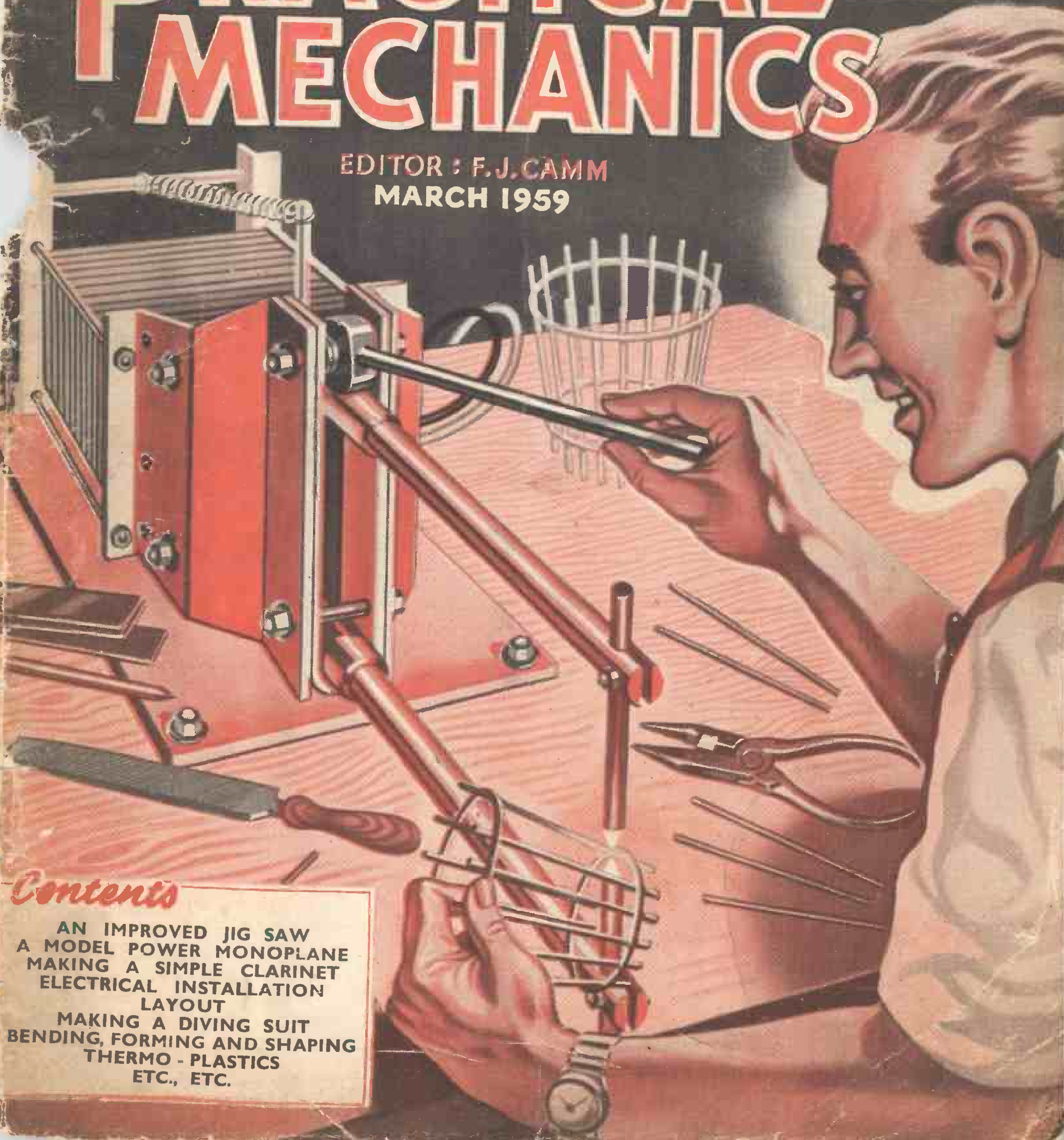
Making a Spot Welder

PRACTICAL MECHANICS

1'3

EDITOR: F. J. CAMM

MARCH 1959



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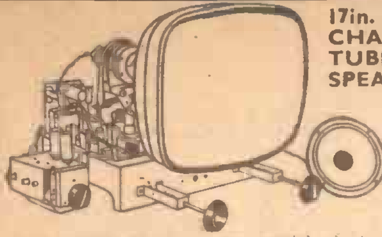

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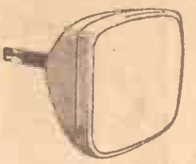

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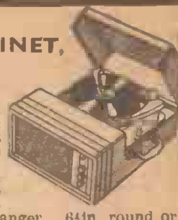

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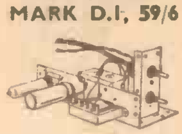

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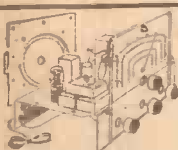

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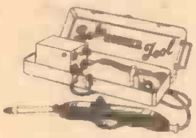

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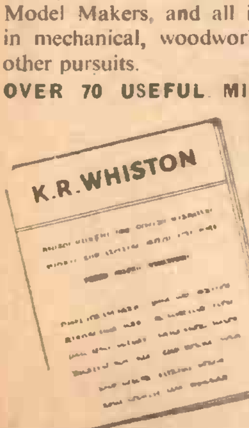

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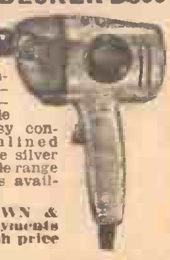

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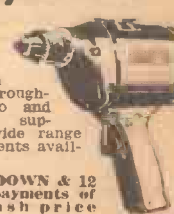

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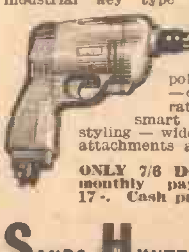

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Edited by F. J. CAMM

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FAIR COMMENT

HOME-BUILT CARS

OLDER readers of this journal will remember the £20 car which I designed, built and demonstrated before the war and the construction of which formed the subject of a series of articles herein. It was a three-wheeler with rear drive, the power unit being a single cylinder air-cooled motor cycle engine. I followed this up with a design for a four-wheeler, eliminating the costly differential gear by using a divided back axle with drive to one wheel only. Many hundreds of these cars were built and some are still running.

I have received numerous requests for a repetition of those designs modified to 1959 requirements in view of the high price of even the smallest cars and the incidental purchase tax. It is generally realised, of course, that such a car could not be built for £20 today, the figure for a comparable specification being over £100. Notwithstanding this, a large number of readers still want to essay the task and I have devoted much thought to the matter. I already have the design in outline form, but one of the problems is to find a power unit of reasonable price which is readily available to everybody. Many readers do not fancy the two-stroke engine because of its erratic running at low speeds, and its general fussiness. The £20 car made use of a 3½ h.p. Burney and Blackburn four-stroke engine which developed lusty power and was quite adequate for the job.

Another difficulty concerns the law. Obviously, a home-built car must comply with all of the legal requirements on construction, and these have varied considerably since those pre-war years. It is for this reason that I have had to advise readers against building some of the car designs which have been published and which have obviously been prepared by those who know nothing about the law. Every builder of such cars would be inviting a prosecution.

Regarding purchase tax and registration of home-built cars, there is no statutory provision under which a test of the condition of a vehicle can be imposed before it is registered and licensed. In other words, you will have no difficulty in registering the car, although unless properly designed, you may experience some difficulty in obtaining a certificate of insurance. Without this, the car cannot be registered. Nevertheless, the law requires that every vehicle shall comply with the Construction and Use and Lighting Regulations and it is the liability of the owner or user of the vehicle to ensure that these requirements are met. Enforcement of the regulations rests with the police.

It must also be remembered that licensing and registration authorities will not without question grant a new registration to all vehicles which are home-built. For example, if a vehicle makes use of a chassis or a substantially unaltered chassis of a second-hand car, which has previously been registered, the rebuilt vehicle will be required to retain the original registration mark and will become liable to periodical testing under the provision of the new laws about to come into operation, if the original registration took place 10 or more years previously. It will be seen, therefore, that the construction of a car with old parts is not to be lightly undertaken unless the design has been produced by a qualified engineer. Designs which have been lashed up by some slap-happy amateur in a back garden should therefore be avoided.

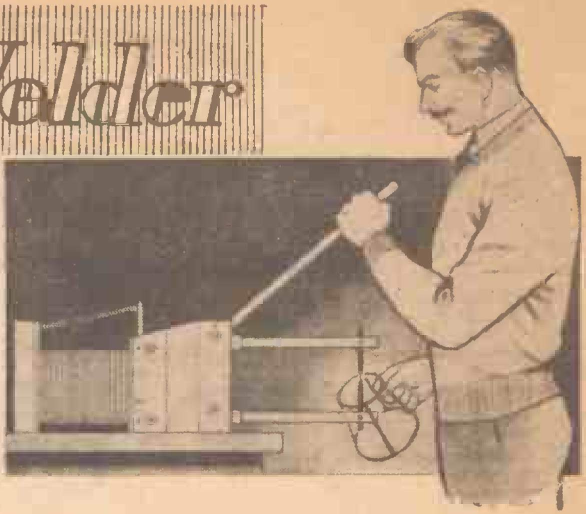
In general, home-built cars do not attract purchase tax. As soon as our design has been further developed, the vehicle built and tested, we shall publish it in this journal. This is something to look forward to and I should be glad to hear from interested readers.

THE ADVANCE OF FIBREGLASS

THE applications of fibreglass are being extended to a wide range of products, and in particular the construction of car bodies. It is light, easily moulded, takes a good finish, and is easily repaired by the amateur. Equally, of course, it is waterproof and rust-proof, and it does not "drum."—F. J. C.

The April, 1959, issue will be published on March 31st. Order it now!

Making A Spot Welder



This Equipment Will Have Many Uses in the Amateur's Workshop

SPOT welding is a fairly simple and an efficient means of joining together thin strips, sheets or wires, and thus has many uses in the home workshop. It is a forge welding process in which the metals are pressed together and are welded during and after the brief interval during which the points are electrically heated. The heat created at the points of welding depends on the resistance R of the two metals placed between the welding electrodes, including

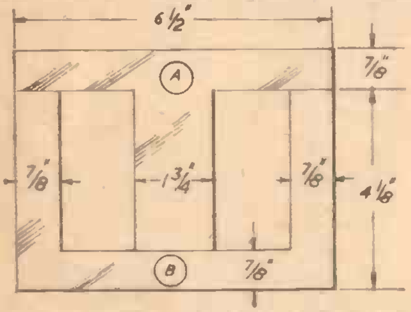


Fig. 1 (Above).—Dimensions of transformer stamping.

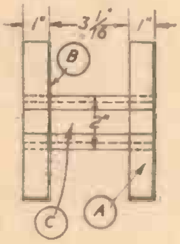


Fig. 2 (Right).—Details of hardwood former.

the contact resistance between the metals, the current (I amps.) passed through the metal between the electrodes, the time t during which the current flows, and a factor k which depends on the heat loss from the electrodes and the metals being welded. The heat applied to the metals $= I^2 R k t$.

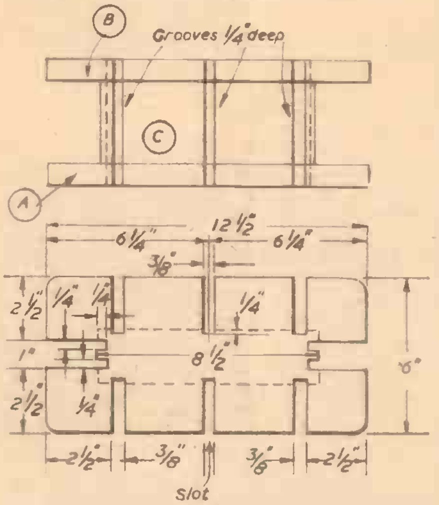
The resistance R is normally quite low, so that a high current I is required to create sufficient heat. Due to the comparatively low resistance only a low voltage is applied between the electrodes. In the case of metals of very low resistance, such as copper and aluminium a still greater current is required, which is usually obtained by electro-magnetic discharge through the primary windings of a welding transformer. A commercial spot welder may be rather complex, incorporating water-cooled electrodes and special devices for controlling the duration of current flow.

A Small Spot Welding Transformer

However, such a welder is not necessary for the amateur, who is not normally concerned with production work. The spot welder to be described is suitable for operation from a 15-amp., 230/240-volt, 50-cycle, single-phase a.c. supply and may be used for spot welding iron or mild steel up to about 20 s.w.g.

The heart of the welder is the step-down transformer, which must be carefully constructed. The secondary coil must have a large cross-sectional area in order to carry the high welding current without overheating, and without undue volt drop which would reduce the welding current. The large cross-sectional area limits the number of secondary turns which can be adopted in practice to a single turn. This limitation fixes the approximate cross-sectional area of the transformer core, and a deep core has been adopted in this case. Fig. 1 shows the core stampings employed, these being of stalloy 0.014in. thick, which are varnished on both sides. The core is to be built up to 8¼in. thick, approximately 570 of the stampings A being required, and the same number of the stampings B.

A hardwood former is used for winding,



the dimensions of a suitable former being given in Fig. 2. The two end pieces A and B are screwed to the 8½in. × 3 1/16in. × 2in. centre piece, so that the former can be dismantled for the removal of the windings. It will be noted that six ⅜in. wide slots in each end piece are cut to line up with grooves ¼in. deep which cross the centre piece. There are also two 1in. wide slots in each end piece, each slot lining up with two grooves ⅛in. wide × ¼in. deep which cross the centre piece.

The Primary Winding

The former should be made absolutely smooth with fine sandpaper, and should then be rubbed over with french chalk. The insulation between the primary windings and the core is partly of leatheroid 0.010in. thick. A strip of this leatheroid is cut 3 1/16in. wide × 44in. long, and is tightly wrapped round the centre C of the former twice. A strip of 0.010in. empire cloth 3 1/16in. wide × 67in. long is next required, this being tightly wrapped round the leatheroid and secured with a little Chatterton's compound. The primary is to be wound with 13 s.w.g. (0.092in. diameter) double-silk-covered (D.S.C.) copper wire. About 130 yards (10 lb.) of this conductor will be required.

To start the winding about 18in. of the wire is passed through a systoflex sleeve and the covered wire secured with the end outside the former, and about 1in. of the sleeved wire inside the former, through the 1in. wide slot in the end piece. The winding is then commenced, the wires being pressed down quite flat to produce an even layer occupying as little depth as possible. Thirty turns should be wound on the first layer. Over this layer should be wound a layer of paper and the second layer of 30 turns wound back over the first, followed by a layer of paper and the third layer of wire, which ends at the opposite side of the former to the start of the coil.

At the end of the third layer about 18in. of the wire should be brought out of the former through the 1in. wide slot and cut off, with a systoflex sleeve slipped over the wire so that it enters about 1in. into

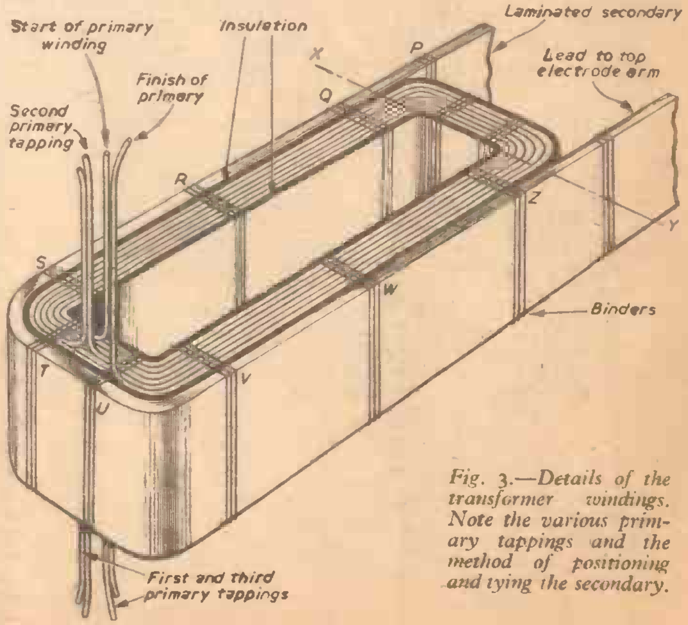


Fig. 3.—Details of the transformer windings. Note the various primary tappings and the method of positioning and tying the secondary.

the former. The fourth layer is then commenced after wrapping a layer of paper over the third layer, an 18in. lead being left for the start of the fourth layer. Thus two leads will then emerge from the back end of the former to form the first tapping indicated in Fig. 3, these two leads being the end of the third layer and the start of the fourth layer. At the end of the fourth layer the wire is cut off about 18in. outside the coil and a systoflex sleeve slipped over the lead as before. After wrapping a layer of paper over the fourth layer the fifth layer is commenced, an 18in. lead to the fifth layer being left outside the former. The second tapping thus comprises the end of the fourth layer and the start of the fifth layer, and is brought out at the starting end of the coil. Thirty turns are to be wound on each layer. A similar tapping is brought out at the end of the fifth layer and the start of the sixth layer. The sixth layer ends at the starting side of the former, the end of the conductor being cut off about 18in. long and a systoflex sleeve slipped over the conductor.

The Secondary Winding

Over the primary winding is tightly wrapped three layers of 0.010in. leatheroid, followed by three layers of 0.010in. empire cloth, before fitting the secondary winding. The secondary winding consists of 24 strips of 32 s.w.g. (0.0108in.) copper 3in. wide and 40in. long, which is to be bent into a U shape as in Fig. 3. For a start the strips may be tied with fine cord at one end, as at P in Fig. 3. Next the laminated strip is positioned so that the distance from X to the end of the strip is 5in., i.e., this end of the laminated strip should project 3in. beyond the side piece of the former. Strong thin cord is then passed through one of the $\frac{3}{8}$in. wide × $\frac{1}{4}$in. deep grooves in the centre piece of the former, up round the $\frac{3}{8}$in. wide slots in the end pieces of the former and tied tightly round the secondary strips and primary coil to form the binders Q in Fig. 3.

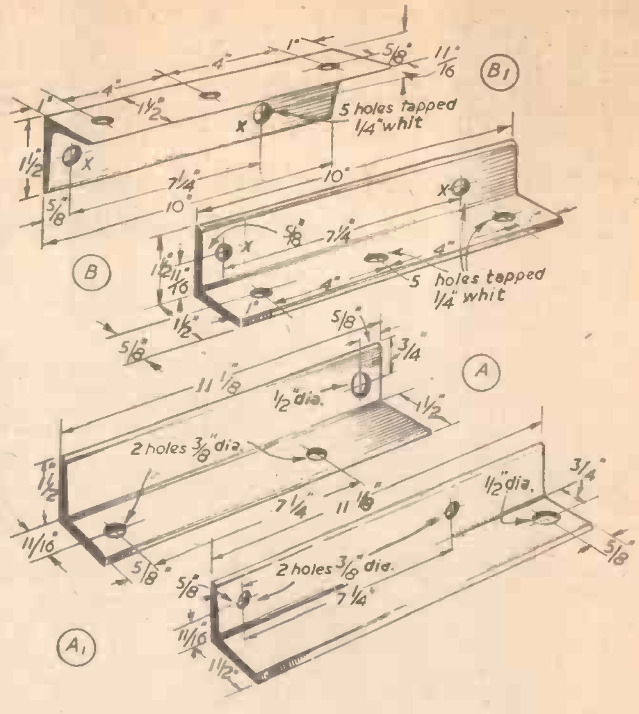
The secondary strip is pressed tightly round the primary and the next binders R fitted, as in Fig. 3. The procedure is repeated with the binders S, T, U, V, W and Z as shown. The former can then be dismantled and the winding removed, which should appear somewhat as in Fig. 3. One lead should be about 7in. longer than the other.

Drying Out

It is important that the coil should be dried out. This may be done by suspending the winding in an oven which is kept at about 180 deg. F. for about two hours. The temperature in the oven should be checked periodically during this period, and must not be allowed to exceed 200 deg. F.

Varnishing

Immediately the hot coil has been removed from the drying oven it should be immersed in insulating varnish, such as Ohmaline or Armacell, making sure that the primary coil is covered by the varnish, but that the secondary leads are completely above the surface of the varnish. No naked light should be allowed in the vicinity of the varnish.



Figs. 5, 6, 7 and 8 (Top to bottom).—Dimensions of the two pairs of angle irons.

Drying the Varnish

After remaining in the varnish for about five hours the winding should be hung up to drain off surplus varnish, during which period it should be turned round occasionally to avoid varnish accumulating in any one part. The varnish should be drained away from the leads to the secondary winding. If air-drying varnish has been used the coil should then be thoroughly dried out in air. If stoving varnish has been used, the coil should be suspended in the oven for about six hours. The coil, excluding the leads from the secondary winding, should then be bound with $\frac{1}{2}$in. empire tape passed through the centre and round the coil to cover it. Over the empire tape may be wrapped cotton tape, and the winding given two coats of Pakyderm air-drying varnish. Whilst the primary winding must be well insulated from the core and from the secondary winding, a high degree of insulation on the secondary winding is not essential, since the maximum voltage of this winding is less than 3 volts.

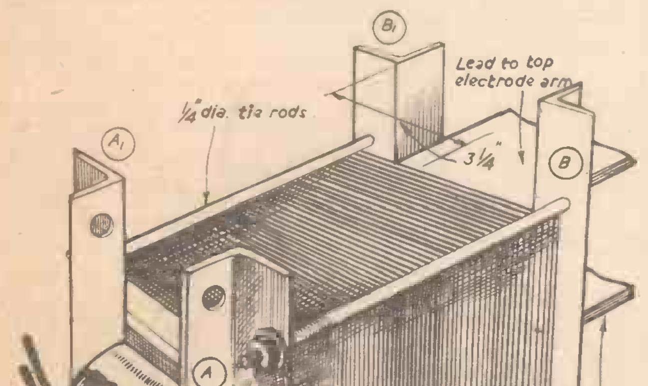


Fig. 4.—Transformer assembly.

Core Assembly

The core may then be assembled. The centre limb of one of the stampings shown at A in Fig. 1 is passed through the coil from one side. Next one of the stampings A is passed through the coil from the other side, and a stamping B laid opposite this on the first layer of the stampings. In this way the core is built up with the two types of stampings projecting alternately at opposite ends, so that the joints in one layer are covered by the next layer. It is very important that the stampings should be pushed together tightly so that no air gaps are left in the core, and the stampings should be tightly packed.

Transformer Assembly

The assembly of the transformer can now be undertaken, the general arrangement being given in Fig. 4. It will be seen that two pairs of angle irons A and A_1 and B and B_1 are required, the dimensions of which are given in Figs. 5, 6, 7 and 8. Additional holes will be required in the pieces A and A_1 (Figs. 5 and 6), through which the primary coil leads are passed as in Fig. 4. These holes should be drilled in convenient positions, avoiding any serious weakening of the angle irons, and the edges of the holes should be rounded off to avoid risk of damage to the insulation of the leads. The leads can be bent as may be required.

