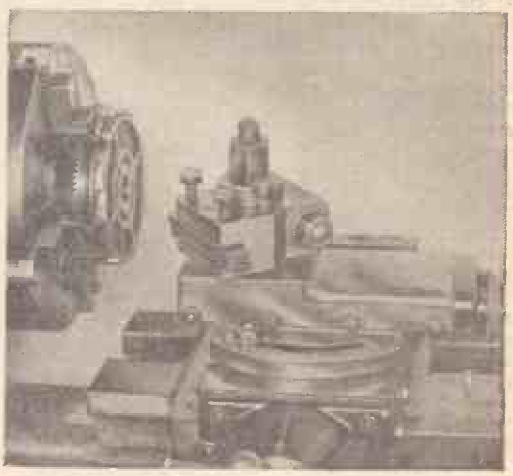


Fig. 1. (Right)—Dimensions and details of the holder. (Below Right) Universally adjustable toolholder in use on a Myford ML7. (Below) Toolholder modified in size fitted to a home-made 1⅝in. centre baby lathe.



NOVA

This largest known rocket engine consumes three tons of fuel per second

by
DONALD S. FRASER

THE bigger the booster the better the climber—might be the maxim for long-distance space flight. With this in mind, the National Aeronautics and Space Administration have planned the F-1 liquid propellant engine as their basic space booster engine. Arranged in clusters of from two to eight, it is expected to power the Saturn C-3 and other vehicles on deep space missions.

It is a single chambered engine developing 1,500,000 pounds of thrust. This is nearly 20 times the thrust of the Redstone rocket engine, which launched America's first astronauts on their suborbital journeys into space, and put the first U.S. satellite, Explorer 1, into earth orbit. Its thrust is more than four times as great as the propulsion systems that power the 6,000-mile Atlas inter-continental ballistic missle.

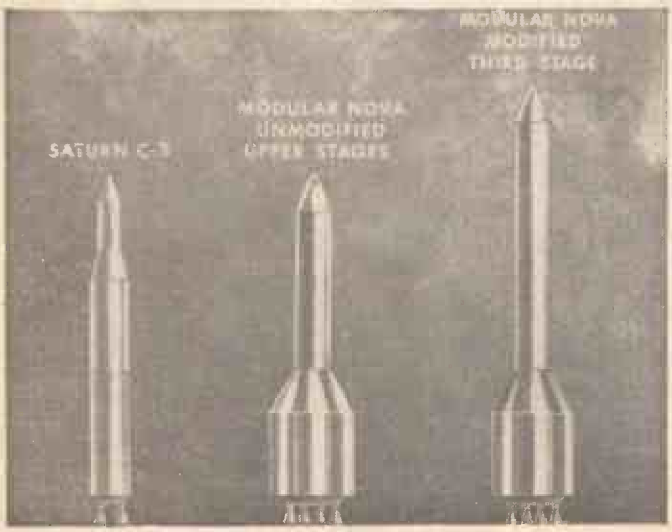
The decision to develop the F-1 was one of the first made by NASA after its establishment in October 1958. The decision was made on the basis of an urgent, foreseeable need for a large thrust engine to power large space vehicles for such missions as manned circumlunar flights, and landing a man on the moon and returning him to earth. Such a large vehicle—designated Nova—existed only as a design concept for several years.

Since President Kennedy urged an accelerated programme to land man on the moon and return before the end of the decade, it is possible that first use of the F-1 engine could be in an advanced Saturn booster designed to approximately double the power of the Saturn C-1 booster. One possible configuration would be powered by a cluster of two F-1's for one lift-off thrust of 3 million pounds.

The Saturn C-1, with 1·5 million pounds lift-off thrust developed by eight Rocketdyne H-1 engines, will carry the three-man Apollo spacecraft in earth orbital missions of up to two weeks. The second stage of the 90,000 pound thrust S-1V stage powered by six Pratt and Whitney RL-10-A3 liquid hydrogen-liquid oxygen engines.

First test launch of the C-1 booster with two inert upper stages is scheduled for later this year. The advanced Saturn referred to above could be used to place the Apollo spacecraft into orbit about the moon and return it to earth. One configuration under study for the first stage would consist of two F-1 engines; the second (S-11) stage of four J-2, 200,000 pound thrust liquid hydrogen-liquid oxygen engines also under development by Rocketdyne; and the third stage would be the S-IV, which is under development at Douglas's Missile and Space Division. This possible configuration would be capable of lifting an approximate 30,000 pound payload on a lunar mission.

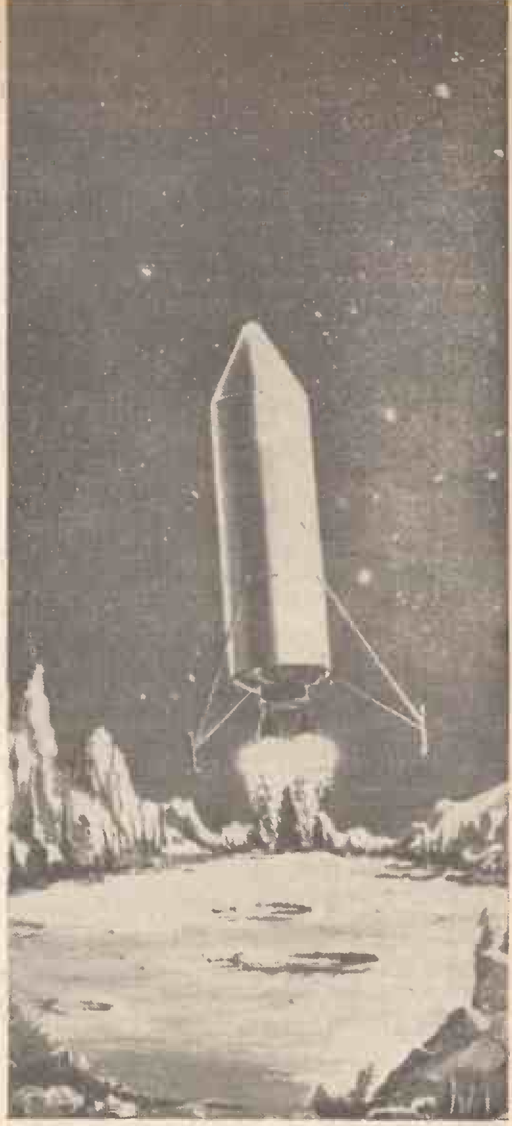
Three possible rockets in which Nova may be used.



The mission of Nova will be to boost the Apollo to lunar landings and return to earth. The configuration of Nova is under intensive study by NASA. Many of the versions under study employ F-1 engines in the first stage and some use

Nova under test.

Hypothetical spacecraft Nova—launched near the moon's surface.



F-1's in the second. One of a number of configurations employing F-1 engines consists of a booster made up of four clusters of two F-1—or eight engines generating a total of 12 million pounds thrust. A possible second stage would be a cluster of two F-1's. The 200,000-pound-thrust J-2 engine —in a cluster of four—would power the third stage in this study configuration. This vehicle would have a capability of lifting some 160 tons into earth orbit or some 50 tons on an escape mission.

The F-1 has been under development by NASA for two and a half years, but earliest feasibility studies on a million-pound thrust single chamber engine date back to 1955—two years before Sputnik —when Rocketdyne proposed such an engine to the American Air Force.

In January 1959, a $102 million NASA contract for development of a full-scale 1·5-million-pound thrust engine was initiated. This was followed by a long series of exacting tests. Each component was tested and re-tested to assure maximum reliability and top performance. Then, in a series of carefully prepared tests, the components were gradually assembled for full-system firings.

First Test

The first complete engine test was made on 13th June, 1961, at the high thrust test area at Edwards, California. Approximately one million pounds of thrust was generated at that time. This achievement was of high significance to the U.S. space effort. Prior to that, 140 unofficial tests had been made, one of which included a thrust chamber test during which a record thrust of 1,640,000 pounds was achieved. The F-1 uses the same propellants and basic designs as the Rocketdyne engines that powered the Atlas, Thor, Jupiter and Saturn vehicles and have launched 43 out of America's 47 successful satellites and space probes. More than 650 scientists and engineers are assigned directly to the F-1 programme. They are supported by hundreds of manufacturing, quality control and administrative persons.

Basic components of the engine are a tubular-wall regeneratively cooled thrust chamber assembly, direct drive turbopump, gas generator and required controls.

Thrust Chamber

The thrust chamber assembly consists of a tubular-wall chamber, an uncooled nozzle extension, double-inlet oxidizer dome, two fuel valves and a flat-face injector.

The basic chamber is formed of high strength alloy steel tubes which are contured, stacked and then brazed in a specially designed gas-fired brazing furnace.

In operation, fuel flows through alternate tubes the length of the chamber and then returns to an injector feed manifold. Here it is distributed through 32 spokes into the injector from which it passes through approximately 3700 holes into the combustion chamber, where, combined with liquid oxygen, combustion occurs.

The cooled portion of the thrust chamber is 11ft. long, 40in. in diameter at the throat chamber and 9½ft. in diameter at the exit.

A unique feature of the chamber is a design to provide for attachment of segmented uncooled extensions. This feature is important for two reasons. It makes it easier to transport the engines, since the uncooled segments can be packaged and shipped separately, and it makes it possible to tailor the engine for specific missions. This is done by attaching uncooled segments of different lengths to attain any required expansion area ratio (ratio between throat of nozzle and exit of gases) from 10-1 up to 16-1. Larger expansion area ratios are required at an altitude other than at sea level to get efficient engine operation.

Turbopump

The F-1 turbopump, which weighs 2,500 pounds and develops 60,000 horsepower, is so powerful that it can move three tons of propellant—two tons of liquid oxygen and one ton of narrow-cut kerosene—into the combustion chamber in one second.

In three seconds enough oxygen is consumed by the F-1 to provide for the breathing requirements of the entire 180 million people in the United States for one second. In the same three seconds, the engine burns up as much fuel as the average motor car uses in one year of heavy operation.

Gas Generator

Power in the form of gases to run the turbopump is provided by a gas generator which burns fuel-rich liquid ozygen and kerosene. About 2% of the total propellants used in the F-1 are burned in the gas generator.

A feature of the gas generator, which is partially spherical and about 10in. in diameter, is its double-wall combustion chamber. Fuel flows between the chamber walls to cool it. This gives added safety in engine operation by eliminating a hot outer surface and reducing heat radiation to adjacent components.

Controls

The main controls are two fuel valves and two oxidizer valves mounted on the thrust chamber dome; a gas generator valve; a fuel and oxidizer flow regulator for the gas generator and a four-way solenoid valve, which controls the other valves.

The latter is one of the only two components in the engine requiring electrical wiring. The other is the spark exciter which ignites the gas generator.

Engine Test Facilities

F-1 is tested at facilities located at the high thrust test area on Leuhman Ridge, California. These facilities include a thrust chamber stand and two engine test stands, all capable of captive firings at 1·5 million pounds thrust or more; a centrally located underground control centre and other necessary supporting facilities.

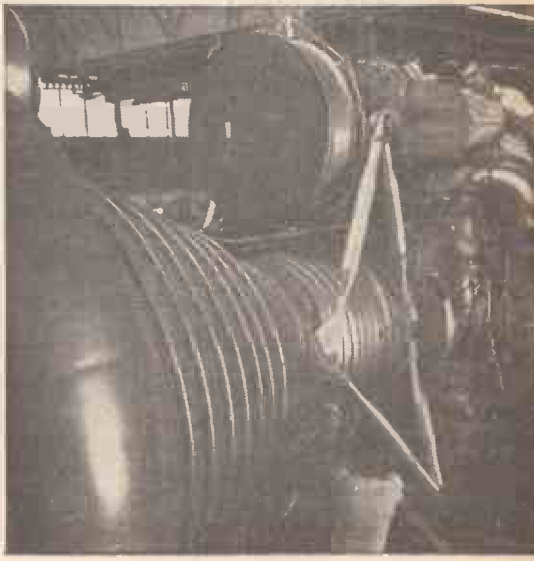
Firings are controlled and test data recorded in the underground control centre. Here central consoles for each test stand are located and test engineers are able to observe firings by means of three position closed circuit TV systems on each stand.

One hundred and seventeen graphic recorders and two high frequency tape recorders gather nearly 200 different measurements during a single engine test. Data is moved by coded teleprinter from the control centres to the Rocketdyne computer centre at Canoga Park. Test information can be analysed and fed back to test engineers at the test site in as little as half an hour.

NOVA
CONTINUED

Recorders used to monitor tests.

Nova under final assembly.



An Electric Pin-table

by Jameson Erroll

Materials required:

9ft 6in. x $\frac{3}{4}$in. planed deal for sides and ends.
12ft $\frac{3}{4}$in x $\frac{3}{4}$in. planed deal for supporting battens.
1 doz. 2in. No. 6 C/S wood screws.
1$\frac{1}{2}$ doz. 1in. No. 6 C/S wood screws.

THIS pin-table, while not claiming to incorporate the many elaborate gadgets such as spring-controlled electric bumpers, featherub roll-over switches, contact leaves, adding devices, etc. will afford a maximum of amusement consistent with its simple design and ease of construction. There is nothing to go wrong once the machine is made and assembled, and the electric circuit is foolproof and calls for no intricate wiring and minute adjustment.

As will be seen from Fig. 1 it consists of a framed, sloping table on which are erected a number of various hazards to impede and deflect the steel balls on their way down the table. Scoring is attained by the balls entering the channels formed by the dividing beads, and as each ball comes to rest it automatically registers an appropriate score by lighting the bulb or bulbs under the large cut-out numbers. There are two lights under each number so that two balls entering the same channel both score; if a third ball runs into a channel already occupied by two balls it must be considered " lost ". At the end of a six-ball run (or more if desired) the total is cast mentally, the competitor with the highest number being the winner.

The Frame

Fig. 7, an isometric projection of the assembled frame, and Fig. 2, a plan of the wooden supporting battens, will make construction plain. The sides and ends are butt jointed as shown, or they may be mitred or dovetailed if desired, and

PART 1

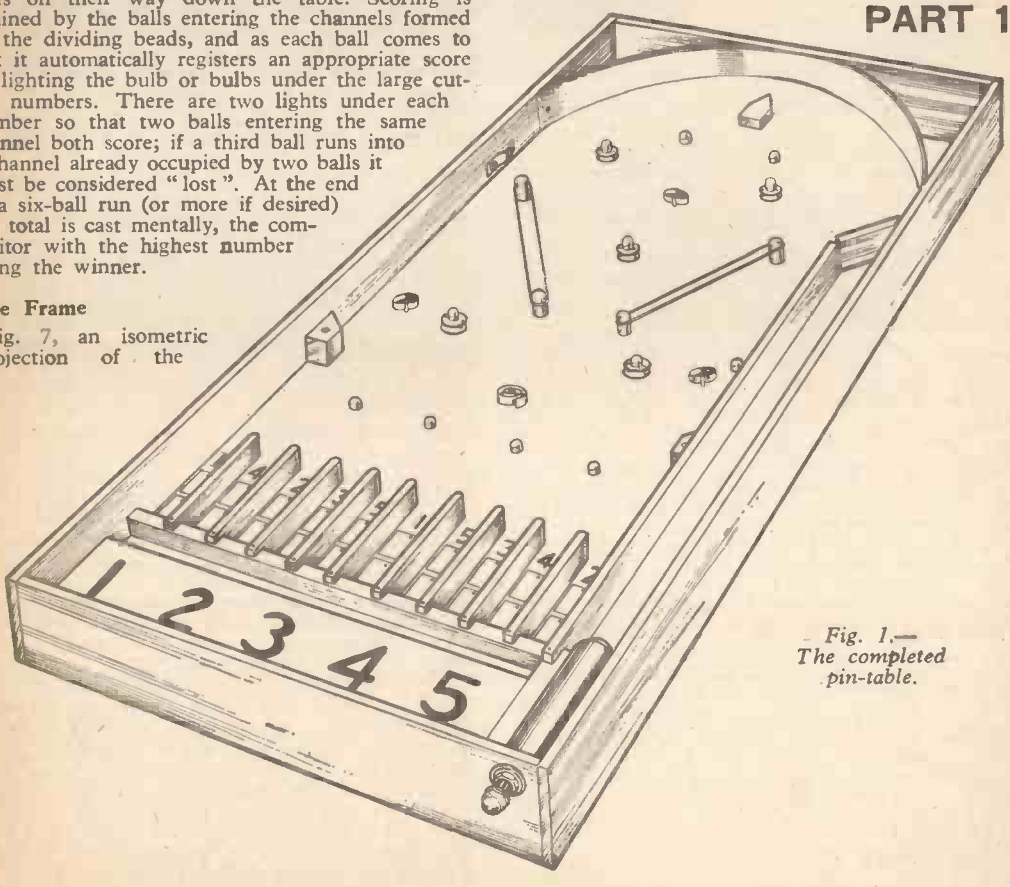


Fig. 1.—The completed pin-table.

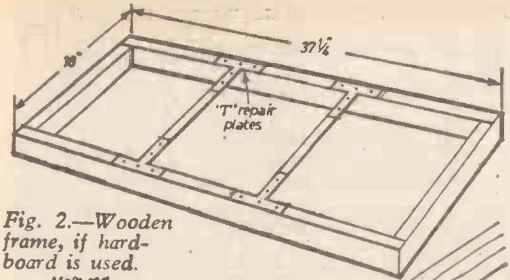


Fig. 2.—Wooden frame, if hard-board is used.

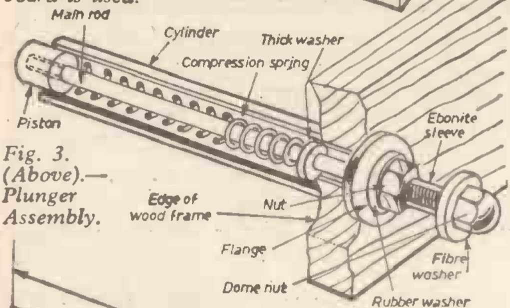


Fig. 3. (Above).—Plunger Assembly.

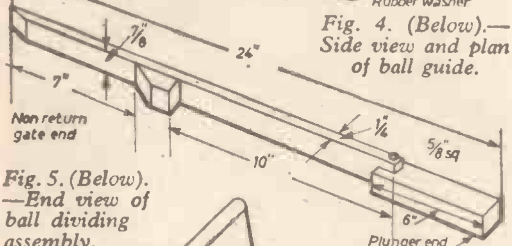


Fig. 4. (Below).—Side view and plan of ball guide.

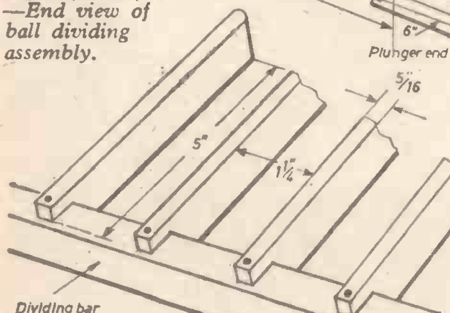


Fig. 5. (Below).—End view of ball dividing assembly.

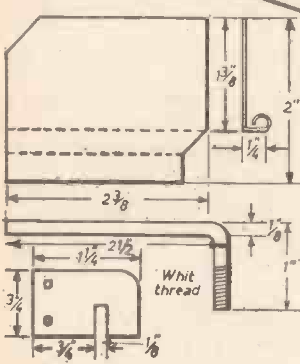


Fig. 6.—Non-return gate parts. (Top) Flap; (Centre) The hinge; (Bottom) Hinge retainer.

glued and screwed with 2in. No. 6 counter-sunk wood screws. The battens are then screwed on from the inside, the slope being 2½in. over the length; the top edge of the batten at the plunger or operating end is fixed 1¼in. from the bottom edge of the frame, and the top edge of the batten at the far end is fixed 3¾in. from the bottom edge of the frame. The two side battens are then screwed in position aligning with the two end battens already fixed. One of two mid supporting battens may also be inserted at this stage if hardboard is chosen for the table; they are fixed with T repair plates as shown. The whole may now be given an under-coat of white matt paint.

The Playing Table

This may be of ¼in. plywood or ⅛in. hardboard—the author favours the latter. It is an ideal surface entirely free from any blemish; is of adequate strength if supported with cross battens as shown in Fig. 2; and it will take a finishing coat of paint quite well. Further, it is extremely easy to drill, and this is all to the good since practically all the work is carried out without removing the table from the frame once it is fixed.

It will require to be 36in. long and 16¾in. wide, and a piece 3ft x 1ft 6in. can be bought ready cut from any timber store. The piece 36in. x 1¼in. left over after cutting serves to provide the semi-circular border at the top around which the ball travels according to the speed with which it has been projected from the plunger. It should be reduced in length to 26in. and its two ends chamfered down so that, when screwed to the sides of the frame, it lies practically flush with them.

Drill four equi-distant 7/64in. holes along both sides and three along each end, setting them in 5/16in. from the edge and counter-sink. These will take No. 4 wood screws (⅝in. long) for fastening the table to the battens. When this is done, gradually bend the semi-circular border after having drilled it centrally and near each end, also with a 7/16in. drill. Fasten to the main frame with ½in. No. 4 raised-head chromium-plated wood screws, fixing the centre one first accurately at the centre of the top of the frame.

The Plunger

This is the next item to be made and Fig. 3 furnishes full details. The cylinder is a 5½in. length of brass or chromium tubing with an outside diameter of ¾in. and an inside one of ⅝in. A smaller, flanged tube with an inside diameter of ¼in. passes through the main frame, and a thick brass washer 'F' with a ¼in. central hole is screwed to the inside face of the frame as shown in Fig. 3. This washer should have an outside diameter of ⅝in. full so that the cylinder is a forced fit over it.