Four $\frac{1}{4}$in. dia. mild steel tie rods, $9\frac{1}{2}$in. long, are required, these being screwed for $\frac{1}{2}$in. at one end and 1in. at the other end. The short threaded ends are to be screwed into the two tapped holes X in each of the parts B and B_1 (Figs. 7 and 8). The rods pass through fibre bushes in the two $\frac{3}{8}$in. dia. holes in each of the parts A and A_1 (Figs. 5 and 6). The transformer is then clamped up as in Fig. 4, using fibre washers to insulate the tie rods completely from the angle iron pieces A and A_1. This insulation is necessary to avoid eddy currents passing through the laminated core, which might cause unwanted heating and loss of efficiency. For the same reason the tie rods should not be allowed to touch the edges of the transformer stampings. The pieces B and B_1 should be spaced $3\frac{1}{4}$in. apart, as noted in Fig. 4, with the same spacing between the pieces A and A_1.

(To be concluded)

A Circular Saw Bench

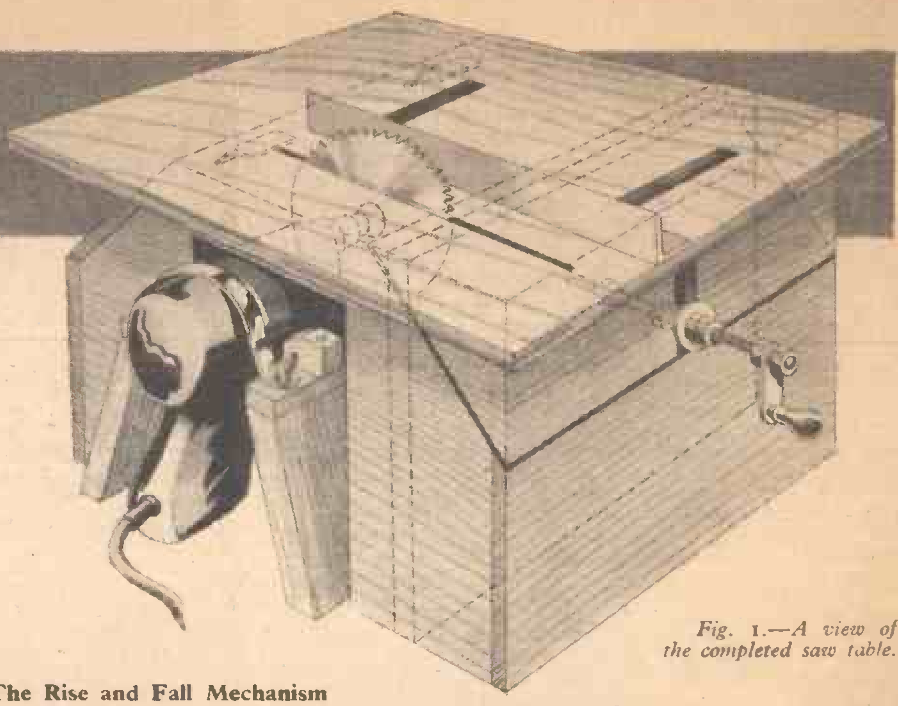


Fig. 1.—A view of the completed saw table.

A Simple Addition to Your Workshop Equipment. Make It to Use With Your Power Drill

By M. Whitaker

MANY owners of electric power drills may desire occasionally to use it as a circular saw. In order to do this the drill must be fixed in a firm position and some means of offering the wood to the saw must be constructed.

Whilst it is possible to purchase the necessary table for this, a simple one can be made on the lines described in this article with various modifications to suit any portable drill and other conditions as regards size, etc.

The drill used in the prototype was a Bridges "Neonic" with a 6in. saw blade.

The Top

The size of the 3/8in. plywood table top is approximately 1ft. 3in. × 1ft. wide with a slot cut to take the saw blade at the appropriate distance in from the edge to suit the drill head. Two other slots are next cut at right-angles to the saw slot to enable the fence to be adjusted.

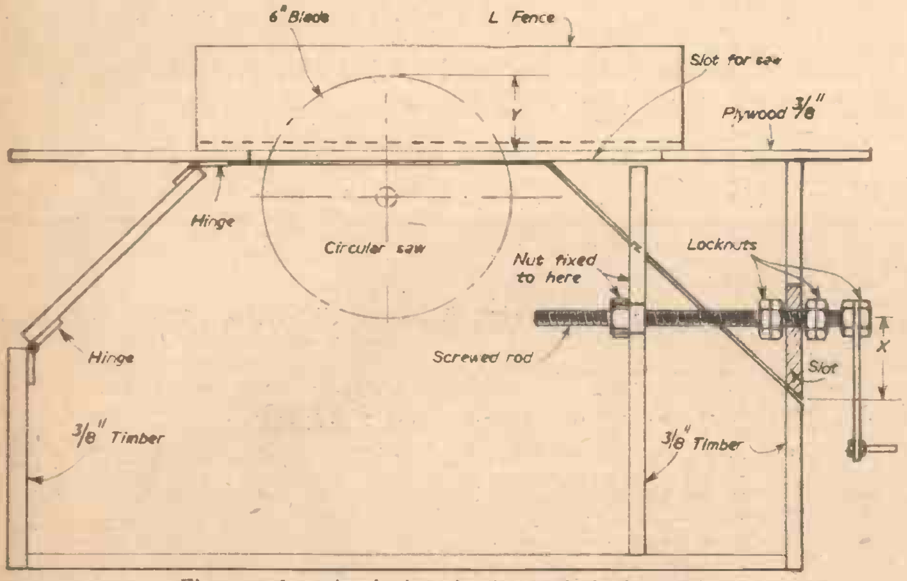


Fig. 2.—A sectional view showing method of operation.

The Box

The bottom part of the table consists of a wooden box structure, open at the top. The two side pieces have the top corners at each end chamfered as seen in Fig. 1. About 3in. or 4in. from the front of the box is fixed a dividing piece extending the full depth and width of the box. On the centre line of this is fixed firmly a nut corresponding to the screw of the winding handle to be mentioned later. The wood is bored out cleanly through the centre of the nut to allow the handle to pass through.

The Rise and Fall Mechanism

On the underside of the table top construct a triangular open box section to correspond with the slope of the chamfered end of the side piece and at the opposite end fix by hinges a board of equal length to the slope so that when the top is placed over the bottom piece the chamfered ends will be covered (see Fig. 2).

Having now constructed the two halves of the box, place them together to form the complete box with a loose flap at one end. On the opposite end make a slot wide enough for the winding handle to pass through and of length "Y" greater than the cutting depth "X" required for the saw (Fig. 2).

Adjustment Mechanism

The winding handle can be made of any suitable threaded rod provided you have enough nuts to go with it and the idea can be easily followed from Fig. 2. This is now threaded through the fixed nut in the dividing piece in the box and the top half of the box must be fitted over it with the rod passing through the slot.

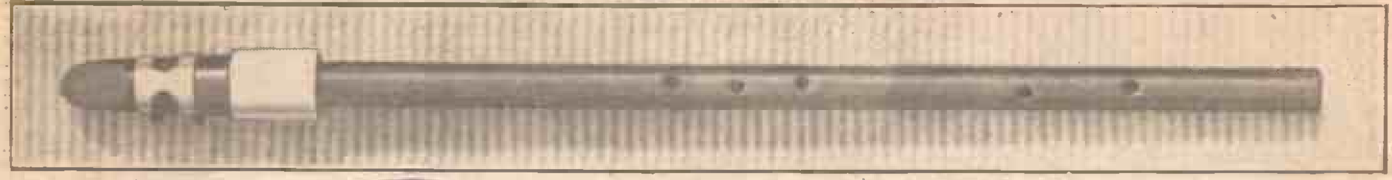
The loose flap at the opposite end is hinged to the bottom box and on turning the handle the table top will rise and fall along the chamfered slope accordingly.

A Refinement

The friction in the turning handle may be sufficient to fix the level of the table top, but a refinement and permanent fixing can be made by cutting half slots along each sloping edge of the top and bottom box sections and inserting a bolt, two washers and a wing nut, thus enabling both parts to be trapped at any position.

The sizes and thickness of all members can be determined to suit the constructor's own requirements.

Home Made Musical Instruments



A Simple Clarinet

F. Hook Continues His Series with Instructions for Making This Deeper-toned Instrument

THOSE who try to group the various instruments already described into a small orchestra may like to include one or two clarinets. These will add another tone colour as well as giving a deeper tone for bass parts which is missing when only bamboo pipes are used.

The instrument to be described is limited to the eight notes of the scale and the intermediate accidentals because no keys are fitted—such work being considered rather outside the scope of these articles.

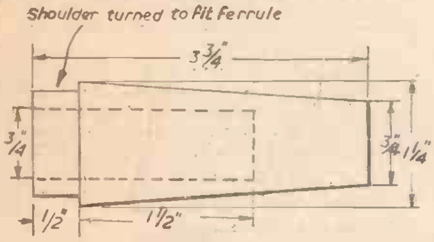


Fig. 1.—Dimensions for the mouthpiece.

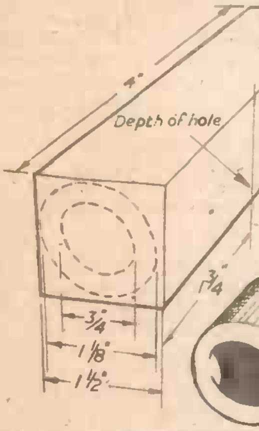


Fig. 2.—Making a clarinet mouthpiece.

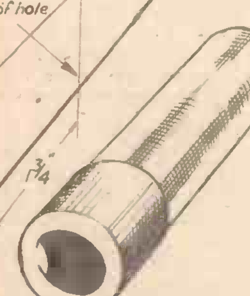


Fig. 3.—Fitting a ferrule.

Like the treble pipe the instrument is pitched in the key of D. On the other hand it would be quite easy to substitute another shank tuned to play in the key of C to be used with the recorders.

In regard to the accidentals of the scale, the G sharp and the C natural are the most needed. The six finger holes are first drilled and tuned as will be described later. Then ⅜in. below and a little to the side of the fourth and sixth holes, two auxiliary holes are drilled. These holes are drilled out 3/16in. diameter and are then tuned to G sharp when the lower three holes and this first auxiliary hole are uncovered, and the C natural when the first five holes and the second auxiliary hole are uncovered.

When the accidentals are not required the first and third fingers of the left hand cover the usual holes and also the additional auxiliary holes.

Materials Needed

One piece of beech or birch (well seasoned) 4in. long × 1½in. square.

One piece of thin gauge brass tube for a ferrule about 1⅛in. dia.

One piece of ebonite tubing, 24in. × ⅞in. outside dia. with ⅛in. wall.

One reed clip or piece of brass 4½in. long, ½in. wide and 16 g. thickness to make a clip.

One clarinet reed or a piece of bamboo to make one the same as was used for making the tenor bamboo pipe.

Making the Mouthpiece

The block for the mouthpiece can either be turned up in a lathe or it may be worked up by hand methods depending upon the facilities that are available. If turned in the lathe the dimensions given in Fig. 1 should be followed.

If the work is to be done by hand, proceed as follows. First, plane up the piece of wood accurately to 1 3/16in. square. On the ends mark the diagonals, and, from their intersection draw a circle of 1⅛in. dia. on each end (Fig. 2).

From one end drill a hole ¾in. dia. to a depth of 1¾in. Take every care to keep the drill parallel to the sides of the block.

Now plane down the square block to be cylindrical in shape. Finish off smoothly with a file and glasspaper. Work a shoulder on the end with the ⅞in. hole to take the ferrule which should be a drive fit (Fig. 3). Alternatively, a ferrule can be fitted over the 1⅛in. dia. with no shoulder to be cut.

Plane the slope for the reed bed as in Fig. 4 which should be to a depth of ¼in., sloping away to nothing at the ferrule. Finish this surface dead smooth.

With a ⅜in. twist bit inserted into the ¾in. hole already drilled, and pointed towards the reed bed, drill a hole until the drill just breaks the surface of the reed bed (Fig. 5). Now carve out an opening in the reed bed as shown in Fig. 6, using a small carving gouge for the purpose. Finish off the opening as smoothly as possible.

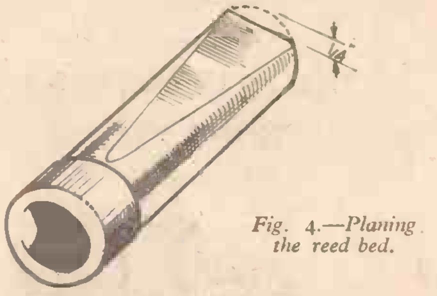


Fig. 4.—Planing the reed bed.

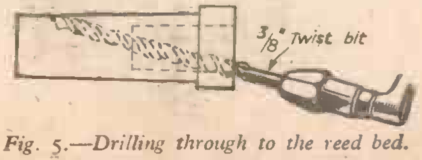


Fig. 5.—Drilling through to the reed bed.

The end of the mouthpiece is now tapered off towards the reed bed as shown in Fig. 6 leaving a margin of a little less than ⅛in. between the wind opening and the outside edge of the mouthpiece. The completed mouthpiece should then be finally finished off as smoothly as possible and given one or two coats of clear cellulose or other finish to exclude moisture from penetrating the wood fibres of the mouthpiece.

The Reed Clip

The clip to hold the reed in position is made from a piece of stout brass 4½in. × ½in. × 16 g. Drill a ⅛in. dia. hole at a distance of ¼in. from each end. At ½in. from each end bend the strip up at right angles. Finally, gradually bend the clip to shape round a piece of broomstick in the first place and then adjust to the circumference of the mouthpiece. A brass 4 B.A. cheese headed screw and a terminal nut are used to hold the clip in position (Fig. 7).

The Reed

Musicians usually purchase their reeds, but even so some adjustment is often made.

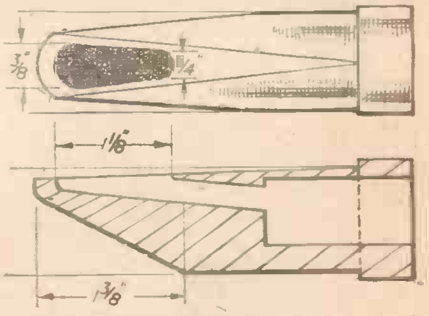


Fig. 6.—Making the windway.

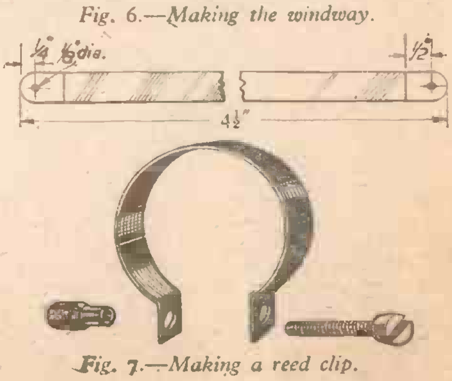
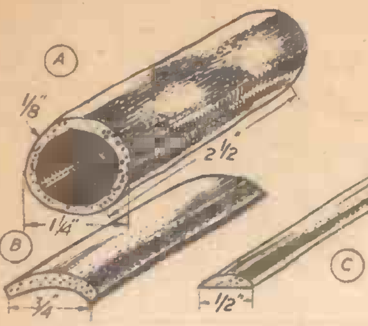


Fig. 7.—Making a reed clip.



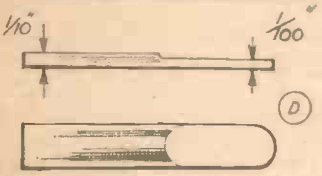


Fig. 10 (*Right below*).—*An adaptor for a commercial mouthpiece.*

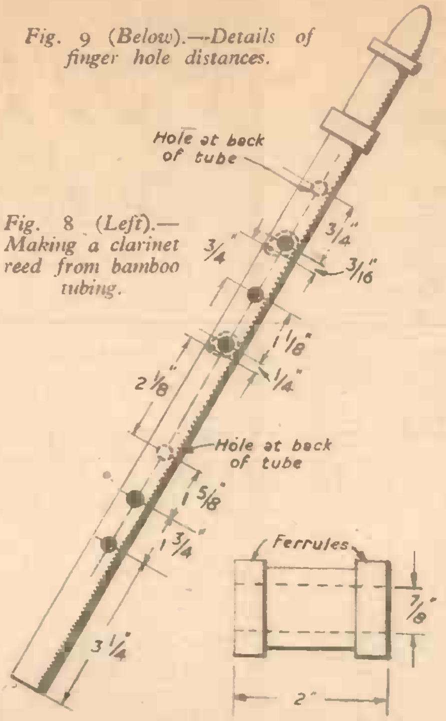


Fig. 9 (*Below*).—*Details of finger hole distances.*

Fig. 8 (*Left*).—*Making a clarinet reed from bamboo tubing.*

The practical mechanic will find much interest in making his own reeds for practically no cost at all.

If the reader has made some of the bamboo pipes already described, the reeds can be made from some of the wider bore bamboo tubing such as is used for the tenor bamboo pipes. Pieces of tubing 2½in. long are required and these are split down in ¾in. widths as shown in Fig. 8. The concave side of each piece is smoothed flat with a finely set smoothing plane until a ½in. width is produced. From a point mid-way in the length the reed is now pared away with a sharp ¾in. firmer chisel to a thickness of about .01in. To finish off, the end is rounded to match the end of the mouthpiece.

Fit the reed in place on the instrument and try to produce a note. This is achieved by drawing the lower lip over the bottom teeth and resting the reed upon the lip. Place the tongue tip in contact with the end of the reed, quickly withdraw it as when saying the sound "Teu." This will permit air to pass by the reed and into the mouthpiece and start the reed vibrating. This is the method used to articulate notes and the process is called "Tonguing" by musicians.

Possibly a note will not be produced at the first effort. Treat the reed with care as it will split easily after which it is useless. The end of the reed should not protrude beyond the end of the mouthpiece. The reed bed should be so adjusted that the end of the reed is raised a little less than a 1/16in. above the bed, enabling air to pass through into the mouthpiece.

High pitched squeaks will reward earliest efforts. These are not required; concentrate on producing a low mellow tone. The thickness of the pared end of the reed is vitally important in regard to the production of a good tone. Scrape away the reed to make it "soft" and easier to blow. A thicker reed is harder to blow and is, of course, called a "hard" reed. Aim for an easily produced tone with quality.

Experiment until a good note is produced before proceeding to tune the instrument. When ready saw off small pieces from the lower end of the ebonite tube until the fundamental note D is produced.

Drilling the Finger Holes

The first finger hole is centred 3¼in. from the base of the instrument, the distance being about one-sixth of the distance from the tip of the mouthpiece to the lower end of the clarinet.

The second hole is 1¾in. above the centre of the first. These two holes are opened out in the same way as described for the other instruments.

The third hole is 1⅝in. above the centre of the second hole. Such spacing makes it very difficult to cover with the three fingers of the hand unless one possesses very long fingers. Therefore, the third hole is made at the back of the instrument and covered with the thumb of the right hand.

These first three holes will enable the player to produce the notes, E, F sharp and G of the scale of D major.

The next hole to make is that which produces G sharp. This is 2⅛in. above the centre of the G hole. This hole is drilled ⅛in. to the left of the centre line of the lower holes as shown in diagram. The hole to produce A is ¼in. higher but in line with the lower holes. The third finger of the left hand covers these two holes in the ordinary way, both being uncovered to produce A. The finger closes the top one only if G sharp is required. It sounds complicated but is easy in practice. A shallow oblique groove can be filed in the ebonite tube to include these two small holes so that their position may be easily located when playing the instrument.

The next hole is 1⅛in. higher and is tuned to B.

The hole giving C natural is drilled ⅛in. out of centre in the same way as the G sharp hole. It is ¾in. higher than the B hole. The hole for the leading note of C sharp is 3/16in. higher and is drilled centrally.

Finally, the thumb hole on the back of the instrument is ¾in. higher and is tuned to upper D.

It should be said that if the constructor wishes to omit the two holes for the two accidentals at first to simplify the construction they may be added at a subsequent date quite satisfactorily.

If the reader wishes a commercial B flat clarinet mouthpiece may be purchased instead of making the mouthpiece as described above. In such a case it will be necessary to make an adaptor for it to fit to the finger tube (Fig. 10). This consists of a piece of wooden or ebonite tubing 2in. in length and of ⅞in. bore. The commercial mouthpiece has a cork inset on the lower end and it may be necessary to glasspaper this down a little in order to get it to fit smoothly into the adaptor.

On the left of Fig. 11 the stages in making the mouthpiece from a block of wood are illustrated. On the right of the illustration is shown a commercial mouthpiece fitted to the adaptor ready to place on the finger hole tube.

The completed clarinet is shown in the heading.

(*This series is to be continued*)

Fig. 11.—*On the left are shown two stages in making the mouthpiece, right is a commercial mouthpiece. A reed clip is shown in the foreground.*

PUZZLE CORNER

1.—Banking Problem

IF Adam had invested a penny at ½ per cent. compound interest, what would the principal amount to after 6,000 years (Adam being born at approximately 4000 B.C.)?

2. Can You Send Us a Solution?

EVERY odd number over seven can be expressed as the sum of three odd prime numbers. (A prime number is one which has no factors but itself and one, e.g., 13 is 13 × 1 and is prime, whilst 16 has several factors, e.g., 16 × 1, 8 × 2, 4 × 4, and is therefore not prime.) Consequently, in the theorem in question, 35 can be written 29 + 3 + 3. Thirty-seven can be written 29 + 5 + 3, and so on. We can easily test this by actual working out in the case of low-power numbers such as just given, but can you prove that it is true for every possible odd number—one going to billions of trillions?

Answers

1.—£43,650,000,000. Such a calculation is best worked out by logarithms. Where the principal is P, the rate r, and the number of years n, the total amount Pn will be: log: Pn = log P + n log (1 + r).

2.—We do not know if this problem can be solved, but invite readers to tender solutions for our Letters to the Editor pages.

Portraits in a Flash

A Flash Photograph Need Not be Distinguishable from One Using Other Forms of Illumination

By E. Clements

Fig. 1.—One PF1 (diffused) at camera and one PF14 (not diffused) as back light. The exposure was 1/25 sec. at f/16 on Panatomic X developed in ID11.

THE facility with which, using flash, one can produce at a moment's notice a source of powerful illumination far greater than any reasonable number of photoflood bulbs, also eliminating the necessity of carrying all the impedimenta of floods, is well worth the extra expense involved. With the use of extension units and other techniques, such as bounced flash, it is possible to obtain pictures of comparable quality to floodlight

Fig. 2. (below).—One PF25/97 (diffused) at camera and one PF25/97 as modelling light. The exposure was 1/25 at f 16 on FP3, developed in ID11.