The plunger itself is assembled around a 7¾in. length of ¼in. Whitworth rodding, to one end of which the piston is threaded on and pinned through. The compression spring is of comparatively light substance and should be about 5in. to 6in. long and be a sliding fit over the rodding. The rubber washer is introduced as a kind of silencing buffer, while two nuts tighten on the ebonite sleeve placed between them. The fibre washer is of larger diameter than either, and if of a brilliant colour (red for example) serves as a decorative feature as well as

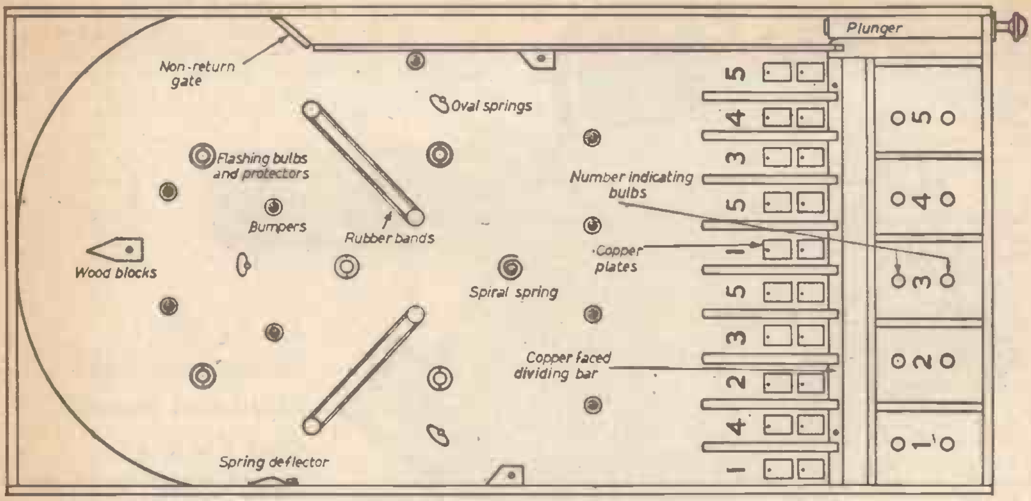


Fig. 7.—Plan of the lay-out of hazards, etc.

furnishing a good grip for the finger and thumb operating the plunger. A few drops of oil should be introduced inside the cylinder and the flanged tube before assembly; a touch or two on the spring will not do any harm either. Note when drilling the hole in the main frame for the flanged tube that it should be in such a position that the bottom of the cylinder rests on the table and the side against the inside of the frame. Since the bulk of this assembly is left visible, it should be highly polished.

The Ball Guide

This is made up of a 19in. length of 1in. x $\frac{1}{4}$in. hardwood and a 6in. length of $\frac{3}{8}$in. x $\frac{3}{8}$in. hardwood, and a block shaped from a piece of wood 2in. x 1in. x 1in., see Fig. 4. This latter piece serves the double purpose of being a means of fastening the guide to the table and also as a ball deflector. Note the obtuse bevel at the far end. Screw the guide to the table with two raised-head chrome-bolts, one passing through the aforementioned block, the other through the 6in. x $\frac{3}{8}$in. x $\frac{3}{8}$in. strip; the inside face of the guide should be exactly $1\frac{1}{4}$in. from the inside face of the frame; this allows perfect freedom for the 1in. steel ball to travel easily.

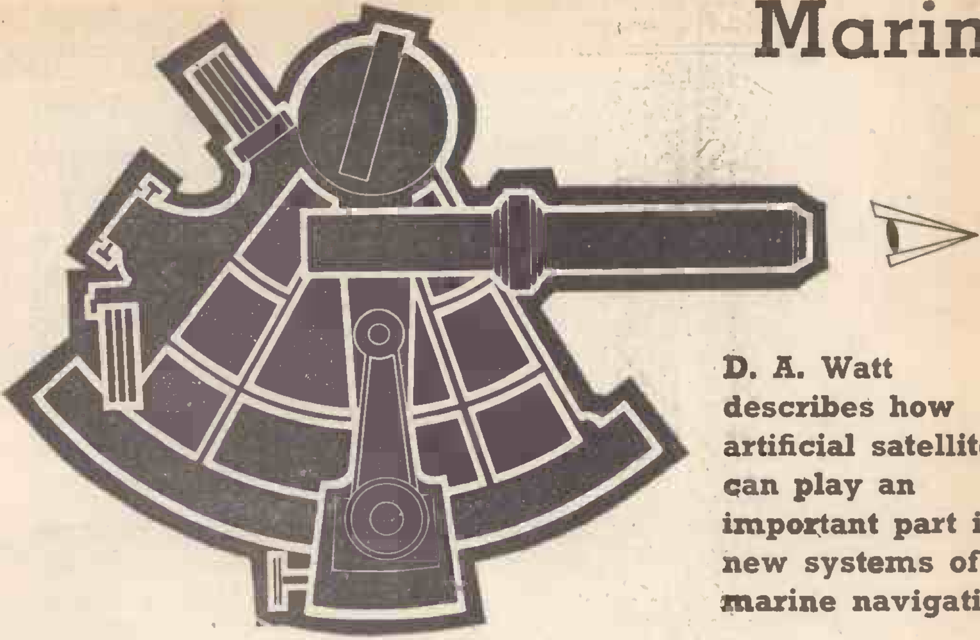
The non-return gate, which may be considered as part of the ball guide, is illustrated in Fig. 6 and shows that it is made from a $2\frac{3}{8}$in. x 2in. piece of thin brass which forms the flap; a piece of similar material $1\frac{1}{4}$in. x $\frac{3}{4}$in. for retaining the hinge; and the hinge itself which is of $\frac{1}{8}$in. round brass rod. Cut the flap to the shape shown and bend at the dotted lines to form a swinging fit over the brass rod which, in this case, was made from a large dresser hook. This is a tapped-in fit to the top edge of the guide as seen at 'J' in Fig. 8. The hinge retainer is screwed to the inside of the frame and prevents the hinge swinging outwards when the flap is struck by the ball.

The Scoring Divisions

Parts of these are shown in Figs. 5 and 7, from which it will be seen that nine beads project at right-angles from a dividing bar and thus provide ten separate divisions into any one of which the ball may ultimately come to rest. Ordinary beading 1in. x $\frac{1}{2}$in. (finishes $\frac{7}{8}$in. x $\frac{3}{8}$in.) is ideal as it has a rounded edge which adds to appearance. Nine pieces each 5in. long are required, and the dividing bar is $15\frac{7}{8}$in. long by $\frac{7}{8}$in. x $\frac{3}{8}$in. Round the front edge of each bead as shown—so that a slowly travelling ball cannot rest on the edge—and cut out a $\frac{3}{8}$in. x $\frac{3}{8}$in. rebate from the other end. Drill this top edge $\frac{3}{32}$in. to take $\frac{1}{2}$in. No. 2 raised-head chromium-plated wood screws to fasten the beads to the bar; their further extremity is screwed from the underside of the hardboard with $\frac{1}{2}$in. No. 2 round-head iron screws. The inside separation between each bead is $1\frac{1}{4}$in. Before the beads are screwed on, however, the inside vertical face of the dividing bar is faced with thin copper foil; it may be attached with one of the many universal adhesives now on the market or with $\frac{1}{4}$in. brass pins. At the extreme end—near the plunger—a small 6B.A. terminal is passed through the copper and the bar; this is for later connection to the electrical circuit, details of which will be given next month. The whole ball-dividing assembly may now be screwed to the table, from the underside, with its rear edge 5in. from the inside of the frame.

(To be concluded next month)

Marine



D. A. Watt describes how artificial satellites can play an important part in new systems of marine navigation

MODERN ships are navigated about the oceans of the world mainly by astronavigation with limited use of short-wave radio aids. The degree of accuracy achieved with astronavigation is, at best, barely adequate and can be seriously affected by bad weather conditions.

A continuously available radio navigation system combining the accuracy of astronavigation and the simplicity of a short-wave radio aid would be extremely valuable to the mariner. Existing radio aids achieve this only at limited ranges due to the effects of the ionosphere, as we shall see later. Thanks to the recent advances in the science of radio astronomy, and the ability to launch artificial satellites into a controlled orbit, two suitable radio navigation systems are now practical possibilities.

The Collins Radio Company of the U.S.A. have spent several years developing a radio sextant which can locate the position of the sun or moon, whether visible or not; and can be used to obtain a position in much the same way as with a normal sextant. Fig. 1 shows how a sextant is used to determine the angle between the sun's rays and the horizon. A chronometer is used to obtain the exact Greenwich Mean Time at which the observation is made, and, by reference to tables in the Nautical Almanac, the navigator can calculate his latitude.

As well as light waves the sun also emits radio waves. The radio sextant can be regarded as a miniature radio telescope able to detect these radio waves and use them to measure the sun's angle relative to the horizon. The waves are received direct from the sun at daytime or reflected from the moon at night (in the same way as moonlight is reflected sunlight), and can thus be used regardless of weather conditions.

The development of this radio sextant has been carried out in conjunction with the U.S. Navy but information about the details of the equipment is not yet available. Ships have been navigated using this equipment and it was found that a position at least as accurate as an "astro fix" could be obtained at practically any time of day or night.

A possible disadvantage of this system is the cost of installation and maintenance of the equipment on the ship, and, from the military point of view, the vulnerability to jamming by an enemy.

An ambitious but perfectly practical radio navigation system has been suggested based on the reception of signals from an artificial earth satellite. The principle of operation of this system would be as follows. A satellite having a long life and equipped with a radio transmitter sending out a steady, constant-frequency signal would be launched into a predetermined orbit. Once in this orbit it would be possible to calculate precisely the position of subsequent orbits relative to positions on the earth's surface. By a method known as measuring the Doppler shift of frequency at the satellite's signal as measured by a receiver on a ship it would be possible to determine the ship's position.

Using this method all that is required on the ship is a receiver having a simple dipole aerial and a system capable of measuring the frequency of the received signal.

Before taking a closer look at this equipment we must understand the Doppler Effect and how it is used in this system.

Let us first consider the satellite stationary in space and transmitting radio waves of constant frequency which we will call F_t. The space between the transmitter and the receiver on the ship is occupied by oscillations (or waves) having a wavelength λ related to the velocity of propagation, c, by the expression

$$F_t = \frac{c}{\lambda}$$

These waves move through space at the velocity c and for each wave that leaves the transmitter one is received at the receiver.

Navigation

Now let us see what happens if the transmitter were moving directly towards our receiver at a velocity V_s. The distance between transmitter and receiver would be decreasing by a distance equal to V_s every second, but as this distance is filled with waves of wavelength λ, more waves are picked up by the receiver per second than are sent out from the transmitter. It follows then that the received frequency is greater than the transmitted frequency by the number of wavelengths in a distance V_s, thus the received frequency (which we will call F_r) is given by

$$F_r = F_t + \frac{V_s}{\lambda}$$

$$\text{and frequency change} = \frac{V_s}{\lambda}$$

Similarly it can be shown that if the transmitter were moving directly away from the receiver the frequency is decreased by $\frac{V_s}{\lambda}$

Thus the Doppler Effect means that frequency of oscillations from a moving transmitter received at a stationary receiver changes as the transmitter approaches or moves away, the true frequency being obtained only when the transmitter is stationary relative to the receiver. A well-known fact which illustrates this principle is the change in note observed when an approaching express train passes a person standing beside the track. This is due to the change in frequency of the sound pressure waves which behave in just the same way as radio waves in this instance.

In practice the satellite would not be moving directly towards or away from the ship but at any instant would be moving in a direction at an angle to the straight line joining the satellite and the ship as shown in Fig. 2. We will call this angle θ. In this case the change in frequency due to the Doppler Effect is still given by $\frac{V}{\lambda}$ but in this case V is the radial component of velocity, that is the apparent velocity of the satellite relative to the ship, and is given by $V = V_s \cos \theta$.