One may therefore enter the homes of friends, club houses and pubs and, with a minimum of preparation, produce very worthwhile results. All this without the anxiety of possibly blowing the fuses. For the illustrations with this article the minimum requirements of two flashbulbs were used; it is quite possible even with one bulb to make attractive pictures, but the versatility provided by the extra source will be quickly appreciated after a few exposures have been made. The use of reflectors has been eliminated as being often uncertain; the best ones must necessarily be bulky and not easily portable.

First Attempts

The basic requirement of correct exposure can only be obtained with the experience gained by following the recommended flash factors of the bulb manufacturers and adjusting this to suit one's own technique of development and apparatus variations. In the beginning it is as well to keep to one constant shutter speed (the simpler synchronised shutters leave no alternative, thus eliminating one variable) and if necessary use diffusing material over the bulb to reduce the power. The first attempts should be made with a single bulb near the camera to establish the minimum correct exposure required, and it is necessary to emphasise again that over-exposure must be avoided.

The diffusing material, which can be muslin, curtain net or anything similar, will improve the modelling quality of the light and make it more manageable. To establish the light cutting power of the material it is only necessary to take a meter reading of any scene with and without the material over the meter and note the effect in value of "stops" of its use. It is useful to have a number of materials, or thicknesses of the same material, available in ascending value of stopping power, say, ½, 1, 2 and 4 stops.

The Second Lamp

Having with one lamp established basic exposure which will give adequate shadow detail and good modelling one may proceed to employ the second lamp in any one of a variety of positions depending upon the effect required. This lamp then may be used in the classical 45° position (45° to camera and 45° of elevation) to give a livelier picture with greater contrast, as a backlight giving a "halo" effect or from the side for even greater brilliance and character studies; in short, to achieve any mood the photographer desires.

The effect of the distance of the second light from the subject is of paramount importance in achieving the desired contrast

Fig. 3.—One PF14 (diffused) at camera and one PF25 (diffused) as modelling light. The exposure was 1/25 sec. at f/22 on FP3 developed in ID11. A blue filter was used.

Fig. 4.—One PF1 (diffused) at camera and one PF14 as modelling light. Exposure was 1/25 sec. at f/16 on Panatomic X developed in ID11.

Fig. 5.—The lighting used was the same as for Fig. 4 as also was the exposure and processing.

in the subject; it is not, however, easy immediately to fix this distance, but as a start one might place this at three-quarters of the camera subject distance, assuming that the same amount of diffusion is used on both lights and that the first lamp is at the camera. This should give a pleasing balance without undue contrast. The problem, as in all portrait work, is primarily the one of balance between fill in and modelling or accent light and the beginner is recommended to keep contrasts low until greater experience is obtained.

Exposure

The flash factors provided by the bulb manufacturers are the basis of all flash work and one may use these both when employing one or two bulbs. In fixing the basic exposure it has been suggested that a constant shutter speed be used; 1/25 sec. is suitable for portraiture and it also obtains the most light from any given bulb, it is also useful in quickly determining the second lamp position by means of the flash factor, for it is only necessary to remember one factor, or two at the most, if bulbs of two different powers are used.

With the aperture fixed by means of the basic exposure previously obtained it is only necessary to divide this aperture into the flash factor for the second bulb to obtain the distance for this bulb. However, it is not quite as easy as that in practice, for as it stands, the resulting set-up would give equal effect by both bulbs and the power of the basic bulb must therefore be reduced to increase the modelling effect of the extension. It is here that the facility of using diffusing material is appreciated for, by the choice of material of suitable stopping power, one has control over the contrast obtained. As the basic light is reduced so must the overall contrast be increased. Alternatively, the extension light may be moved closer.

One of the difficulties in using the second light is that of establishing its actual position relative to the subject, for one cannot, of course, see the effect of this, either in terms of contrast or modelling, and one has to learn by experience in sighting over the reflector the angle at which the light will strike the subject. With a little experience, however, it is possible to visualise quite accurately the result of using the bulb in any given position.

Particular Requirements

Generally speaking men can stand a stronger treatment than women and children both in contrast of lighting, vigour of pose, etc., and are therefore a more fruitful field for experimental work, when it is also necessary to please the sitter. Apart from greater scope in lighting one can with advantage use the orthochromatic rendering either by means of the ortho film or, if it is required to photograph both men and women on the same roll of film, by the use of blue flashbulbs and a blue filter over the lens. Exposures with blue bulbs when used with monochrome film are not usually given, but a safe guide would be an increase of one stop over the normal for a similar type clear bulb (i.e., PF25 compared with PF25/97).

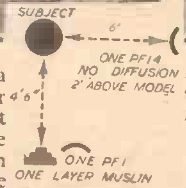
With male subjects one may with safety dispense with the flash at the camera and, especially when using the higher speed films to provide some shadow detail, place the one light in any one of a wide variety of positions. The male sitter will not be nearly so concerned with dark shadows and the showing up of one or two wrinkles as will a female one.

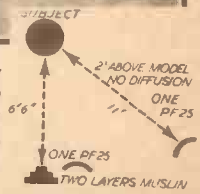
Female models, unless they are very beautiful and can stand "glamour treatment," seem to prefer a softer type of lighting; the light at the camera should therefore be invariably used and the range of contrasts kept to the limits of a softly lighted studio portrait, say, 4 or 5 to 1. Diffusion of bulbs is most useful with the ladies and both the basic and modelling lamps should be covered with at least one layer of material. Fair hair requires back lighting to give it its full feeling of colour, but does not need to have the lamp quite as close as would the darker tints.

Children are perhaps the easiest of all subjects for flash, for the photographer feels the advantage of the possibility of using a high shutter speed when necessary. An adequate frontal lighting well diffused is all that is really necessary and providing over-exposure is avoided the fine complexions of most children will provide prints of good modelling.

Thus it is possible to use both lamps, one on each side of the camera, to obtain a good general flood of light, or one lamp may be used in practically any side or back position for an accent light.

The technique of bounced flash is worth an experiment or two, especially when photographing children, as the more diffused effect of the flash will be more acceptable to them.





Figs. 8 and 9.—Lighting was as shown on the two sketches and exposure was 1/25 sec. at f/22 on FP3, developed in Microphen.

Fig. 6.—Lighting, and processing for this portrait were similar to that used for Fig. 4.

Fig. 7.—Two PF25's, one of which was diffused, were used as shown above. Exposure was 1/25th sec. at f/22 on FP3, developed in Microphen.

Including a Window

There are two methods of approaching the problems of including window space in any picture and it has to be decided what type of picture is aimed for. Whether in fact the exposure should be based upon that of the flashbulb or that of the daylight.

If exposure has been adjusted to record adequately the outside light, the fill in flash must be damped down so as to illuminate the shadow side only. This is done by finding the exposure required for the window area and by reference to the flash factor of the bulb and the distance of the camera from subject, selecting diffusing material which would give approximately quarter of the light which would normally be required for the flash if used alone.

If the exposure is based on normal flash requirements without reference to the daylight the latter, being so much weaker than the flash, will fail to register adequately; the outside scene therefore will appear as if the shot were taken at night.

The materials for portraiture by flash should be chosen not for their speed, as adequate light is available, but for rendition of flesh tones and fine grain characteristic. A film of the Panatomic X type is excellent and may be developed in any general developer of the ID11 class for normal time. A light blue filter is also recommended.

Transistor-Operated Counters & Alarms

Part 5

Details of a Mains Power Pack for Operating the Various Units

By E. V. King

A SUITABLE mains power unit will be described, but it is doubtful if it is worth while making such a unit unless great numbers of counts (in the case of the photo-counter described last month) are required as the new range of transistor batteries give very good results very cheaply. The consumption in the static position is only about 2 mA, giving a life (usable in this circuit) of about 120 hours minimum, which works out at 0.2 pence per hour. Heat dissipation in a power pack would amount to more than this figure. Using a PP8 battery (with R11 omitted) the life would be a good 9,000 hours or just about a year's operation, this must be somewhere about shelf life. When counting, the second relay takes about 30 mA and the counter about 450 mA; this is rather heavy, but is momentary and as such does not harm the batteries. The PP1 appears capable of counting at least 5,000 counts over a week and the PP8 probably about five times as many.

However, it is possible to work all the equipment described in this series from the mains and for long continuous operations, as in the automatic door bell/counter, mains operation may prove economical. A suitable power pack circuit is shown in Fig. 45.

The Base and Case

The unit may be made up in any form together with the unit that it is to operate. Details, however, will be given for a self-contained unit supplying approximately 7 v. smoothed D.C. at 2 amps., and another supply of controlled 5 to 6 v. smoothed D.C. and 11 v. A.C. These supplies will enable stable voltages to be used for: (1) transistor supply and primary relay; (2) secondary relay and counter, etc.; (3) the light source using a car headlamp bulb.

The case is made up by screwing the end pieces to the base in the same way as in the other units (Figs. 14 and 15). The warning lamp glass is screwed into a suitable hole drilled in the rear and three double terminal blocks, tag boards, etc., are fixed as in Fig. 45. A small mains switch, S7, of any type is fixed to the front and a hole drilled to take the mains lead. A cover is made of tinplate painted black.

Mounting the Components

Full details of the components are given in col. 3 and only readers with experience should deviate from this list. The positions do not matter very much, a suitable arrangement being shown in Fig. 44. Brackets may have to be made for the mains transformer and air space should be allowed round the rectifiers which are mounted ½in. above the base on metal brackets as shown in Fig. 47. Do not touch the nuts marked N which control the pressure of the selenium or oxide plates.

Condensers may be mounted upright as shown using conventional clips (ordered with the condensers at about 3d. each), or sideways, using small tinplate clips held down with a small wood screw.

Mount the dial lamp to coincide with the glass already fitted and fix VR1 on brackets in any suitable position. Verify that when the metal cover is attached it will not short on any live part of the circuit.

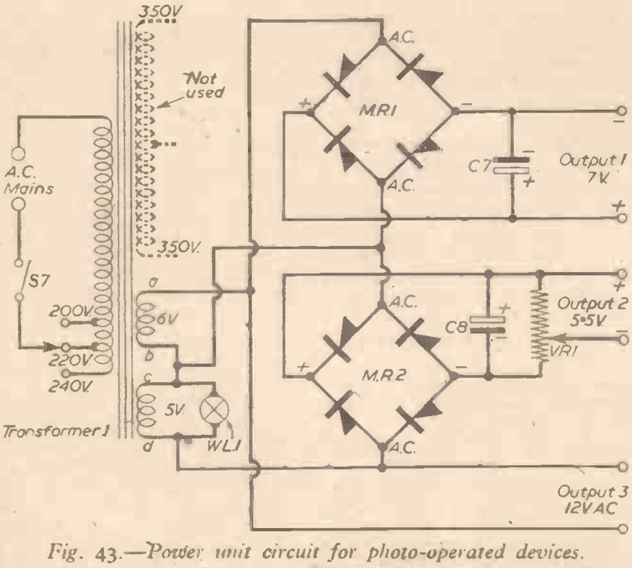


Fig. 43.—Power unit circuit for photo-operated devices.

Wiring the Power Unit

The wiring is as shown in Fig. 43. No special precautions are required. Use the correct tapping of the transformer according to the mains. The rectifiers are marked with a red and black blob of paint so that you may pick out the D.C. tags, the unmarked tags are those for A.C. connection. Sometimes the latter are coloured green. C7 and C8 must be connected the right way round and should not get hot, if they do they are faulty.

Before joining the 6 v. and 5 v. transformer windings together it is necessary to get the phasing correct or the total output will be one volt instead of 11.

Any shorts across the D.C. side will cause the rectifiers to become faulty and readers may wish to put fuses in the output leads. In this case values should be 2 amps. for output No. 1, 200 mA for output No. 2 and 3 amps. for output No. 3.

Shorts across the A.C. side, or faulty rectifiers will cause the transformer to overheat and a fuse in the mains would probably avoid complete failure. A value of 250 mA, if it will hold when the unit is switched on, is quite suitable, but it could be increased to 500 mA. Whether this is necessary will depend on many variable

PARTS REQUIRED

Base of ½in. wood 10¼in. × 4in.
Two end pieces of ½in. wood 4½in. × 4in.
Tinplate cover 11¾in. × 13in.
Three 2-way terminal blocks, tag board or 6-way block.
C7 Electrolytic 200 μF or 500 μF 6/12v. working. (Henry's Radio).
C8 Electrolytic 100 μF 6v. working (Henry's Radio).
MR1 Metal Bridge Rectifier. 12v. 2½ amps. (Henry's Radio).
MR2 Metal Bridge Rectifier. 6v. to 12v 1 amp. (R.S.C. Leeds).
A few inches of metal strip for mounting rectifiers.
Pieces of tinplate, etc.
S7 Toggle type switch.
Warning lamp 6.3v., .3 or .16 amp.
Red or Green warning lamp, glass and holder to suit bulb. (Henry's Radio).

Transformer

Primary to suit mains input.
Output required: One of 6v. 2 amps. and another of 5v. or 6v. at ½ amp.
Almost any ordinary radio transformer will suit, the H.T. windings being left open circuit.
VR1 400 or 500Ω potentiometer, any kind would suit. The prototype used a T.V. slider Circular type would require a mounting bracket, sliding type two small angle brackets.

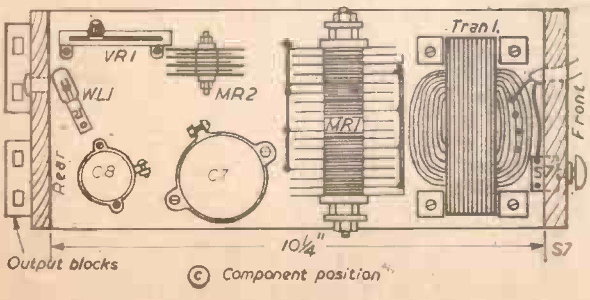
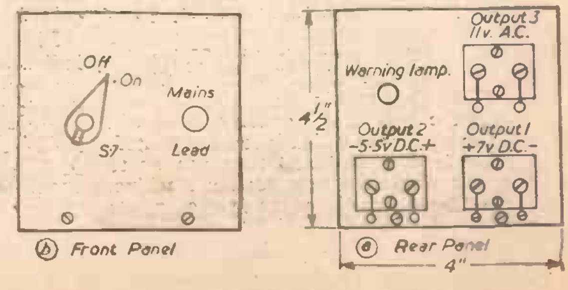


Fig. 44 (Left).—Component layout.

Fig. 45 (Right).—Details of front and rear panels.

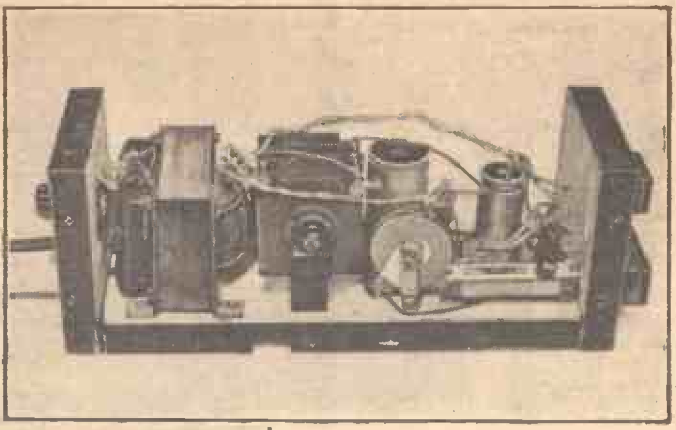


factors, chief of these being the condition of the electrolytics.

Testing the Power Unit

It is advisable to test the unit prior to connection, but if no meter is available a thorough visual check will suffice. Output No. 1 should show about 7 volts D.C. with the needle showing no vibration at all, a volt either side of 7 will not matter. Output No. 2 should be continuously variable between zero and approximately 6 volts (not critical). If output cannot be brought to zero, VR1 is faulty and must be replaced. Set it to give exactly 5.5 volts D.C. If no meter is available set it at the minimum voltage which will operate the photo-transistor in the unit being operated. When setting voltages do it when the mains supply is on a light load (i.e., late at night) and not when demands are heavy (say, Sunday mornings or a very cold evening).

Readers may not be aware that, by Statute, the mains supply is allowed to vary plus or minus 6 per cent. from the mean voltage. Where unstabilised supplies are being used, on transistors especially, readers should make sure the maximum voltage to be attained is a safe one, i.e., set up when mains load is light.



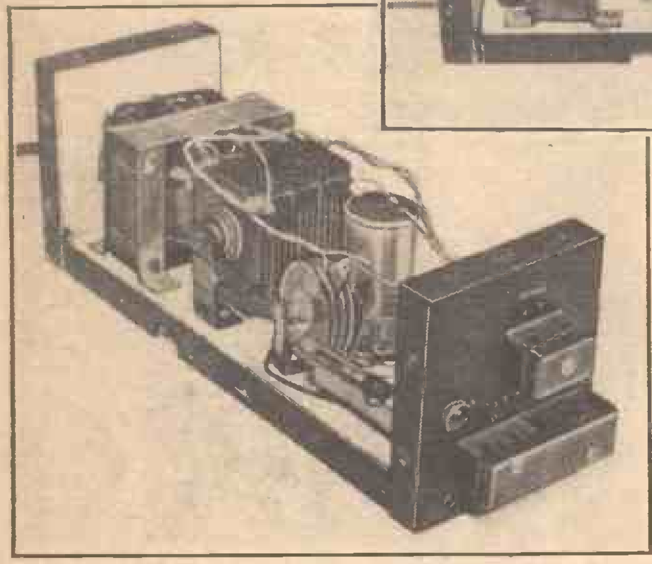


Fig. 46.—Two views of the completed mains power pack.

How to Wire the Units Together

Wiring to the "throw-over switch" is best done as follows: Refer to Fig. 23. S1 may be removed with the battery as a switch is fitted on the power unit. The negative poles of outputs No. 1 and No. 2 are connected to m or g or the switch if it is left *in situ*. One lead may be used for this purpose. The emitter lead marked O No. 2 is unsoldered and connected to output No. 2 positive. Lead marked O No. 1 is removed and output No. 1 positive is soldered to armature of relay No. 1 (marked C) and is left connected to C1.

When wiring to the "Photo-counter," refer to Fig. 37. Use output No. 1 in lieu of B5 and output No. 2 in lieu of B4.

Wiring of the burglar alarm is similar to that for the throw-over switch. The difference being that the bell circuit is completed by wiring leads to B3 to the output No. 1 terminals. There are thus two complete circuits connected to No. 1 output.

If the system of Fig. 33 is used it would be necessary to modify the power unit slightly. A 12 v. winding would be necessary and it would be wired to give another output of about 14 v. D.C. (output No. 4) in exactly the same way as for output No. 2. Two 6 v. windings in series with phase correct, would do. This third output would then be wired in lieu of the two PP1's of Fig. 33. Since the power is only required when a burglar sets the system off, the battery set up is considered best. The burglar could not "mute" the system by pulling mains fuses or shutting off at the mains.

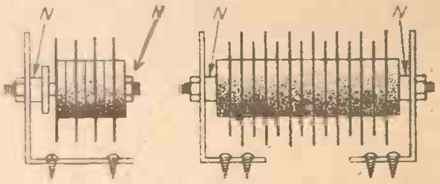


Fig. 47 (Left).—Mounting for MR2 and (right) mounting for MR1.

(To be concluded)

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This system is not suitable for reproducing half-tones, but texts, diagrams, graphs, charts and line drawings reproduce well.

MAKE YOURSELF A DIVING SUIT

(Continued from last month's issue)

LEAVE for a few hours; finally, remove the binding and bottles and the joint is complete. The seals at the wrists, ankles, waist and neck can be dealt with in sequence and the whole job completed in two stages, that is (a) secure all the seals, bind and leave to dry, (b) secure rubber tape to cover the outside edges of the joints.

The ankle seals are secured in a similar manner to those at the wrist. However, the trouser legs are too large to stretch over bottles. If suitable cylindrical formers are not available then wooden ones, as shown in Fig. 9, can be used. The edges of these are radiused to fit into the trouser legs and the ends tapered to suit the small opening of the cuffs. The binding is not so effective in pressing the surfaces together with

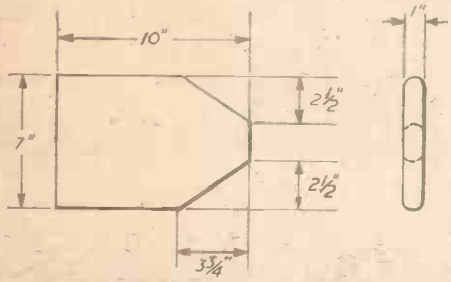


Fig. 9—Former for securing ankle seals.

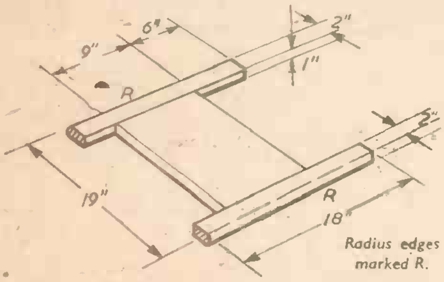


Fig. 10.—Former for securing waistbands.

these flat formers. If flat formers are used, therefore, hammer the two surfaces together, particularly around the edge of the cuff and the 1in. rubber tape, before applying the binding.

The Waistbands

These are secured in a similar manner to the cuffs, but in this case the former shown in Figs. 10 and 11 is used. One waistband is secured to the tunic and the other to the trousers. The waistbands are attached to the tunic and trousers in an identical manner and the former shown is suitable for both garments. Roughen the surfaces that are to be stuck together and then position the tunic and the waistband on the former so that the waistband overlaps the tunic by about 2in., that is, to the previously marked line. Now fold back the overlap of the waistband and apply the rubber solution. The solution has to be applied over quite a large area and it will be found most practicable to apply it and to press the two surfaces together first on one face of the former and then the other. The surfaces cannot be bound together effectively on this wide flat former; they should, therefore, be pressed and then hammered firmly together, particularly around the edge of the waistband. When the waistband is secure, remove the former and check that the inside edge of the tunic is firmly secured to the rubber waistband. Hammer this edge down, if necessary. Replace the former, then roughen the surfaces and stick a band of 1in. rubber tape around the edge of the waistband. Press the tape on firmly and again hammer it down, particularly around the edges. Leave the former in position for an hour or so then remove and use it to attach a waistband to the trousers.

Securing the Neck Seal

The shape of the neck seal makes it

In This Second and Concluding Instalment R. J. Garvey Gives Final Details of the Dry Suit, Some Accessories and a Wet Suit.

impractical to use a former; a little care is required in attaching it without a former, but the operation is not difficult. Roughen the two surfaces that are to be stuck together, apply the rubber solution, wait until the surfaces are tacky and then press the seal firmly into position on the tunic. Make use of the outline previously marked on the tunic and try to place the seal in the correct position first time; it is difficult to re-position it once the tacky surfaces have come into contact. As with the waistbands, it is best to apply the solution and to press the surfaces together first on one side of the tunic and then the other. Hammer the two surfaces firmly together. Pay particular attention in hammering down the edge of the seal; this must be quite secure since it is not to be covered with the 1in. rubber tape as were the other joints. Turn the tunic inside out and make sure that the inside edge, at the neck of the tunic, is firmly attached to the rubber seal. Hammer this edge down if necessary.

The suit is now complete. Make a final examination of the rubber seals. Turn the tunic and trousers inside out and examine the inside edges of the joints. Apply a little more solution and hammer the edges of the joints and the rubber tape down where necessary. Finally, dust the suit and the rubber seals with french chalk.

Fig. 11.—Attaching the waistbands.

Dressing and Undressing

You will need some practice in getting the suit on and off, particularly over bulky underclothes, and may require some assistance to begin with. Try putting the suit on without underclothing at first. The dressing procedure is shown in

Fig. 13. Step into the trousers, stretch the waistband between your shins and roll it down in a tight roll around the top of the trousers. Stretch the ankle seals over your heels and ease them into position just above your ankles. Now grasp the rolled waistband and pull the trousers up to the waist. Unroll the waistband up the chest and then fold it well down over the hips as shown in Fig. 13(a).

Next roll the waistband of the tunic into a tight roll. This can be done by stretching the waistband between your legs and rolling it down on to the tunic. Get the head and arms into the tunic and ease the cuffs into position over the wrists. Pull the neck seal over the head and ease the tunic down to the waist. Make sure the tunic and trousers meet well at the waist, smooth out any folds in the trouser waistband and then unroll the waistband of the tunic over the top of it to form a double thickness over the hips—see Fig. 13(b). Smooth out any folds and then roll the two waistbands into a tight roll around the waist as in Fig. 13(c).

All that remains is to roll on the cummerbund which holds the rolled waistbands in position and so complete the seal at the waist. Stretch the cummberbund between the shins and then roll it up from the bottom edge, over the hips and over the waistbands to the position shown in Fig. 13(c). Now unroll it down over the waistbands. Mask, fins and aqualung complete the ensemble as shown by Fig. 13(d).

To remove suit pull the neck seal over the head and the wrist seals over the hands.

Revertex Limited cannot supply Revultex in small quantities. This can be obtained from P. K. Dutt, Ltd., 1, Alfred Place, London, W.C.1.

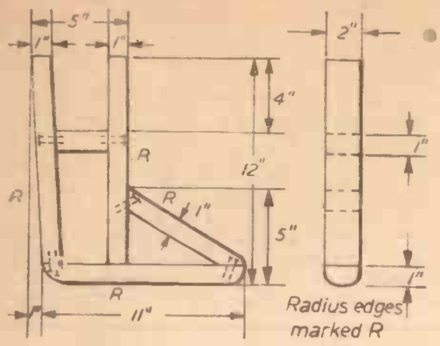


Fig. 12.—The boot former.

Now bend over and pull the tunic down over the shoulders. Once off the shoulders there is no difficulty.

A final check before entering the water: make sure the neck seal fits well around the neck and shoulders. Smooth out any folds in the wrist and ankle seals and pull them up on the forearms and legs, if necessary, to give a tighter fit.

Testing in the Water

Enter the water up to your neck with the arms at the side of the body so that all the air trapped in the suit rises to the neck. The suit can now be vented by easing the neck seal open until all the air has escaped but take care not to let in any water. Make sure that the neck seal is still fitting properly around the neck after this venting operation. Assuming you are suitably trained, weighted and equipped you are now free to dive.

A word of warning: do not dive without venting the suit properly. If your suit is not free of air then:

(a) Your buoyancy will decrease with depth since air in the suit will be compressed as you descend.

(b) The air can rise in the legs of the suit and so affect your "trim" under the water.

If there are any leaks, these may be due to lack of care when dressing; possibly the wrist and ankle seals were not pulled up high enough on the arms or legs. If this is not the cause then examine the attachment of the rubber seals—examine them in any case—and make sure that the 1in. rubber tape covering the edges of the cuffs and waistbands, is secure, particularly at the edges. Turn the suit inside out and make sure that the edges of the garments are firmly secured to the rubber seals. Apply some rubber solution and stick the edges of the garments, or tape, down where necessary.

The hole in the rubber neck seal can be enlarged now if necessary by cutting off one or more of the moulded rings; do not remove more than one ring at a time and try on the neck seal after each cutting until the fitting is satisfactory.

Sponge the outside of the suit down with cold water after use, particularly after immersion in chlorinated or salt water. Turn the suit inside out and hang up to air in a well-ventilated place but keep it away from direct heat and sunlight. Dust all the rubber surfaces with french chalk before putting the suit away and store it so that damp cannot penetrate inside the suit.

Rubber Hood

For a prolonged stay in the water, the head, hands and feet need some protection. In this case it is worth considering the alternatives of a rubber hood and boots in place of the neck and ankle seals and the addition of a pair of rubber gloves.

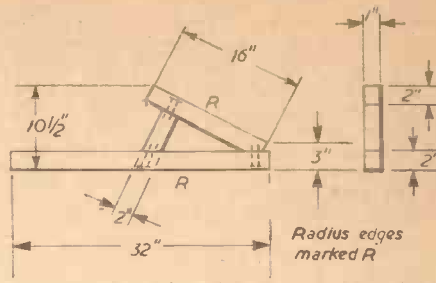


Fig. 14.—Leg piece for short trousers frame.

The hood covers the head and neck; the seal being provided by a tight fit around the face. It is fitted with ear pads designed to equalise the pressure on either side of the ear drums; these should not be removed. It is not practicable to make your own hood; it must be bought; the price is given on the next page. The hood is attached to the neck of the tunic in the same way as the neck seal. If a neck seal is already fitted then stick the hood in position over the neck seal. This gives a double seal against the entry of water and is a feature of some of the more expensive commercial suits.

Boots

Rubber boots can be bought or made. The commercial items are expensive, the suppliers and cost being listed on the next page.

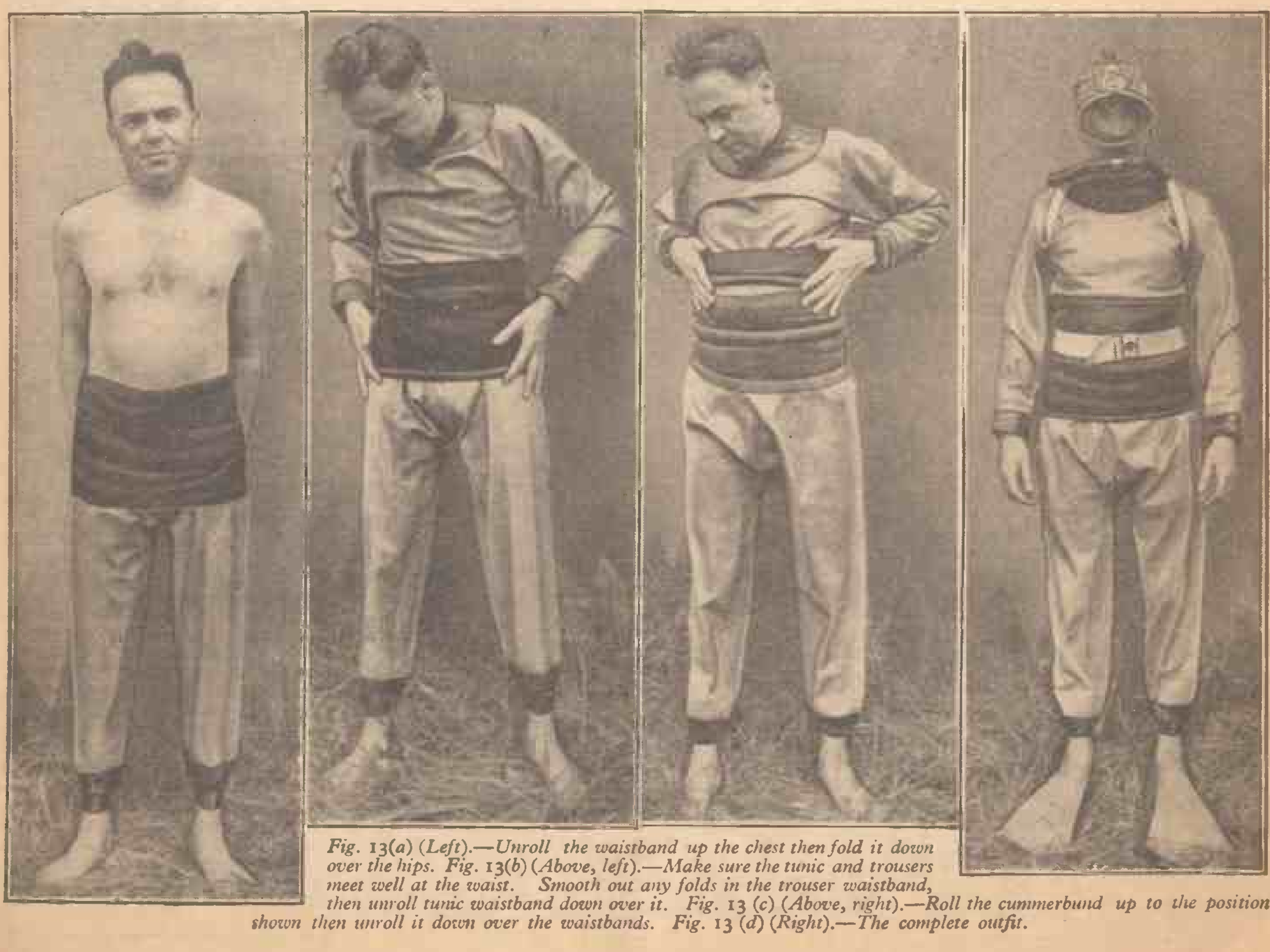


Fig. 13(a) (Left).—Unroll the waistband up the chest then fold it down over the hips. Fig. 13(b) (Above, left).—Make sure the tunic and trousers meet well at the waist. Smooth out any folds in the trouser waistband, then unroll tunic waistband down over it. Fig. 13 (c) (Above, right).—Roll the cummerbund up to the position shown then unroll it down over the waistbands. Fig. 13 (d) (Right).—The complete outfit.

However, a serviceable pair of boots for attaching to the suit can be made by proofing a pair of socks. These should be of generous size and preferably in a thin wool or cotton material. Thick woollen socks are unsuitable since it would be difficult to attach these to the suit. Stretch the socks over a frame, such as the one shown in Fig. 12 and apply four or more coats of Revultex. Now turn the socks inside out

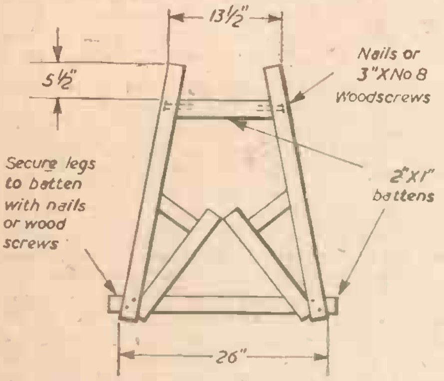


Fig. 15.—Frame for short trousers.

on the frame and apply three or more coats to the top 2½in. of the inside. This provides a rubber surface for adhesion to the trouser legs of the suit. Stick lightweight rubber soles and heels on the underside of the socks. Cut these soles and heels from a thin sheet of rubber if this is available. Thick soles and heels will be difficult to attach, will make the boots heavy and clumsy and it will be difficult to fit on your "fins."

Put the trousers and boots on and trim the trousers if necessary so that the top of the boots overlap the bottom of the trouser legs by about 2in. Now stretch the trousers and boots over a suitable former and secure the boots with rubber solution; the boots to overlap at the joint by about 2in. Hammer the surfaces together to make a tight joint, then stick and again hammer bands of 1in., or wider, rubber tape around the outside edge of the joint.

Rubber Gloves

These, only necessary in extreme conditions, are best worn separately and not attached to the suit. They are fitted with cuffs to provide a seal at the wrists. Any thin rubber gloves are suitable and a pair of cuffs as used on the suit. Cut the gloves off short at the wrist, that is, about 1½in. above the thumb hole. Stretch the gloves and cuffs over bottles and secure the cuffs with rubber solution. Pull the cuffs well down to give an overlap of 1in. or more before securing them to the gloves.

Venting Valve

Another useful accessory is a venting valve. This, a simple "Spear" valve, is fitted at the back of the neck seal or hood and allows air to escape from the suit as the diver enters and descends into the water. The valve can be fitted by cutting a small hole in the neck seal or hood. A short piece of tubing, about ⅜in. o.d. then serves as a former. This is inserted in the hole and the valve pulled down over it so that it overlaps around the hole in the neck seal or hood. The overlap is pulled back, rubber solution applied and the two surfaces stuck together.

The rubber hood, boots and Spear valve can be purchased from Andrews and Dalton, Ltd., 126, Hanworth Road, Hounslow, Middlesex, the costs being:

	£	s.	d.
Hood	2	2	0
Boots	2	5	0
Spear valve		2	9

Wet Suit

A wet suit can be made quite simply and cheaply. Such a suit does not keep the diver dry, but holds a layer of water near to the body, thus preventing the body heat being carried away by the cold water circulating freely over the skin. The suit is made in a similar way to the dry one, but short pants are sufficient and there is no need to go to so much trouble in providing seals against the entry of water. The suit should, however, provide a snug fit at the neck and wrists and around the thighs so water cannot flow freely throughout the suit.

Choose a fairly thick and absorbent material for the basic garments, but remember, if the weave is too open it will soak up an excessive quantity of the Revultex. If short pants of the required tight fit are unavailable then cut the legs off some long ones. If the legs are too wide cut a piece out of each leg and sew them up to the right size. The wet suit should fit closer to the body than the dry one otherwise it will tend to trap a large volume of water which will use up body heat; choose the garments accordingly.

A rubber neck seal, as used on the dry suit, is essential but it need not fit so tightly around the neck. Cuffs can be fitted at the wrists, but they are not essential provided the sleeves fit fairly tightly. Rubber waistbands on the tunic and trousers are unnecessary. A belt, or preferably a single cummerbund (smallest size), around the waist will be sufficient.

Items which must be bought for the wet suit are:

	£	s.	d.
Neck seal		8	0
Cuffs, 1 pair		4	9
Cummerbund		7	6
Revultex, 4lb. at 2s. 4d.		9	4
Rubber solution, 8-oz. tube		2	4
Postage		4	6
	£1	16	5

These are made by the Dunlop Company and obtainable from the sports outfitters mentioned earlier. The remaining items, if not already available, can be purchased for:

	£	s.	d.
Vest or jersey		12	6
Short pants		5	0
Wood		5	0
	£1	2	6

The wooden frame for the tunic should be similar to the one used for the dry suit (Figs. 2 and 3), but the width of the body should preferably be about 1in. less than that shown and the arm pieces about ½in. less in depth. A frame suitable for the

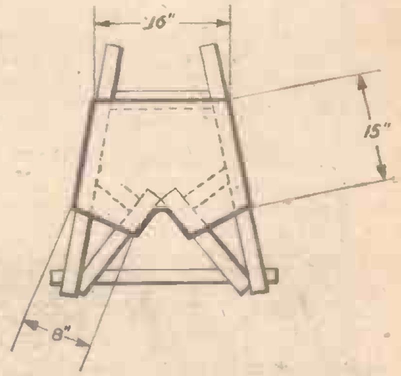


Fig. 16.—Pants stretched over frame ready for proofing.

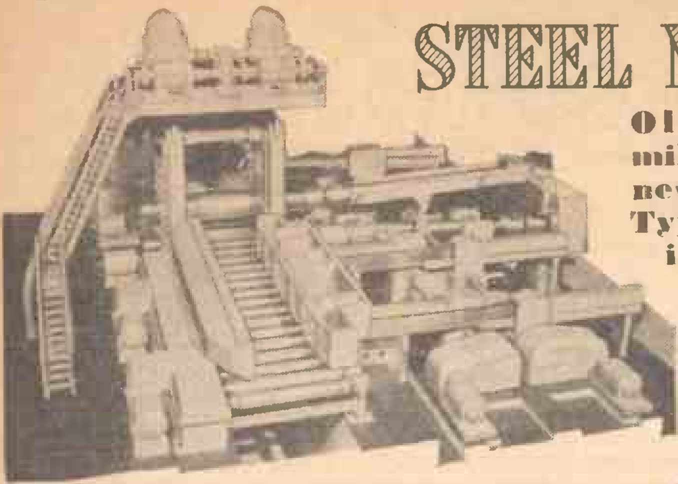
short trousers of the wet suit is shown in Figs. 14 and 15. This is suitable for the average figure. The only important dimension here is that which determines the size of the leg opening since the pants are to fit fairly tightly around the thighs.

Sew some loops inside the waist of the short pants before proofing them. A cord threaded through these will serve as a simple belt to secure the trousers and tunic at the waist. The short trousers should be stretched on the frame, as shown in Fig. 16. Apply at least four coats of the latex to the garments, then attach the rubber seals at the neck and wrists as described for the dry suit.

ANDY MANN **The Practical Mechanic**

STEEL MILL INSTALLATION

Old slabbing mill removed and new Universal Type installed in 14 days!



(*Above*) *A view of the Bassett Lowke model.*

To increase slab rolling capacity from 48,000 to 60,000 tons per week, the installation of a Universal mill was necessary at the Steel Company of Wales' Abbey Works.

As all the steel ingots produced in the works have to pass through one slabbing mill the installation of a new one would have caused interference with production, and therefore a changeover which could be completed in the shortest possible time had to be planned.

Because of the lack of head room in the existing mill building the company's engineers collaborated with Messrs. Davy & United Engineering Company Limited, of Sheffield, to obtain a design for a mill specially to suit their requirements.

(*Above*) *The old mill.*

(*Left*) *The scene during the changeover.*

Prior to delivery the mill was erected, thus enabling adjustments to be made as required and ensuring that on arrival all parts were ready for immediate installation.

While the mill was being manufactured a carefully planned programme was prepared covering delivery and storage of the mill components, removal of the old mill and installation of the new one. Fourteen days were allocated to complete the changeover.

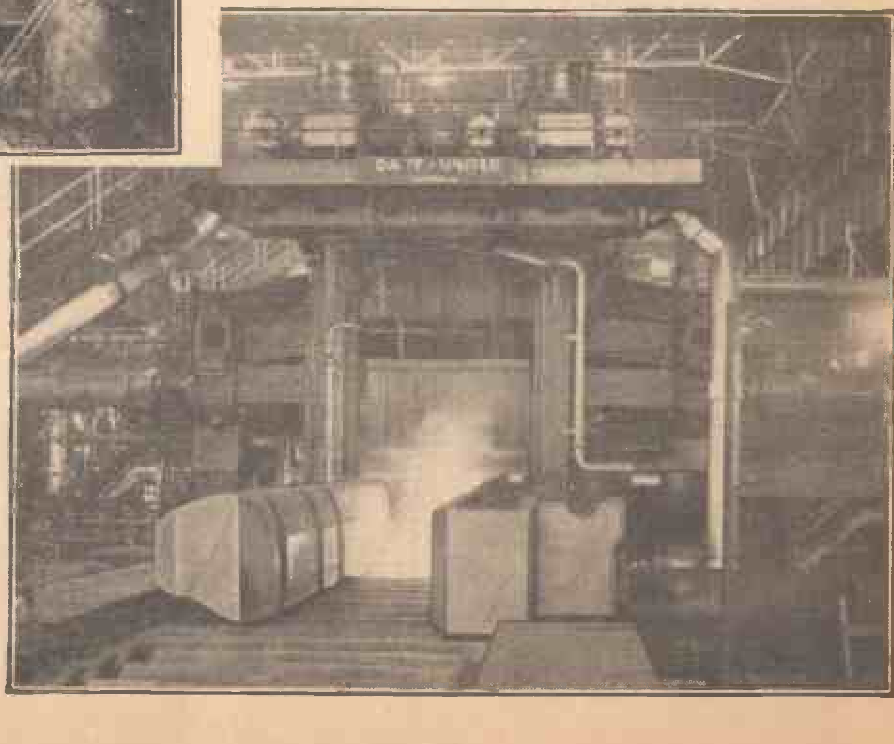
Two scale models were made, one of the old mill by Bassett Lowke Ltd.. and one of the Universal by Mills Bros. (Sheffield) Ltd., and these played a big part in the briefing of personnel. These models could be dismantled and assembled to demonstrate all the different stages of the task. They were used both during the twelve months prior to the changeover and the actual changeover.

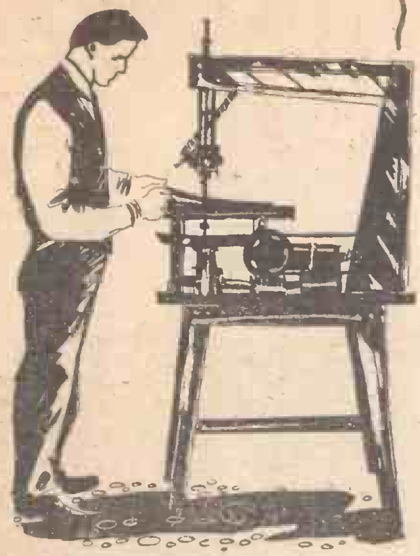
Dismantling of the old mill commenced on November 17th and was completed in two days. During this time 1,374 tons of equipment were removed, including individual items and assemblies ranging in weight from 5 cwt. to 125 tons. The heaviest items were the screw-down assembly weighing 80 tons and the 125-ton mill housings.

The new mill was designed to use the existing foundations, but about 5ft. of concrete over an area of 220 sq. ft. had to be removed to receive the very large soleplate needed to support the vertical edger mill. It took 36 hours to expose a new level of mature concrete which was then dressed smooth in areas on which 18in. square packing plates were to sit. When the 142-ton soleplate was lowered on to the packing plates and bolted down it was levelled to within .006in. at any point.

Erection of the Universal mill commenced on November 20th and 2,375 tons of equipment ranging in weight up to 142 tons were installed. Finally, the electrical work was completed and the whole project finished one-and-a-half days inside schedule.

(*Below*) *The new mill.*





AN IMPROVED JIG SAW

With Positive Double-drive, 3-way Blade-chucks, Tilt and Rise and Fall Table

By Jameson Erroll

THE machine about to be described possesses many features not found, collectively, in any known make on the market. It has, for example, a positive double-drive, i.e., the motor not only pulls the saw on the forward stroke but also on the backward stroke, thus replacing the more normal "spring return." This considerably lessens vibration.