We can determine this radial velocity by measuring the frequency change and can also determine when the frequency change is zero, which gives the instant in time at which the satellite is nearest to the ship on this particular orbit.

Fig. 3 shows how this information is used to determine the ship's position. The satellite's orbit relative to the earth is known. As the satellite approaches the frequency is changing. When this change reaches a predetermined value the time is

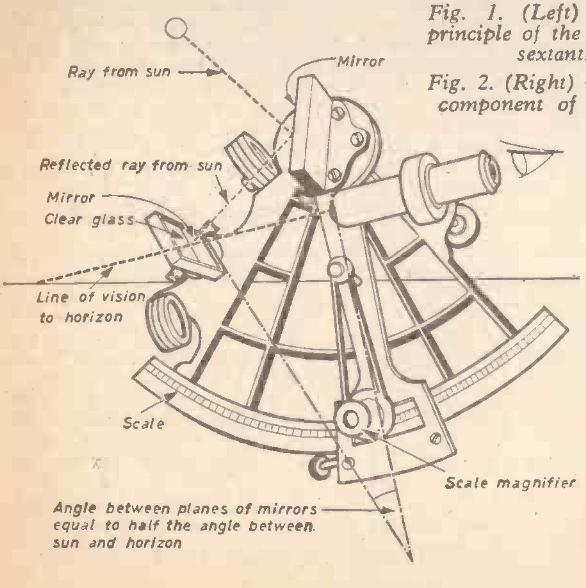
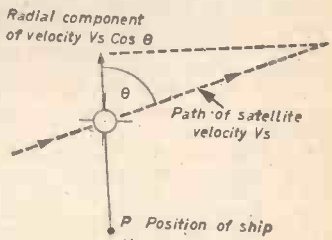


Fig. 1. (Left) — The principle of the mariner's sextant.

Fig. 2. (Right) — Radial component of velocity.



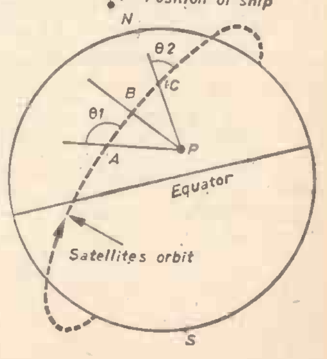


Fig. 3. (Right)—Determination of ship's position.

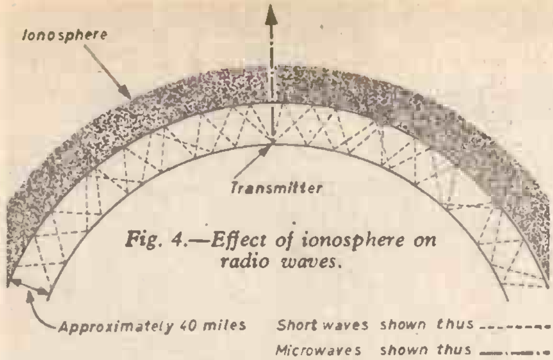


Fig. 4.—Effect of ionosphere on radio waves.

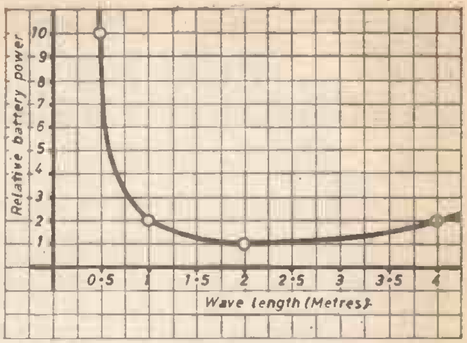


Fig. 5.—Chart showing battery power required in the satellite for various wavelengths.

recorded. This actually occurs at point A, and, as we know the satellite's velocity, we can calculate the angle θ_1. We do not yet know where A lies on the orbit. As the satellite continues along the orbit the frequency continues to decrease until the true transmitted frequency is received. The time at which this occurs is recorded and allows us to establish position B. By constructing the triangle ABP the ship's position is established. A check is obtained when the frequency again reaches the predetermined value at point C, when angle θ_2 can be calculated.

The most costly part of the equipment required for this system is the satellite launcher. The satellite itself would contain quite simple equipment since it is only necessary to provide an oscillator with a frequency stability similar to that of the first Russian satellite. The choice of frequency is a compromise between the problem of achieving adequate signal strength and the need to avoid any difficulties due to the ionosphere. The ionosphere is a layer of gas in the upper atmosphere which is able to reflect short-wave radio waves. Fig. 4 shows how this is used to bend short-waves round the earth. Microwaves of wavelength less than 4 metres can pass straight through this layer, and are suitable for this purpose.

Radio navigation systems using short waves can be affected by irregularities in the ionosphere which allow the waves to pass through, sometimes failing completely when the ionosphere is disturbed by a solar storm.

Fig. 5 shows how the battery power required in the satellite for various wavelengths varies in order to overcome the effects of galactic radio emission and the inefficiences in the transmitter and receiver. From this it is obvious that wavelengths between 1 and 2 metres are most suitable.

The satellite aerial must be as non-directional as possible and the fading due to rotation of the transmitter could be minimised by polarisation.

The receiving equipment on board the ship would also be quite simple by modern standards. A convenient method of measuring the desired quantities is shown diagrammatically in Fig. 6. In this arrangement two narrow band filters are arranged to respond to signals of a fixed frequency, equally spaced either side of the frequency transmitted by the satellite. The output of these filters, together with a signal from a chronometer, are fed into a recorder. The filters would only pass a signal to the recorder when the received frequency fell within their pass band, this frequency would be the predetermined frequency mentioned previously. The mean of the times would give the time at which the satellite is closest to the ship on this particular orbit. Thus all the information required to get a "fix" would be recorded and, with the addition of a simple computer, a completely automatic system would be obtained.

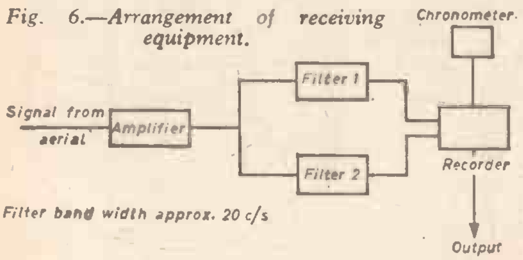
Because of the greater angular speed of the satellite compared with the usual heavenly bodies used for navigational purposes, more accurate time measurement would be necessary, an accuracy within 0·25 secs. being desirable. This should not, however, present too serious a problem.

This system can be operated with a wide variety of satellite orbits but if only one satellite is used maximum coverage would be obtained with an orbit inclined at 64° to the equator, as shown in Fig. 7.

At a height of about 375 miles (mean radius 4,375 miles) a satellite would come within range of a ship anywhere between latitudes 85° N and 85° S. Three or four successive orbits would be observable from any point, each of these providing an opportunity to obtain an independent "fix". The time interval between successive orbits would be a little over one hour.

This arrangement would be adequate for normal marine use, thus astro-navigation could be more than adequately replaced by this system using a single satellite. For complete coverage to provide the more continuous facilities needed for aircraft use, at least three satellites would be required.

Fig. 6.—Arrangement of receiving equipment.



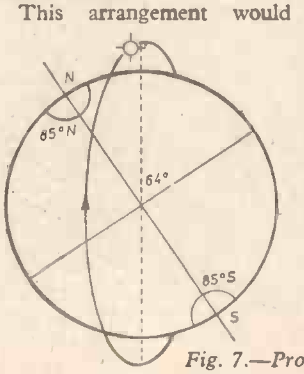


Fig. 7.—Proposed satellite orbit.

Air Thermostats

Their Uses in the Home are Discussed by E. V. King

THERE are many possibilities for using thermostats to control appliances powered by solid fuels, liquid fuels or electricity.

Space Heating Thermostats

These are devices which switch on, switch off or change over an electric current which controls an electric fire, including convector, motor-operated flue valve, air blast types, etc.

The simplest circuit for automatic control of room temperature is given in Fig. 1. There are many thermostats available; Figs. 1 and 2 show the Technical Services Model CS. This is typical of simple non-"accelerated" cheaper models, and is quite suitable for use in the home. Two large terminals are provided and must be wired with a cable capable of supplying the amperage taken by the circuit, and this must not exceed 15A in any event. It does not matter which way round the terminals are connected, but note that the rear of the instrument is "live" and must be covered. Normally, if the thermostat is *screwed* to a wooden batten the live parts are covered; if it is to be "hung" for use, say, with a movable fire, or convector then the back *must* be protected to prevent danger from shock. This model has no provision for earthing the case. A small bolt and two nuts should be fitted in the metal cover for this purpose and the two green wires securely connected to it. Make sure the bolt does not touch any parts within the case.

Mounting Model CS

The thermostat must be mounted at least 2ft. above the ground, the best position being 4ft. 6in. high on a wall well away from the heater. If the heater is a convector type any position not directly over the heater will suit; if it is a radiant type then the thermostat must not be in the line of radiation. Radiation takes place in straight lines so this generally means that the thermostat will have to be placed *behind* the heat source.

Typical thermostat about to be inserted in a 13A. power point socket.

Neglect of these points will cause the heater to cut out before the whole room space has warmed to the pre-set temperature.

The model CS thermostat is best mounted on a piece of hardboard or plywood fitted across a corner of the room with the top and bottom left completely open (Fig. 3). The back of the thermostat is screwed with the escutcheon on to a panel.

Other Mounting Methods

If a bookshelf or open bookcase is present it can often be mounted between two adjacent shelves and a few ½in. ventilation holes cut above and below the thermostat. See Fig. 4.

It may also be satisfactorily hung up in a box with open ends made to the dimensions given in Fig. 2. The lead may come out of the top, bottom or sides as convenient.

Initial Setting of the SC Thermostat

The thermostat will work over any range of 40°F between 40° and 120°F. For normal use the maximum temperature required should be arranged to cut out the heater if the knob is turned

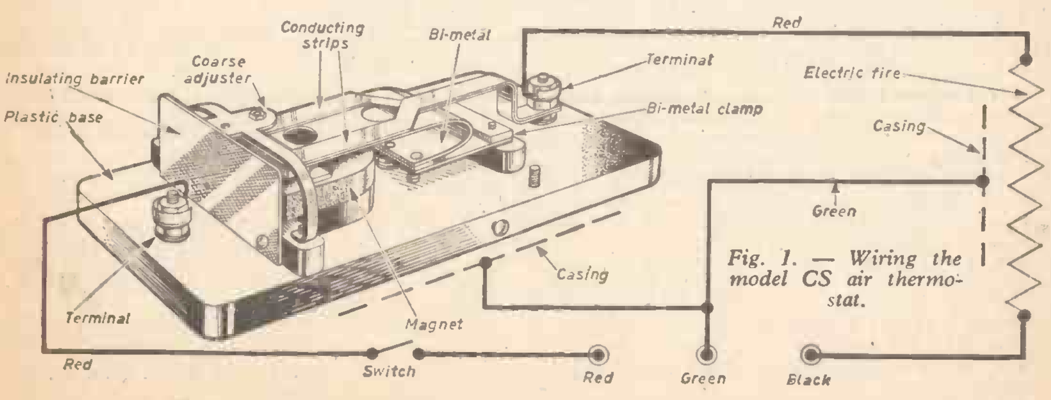
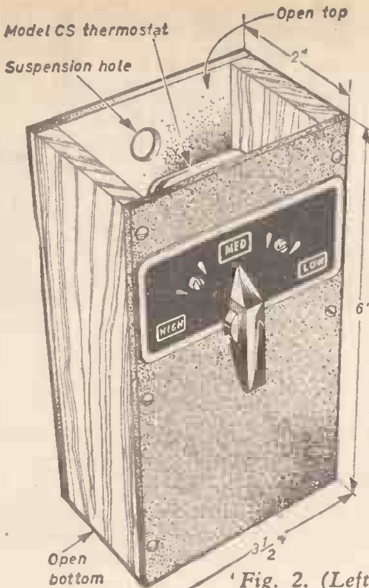


Fig. 1. — Wiring the model CS air thermostat.