The blade-chucks are three-way, thus permitting the saw to be used in the normal front position or from either left or right side. This makes possible the cutting of work wider or longer than the throat is deep.

The table tilts 45 deg. and, in addition, rises and falls. This latter movement allows for the use of the full blade length instead of the usual inch or so which, when blunt, calls for a new blade although more than half of it is quite sharp and unused.

Fig. 1 is a general view of the machine except that the table has been removed for the sake of clarity. This, together with Fig. 2, which is a close-up of the mechanism, should enable the constructor clearly to identify the details furnished in the scale drawings.

This jig saw has been constructed so that it may be used with an independent motor and stored when not in use. Its size, therefore, may be varied according to individual requirements provided that the stroke of $1\frac{1}{2}$in. is adhered to. Also, the ball-bearing rollers or bobbins around which the strap passes will necessarily be of a type which are available or which are most easily made. Those used on the machine being described were rather like cotton reels, but any type of plain roller will serve. Similarly, the lid-stays were used because of their eminent suitability, but the fortunate possessor of a milling machine may prefer to vary the construction slightly and make his own grooved guides.

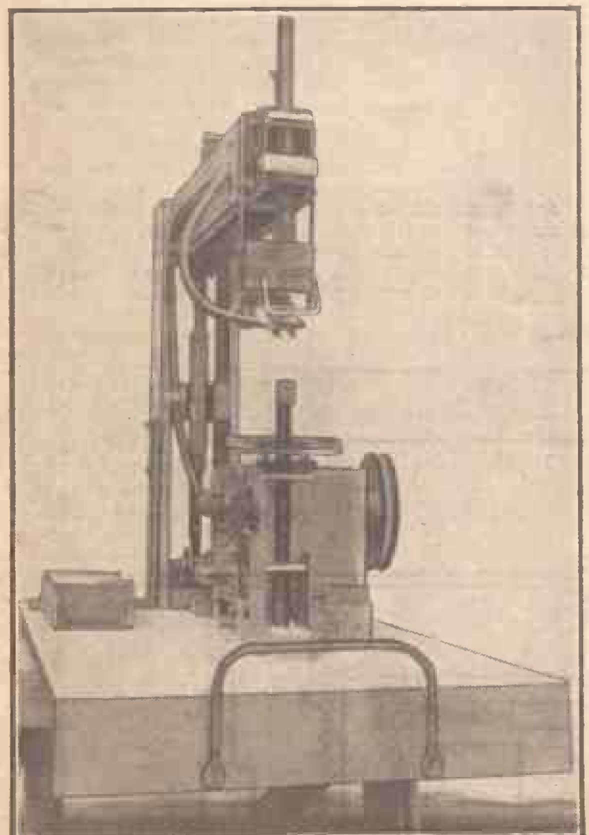


Fig. 1.—A general view of the machine with table removed.

The General Mechanism

Each end of the sawblade is attached to an otherwise endless belt (or strap) which, at one point, is engaged by an oscillating mechanism. Figs. 3 and 4 show that this engagement takes place via a slotted rocker arm through the bottom end of which a driving pin, riding between two lugs, transfers lateral movement to a metal plate to the ends of which the belt is attached. At its upper end this slotted arm connects with an eccentric pin placed at $\frac{3}{4}$in. from the centre of the main shaft. This gives the arm a rocking motion since it is fixed at its centre to a riding pivot.

To this same eccentric pin is attached a connecting rod which actuates a piston carrying a leather washer in an enclosed tube. In the far end of this tube is fixed an ordinary football pump-adaptor connected by a length of rubber tubing to a metal nozzle situated near the hold-down. This assembly supplies the necessary "blower" which keeps the sawdust clear of the cutting line.

The main shaft is driven from a 5in. "V" pulley powered by a motor fitted with multiple pulleys. The speed of the machine can, therefore, be varied as desired, and any speed between 500 and 1,000 r.p.m. is suitable. The faster the speed the quicker the cut, but at high speeds the cutting line is much harder to follow accurately and

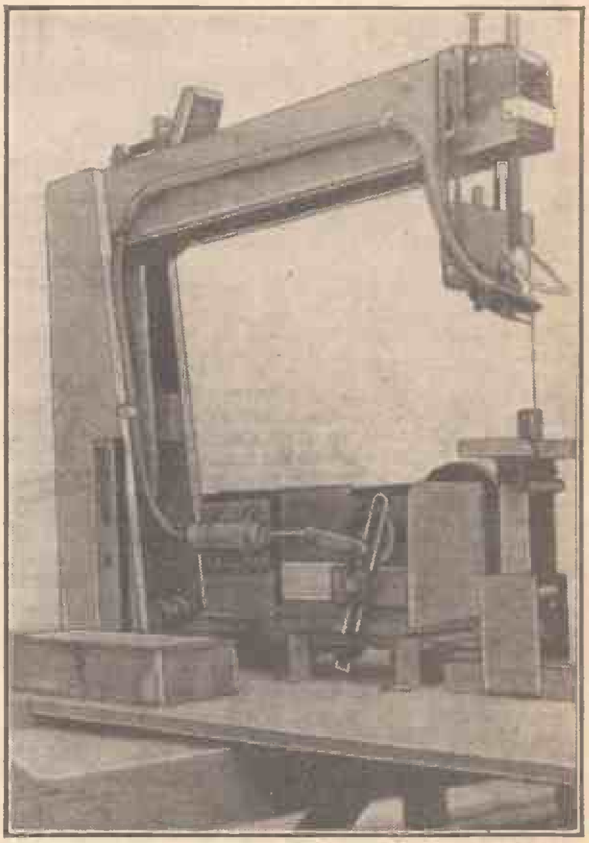


Fig. 2.—A close-up of the mechanism.

there is, naturally, more vibration. The author prefers a slow speed, particularly when dealing with intricate or sharply curved work. A $\frac{1}{4}$ h.p. motor will furnish ample power if work is confined to a reasonable thickness—say, up to $\frac{3}{4}$in.

The Main Frame

Construction may well begin with the baseboard, the upright, and the cross-bearer—see Fig. 5. The base is of $\frac{1}{2}$in. plywood and needs only to be cut to the required size; in the present case it is 30in. long × 18in. wide. The upright and the cross-bearer are both built up from $\frac{1}{2}$in. plywood separated and strengthened by blocks of 3in. × 2in. and 2in. × 2in. deal. The upright is 20in. high and $5\frac{1}{2}$in. wide at the base, tapering to $3\frac{1}{2}$in. at the top. The plywood is separated by a $5\frac{1}{2}$in. length of 3in. × 2in. at the base and a similar block, 3in. long, about halfway up. Note that a step has been cut in the base block in order to clear the bottom bobbin, and that the centre block is reduced in depth so that it does not offer obstruction to the belt. The

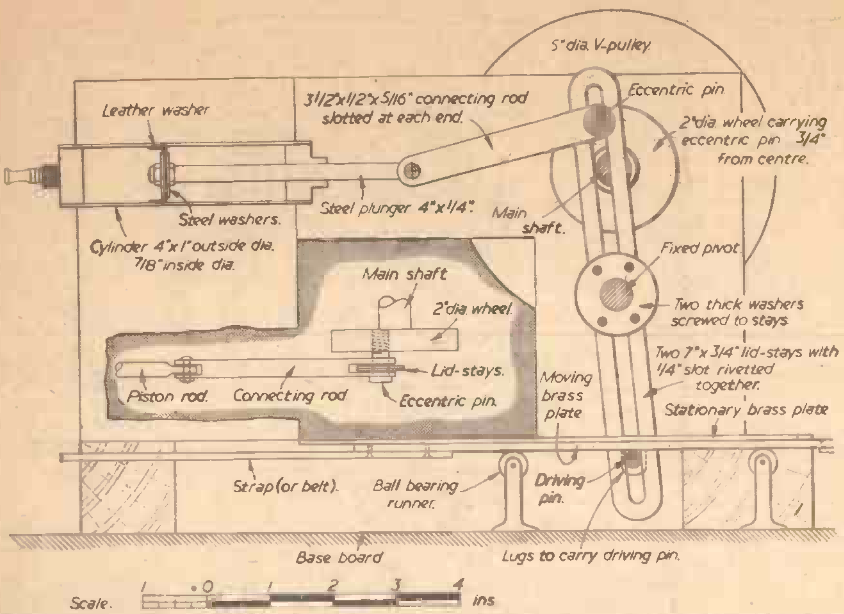


Fig. 3.—Scaled detail of driving unit and blower. The inset shows plan of the connecting rod.

bottom block is fastened firmly to the base with two ¼in. Whitworth bolts and nuts, and the upright by two strong, steel brackets.

The cross-bearer is also 20in. long and is 3in. wide throughout its length. These two pieces of plywood are separated by a 5in. length of 3in. × 2in. at the point of juncture with the upright, and by a similar length of 2in. × 2in. about midway. It will be seen that the larger block has also been stepped and bevelled to give clearance to the tensioning bobbin, while the centre block leaves a clear space for the passage of the belt. The 3in. × 2in. block shown at the head of the cross-bearer forms part of the construction of the head and need not at the moment be considered.

Before fitting the cross-bearer to the upright it will be necessary to make the belt tensioning device. As will be seen from Fig 6 this consists of a bobbin mounted between two curved metal plates which are hinged on a ½in. bolt and, at their upper ends, mounted on an oak block 4in. × 1¾in. × ¾in. This block is moved forward by the action of a 3½in. shutter bolt fastened to a bracket and carries the bobbin farther from both the bobbin at the head and that at the base of the upright. This movement stretches the belt and automatically tightens the saw between the two chucks. When bought, the shutter bolt is supplied with a threaded nut from which two lugs protrude; it is, therefore, a simple matter to mount it on the steel bracket which, incidentally, should not be of less thickness than ⅛in. The width of the oak block should be planed so that, together with the thickness of the two curved plates, the whole is a tight fit between the two pieces of plywood. It is important that there should be no movement whatever, in any direction, except that brought about by adjustment of the shutter bolt. Note that a striking plate is screwed to the front of the oak block to prevent the bolt from cutting into it. Fig. 2 plainly shows this tensioning device, also the lower bobbin.

The cross-bearer may now be fastened to the upright and, since it is separated by 2in. space blocks, whereas the upright is separated by 3in. blocks, it should be a comfortably tight fit into the top of the upright.

The Driving Mechanism

Fig. 3 gives scaled details of this, and the various photographs show that the mechanism is built up on a wooden framework which is entirely isolated from the rest of the machine and is finally bolted to the baseboard. For convenience this will be referred to as the "general structure."

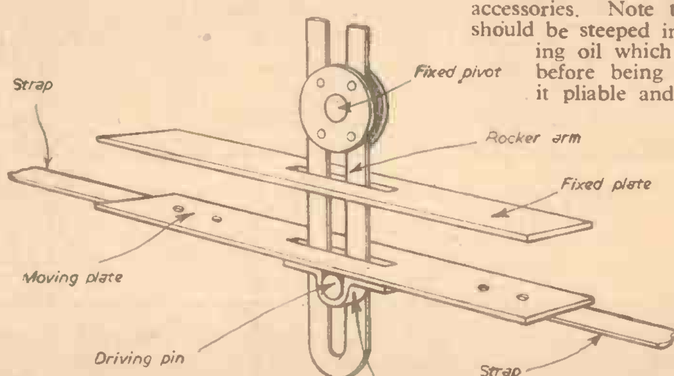


Fig. 4.—Details of the slotted rocker arm, driving pin and lugs.

The main shaft runs on two ball-bearings set approximately 2in. apart; one end carries the 5in. "V" pulley, the other the 2in. wheel on which the eccentric pin is fixed. The rocker arm—in this case two 7in. lid-stays riveted together—is pivoted centrally at a point vertically 2in. down from the main shaft. Two thick steel washers with ¼in. holes are bolted to the stays and secured in position by a ¼in. steel bolt threaded deeply into a wooden block built into the general structure. Under the base of this structure a stationary brass plate 8in. × 1in. × ⅛in. is screwed—see Fig. 4. In this plate, at 3in. from one end and for a length of 2in., a centrally placed slot ¼in. wide is cut. The plate is screwed to the underside of the general structure in such a position that, when the rocker arm is perfectly vertical, it will occupy the centre of the slot. This gives ample clearance for the arm to move along the slot when activated by the eccentric pin. Note that Fig. 4 also shows a lower, or moving plate, which is of the same size as the fixed plate. The slot is placed centrally in the length, and to the underside are fitted two lugs (one each side of the slot), which will carry a ¼in. driving pin passing through the slot in the rocker arm.

The connecting rod which works the blower is also engaged with the eccentric pin and rides on it with the lid-stays, as shown in the inset Fig. 3. A 4in. × ¼in. bolt was used for the piston rod, the head being filed flat and drilled to take a 4 B.A. bolt. The cylinder is a 4in. length of 1in. o.d. brass tubing with walls 1/16 in. thick. The tube is blocked at both ends with silver steel rod, that at the rear being about ¾in. long (to offer good guidance to the piston rod) and that at the front being about ⅜in. long. Into the former a ¼in. hole is drilled to take the piston rod, while the latter is drilled and tapped to take a football pump-adaptor. Both these holes—and, particularly, the rear one—must be absolutely central. The inside washer unit is built up from ordinary bicycle pump accessories. Note that the leather washer should be steeped in olive oil (not lubricating oil which is injurious to leather) before being fitted. This will keep it pliable and air-tight, and will also preserve it.

It will be observed that the general structure is mounted on two blocks which raise it from the baseboard. This is to give clearance to the strap and to bring the driving mechanism, i.e., the moving plate, to the same height as the bottom of the lower bobbins. One of these latter—that at the base of the upright—may now be fitted. This is quite a simple job (see detail "A" in Fig. 8) and consists of mounting it by means of its spindle to a strip of ¾in. × ⅛in. mild steel about 4½in. long and bent up at right-angles at each end about 1¼in. so that the bobbin

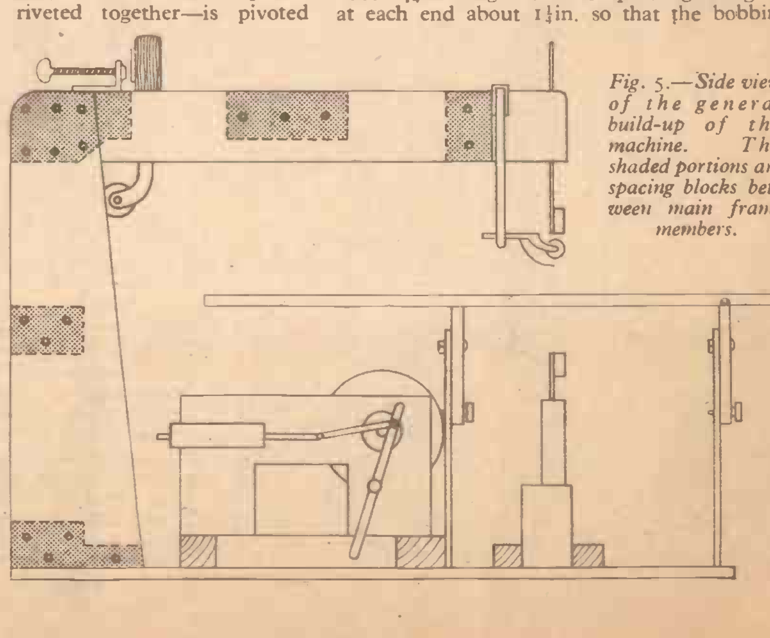


Fig. 5.—Side view of the general build-up of the machine. The shaded portions are spacing blocks between main frame members.

runs freely. This double bracket is then mounted on the stepped bottom spacing block by means of a ¼in. bolt passing through a central hole.

The general structure may now be mounted on the baseboard with two 5/16in. Whitworth bolts. Reference to Fig. 5 shows that the blower end should rest about 1½in. from the inside of the base of the upright in order to give sufficient room for the toe unit, when fixed to the baseboard, to align vertically with the head unit. Be sure that the centre of the stationary brass plate is in a line with the centre of the lower bobbin and that it lies in the same horizontal plane.

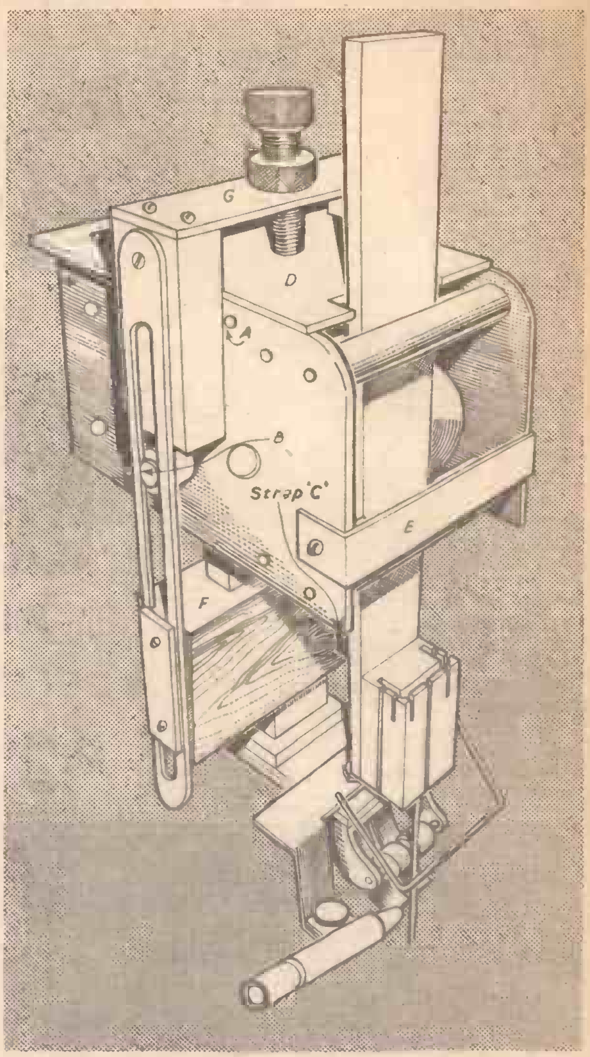
The Head Unit

This unit, together with the toe unit, will carry the saw blade, and Fig. 7 is a perspective drawing which, with a glance or two at the photographs Figs. 1 and 2, should enable the reader to construct it without difficulty.

The head is constructed in the main between two brass or steel plates each 4½in. × 3in. × ⅛in., and separated at their end by a wooden block 1¾in. thick, 3in. deep, and 2in. long. Through this block a slot is cut as shown in order that the belt may pass through it and thus over the bobbin. Four countersunk holes are drilled to take ¾in. No. 8 wood screws for fastening the plates to the block, and both plates should be drilled together to ensure perfect alignment. At the same time the holes to carry the bobbin and the four rollers should be drilled, also holes to carry the small guide pins "A" and the larger guide pins "B."

The diameter of the rollers and their positions are not critical except that they should be so spaced that the top two are ⅛in apart and the bottom two ¼in. apart. The mild steel strip to which the leather strap and the saw-chucks are attached rides between these rollers and should be allowed only sufficient play as will permit them to slide without undue friction. But since the strap will be attached to the steel strip at the point where it passes between the lower pair of rollers, these must be set farther apart than the top pair. The rollers can either be made from silver steel rod or from tubing running on centre spindles. They should be just under 1¾in. long (plus their riding pins) and from ⅜in. to ½in. is a convenient diameter. When these are prepared the unit may be assembled by inserting them, and the bobbin, between the two plates and screwing the latter to the wood spacing block.

It will now be appreciated that the steel strip must be guided in some way to prevent any side-to-side motion: this is accomplished by means of the cover "D" and the angle strip "E." These are shown in detail in Fig. 8. The former is a piece of aluminium or brass screwed down on the top of the wood block; in the front of this has been cut a central notch in which the steel strip can ride. The latter is a piece of brass bent and notched as shown; this slides between the brass plates but the two lugs pass outside the plates to which they are secured with two 4 B.A. ¼in. bolts. These two notched pieces, jointly, prevent any side movement of the steel strip.



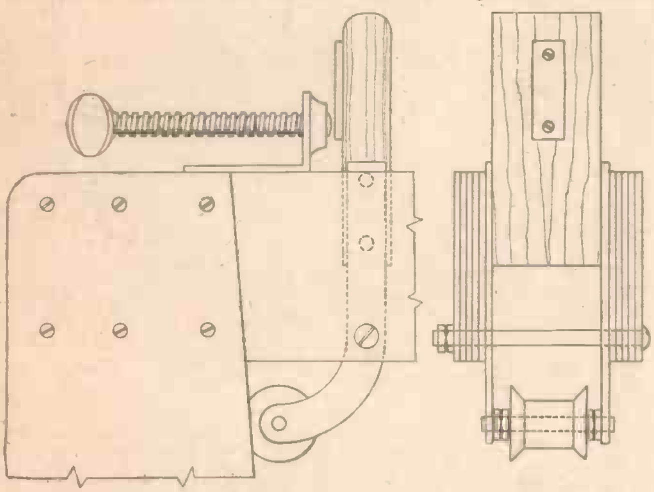


Fig. 6 (Left).—Rear and side views of the belt tensioning device.

Fig. 7 (Right).—Details of the machine head.

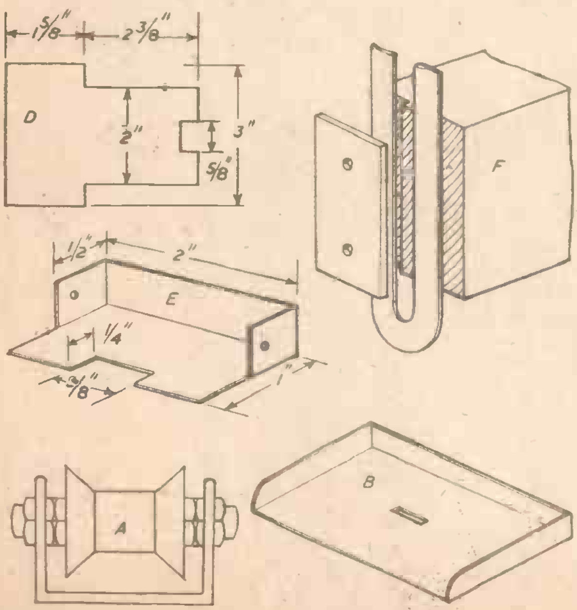


Fig. 8.—Some enlarged details.

Adjustable Hold-down, Blade Guide-roller and Blade Guard

This part of the unit also carries the blower nozzle. Two lid-stays are used in conjunction with thick metal supports at the top and a wooden spacing block at the bottom. These are spaced at the top by means of a metal cross strip ("G" in Fig. 7) to the centre of which is soldered a threaded nut to carry the adjusting screw. The two lid-stays are fastened to the side of the blocks and the whole slid over the top of the head, the guide pins "A" and "B" preventing any movement other than strictly vertical. The wooden spacing block "F" shown in detail in Fig. 8 is rabbeted at each end so that it slides in the grooves in the stays, and to the outside are screwed two brass plates to prevent the stays from springing away from the block. When finished, this block should be just movable by hand along the slots. Through the centre of this block a ⅜in. vertical hole is bored to admit entry of the length of steel bar which will carry the plate on which the hold-down, blade guide-roller and blade guard are fixed. This steel rod is locked in position by means of a thumbscrew passing through the rear centre of the wooden block. It will thus be seen that the block can be moved vertically along the slots; that the rod can be moved in a similar direction; and that the whole can be finely adjusted by the knurled screw which passes through the threaded nut soldered to the cross strip. So, as the table is raised, lowered, or tilted, the hold-down, etc., can be moved within fine limits to vary their height from the table.

These three fitments are all mounted on a piece of steel 2½in. × 1in. × ⅛in. slotted down the centre for about 1in. This provides for horizontal adjustment of the guide-roller against the back of the saw blade. The roller is mounted between two arms exactly similar to those found on an ordinary castor—in fact, a small castor was used for this purpose, the china wheel being replaced by a steel one grooved in the centre to a depth of about 3/32in.

(To be concluded)

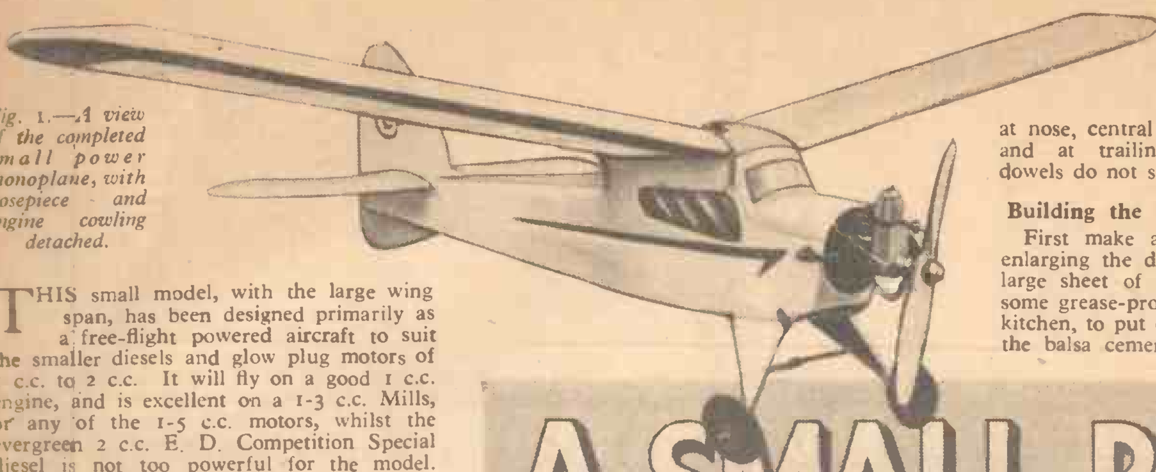


Fig. 1.—A view of the completed small power monoplane, with nosepiece and engine cowling detached.

A SMALL POWER

A SIMPLE MODEL; EASY TO ADJUST; PORTABLE A

By C. E. BOWD

THIS small model, with the large wing span, has been designed primarily as a free-flight powered aircraft to suit the smaller diesels and glow plug motors of 1 c.c. to 2 c.c. It will fly on a good 1 c.c. engine, and is excellent on a 1-3 c.c. Mills, or any of the 1-5 c.c. motors, whilst the evergreen 2 c.c. E. D. Competition Special diesel is not too powerful for the model. (Figs. 1 and 6.)

A model of a similar type is still flying after 10 years. The balsa sheet fuselage construction and wing box spars have much to do with this.

The model can be covered with paper if cost is all important, but better, it can be covered with light silk, or with the cheaper light butter-muslin, shown in the photographs. If radio is to be fitted, muslin or silk are the best coverings.

Although the model is primarily for free-flight sport flying, it may be desired to fit the latest lightweight radio equipment. Sufficient wing area has been provided to carry radio such as the single-channel E. D.

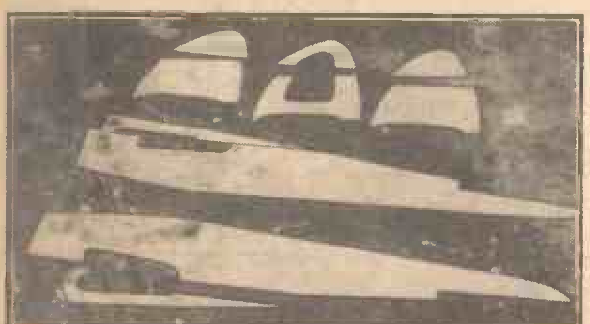


Fig. 2.—A view of the cut-out sides and pieces for forming the laminated fin.

Fig. 3.—The two fuselage balsa sheet sides complete with longerons and uprights cemented in, together with celluloid windows.

"Airtrol" receiver, which has one sub-miniature hard valve with two transistors. The E. D. rubber-powered, self-centring miniature actuator is suitable to operate the rudder, or alternatively, if self-centring, the little Rising clockwork actuator can be used. This is obtainable from F. Rising, of Whissendine, Oakham, Rutland.

As the model is designed to take a number of different motors of varying weight, to obtain the correct weight distribution, or C. G. position, it has been provided with a

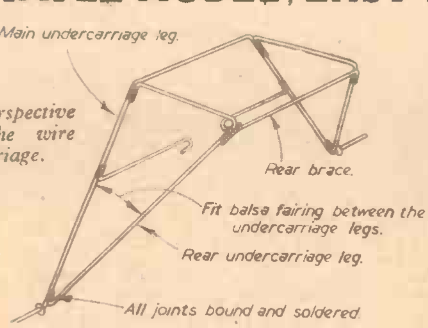


Fig. 4.—Perspective view of the wire undercarriage.

detachable nosepiece, which is held on to the fuselage by rubber bands. This not only saves damage in bad landings, but enables varying distance packings to be added, between engine nosepiece and fuselage, to compensate for varying engine weights. The method is explained on the plan (Fig. 5) and in the photographs.

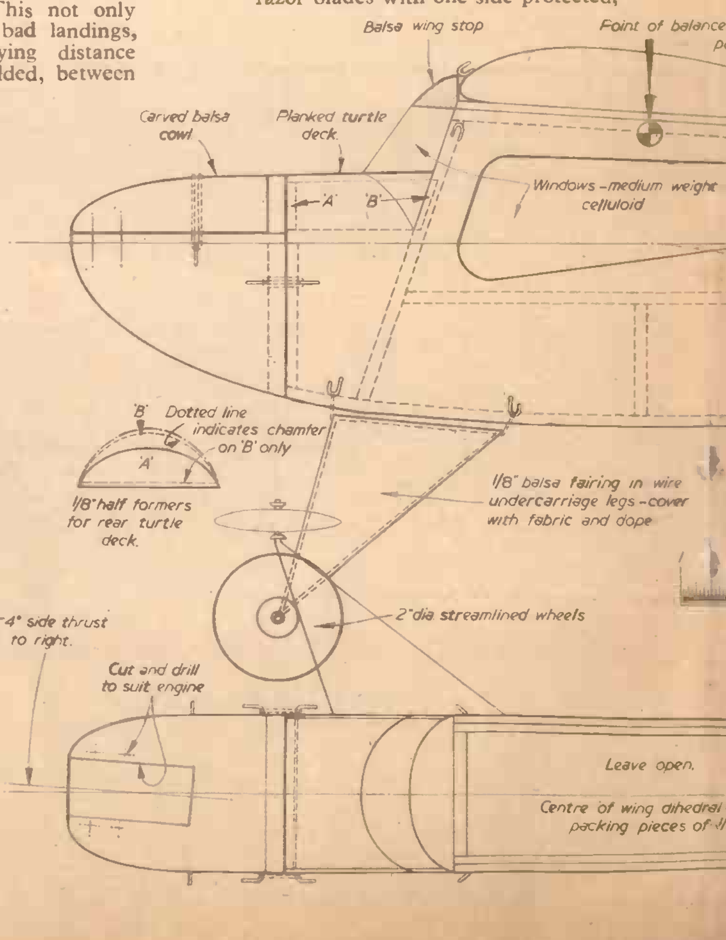
Furthermore, this detachable nose permits engine thrustline trim to be altered by balsa packings, to obtain different offset or downthrust trim as required for power-flight.

All units, such as wings, tail and undercarriage, are detachable and shock absorbed by rubber bands. Thus the whole model can be packed up into a small area for transport. The wings are made in two detachable halves so that they will give under the weight of the model should it turn over on its back during a bad landing. The two halves are held together by two short locating wooden dowels, which fit into holes in the opposite wing, and rubber bands to wire hooks located at nose, central spars, top and bottom, and at trailing edge. Short stub dowels do not snap off as long ones do.

Building the Fuselage

First make a full-scale drawing by enlarging the drawing, Fig. 5, on to a large sheet of kitchen paper. Obtain some grease-proof paper, as used in the kitchen, to put over the plan to prevent the balsa cement sticking to the plan.

An alternative is to rub the plan lightly with oil. Obtain a box of ordinary dressmaker's pins (tinplated variety), a number of tubes of balsa cement and two tubes of plastic wood. To build well, do not economise on cement or plastic wood. A number of lightweight soft 1/16in. balsa sheets, preferably 4in. wide, are required, and three sheets of soft ⅛in. sheets for ribs. You will also need a dozen sticks of lightweight soft balsa 3/16in. × 3/16in. for longerons, etc., two sticks of ¼in. × ⅛in. balsa, one sheet (for fairings. etc.) of soft ⅛in. stock, a few safety-razor blades with one side protected,



some sandpaper, a small pair of pliers and a few lengths of spring steel model wire as specified on the plan for the undercarriage and rubber band retaining hooks on fuselage and wings.

Lay the plan on the kitchen table or on a flat building board with some grease-proof paper over it and pin down, after having first traced the fuselage sides on to 1/16in. sheet balsa. These sides are wider than the 4in. wide sheet, and, therefore, you must butt join and cement two sheets together for a fuselage side, allowing to dry under weights to prevent cockling at the joints.

The photographs, Figs. 2 to 11, show stages of construction pictorially. Cut out the fuselage outline with razor blade, Fig. 2.

Now cement 3/16in. × 3/16in. longerons all round the fuselage sides, retaining these in position with household pins. When set, withdraw the pins. Where the longerons are on a curve, gently crack the wood before cementing. Cement in uprights where shown in Fig. 5. Cement in medium-weight celluloid sheet windows on the insides of the fuselage sides, retaining with pins until the cement is set. Make sure that the fuselage sides are pinned or weighted down whilst the cement sets, to prevent warping. Be certain to cement longerons, uprights and windows into the inside of each fuselage side, and not on the same side, or you may find you have made one side with its longerons, etc., on the outside when you come to assemble the fuselage! See Fig. 3.

It will now be noted, as already mentioned, that the correct angles of wing and tailplane have been constructed into the fuselage sides automatically. When these two sides are complete, pin them together side by side, carefully trim the edges so that each side is exactly similar, then separate.

Place the two sides vertically upright and cement in the crosspieces to the width of the fuselage, as shown in Fig. 7, keeping these in position by pins to assist rigidity until the fuselage top and bottom is covered with 1/16in. sheet balsa, which is the final stage. Great care must be taken at this stage, or the fuselage may become twisted and untrue. It can be propped upright with boxes on either side during assembly.

R MONOPLANE

Fig. 6.—A further view of the completed plane.

ND ALMOST INDESTRUCTIBLE

Wire Hooks

All wing and tail retaining hooks of wire are fitted at this stage. The wire is 18 s.w.g. spring steel model wire. Wings, tail and undercarriage and nosepiece, are all held to the fuselage by rubber bands to these hooks, which pierce through the fuselage sides, and at these points are smeared liberally with cement and plastic wood to spread the load. The darker plastic wood patches can be seen in Fig. 9, which also shows the curved forward decking in position. Fig. 8 shows the forward curved decking being planked with ⅛in. × ½in. balsa planks laid side by side and cemented on to the two half-round formers, cemented on to the fuselage in front of the wing position. It will also be noted that a soft ½in. width front with a three-ply square cemented to it is lying on the ground ready to cement up to the planked up turtle decking when complete. This operation can be seen completed in Fig. 9. The ½in. front is made by laminating from the ¼in. sheet originally obtained.

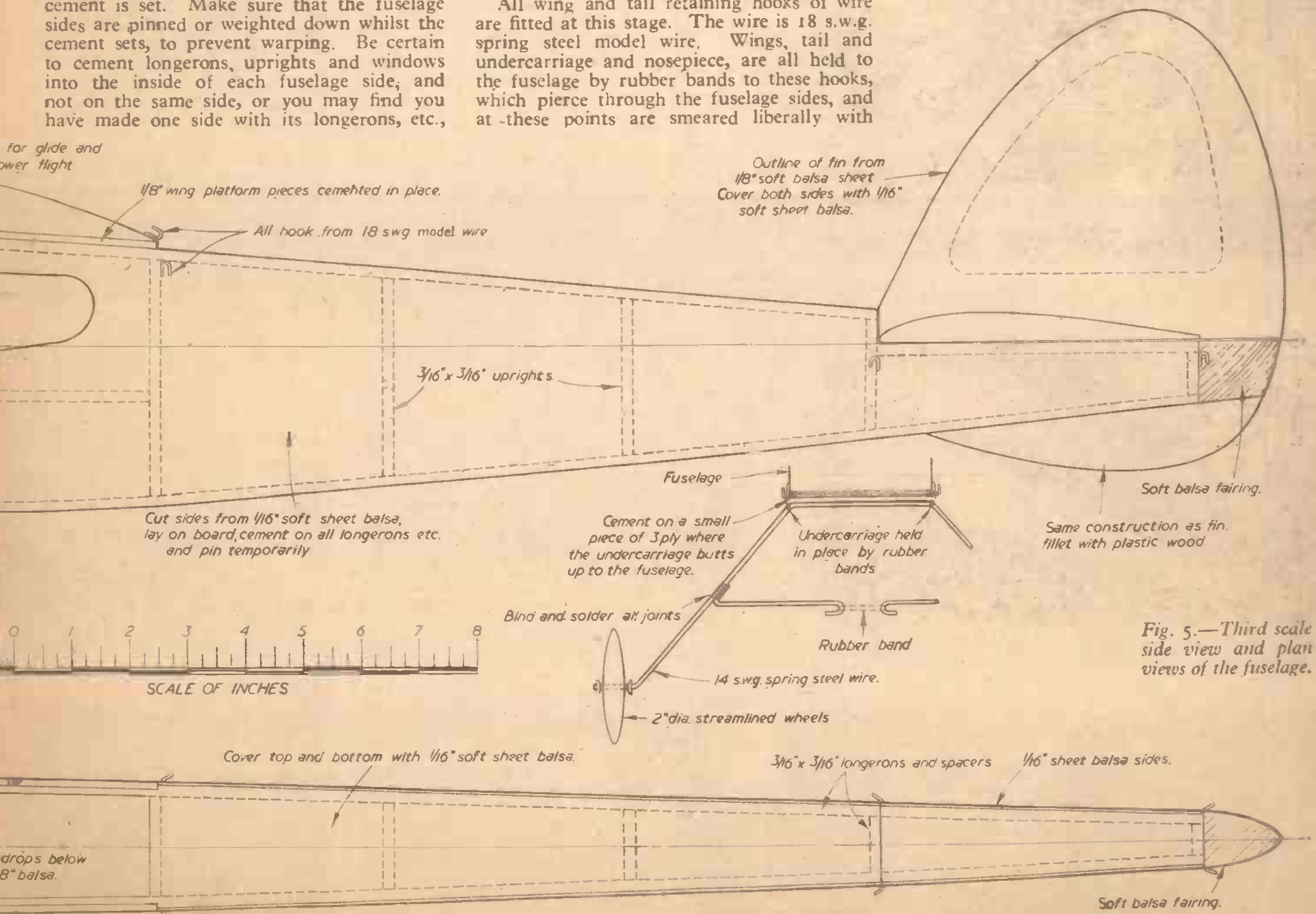


Fig. 5.—Third scale side view and plan views of the fuselage.

The $\frac{1}{8}$in. three-ply cut-out forms the locating position for the detachable engine nose, which has a three-ply square fixed to its rear, to fit on to the cutaway on the fuselage, the two being held to each other by elastic bands from the wire hooks on the fuselage and the detachable nose. When trimming the model for flight, it is a simple matter to add or take away packings of $\frac{1}{4}$in. soft balsa sheet to lengthen the nose or shorten it to suit different weights when obtaining correct "point of balance" position of the model in relation to the wing.

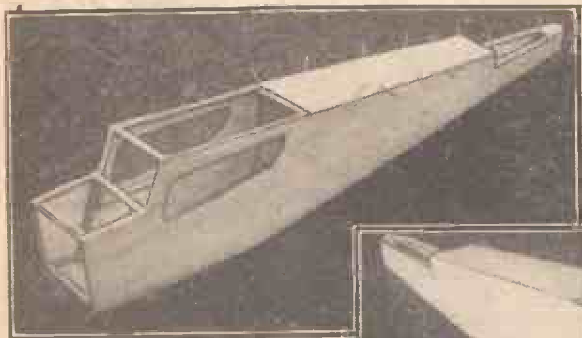


Fig. 7.—The two sides connected by balsa crosspieces top and bottom and covered with sheet balsa.

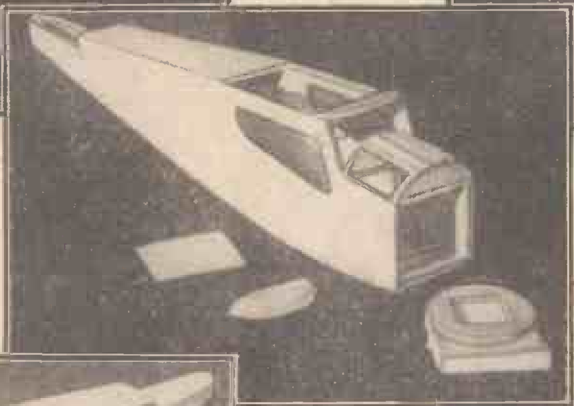


Fig. 8 (Right).—Front turtle decking partially planked in. Note the forward nose packing with its three-ply cut-out waiting to be attached to the fuselage.

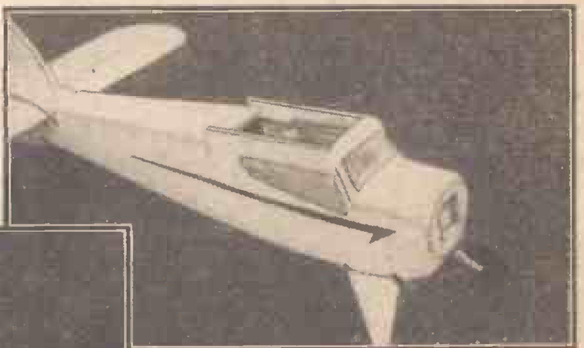


Fig. 10 (Right).—The fuselage is next covered with silk or paper. This photograph also shows the detachable tailplane and undercarriage held in position by rubber bands.

Fig. 9 (Left).—Turtle deck complete and three-ply cut-out in position. Wire retaining hooks have also been cemented in place.

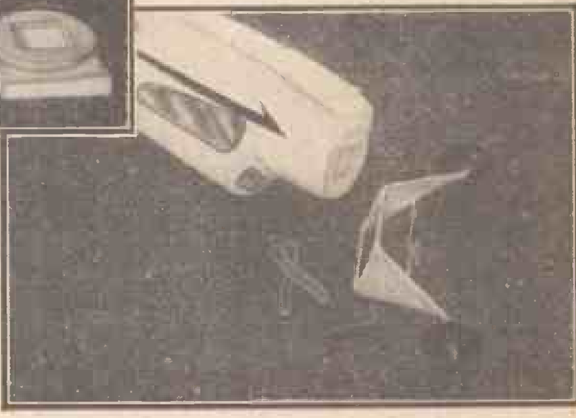


Fig. 11 (Right).—The undercarriage unit detached from the fuselage.

The Undercarriage

This is made from spring steel model wire, soldered at the overlapping joints, as shown in Fig. 4. The soldered joints are first bound with thin florist's wire, and have solder flux painted on. The undercarriage is a separate unit and, when complete, is held up to the fuselage bottom by elastic bands to hooks protruding from the bottom fuselage sides. Where the undercarriage bears up to the fuselage bottom, a small piece of three-ply wood should be added, or the nose and fuselage bottom here can have fibreglass added to prevent damage in hard landings.

In Figs. 8 and 9 it will be noted that a wing stop of balsa has been cemented on, and a forward celluloid window stuck in position. Two $\frac{1}{8}$in. platform sides are cemented on for the wing to rest upon and to allow the dihedral centre of the wing to sit slightly below the inside top of the fuselage which is left open at this point. On a radio controlled version access to the receiver would be through this open hatch below the wing. These two lengths of $\frac{1}{8}$in. sheet are pinned down and strengthened by plastic wood, because they take the wing loads in flight, and they also strengthen the only open part of the fuselage, namely below the wings. These two parts can be seen in Fig. 9. Fig. 10 shows the undercarriage in position, after the fuselage has been sanded down and covered with paper, thin silk or butter-muslin, over smeared on photopaste, and then given two coats of full-strength clear glider dope. The model can next be given white dope on the fuselage only, and lined in red. Use full-size glider tautening dope, as it makes a far stronger model, but if unobtainable, three or four coats of "full-strength" model dope will suffice. Do not use the thinner model dopes. Fig. 11 shows the undercarriage unit detached from the fuselage. The wire undercarriage has balsa sheet inserts cemented into the legs, covered with silk or butter-muslin and doped. The solid rubber streamline 2in. dia. (control line model) wheels are secured by wire bindings of florist wire stops, and soldered.

(To be concluded)

Mars

In November last year Mars was better placed for observation than at any other time until 1971. Mars made a favourable approach to the earth in 1956, but observations were hampered by a great yellow cloud, which obscured the planet's surface. The U.S. Navy is to make a study of Martian surface features by using a large telescope mounted on a balloon floating 80,000 feet above the earth's surface.

Astronomers around the world are adopting a new naming system for Martian features. Small details are to be known by their approximate longitudes and latitudes.