'Fig. 2. (Left)—CS thermostat in box mounting.

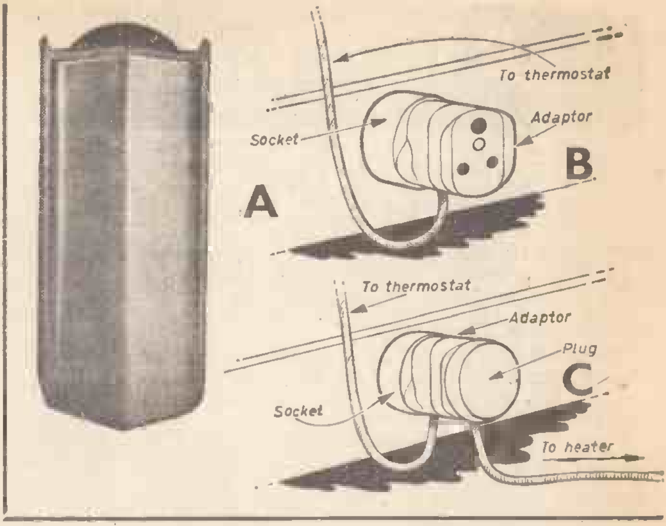


Fig. 5. (Above)—(a) the adaptastat; (b) first plugging operation; (c) second plugging operation.

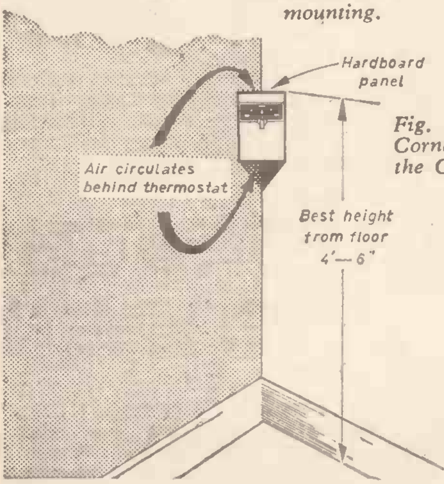


Fig. 3. (Left)—Corner mounting the CS thermostat.

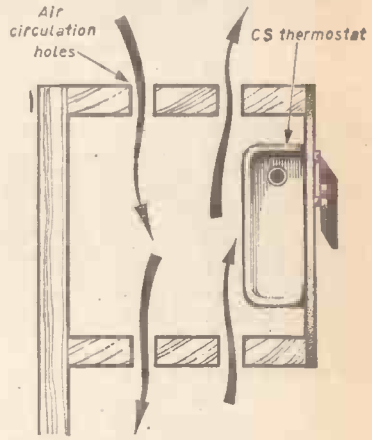


Fig. 4. (Right)—Shelf mounting the CS thermostat.

nearly fully anti-clockwise between Medium and High.

This is arranged as follows. Turn the knobs slowly anti-clockwise and notice where the click is heard. This is the "cut-out" point. Observation of the contacts will show that they have opened, or a torch lamp and bulb will verify this.

Go into a small room fitted with an electric fire and a thermometer, and when the temperature of the room is at the cut-out point required rotate the knob. If the makers' setting is not what is required further adjustment is possible using the two coarse adjusters which are fitted with lock nuts (see Fig. 1). Trial and error will soon reveal correct setting.

Unless the wanted setting is far from the makers' setting it is best to leave it alone, as although it is easy to set the cut-out point it is not so easy to set the "pull in" point to operate at a close but lower temperature. When obtained the differential is about 5°F. This is quite good enough for domestic use.

The Adaptastat

This is a similar unit to the CS thermostat, but is more decorative, is easier to mount on the wall and can be obtained complete with an easy wiring adaptor. If purchased without the adaptor the circuit of Fig. 1 is suitable; if purchased with the special adaptor basically the circuit is the same, but the wiring takes the appearance shown in Fig. 5b and c. The thermostat is shown at 'A'.

Using the Adaptastat

The Adaptastat control knob is put in position No. 7 and the heater switched on. Alternatively the control is set and the socket adaptor (Fig 5b) plugged in and the fire (or other device) plugged into the adaptor (Fig. 5c).

While 70°F. is considered a reasonable room temperature (No. 7 position) the unit will work between 35°F. (No. 1) and 85°F. (No. 9). The

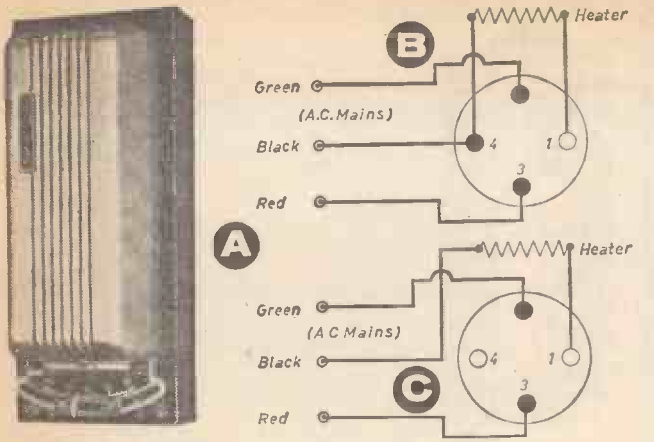


Fig. 7.—Pullin "Plug-Stat" operating a tubular heater.

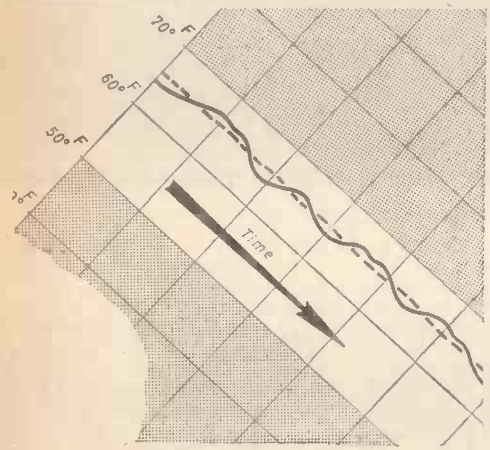
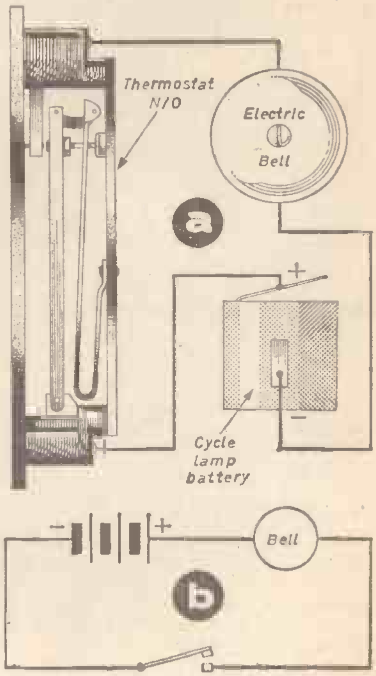


Fig. 6. (Above) —(a) Satchwell "Q" type thermostat; (b) Circuit if heater draws under 11A.; (c) "Q" type circuit if heater draws over 11A.

Fig. 8. (Right) —Frost alarm (a) Practical wiring (b) Theoretical wiring.

Fig. 9. (Left)—Graph showing the slight improvement obtainable with accelerated thermostats.



35°F. setting is useful when it is desired to keep frost out of a room or house as cheaply as possible. No pre-adjustment is required or should be attempted.

The Pullin Plug-stat

This is similar to the Adaptastat, but requires wiring to the heater. This is a good point, as bad connections (due to dirty plug pins, etc.) near a thermostat will cause heating and the circuit will be broken when the room is cold. A close view of the 13A. flat pin model is shown in the heading photograph, and the unit connected to an electric convector heater is shown in Fig. 7.

Being low on the side of the room the temperature will not be controlled as well as if the plug were just over 4ft from the floor.

Accelerated Thermostats

If a room is heated by a thermostatically controlled heater, the actual temperature will rise and fall over a few degrees in cycles when the points are either closed or open (this is due to the differential setting). This is shown diagrammatically in the graph of Fig. 9.

The wavy solid line is that caused by the type of thermostat already described, but the steady dotted line results from a special type of thermostat which incorporates a heater inside itself. Naturally if one requires such steady regulation the cost will be greater.

An accelerated thermostat suitable for domestic living rooms is shown in Fig. 6a. It is attractive in appearance and very accurate in working. It is calibrated in degrees Fahrenheit and two adjustable end stops allow individual choice of control over certain limits. The instrument shown is set at 65°F.

Wiring Accelerated Thermostats

Since a heater is incorporated, the wiring is more complicated and varies slightly according to whether the heater in circuit draws 11A. or below, or between 11A. and 15A. (the maximum controllable.)

(Concluded on page 190)

SCIENCE NOTES

RECENTLY demonstrated before the War Minister and members of the Houses of Parliament was the HOVERSLED for carrying a single wounded man over very rough ground without suffering additional damage. The simple platform is supported on an air cushion maintained by a motor-driven central fan enabling the vehicle to be towed or pulled by hand.

Coal passing through a twisted chain air seal.

Twisted Chain Air Seal

Mr. P. Thorp, a ventilation engineer with the National Coal Board, has proved that suspended rows of cross chain twisted link can be used to provide a very efficient, cheap, permanent and simple air seal at places where a coal carrying conveyer has to pass through an air lock. The individual lengths of chain are so placed as to form (normally) three curtains over the opening to be sealed. Adjacent chains in the same curtain, and the curtains themselves, are hung close together, the links fitting into each other and forming a closely knit barrier against air-flow. The lower ends of the chain mould themselves very precisely to the profile of the coal-load passing under the barrier, thus avoiding concentration of air-velocity and reducing dust pick-up to a minimum. Air leakage associated with the present conventional type of "belt" door often produces a dust problem, is very wasteful and costly, and adversely affects the ventilation of the production faces.

Photograph taken at the Hoversled demonstration.

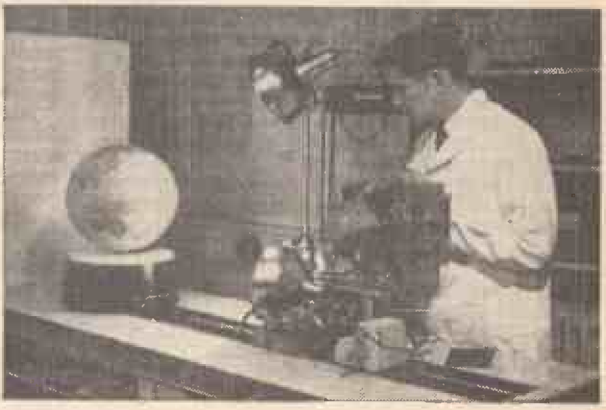
Periphery Camera

A camera that photographs all sides of an object at once has been developed at the Thornton, Cheshire, Research Centre of "Shell".