Sun Spot Activity

During the International Geophysical Year, from July 1st, 1957, to December 31st, 1958, the sun engaged in the greatest sun-spot activity ever recorded. On June 28th, 1957, the sun burst forth in a great solar flare. The IGY was able to witness brilliant displays of northern and southern lights made by particles flung into space from this eruption and which started arriving at the earth two days afterwards.

Robot Composed Music

In an experiment to prove that electronic brains can contribute to creative arts, a high speed digital computer at the University of Illinois composed an original four-movement piece of music.

Random integers (whole numbers, not fractions) are made the equivalent of notes, rhythmic beats, etc., for computer composition. These are fed into the machine after they have been worked over mathematically to express rules of composition. It was stated at a meeting that musical composition by robot is not an expression of the machine's soul but the extraction of order out of a chaotic environment!

THERMO-PLASTIC MANIPULATION

Bending, Forming, Shaping and Bonding to Other Materials

By W. Groome

Fig. 3 (Above).—Bending hot Perspex between layers of ply wood.

Fig. 4 (Left).—A curved shape produced by the method shown above.

THE ease with which Perspex sheet can be fashioned in the cold state is already well known. This article is concerned with the wider range of work, both functional and decorative, that becomes possible when this modern material is manipulated in the plastic condition. At a temperature a little over that of boiling water it becomes soft and limp, and can be formed into shapes that become permanent as it cools. This enables continuous forms to supersede many of the joints that would otherwise be necessary, bringing a pleasing range of modern design to replace the angularity of cold-worked products. The formers

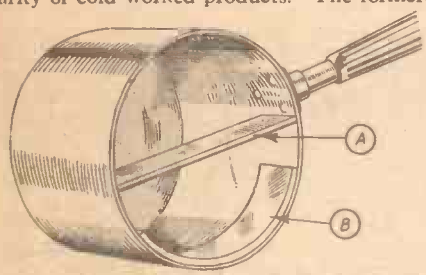


Fig. 1.—Forming curves with a saucepan.

that determine the shapes, and the methods of manipulation, are simpler than might be expected. It will also be shown that the difficulties of uniting Perspex with other substances can be overcome by exploiting its thermo-plastic properties.

Dry Heat

Despite suggestions that certain additives can raise the boiling temperature of water enough to soften the plastic, the writer strongly urges the use of dry heat. Hot water is unlikely to provide sufficient reserve of heat to prevent premature cooling during manipulation, yet adds unnecessary discomfort and danger to the work. In the event of a mishap a scald is generally more extensive than a dry burn. The domestic oven, with the thermostat turned to its lowest setting, softens the material quickly without impairing its glossy surface, and the process is no more hazardous than cooking.

Forming Curves

Curves are the basis of many interesting designs, and the more usual ones are merely portions of the circle such as arcs and quadrants. No special formers need to be made for these because there are so many circular metal articles already available in every household. Fig. 1 shows the simple procedure using, in this example, a saucepan. A strip of Perspex is rested across the inside of the saucepan (A) and they are put in the oven together. As the plastic softens it sags by its own weight and finally rests snugly against the wall of the former (B). The former is taken from the oven and, while still hot, the position of the plastic adjusted if necessary, using any conventional tool applied to excess ends so that marks will not be present after final trimming.

Fig. 2.—A hollow quadrant wall lamp.

As the heat is quite moderate, natural cooling is quick enough for most workers and brings no risk of disturbing the plastic before it hardens to permanent shape. Indirect cooling by water on the former will hasten the job, but if water is allowed to flow directly over the hot Perspex the surface may become rippled.

Shaping on the Inside of a Circular Former

This is a very convenient method, for the Perspex practically shapes itself; even the slight tendency to restraighten as it cools is in a direction that settles it more firmly in place. The longest straight strip that can be set across the inside is a little less than the diameter, limiting the curve to about one-third full circle. Longer strips can be heated and roughly preformed by hand to enable them to be accommodated in the former for curves approaching semi-circular. Beyond this the collapse of the plastic would be away from the wall of the former.

The range of curved work within the scope of this simple method is surprisingly large, for its working limits cover most of the curves likely to be needed in decorative articles. For example, the hollow quadrant wall lamp shown in Fig. 2 is of simple design, greatly enhanced by the beauty of amber Perspex, while the apparent absence of wiring in the transparent quadrant is an added novelty. The front and back curves were formed on two sizes of saucepan by the method just described.

Shaping on the Outside of a Circular Former

Curves greater than semi-circular must be

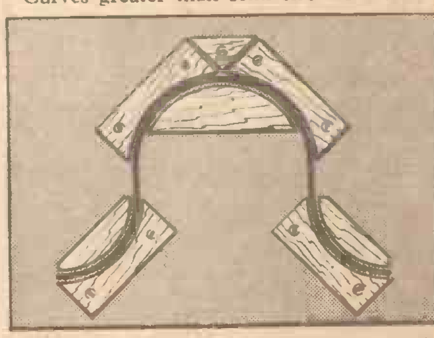


Fig. 5.—A plastic and plywood "sandwich."

shaped on the outside of the former and cannot be left to form in the oven. Therefore, heating and forming must become separate operations, as they must also for the other methods that are to be described. A smooth metal or enamel surface must be provided in the oven to avoid damage to the plastic. It is capable of remarkable recovery from pressure marks, for such depressions tend to fill out provided the cause is removed before cooling begins. Nevertheless, it is better to avoid damage of any kind. The former should be warmed to prevent chilling the Perspex to solidity before the work is completed. Manipulation is a simple matter of allowing the hot plastic to collapse on the outside of the former and then keeping its ends in place until it has cooled and hardened.

The need for smooth, unblemished surfaces on metal formers will be obvious; flaws will be transferred faithfully to the plastic, and the shiny finish shows them up very distinctly. Perspex is supplied with protective paper on both sides of the sheet and not only should this be stripped off but the gelatine with which it is attached must also be removed with warm water. The material must be thoroughly dry before it is heated.

There is probably no other material that allows so much liberty in the rectification of errors, for it can be reheated and re-formed many times before it becomes a total loss. If a curved piece is put back in the oven it will quickly revert to its normal flat condition and small dents and pits will fill out. It can then be re-formed. Apart from the correction of errors this characteristic enables the worker to practise and experiment without an expensive loss of material.

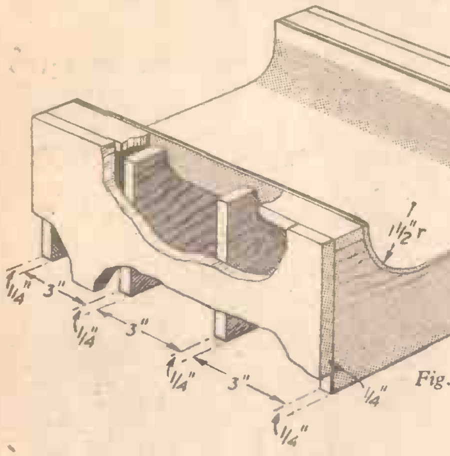


Fig. 6.—*A skeleton former.*

Formers

When elaborate shapes are contemplated, the time and labour spent in making formers must be kept in proportion; hours of work spent on accurate solid wood formers are ridiculously wasted when only a few plastic pieces are wanted. The answer to the craftsman's prayer, therefore, would be a quick and simple method adaptable to all requirements. Something approaching this ideal is used in making hollow plastic letters for illuminated advertisement signs. As the thirty-odd letters and numerals can be multiplied by the considerable number of styles from quaint to contemporary the method is clearly able to provide a great variety of shapes.

The idea, demonstrated in its simplest form in Fig. 3, is based on the fact that three-ply wood can be easily flexed into curves without buckling or collapse. If hot Perspex is laid between two strips of three-ply the complete sandwich can be bent as shown in the photograph; the limp plastic, controlled and supported, will conform with the shape set by the outer layers. As plywood does not readily conduct heat the plastic is not chilled and there is ample time for manipulation, while the operator works without discomfort.

Smooth contact surfaces are essential; if the plywood still tends to transfer grain marks even after careful cleaning up, glossy paper, sold by the art suppliers, can be interposed in the sandwich. During bending the grip must allow the necessary slight amount of independent "slide" between layers so that each can adopt its correct position without parting from the snug contact required for control. For easy bending the plywood should be cut with the grain of the outer ply crossing the strip, not running lengthways.

With a little practice quite intricate shapes can be produced by manipulation entirely by hand, working to guide-lines on paper placed on the bench, or merely by judgment for some purposes. Fig. 4 shows the curve produced at the time the photograph of Fig. 3 was taken. Pegs or screws set in the bench-top or to a board can help by acting as stops to set the limits and changes of direction in the curve.

Simple Jigs

For accuracy, for repetition work, or for jobs too difficult to manipulate entirely by hand the sandwich can be bent to a simple jig comprising wood blocks, pegs, screws or clamps (or combinations of these) on a baseboard. Fig. 5 is an example in which fixed blocks set the outer shape of the sandwich while loose blocks are pressed to the inner sides by means of C-clamps. The clamps have been omitted from the diagram, but their use will be obvious. The sandwich, comprising the plastic and two strips of three-ply, is indicated by a heavy black outline. The use of three pieces of wood instead of one for the larger bend is merely to eliminate the labour and wastage of cutting from a single block.

The sandwich containing the hot plastic should, wherever possible, be secured first somewhere about the mid-point of the shape, in the example of Fig. 5 to the semi-circular portion. The loose block, it will be noticed, is not complete for that portion of the bend, but the springiness of the plywood takes care of the portions not clamped. After the other clamps have been adjusted the job is left to cool. Clamping should be light—just sufficient to retain the work in position; heavy pressure will cause marks on the plastic.

Skeleton Formers

The sandwich-and-jig method is suitable for strips up to about 3in. wide, perhaps more, but for very wide jobs a special former may be essential. The laborious shaping of solid wood can be dismissed as impracticable and expensive, for greater accuracy is obtainable at a fraction of the cost by making a "skeleton" former as shown in Fig. 6. The shape is determined by the vertical ribs, of which four are shown in the drawing. It is obviously easier to make a few of these to identical shape than to carve a solid block with sufficient accuracy. The shaped ribs, made of ½in. plywood for strength and easy working, are assembled with end and top strips to form a rigid skeleton to which the working surface of flexible three-ply is pinned and glued.

Work with the former shown in Fig. 6 would be aided by the collapse of the plastic, as in the case of the ready-made circular one. Although some shapes may need some hand manipulation with this simple type it is worth while to avoid complicating the former.

The methods described cover most practical requirements and it is not intended to deal with the complexities of top and bottom matching formers that are rarely needed.

Bonding to Other Materials

Although Perspex-to-Perspex joints can be made to reach the perfection of welds the plastic does not bond with other materials with which it could be usefully combined for technical or economic reasons. When the impracticable suggestions have been ruled out only metal-thread screws and self-threading screws can be considered as efficient cold fastenings, but thermo-plastic properties can be exploited for the purpose. As an experiment, grip a panel-pin with the pliers, heat it in a gas flame and press it into a cold piece of Perspex. On cooling the pin will be found to be immovable. This is more than a simple tight fit. The Perspex, softened locally by the hot pin, squeezes closely into every imperfection and irregularity of the metal, giving a mechanical lock that cannot be broken without destructive violence or, of course, reheating. The pin has become an "insert" comparable with the embedded metal parts in Bakelite mouldings. Developments of this idea can solve most of the problems of using Perspex in partnership with other materials.

Using Screws

Metal-thread screws make useful inserts because they can be arranged with sufficient thread exposed for the attachment of other parts with the usual nuts, with the advantage that they cannot loosen as in tapped holes. The portion just under the head that will be embedded can be slightly mutilated to improve keying, although generally the plastic holds firmly enough on existing imperfections in the thread. Simply press the hot screw into an undersize hole made with a tapping size drill, so that the thread emerges on the side on which the nut attachment is to be made. The writer uses B.A. screws, numbers 4, 6 and 8, which are standard for electrical and radio work and convenient for models, toys and gadgets. Where the screw must be removable a threaded hole can be formed without tapping by a slight variation in method. Drill to tapping size and plunge the hot screw into the hole as before, but keep it rotating about a quarter turn each way until cold to prevent the plastic from binding.

The use of screws as just described still leaves the attachment of the other parts by nuts as separate operations. A more direct

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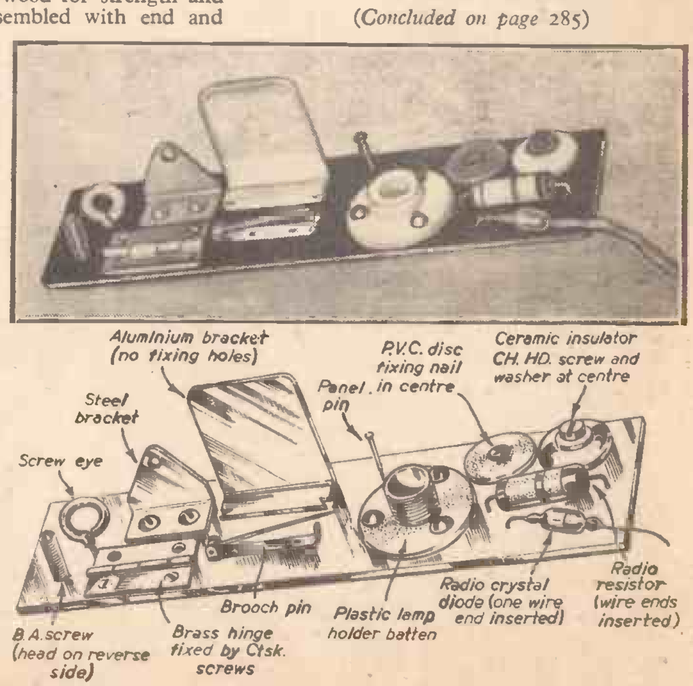


Fig. 7.—*Collection of articles firmly anchored by heat.*

Electrical Installation Layout

Wire Your House Safely and Legally

By J. L. Watts

WHEN planning a domestic wiring system, or an extension to an existing system, it should be designed so that it is adequate for the required purpose, and so that there is no risk of fire or electrical shock in the event of a fault. The wiring and fittings must be installed in accordance with the requirements of the local Electricity Supply Authority, which are normally based on The Electricity Supply Regulations; and on the Regulations for the Electrical Equipment of Buildings, issued by the Institution of Electrical Engineers. The Supply Authority should be notified when the installation is completed and ready for inspection.

The Electricity Supply Regulations briefly require that the Supply Authority shall not provide or maintain, a supply of electricity to domestic premises unless: (1) The insulation resistance of the insulation is sufficiently high that the leakage current is no more than $\frac{1}{10{,}000}$ part of the maximum current to be supplied. Insulation resistance is measured by means of an insulation test set, such as a "Megger" In order to comply with this requirement the insulation resistance between earth and the conductors connected to the "live" pole, and also between conductors connected to the two poles, shall not be less than $\frac{10{,}000\ V}{C}$ ohms, or $\frac{V}{100\ C}$ megohms, where V is the nominal supply voltage, and C is the maximum current in amps. This means that no supply can be given to a 240 volt installation if the insulation resistance is less than 0.16 megohm for a 15 amp. installation, 0.08 megohm for a 30 amp. installation, or 0.04 megohm for a 60 amp. installation. In practice much higher insulation resistances are desirable, and are usually obtained.

(2) All conductors and apparatus are of sufficient size and are constructed, installed and protected so as to prevent danger.

(3) All single-pole switches are connected in "live" conductors only.

(4) Fuses or circuit breakers of adequate design are used to protect all the circuits.

(5) Efficient switches in readily accessible positions are fitted to control all motors.

In the case of a supply of higher voltage than 250 volts there are additional requirements, but these do not apply to the low-voltage supply provided for the normal household.

The Regulations for The Electrical Equipment of Buildings (the I.E.E. Wiring Rules), issued by the Institution of Electrical Engineers, of Savoy Place, Victoria Embankment, London, W.C.2 (price 6/-, post free), cover the whole field of electrical wiring and give detailed information regarding planning and execution of first-class installations. Persons engaging in such work are advised to obtain a copy. In the case of premises in which articles are made, finished, altered, etc., or are adapted for sale by way of trade, etc., the provisions of the Electricity Regulations of the Factory and Workshops Act may also apply. In addition to the general regulations for electrical installations, premises subject to the Factories Act have special requirements for motors and transformers, etc. Also, only authorised or competent persons may carry out electrical work on installations which come under the Factories Act; whilst, if the work requires technical knowledge in order to prevent danger, no person under 21 must carry out the work and no one must do the work unaccompanied.

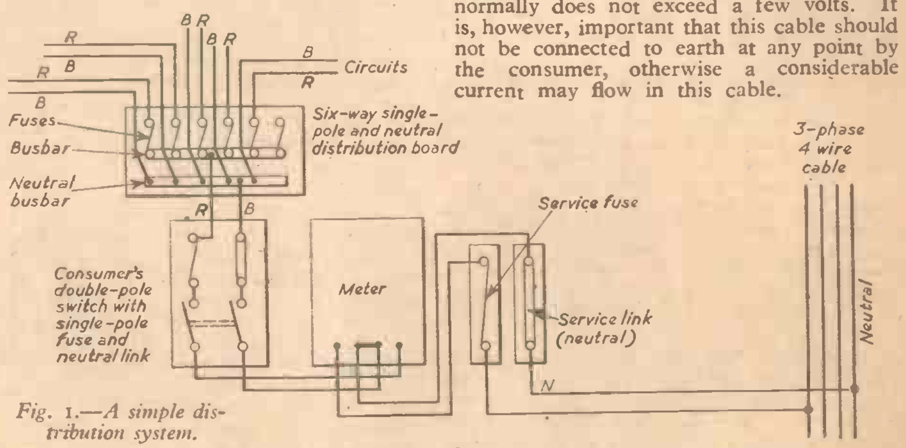


Fig. 1.—A simple distribution system.

Connections of Fuses and Single-pole Switches

The supply to a domestic installation is usually a two-wire supply. It may be either direct current (D.C.) or single-phase alternating current (A.C.). If the supply is D.C. is it most likely that it will eventually be changed over to A.C. and, before investing in a considerable amount of D.C. apparatus, the consumer should ascertain, from the Supply Authority, who is to bear the cost of replacing or converting the apparatus when the supply is changed to A.C. Fortunately, most domestic electrical apparatus, such as filament lamps, fires, water heaters, electric irons and vacuum cleaners will operate on either D.C. or A.C. of the same voltage. Eventually single-phase A.C. voltages in this country will be standardised at a nominal value of 240 volts at a frequency of 50 cycles per second. However, the voltage at the consumer's terminals may vary plus or minus 6 per cent. of the declared value, depending on the load conditions.

One pole of the supply to domestic premises is usually connected to a neutral cable of the distribution system, as shown in Figs. 1, 2 and 3, this cable being connected to earth at the generating station or transformer. The voltage between this neutral conductor and earth, or points connected to earth such as a water pipe, normally does not exceed a few volts. It is, however, important that this cable should not be connected to earth at any point by the consumer, otherwise a considerable current may flow in this cable.

If the neutral cable should become interrupted in any way it may reach a considerable voltage from the "live" cable. For this reason the I.E.E. Regulations require that no fuse shall be connected in the neutral cable. Furthermore, no switch should be connected in this cable except when the switch as a double-pole switch so arranged that the "live" pole is interrupted at the same time as the neutral pole. Although no fuse may be connected in the neutral cable a connecting link can be connected in this cable in the incoming service boxes from the mains and in the consumer's main double-pole switch and fuse box. If the neutral is *not* permanently earthed fuses may

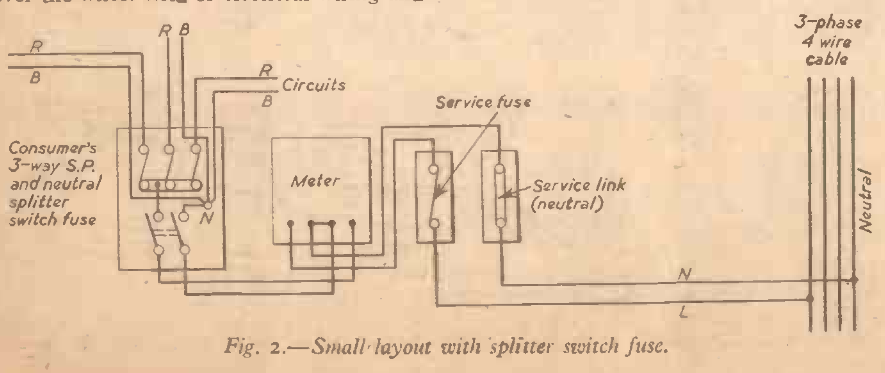


Fig. 2.—Small layout with splitter switch fuse.

be connected in this cable but, in any case, all single-pole switches used in an installation should be connected in the same pole throughout.

Main Switch and Distribution Gear

The service boxes, which are provided and sealed by the Supply Authority, contain a fuse in the "live" pole, the purpose of which is to cut off the supply to the premises in the event of excessive current flowing in the supply cable, due to failure of insulation on the consumer's wiring or otherwise. In the event of this fuse melting the Supply Authority should be notified so that the fuse can be replaced. The service boxes are connected to the meter, or meters, from which cables are fed to the consumer's main switch or main switches.

The purpose of the consumer's main switch is to enable the installation to be isolated from the supply when required for testing or otherwise. This main switch may be connected to the consumer's main fuse, which may be combined in the switch as shown in Fig. 1; the function of this fuse is to cut off the supply in the event of a fault, particularly due to excess current resulting from failure of insulation of the cables between this fuse and the distribution fuse board, if such a board is fitted. In some cases the consumer's main fuse may be omitted. For instance the Supply Authority may consent to allow their service fuse to act also as the consumer's fuse. In other cases, where the total load is not more than 60 amps., the consumer's main switch may be a splitter switch fuse, i.e., a main switch which is combined with a distribution fuse board with fuses for up to eight circuits, each rated at not more than 30 amps. See Fig. 2.

Domestic consumers' control units are also being fitted for domestic premises connected to A.C. supplies. These units provide accommodation for the Supply Authority's service boxes and meter, and consist of a case which also contains a 60 amp. double-pole switch with neutral busbar and several circuit fuses; an earthing bar being provided. A 30 amp. fuse may be provided for a cooker, with one or more 30 amp. fuses for wash boiler, water heater and socket outlet circuits fed from a ring circuit. Two or more 5 amp. fuses are fitted for lighting circuits. These units are obtainable, if required, for flush mounting into a 4½in. brick wall.

In an extensive installation there may be additional distribution fuse boards fitted in convenient positions in the premises, each fuse board being fed either from the main switch or a separate way on the main distribution fuse board of higher rating (see Fig. 3). Alternatively, the busbars of two or more distribution fuse boards may be looped together to form a ring circuit, in which case fuses or disconnecting links may be inserted in the connecting circuits between the busbars. In many installations the wiring is divided into two sections, one for lighting and the other for heating circuits, each with separate main switch and meter as shown in Fig. 3. Figs. 1 to 3 inclusive show the correct colours of the cables, red (R) conductors being connected to the "live" pole, whilst black (B) conductors are to be connected to the neutral pole. All single-pole switches or fuses should be connected in the R conductors, none should be connected in the B conductors.