The picture it takes is a continuous all-round view such as would be seen if all the surface of the object had been peeled off, like the skin of an orange, and laid out flat.

For example, this camera can photograph a globe of the world and produce a print that looks like a wall map.

This technique is known as periphery photography, which in itself is not new, but previous methods have been limited by the size and shape of the object being photographed. The Thornton camera overcomes these limitations, and also means that the inside surfaces of hollow objects can be photographed.



(Right) The periphery camera in use. It can also be used to photograph objects as small as fingerprints on a pencil.

a hatching gadget

By J. A. Logue

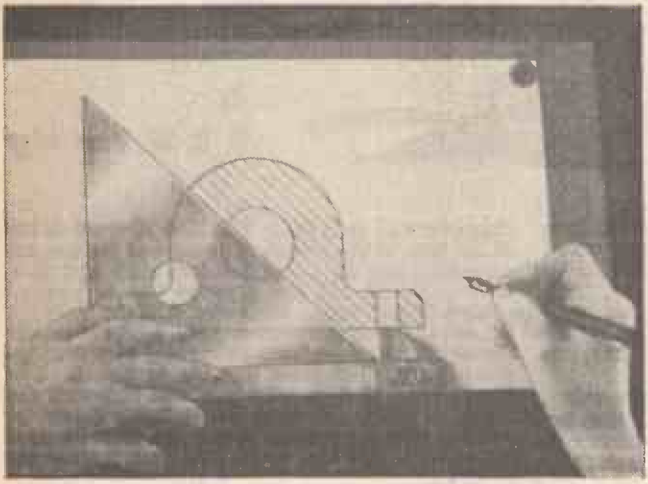


Fig. 1.—The instrument in use.

ACCURATE and neat section lining improves the appearance of mechanical drawings and sketches. The instrument when used in conjunction with a set square as shown in the photograph, Fig. 1 will give equally spaced lines quickly and neatly.

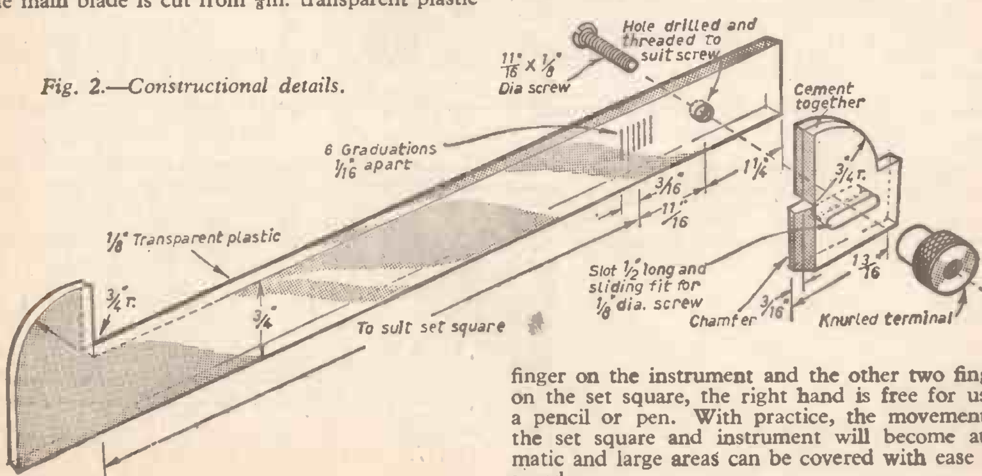
Construction

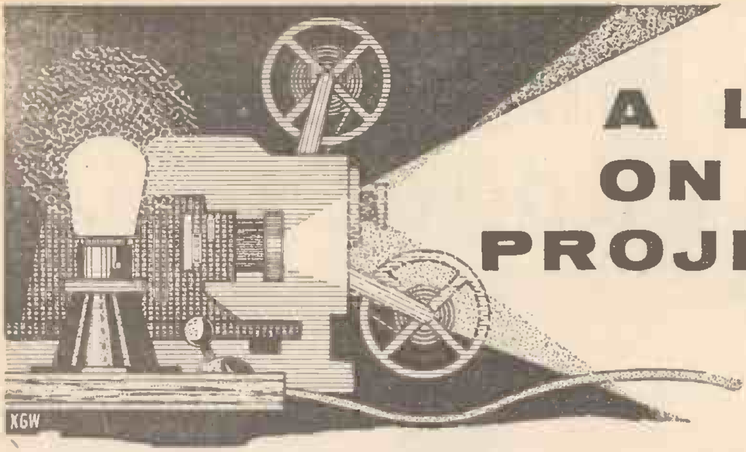
Details of the instrument are shown in Fig. 2. The main blade is cut from $\frac{1}{8}$in. transparent plastic and edges polished; the overall length depends on the size of the set square to be used. Scribe six graduations on the front face $\frac{1}{16}$in. apart. Drill and tap where shown to take the $\frac{1}{8}$in. diameter set screw and countersink the back to accommodate the head. with the screw in place lock the head with a spot of suitable plastic cement. Cut the adjustable sliding stop from two pieces of $\frac{1}{8}$in. transparent plastic, chamfer edges, and cut out the slot before cementing the pieces together. when the cement has hardened, polish all edges. A suitable knurled clamping terminal is threaded on to the set screw.

Using the Instrument

This instrument is adjustable to give lines spaced between 0 and $\frac{3}{8}$in. Before using, the adjustable stop is set to the spacing required and the clamping terminal tightened. The relative positions of the set square, T-square of drafting machine blade and the instrumentment are as shown in the photograph, Fig. 1. When a line is drawn against the edge of the set square, the instrument is moved until stopped by the set square which is held stationary; the set square is then moved until stopped by the instrument which is now held stationary and another line drawn, and so on. These movements can be carried out with the fingers of the left hand, by placing the thumb and first finger on the T-square the next finger on the instrument and the other two fingers on the set square, the right hand is free for using a pencil or pen. With practice, the movement of the set square and instrument will become automatic and large areas can be covered with ease and speed.

Fig. 2.—Constructional details.





A LIGHT ON YOUR PROJECTOR

By

G. R. W. Partridge

SOME projectors, ciné as well as slide, have no inspection lamp, which is a light which enables the operator to thread the film or set up the slides when the room lights are off. This means that these lights have to be turned on every time a film or slide magazine is changed, which tends to take the "professional touch", if any, out of the show.

This simple circuit can be made up in an evening. It is automatic from the point of view that the inspection lamp comes on when the projector is turned off and vice versa. But both projector and lamp can be turned on at the same time if necessary.

Construction

Fig. 2 shows the lamp mounted on its control panel, which is made out of wood. Fig. 1 gives the dimensions of each part. The kind of wood is left to the taste of the reader. The sides of the box are assembled first by using one inch nails and glue. Now glue and nail the plywood top in position using half inch nails. Mark and drill the holes for the switches and lamp wires. (Fig. 1.) Now mount the switches and the lamp holder and wire them up according to the circuit diagram in Fig. 3. The lamp Fig. 2 is a 15 watt type and assuming the projector draws 300 watts the switches should be not less than 2 amperes. Power flex must be used throughout. The lead to the plug must have ample length, about 3 yards, while a yard will be enough for the projector. The plywood base is not glued, but held in position with eight ½in. screws.

It is an idea to fit a small reflector to the lamp so as to concentrate the light in the required direction. (Fig. 4.)

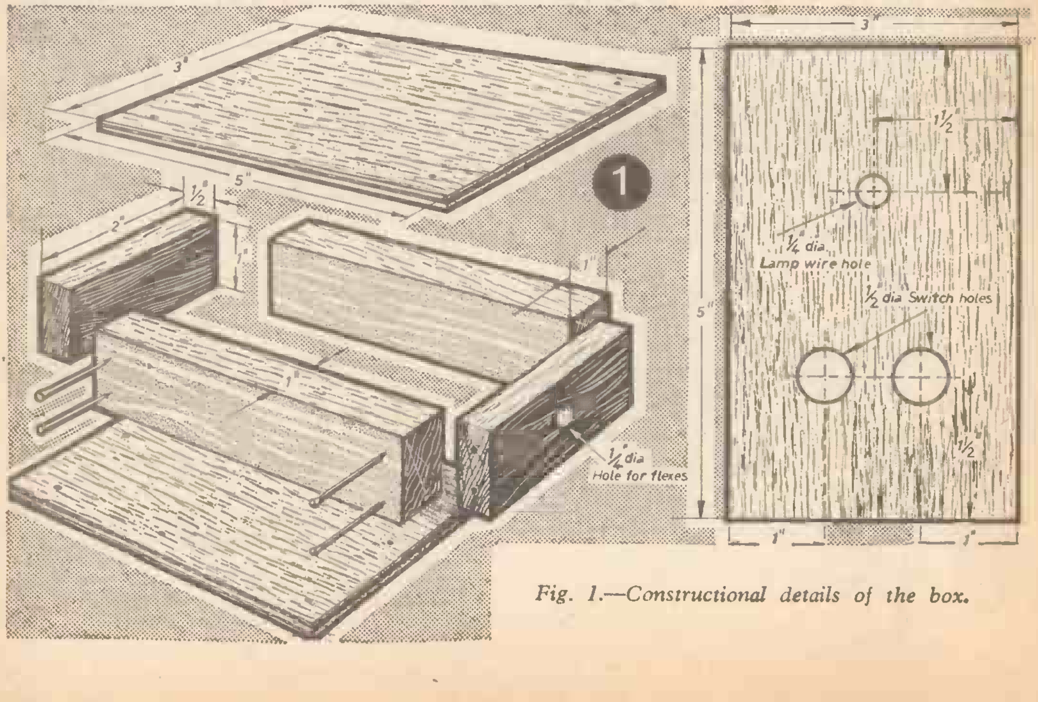
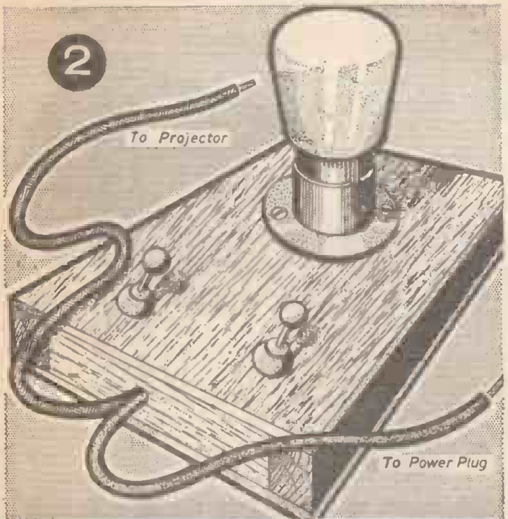


Fig. 1.—Constructional details of the box.



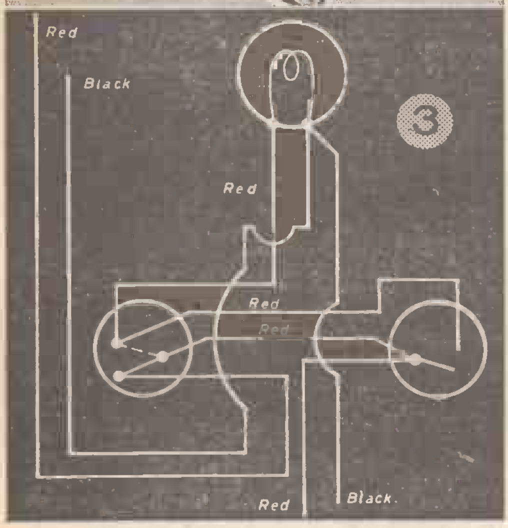
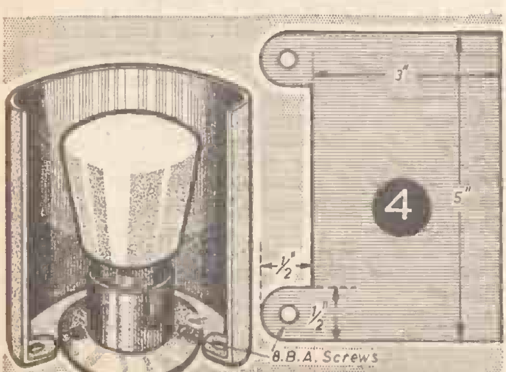


Fig. 2.—The inspection lamp.
Fig. 3.—Circuit details.
Fig. 4.—The reflector.



PUZZLE CORNER

The Stamp Auction

TWO friends attended an auction sale to bid, individually, for three similar rare foreign stamps. 'A' was prepared to bid up to £20 and 'B' up to £25. A third party, however, was keen on acquiring the stamps and bid £30 over 'B's' £25. The two friends decided quickly to pool their resources and eventually outbid the third party and secured the stamps for £45. They kept one stamp each for their own collections and sold the third for £20.

In what proportion should they divide this sum?

Answer

Since each stamp cost £15 and both 'A' and 'B' kept one, 'A' contributed £5 towards the cost of the third stamp and 'B' £10. 'A' should therefore receive £6 13s. 4d. and 'B' £13 6s. 8d. as a result of the sale of the third stamp for £20.

The Flying Sorcerer

(Concluded from page 158)

Slowly, the platform with the girl rises until it is at maximum height. With performer standing to the rear immediately behind the elevator tube, the hoop-passing routine begins. Thes four moves are detailed on Fig. 7 and shows how the big hoop is first passed over platform—and girl—from the feet end. As soon as the hoop—Stage 1—touches the edge of the fixed back-drape, it is pivoted forward to Stage 2 so that it swings over the girls head and lies parallel with the rear edge of the board.

Stage 3—and the hoop is passed along the back of the board with bottom of hoop slipping under the fixed drape between the cloth and the elevator tube. Finally, in Stage 4, the hoop is swung over the feet of the girl again, but this time the hoop can be taken right across her body the length of the platform and removed over her head. The move is then reversed until the hoop is finally taken off from the feet end of the platform.

The 3ft. 6in. hula hoop will do this routine satisfactorily providing the girl is about 5ft. in height. Otherwise, make up the larger hoop or use the more flexible rope loop. Always pass the hoop for examination before and after the trick. Use care when passing the hoop near to the fixed drape so that the elevator tube is not displayed accidentally.

Old time magicians used an elevator tube that came up through the stage and behind the magician's legs. The drape method is an improvement as the performer is not tied to one position on the stage and can walk away and round the floating lady at the point of highest elevation.

When the jack operator releases the pressure, your flying lady floats back to earth again and the loose drape can be removed.

Workshop Aid

A USEFUL CONTAINER FOR SMALL DRILLS AND TAPS

DESCRIBED BY
J. H. B. GOULD

Fig. 1.—The completed container.

HOW often is the model constructor faced with the problem of storing small twist drills, drills with code numbers in the fifties and sixties, which are too small to be size-stamped by the makers.

The drill box described here not only provides complete protection for its contents, but enables the drills to be easily and surely identified. It is made from the type of can in which 35mm. bulk film is sold (or from a container similar in form). (Fig. 1.)

The illustrations show the use which can be made of a can intended to hold five metres of film, but the same principle can be applied to other sizes. The cans in which loaded casettes are sold will make a holder for a set of drills and taps for one screw size while, conversely, a 100ft. bulk film container would certainly provide accommodation for all the small drills and taps that anyone could possibly require!

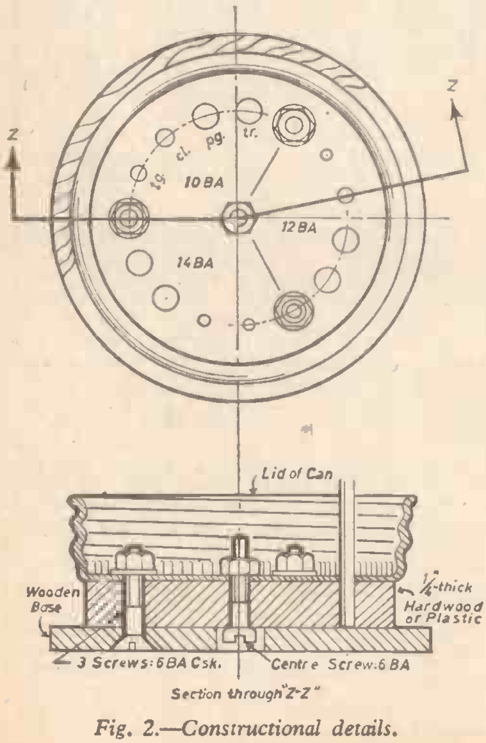


Fig. 2.—Constructional details.

With regard to construction, the holes to carry the drills are made by the drills themselves and, in this way, they also serve to identify the drill sizes. The holes for taps should be drilled to the *shank* diameter (taps should never be nested by their threads). Fortunately, no identification problem arises with taps, as the sizes are always marked on the shanks.

During construction, the lid of the can is held against the 1¼in. thick plinth block with the aid of the centre screw (see Fig. 2). After the stand has been assembled, this screw can be dispensed with.

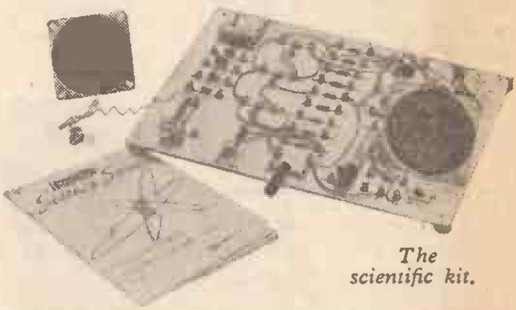
The sizes of the drills or taps can be marked against the holes they are to occupy. This can be done in either pencil or ink, although the latter is clearer and more permanent. If the ink refuses to "take", the aluminium surface should be rubbed with an ink eraser which roughens the metal and deposits a thin, absorbent coating.

TRADE NOTES

A REVIEW OF NEW TOOLS, EQUIPMENT, ETC.

Educational Toy

DAYSTROM Limited, of Gloucester, makers of the d-i-y radio and stereo hi-fi Heathkits, enter a new field with the Heathkit EW-1, a novel educational toy. Some of the models which can be built with the kit are: a code practice flasher, burglar alarm, electronic timer, electric eye and six different type of transistor radios, etc. The kit is obtainable from Daystrom Limited, Gloucester. Price £7 18s., including P.T.



The scientific kit.

Stanley Saw Knife

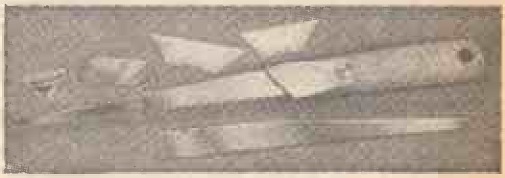
A HANDY saw-knife set costing 7s. 6d. has been produced by the makers of Stanley tools.

It consists of a Stanley trimming knife with two 6¼in. long saw blades (one for wood and one for metal), three razor sharp, double ended knife blades and a blade guard.

Only one screw has to be loosened to change blades and this can be turned with a coin.

Spare saw blades cost 1s. 9d. each and spare knife blades 2s. (normal)and 2s. 6d. (heavy duty and hooked) per packet of five. These fit all existing Stanley trimming knives.

The trimming knife has also been modified to enable it to be turned into a paint scraper by fitting the knife blades parallel to the mouth. Sold without the saw blades, but with an assortment of five knife blades, it costs 6s.



The Stanley Saw Knife set.

Gould's Folding Bench Table

DESIGNED for use in the garage or workshop where space is limited.

The Timber Bench Top 42in. x 20in. is mounted on a steel frame, finished dark green stove enamel, can be secured to the wall with plugs and coach screws provided.

The Tool Cabinet, designed to fix above the Bench, which can be purchased as an extra, measures 30in. x 24in. x 5¼ deep, leaving storage space for the vice, lined with peg board, hooks and tool clips provided, and fitted with five drawers 5½in. x 4⅜in. x 3in. deep, with shelf above. The Cabinet Hood is also fitted with bracket and lamp holder.

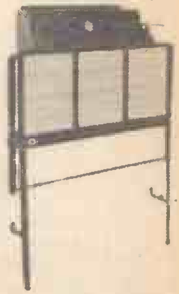
Bench Top and Hood, when folded, completely enclose the Cabinet and the maximum projection is only 8½in., leaving ample space for movement of a popular size car in a small garage.

Retail prices:—Folding Bench (less vice) £8 8s., Cabinet £6 19s. 6d.

Packing and carriage paid within 100 miles radius.

Made and marketed by:—C. Gould & Co., New Bond Street, Birmingham 9.

Left.—The bench ready for use.

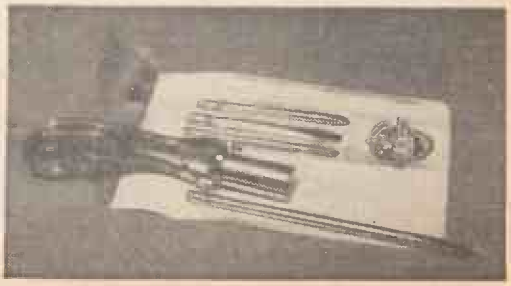


Right.—The bench in closed position.

Pistol Grip Screwdriver

THE Steadfast multiblade ratchet screwdriver recently marketed by J. Stead and Co., has an amber plastic pistol grip handle, incorporating ratchet action barrel with positive blade locking device. Four interchangeable "quick release" blades comprising Nos. 1 and 2 socket cross point, engineers' type and electricians' type. The tool is packed in a press-studded plastic wallet. The retail price is 19s. 6d. and replacement blades cost 2s. 3d. each. It is available from most hardware and tool dealers.

The multiblade ratchet screwdriver.



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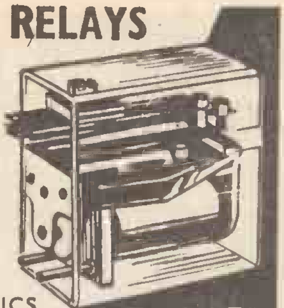
BRAND NEW—
GUARANTEED

6 volts, 1 watt, D.C. Coil, Weight 1 oz. Contacts D.P. changeover rated at 1 amp. non-inductive.
Price 18/6 ea. Post Paid.
Cash with order only.

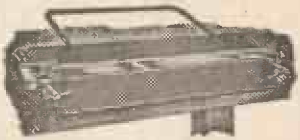


ACTUAL SIZE

SECURITY ELECTRICS
10 QUEENS RD. COVENTRY

PARKER'S SHEET METAL FOLDING MACHINES

NEW BENCH MODEL



Capacity 36 in. wide x 18-gauge mild steel. Forms channels and angles down to 45 deg., which can be flattened to give safe edge. Depth of fold according to height of bench. Will form flanges.
Weight approx. 2 cwt.
Price £17/15/0, carr. free. Also the well-known vice models of:

36 in. x 18-gauge capacity ...	£8 10 0	*Carriage free*
24 in. x 18-gauge capacity ...	£5 5 6	
18 in. x 16-gauge capacity ...	£5 5 6	

One year's guarantee: money refunded without question if not satisfied. Send for details:

A. B. PARKER, Wheatcroft Works
WELLINGTON STREET, BATLEY, YORKS. Tel.: 426

REBUILT TUBES

12 months' guarantee
Ins. Carr. 15/6

15, 14, 12in.	70/-
17in.	90/-
21in.	99/6

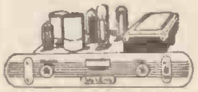
£1 extra without old bowl, refundable if same received within 14 days.

14in. T.V. TUBES

14KP4 35/- 36/24

Due to large purchase of Renters replacement tubes. *Carriage 5/-*

TAPE RECORDER AMPLIFIER £7.19.6



Compact, well designed 5 valve amplifier. O.P. 3.5 watts. Input for mike, radio and gram. Controls: Record, playback, volume and on/off tone. Size 8½ x 3 x 4½ in. Ins. and carr. 4/6. Data available.

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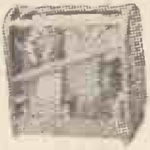

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PRESSURE GAUGES. 2½in. diam., 0-24 Pressure, 0-6 Vacuum. 6/6. Post 2/-.

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COIL SPRING BELTS. ¼ x 12in. extends to 15in. Any number can be joined together. 20 for 4/6. Post 1/-.

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EASTERN MOTORS, ALDEBURGH, SUFFOLK. Phone 51

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Copies and full list free of charge or obligation.

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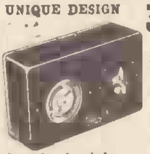
(*TECHNICAL DEPT.*) Cheltenham, Glos.

3-TRANSISTOR POCKET RADIO

WITH MINIATURE LOUDSPEAKER
ABSOLUTELY NO SOLDERING REQUIRED

UNIQUE DESIGN



39/6 Superb appearance. Simple instructions. Built in an evening. No drilling, no soldering. Complete in every detail. Receives entire broadcast band. Aerial required certain areas. Pocket size 4½ x 2¾ x 1½ in.

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ALL PARTS SOLD SEPARATELY
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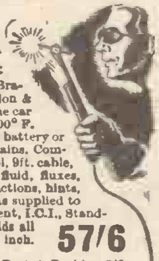
THE FAMOUS
HARRIS ELECTRIC

WELDER

and Complete Kit



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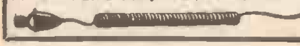

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Self Tap Screws. 100 Assorted	3/-
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YOUR *Queries* ANSWERED

RULES

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

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

Dry Copying

WOULD you please tell me how the dry-copying machines sold for office use work?—J. L. Harden (Cambs).

THE system is a photographic one and uses sensitized paper which is placed in intimate contact with the typescript and irradiated with a 500 c.p. light. This paper becomes a matrix when developed and 4 to 5 copies can be "pulled off" under slight pressure and within a few seconds of complete development of the matrix.

Detergent Formula

CAN you please inform me of a formula for making a washing-up powder?—R. H Russell (Devon).

THE following formula will be quite suitable for a washing-up detergent:

Sulphonated alcohol 5 parts
Trisodium phosphate 60 parts
Tetrasodium pyrophosphate 35 parts

Waterproofing Bamboo

THE support arms on my aerial are made of bamboo poles and after a while these poles tend to split. Is there a method of treating the bamboo to prevent it splitting at the ends?—M. Johns (Eire).

THIS splitting is probably due to weathering, particularly if the top (open to atmosphere) is not plugged. You can cap the poles in some suitable material; or close to atmosphere with a daub of pitch. Paint with exterior grade varnish.

Cleaning Old Coins

I HAVE a quantity of coins and wonder whether you can give me some information on how to clean them?—R. G. Dark (Birmingham).

YOU can clean old coins, brasswork or copper articles by immersing them in a weak solution of hydrochloric acid for about half a minute and then washing them for five minutes under a running tap. A solution of about five to one, or even weaker than this will be sufficient and the finish obtained is a bright matt surface. A little experiment with both the acid composition and the time of immersion will produce good results. Use a glass container.

Shaping Wood

COULD you please tell me how plywood and hardboard is bent to the various shapes as used in the manufacture of furniture?—P. Healy (London, N.W.2).

WOOD is bent under pressure after it has been previously heated by steam or soaked in hot water and though this work is naturally within the scope of the home mechanic it becomes a costly process if only single articles require bending. The wood is left under pressure for some time, whereupon it takes up the permanent shape imparted to the two wood blocks used as dies. A press is essential for this process unless the shape is a simple one, and then a vice will accomplish the work satisfactorily. We suggest you might initially try your hand at something of a simpler character—a slight bend in a length of timber is sufficient to give you a lead to this operation—and then you can determine whether you can achieve your necessary requirements without having to expend too much money on the project.

"Practical Mechanics" Advice Bureau. COUPON.
This coupon is available until January 31st, 1962, and must be attached to all letters containing queries, together with 6d. Postal Order. *A stamped addressed envelope must also be enclosed.*
Practical Mechanics. January, 1962.

Garbage Disposal

COULD you please tell me the principles of a garbage disposal unit?—G. Gough (Co. Cork).

THESE units operate as follows. A small electric motor drives a cutter over a stationary member and the garbage is destroyed to very fine particles by the rotating action of these details. Water then washes away the waste. The manufacturers of the units claim that they will break down bones of reasonable size and so allow these to be disposed of down the household drain.

Metal Differentiation Test

COULD you please tell me of a simple method of differentiating between brass and copper. —T. F. Gates (Hants).

BRASS, due to its zinc content, is much harder than copper. The two metals can easily be distinguished by scratching the surface with a scriber. Moreover, copper is strongly reddish in tint—far more so than brass.

Hair Lacquer

WILL you please let me have a formula for hair lacquer, of the type that is sprayed on to keep the hair in position after it has been set. —D. Lacey (Lincs).

A SUITABLE formula is:
Gum tragacanth 1 oz.
Glycerine 1 fluid oz.
Rose water 15 fluid oz.

CLUB NEWS

Ramsgate and District Model Club, hon. secretary Mr. E. Church, 103 Pegwell Road, Ramsgate.

On the 19th January there will be a demonstration and lecture of tool sharpening by Mr. E. Weekes at 7.30 p.m. at the club's premises Effingham Street, Ramsgate.

AIR THERMOSTATS

(Concluded from page 179)

As usual a good earth is required and three-core cable will be necessary. Fig. 6b shows the wiring required for low current operation. Notice that terminal 2 is not used and that the mains neutral and the heater are connected to terminal No. 4.

Fig. 6c shows the wiring necessary if the current consumption is heavy; terminals No. 2 and 4 are not used in this case.

Availability of Thermostats for Space Heating

1. The CS unit is obtainable from Technical Services Ltd., Banstead, Surrey.
2. The Adaptastat is obtainable from usual retail suppliers and is marketed by P. W. Baker & Sons (Sales) Ltd., Fontwell Avenue, Eastergate, Chichester, Sussex.
3. The "Q" type thermostat is made by the Rheostatic Company Ltd., Slough, England, and is obtainable through normal retail channels.
4. The Pullin Plug-stat is available from Messrs. Selfridges, Oxford Street, London, W.1.

Other Uses for Space Heating Thermostats

Greenhouses. Special types are made for greenhouse use and very careful wiring is necessary to prevent water causing danger of shock. Good earthing is the prime necessity.

Airing Cupboards. The airing cupboard may receive automatic heat supplementation when the temperature falls below a fixed value. Black heat "tubes" or cables are the safest type of electric heater in this location.

Frost Warning. Frost warning systems have uses in the orchard, greenhouse and loft and are easily fitted up as shown in Fig. 8. Low-voltage systems are suitable and battery operation is economic as there is no drain until the alarm functions. Thermostat 2355 (Annakin) and other surplus types will suit, but they MUST come on when cooled and go off when heated. The magstat SNT40 costs only 5s. 6d. and if protected from dust will be ideal. It must be placed in water containing a few pieces of unmelted ice and the small adjustment screw in the side must be set so that the "points" touch, but when placed in water very slightly warmer they open. This is best observed with a flash-lamp battery and bulb in circuit. Dry the thermostat out afterwards.

Frost alarm thermostats should be placed either next to the apparatus or objects it is desired to protect or low down, since cold air falls. The alarm bell, buzzer or lamp may be fitted wherever required.

SALES AND WANTS

The pre-paid charge for small advertisements is 9d. per word, with box number 1/6 extra (minimum order 9/-). Advertisements, together with remittance, should be sent to the Advertisement Director, PRACTICAL MECHANICS, Tower House, Southampton Street, London, W.C.2.

MISCELLANEOUS

AQUALUNG AND COMPRESSOR Equipment, Ballraces and Miscellaneous items. Lists 3d. PRYCE, 157 Malden Road, Cheam, Surrey.

VENNER TIME SWITCHES reconditioned 14 day, 25/-. For Car Lights, Fish Tanks, Charging. BATCHELORS, 4 Park Road, Bromley, Kent.

FOR SALE

ALUMINIUM LADDERS/STEPS. Gigantic offer, 400 models.—SANCO LTD., 17 (PM) Boundary Road, Hove.

ASTRO TELESCOPE making. Standard Ramsden Push-in Eye-pieces. ¼in., ½in., ¾in., focus, 35/-; with R.A.S. thread, 42/6 each. S.A.E. list, Object Glasses, Newtonian Mirrors, Diagonal Mounts, Focusing Mounts, Tripods, Mountings and Terrestrial Telescopes. W. BURNET, Grand Sluice, Boston, Lincs.

TAILORED REFRIGERATION. An Avimo absorption unit is easily installed in home-built refrigerators, costs only £9/10/- complete. 3½cu. ft capacity, with extra large freezer, electrically or gas operated. Guaranteed five years. Full details from: AVIMO LTD., Taunton, Somerset.

Brand new ex M.O.S. electric gramophone units in heavy gauge metal cases fitted carrying handles and locks, finished black crackle. Heavyweight 200-250 volts A.C. motor pick up, 78 r.p.m. only, cost £20 each, case alone worth more than my price, 35/- plus 5/- carriage. Ditto used 20/-.

Brand new Dallmeyer 4in. projection lenses especially designed for 35 mm. transparency projectors, but will cover up to 2¼in. square, original price £7, only £3, post 1/6.

2in. Bi-Convex Glass Condensers 2/6 each, post 6d. Epidiascopes from £20 each.

Brand new Avominor moving coil Multirange A.C./D.C. Test Meters (ex M.O.S.) solid hide case with shoulder strap, leads and test prods, in original tropical packing list over £11, price £5, post 2/6.

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