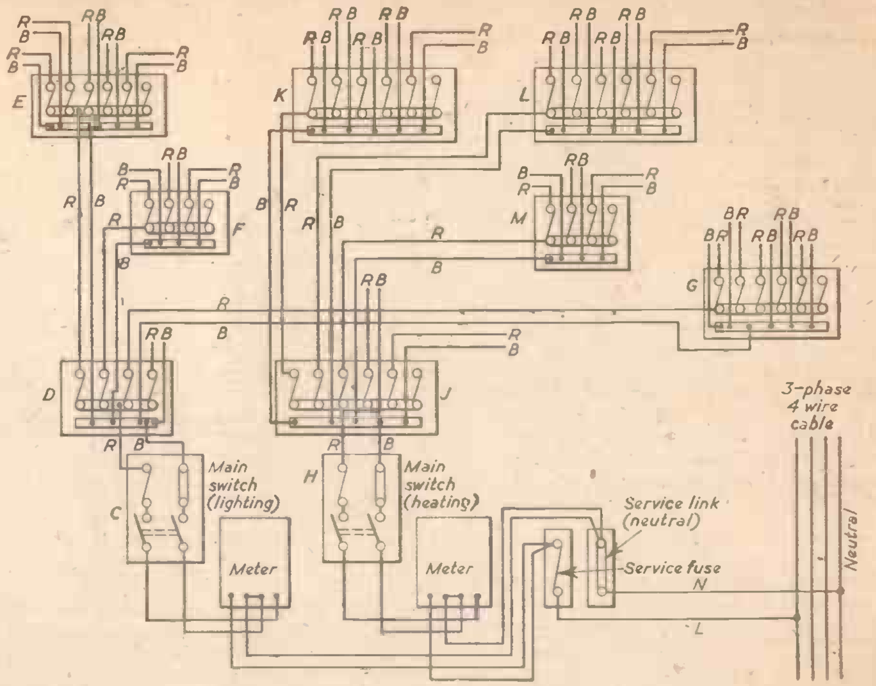


Fig. 3.—Large power and lighting distribution system.

Final Sub-circuits

A final sub-circuit is a circuit which is connected to points at which the current is used, i.e., the lampholders and switches or the socket outlets. Each final sub-circuit, rated up to 15 amps., must be fed from a fuse of a distribution fuse board, except in the case of a small consumer, where there is only one such sub-circuit, it may be connected to the main fuse. A final sub-circuit, rated at not more than 15 amps. may supply any number of points, provided that the total current rating of the points does not exceed the current rating of the cable, that there is at least one final sub-circuit for fixed lighting alone per 1,000 sq. ft. of floor area, and that flexible cords are fully protected. It is, however, an advantage to have not more than about 10 lighting points on each final sub-circuit, in order to facilitate testing and to limit the number of points which are rendered inoperative when a fuse melts. Lighting circuits are commonly fed from 5 amp. fuses with cables rated at 5 amps. Three 5 amp. socket outlets may be wired on a 15 amp. circuit.

Each final sub-circuit having a rating over 15 amps. may supply one point only; or, if the conductors are rated for 20 amps. (7/.029) and the circuit is protected by a fuse rated for not more than 20 amps., it may feed two 13 amp. socket outlets. See Fig. 4, a and b. If a final sub-circuit is wired with 7/.036 cable and is protected by a fuse rated at not more than 30 amps., it may supply not more than six 13 amp. socket outlets as shown in Fig. 4c. However, six socket outlets should not be used at the same time if the total load exceeds 30 amps.

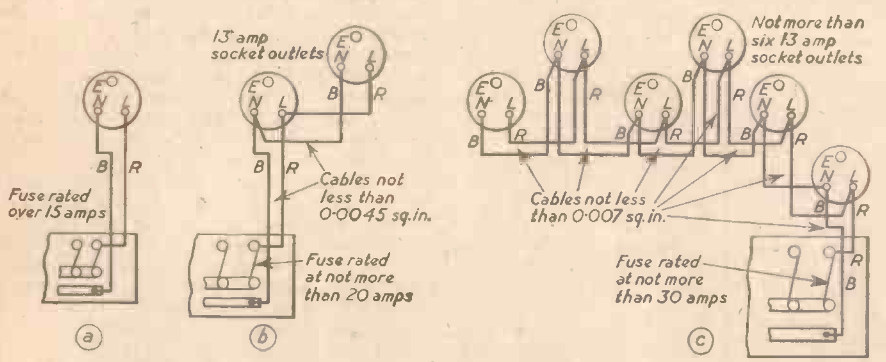


Fig. 4.—Permissible arrangements for sub-circuits rated at more than 15 amps.

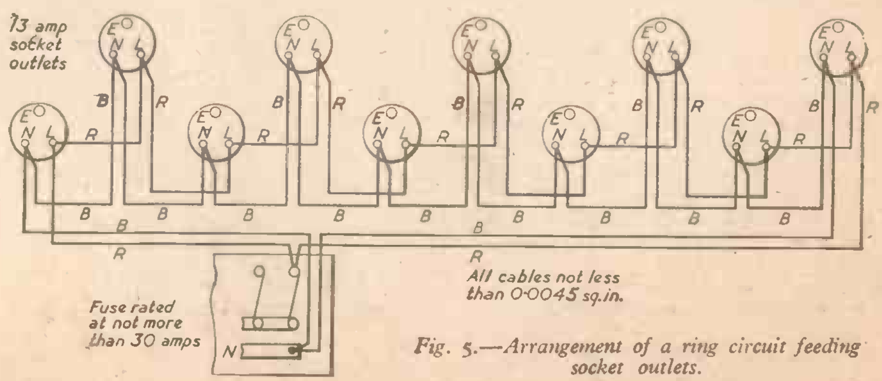


Fig. 5.—Arrangement of a ring circuit feeding socket outlets.

Ring Circuits

If a final sub-circuit is wired with 7/.029 cable in the form of a ring, both ends of which are connected to the fuse rated at not more than 30 amps. as shown in Fig. 5, it may serve up to ten 13 amp. socket outlets, or an unlimited number of such socket outlets in the case of domestic premises or flats having a floor area of not more than 1,000 sq. ft. One or more such socket outlets may be connected to this ring main at various points by means of branch cables not less than 7/.029 as shown in Fig. 6, provided that the permissible number of socket outlets is not thereby increased, and not more than 50 per cent. of the socket outlets are fed from such branch cables. Of course, the total load must not exceed 30 amps, and not more than two 13-amp. socket outlets may be fed from any one branch cable. A fixed appliance of rating not exceeding 13 amps. may be fed from a fused plug or a local fuse. Where there is a limiting number of socket outlets permitted, the number of socket outlets should be reduced by one for each fixed appliance so connected to the circuit. When planning an installation it is wise to allow for one or two spare final sub-circuits in the distribution fuse boards, as extra appliances may be required to be connected up at some later date.

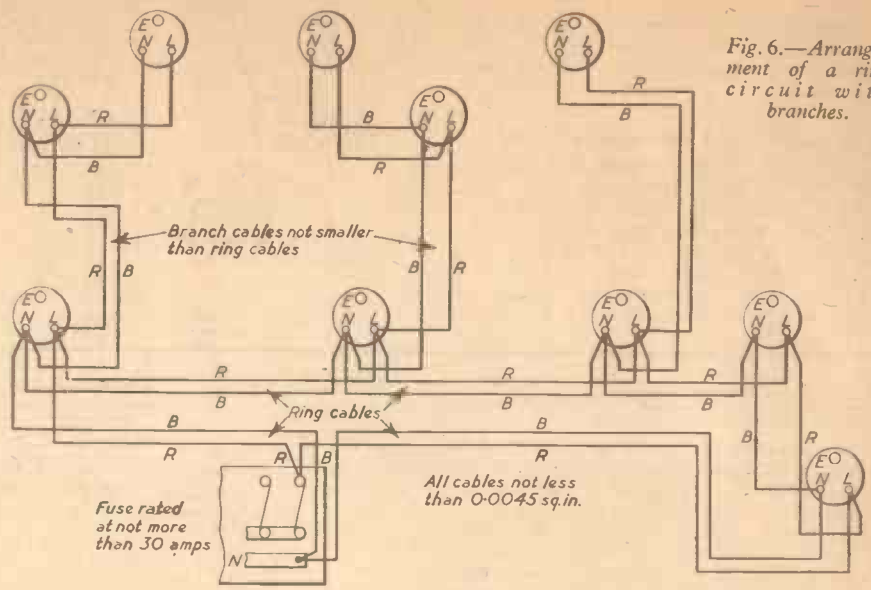


Fig. 6.—Arrangement of a ring circuit with branches.

Size of Cables

It is important that the conductors used at each point of an installation should be large enough for the required purpose. If the conductors are too small they may overheat, in which case the insulation may become perished and brittle so that its life is reduced and an early failure may occur; if a cable is seriously overloaded there may be a risk of fire. In addition, if the cables are small there will be loss of voltage and power, which will tend to reduce the light of lamps, etc. The size of cable should be such that the voltage drop from the consumer's terminals to any lighting point on the installation does not exceed one volt plus two per cent. of the declared voltage, i.e., so that the volt drop on the lighting circuit does not exceed 5.8 volts on a domestic lighting supply connected to a 240 volt supply. The volt drop on cables supplying a motor circuit should not exceed 7.5 per cent. of the declared voltage on full load.

TABLE I. CURRENT RATING AND VOLT DROP FOR SINGLE-CORE V.R.I., P.V.C., T.R.S., OR LEAD-SHEATHED CABLES ON SINGLE-PHASE A.C.

Size of Conductor		Cables in conduit or bunched Maximum length of cable run for 1 volt drop			
Number and diameter of wires	Area (square inches)	2 cables		4 cables	
		amps.	feet	amps.	feet
1/.044	0.0015	5	16	5	16
3/.029	0.002	10	10	10	10
3/.036	0.003	15	11	13	12
7/.029	0.0045	20	12	15	16
7/.036	0.007	28	13	22	17
7/.044	0.01	36	16	29	20
7/.052	0.0145	43	18	34	23
7/.064	0.0225	53	23	42	29
19/.044	0.03	62	25	50	31
19/.052	0.04	74	29	59	36

On many installations it happens that the length of cables required is such that, even if the cable is large enough to carry the current without overheating, the volt drop on the cable may nevertheless be excessive. On long cable runs volt drop considerations may, therefore, require the use of larger cables than do considerations of cable heating alone.

When current is passed through a cable its temperature rises gradually, heat being dissipated from the cable at an increasing rate as the temperature of the cable rises, until a certain temperature is reached at which heat is being dissipated from the cable at the same rate as it is generated. It will be noted from Table 1 that the current rating of a given size of cable is reduced somewhat when an increased number of cables are bunched together or are contained in the same conduit. This allows for the fact that there is a reduced rate of heat dissipation from bunched cables. Table 1 shows that, for a maximum volt drop of 5.8 volts, two 1/.044 V.R.I. or P.V.C. sheathed cables will carry 5 amps. up to a total length of cable run of 93ft.; 3/.029 cable will carry 10 amps. up to 58ft. Similarly two bunched 3/.036 cables will carry 15 amps. up to 64ft., whilst two bunched 7/.029 cables will carry 20 amps. up to 70ft. On longer cable runs larger cables should be used for the same current rating if lights or heaters, etc., are to be supplied.

Fuses

It is important that each cable and flexible cord be protected by a fuse having a rating not greater than that of the cable or flexible cord. The fuse may be fitted in a distribution fuse board, or may be a cartridge fuse in a plug. Table 2 shows suggested sizes of fuse wires. It is important that a cartridge fuse should not be replaced by a piece of fuse wire, as the cartridge is designed to interrupt fault current in a confined space, and to prevent the spread of conducting vapour which might otherwise result in an extensive short circuit. The use of fused plugs to supply appliances has the advantage that it enables economies to be effected in cable costs where a large number of appliances are to be supplied in a small area, and it ensures proper protection of the appliances irrespective of the socket outlet with which they are used.

The fuses in the distribution fuse boards are intended to cut off the current in the event of a fault in the sub-circuits, or in the supplied apparatus. If larger fuses are fitted they may fail to melt if a fault occurs, in which case one of the fuses in the main distribution fuse board or the main fuses may melt and cut off a large part of the installation. If the consumer's main fuse is too large the Supply Authority's main fuse may be melted, necessitating calling in the Authority to renew the fuse. In any case the main fuses will not provide the same degree of protection to the final sub-circuits as should the sub-circuit fuses. If fuse wires are too small, they may overheat on normal load, often causing premature melting. Cartridge fuses are preferable to rewireable fuses, since they are reliable and easy to distinguish.

TABLE 2.—SIZES OF FUSES FOR VARIOUS CABLES.

Rating of fuse (amps.)	Size of tin-lead fuse wire (s.w.g.)	Size of tinned-copper fuse wire (s.w.g.)	Minimum size of cable (sq. in.)	Minimum size of flexible cord
3	23	38	0.0015	23/.0076
5	21	35	0.0015	23/.0076
10	—	29	0.002	40/.0076
15	—	25	0.003	70/.0076
30	—	21	0.01	—
60	—	17	0.03	—

GETTING IT SHARP

Some Notes on Focusing For the Photographer

By J. B. Knight

THE question of correct focusing is important since errors leading to unsharpness in the negative cannot be offset in the print. Within reasonable limits quite passable pictures can be made from negatives which suffer from under or over exposure but an out-of-focus negative is useless.

The question of whether a picture should be sharp all over or not is dependent upon the subject matter or indeed upon personal taste, the photographer's aim being usually to ensure that the principal subject matter is really crisp with the less important and perhaps ugly background actually out of focus. An example of this is a portrait or figure study where a sharply detailed background would obtrude, detracting interest from the figure. Using a long focus lens this same effect is even more finely controlled to produce an effective "head" in which

Fig. 1.—"Portrait of Margaret."

the sharpest focus is on the eyes, the focus then falling away until the ear, though defined, is soft. In Fig. 1, despite the use of a wide aperture (f/3.5) the depth is more than was considered desirable, in that the curtains are still too well defined and the near shoulder too sharp. The extra prominence of this shoulder is due to the use of a short focus lens at close range. Alternatively, of course, all over sharp definition may be required.

Control

The desired effect is obtained by use of what is called depth of field and this is simply the depth of subject matter which a lens can render acceptably sharp at a given aperture and distance focused upon.

For example, you are shooting a standing figure at 10ft. from the camera, which is a miniature with a 5 cm. lens (2in. or 5 centimetres focal length). The distance is measured, the focusing scale is set at 10ft. and the exposure required is found to be 1/100 sec. at f/8. If the shot is now made, an examination of the print will reveal that in addition to the figure, the acceptably sharp detail in the picture extends from a point in front of the figure to a farther point some greater distance behind it. This is the depth of field and based on the above conditions would be in the order of 3ft. 3in. in front of the figure and 9ft. 3in. behind it; a depth of 12ft. 6in.

If a second shot is taken, this time using f/5.6, it will be found that the depth is less, actually only 7ft. 8in. At f/3.5 it goes down to 4ft. 5in. and at the other end of the scale a depth of 245ft. would result from employing f/16.

It will be seen that a large lens aperture produces a small depth of field and a small stop (high f number) increases this depth.

For the same lens and given stop (f number) the depth alters with the distance focused upon, as shown below:

For 2in. lens

f No.	Distance	Depth
f/8	10ft.	12ft. 6in.
f/8	5ft.	6ft. 6in.
f/8	3ft.	10½in.

The depth increases then as the distance focused upon becomes greater. The box camera with its fixed aperture of about f/14 renders everything acceptably sharp provided nothing in the subject matter is nearer to it than about 6-8ft.

Change of Focal Length

The focal length of a 35 mm. camera is about 2in. and this compares with the 4¼in. lens of the 120/620 rollfilm camera and the 3½in. lens or thereabouts used in the usual twin-lens reflex and "12 on" instruments.

To show how depth of focus becomes progressively less as focal lengths increase the following lenses are considered to be focused on 10ft. and stopped down to f/8.

Focal length	Depth of focus
2in.	12ft. 6in.
6in.	3ft. 3½in.
10in.	1ft. 11in.

Greater care has to be given to accurate focusing in the case of the very much longer lens.

Use of Depth of Field in Practice

The foregoing indicates the way in which the depth of field varies for different lenses and varying conditions of camera/subject distances and f number.

In practice the photographer is assisted by the modern camera manufacturer to utilise the depth characteristics appropriate to his particular instrument by the scales engraved on and adjacent to the lens mount.

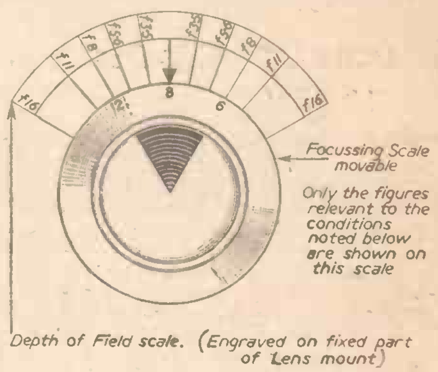


Fig. 2.—An example of depth of field scale.

The depth of field indicator is engraved on the fixed part of the lens mount or, in a reflex camera, on the body around the focusing knob (see Fig. 2). In operation the depth of field which will be obtained at a given aperture is shown by the indicator after the camera/subject distance has been set on the focusing scale.

The extent of the field is indicated by the distances subtended by the aperture numbers

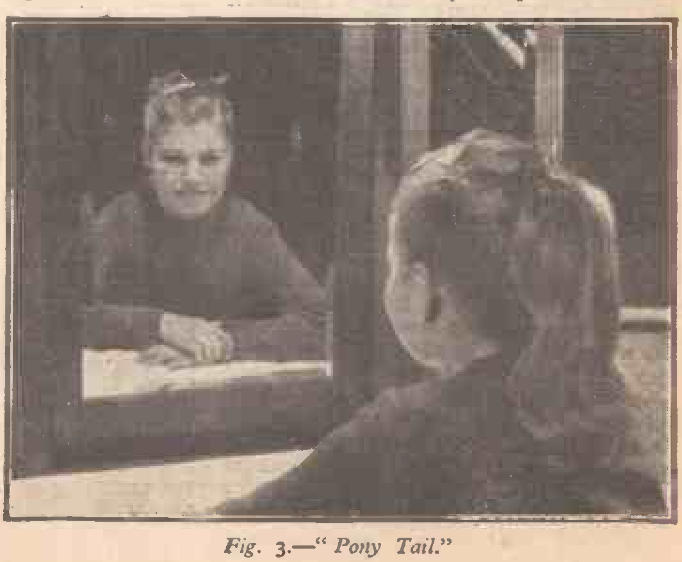


Fig. 3.—"Pony Tail."

engraved on either side of the setting mark on the depth of field scale (see heading photo).

Fig. 2 shows how this appears when a 2in. lens is set at 8ft. and at an aperture of f/8. and Fig. 4 shows an actual photograph under these conditions. A larger stop would have further softened the background as would the 4½in. lens of a 120 camera at the same aperture.

Snapshooting

One or two special marks, say, a triangle and a circle are often engraved on the focusing scale to be used in accordance with the instruction manual for the camera.

In the case of a moderately priced miniature instrument (2in. lens) setting the first of the special marks on the scale would result in an acceptably sharp depth ranging from 8ft. to 18ft., the second mark giving depth from 15ft. to infinity. In both instances the aperture would have to be f/5.6.

Speed of Operation

Even a coupled rangefinder can be ignored for snapshooting with terrific advantage in speed of operation simply by committing to memory the appropriate zone focusing information. Many a promising shot is lost while fiddling with a rangefinder. A camera should always be carried at the ready with the lens set at one of the snapshooting settings and an aperture of f/5.6 or smaller.

Acceptably Sharp

It is necessary here perhaps to point out the reason for the use of the expression "acceptably sharp" in reference to the various depths of focus discussed. It is simply this. That part of a picture which one can expect to be "pin sharp" is the plane on which the lens is focused. Throughout the depth of focus region behind and in front of the plane in sharp focus, the definition will be falling off gradually, but in comparison with planes outside these limits it will be "acceptably sharp."

Fig. 4.—"Girl by the Water."

Fig. 3 is an interesting example. The figure is only about 3ft. from the camera with the mirror 5ft. distant. Camera subject distance was about 7ft. so far as the mirror was concerned. The depth of subject was therefore about 4ft. Distance focused upon was about 4ft. 6in., the exposure was ½ sec. at f/16 with a 2in. lens.

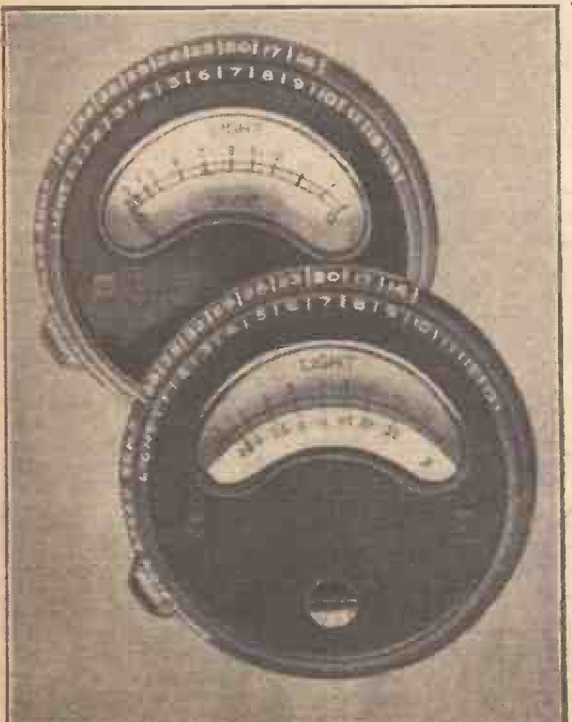
DIRECT READING SCALE FOR EXPOSURE METERS

By F. G. RAYER

THE "light value" scale fitted to some new cameras and meters allows shutter speed and aperture to be set immediately, and to remain interlocked at the correct exposure. For quick and simple operation, an extra scale can be added to the older type of exposure meter, and it will provide direct aperture settings for the usual camera without light value scale. The benefit of interlocked aperture and speeds is not, of course, present. But against this is the advantage that the meter can always be used in the normal way, for exceptional conditions not covered by the new scale.

The unmodified meter is shown in the photograph and operates in the same manner as many popular meters. That is, the light value is read and set against the film speed when apertures and shutter speeds can be read off on the reverse side. Setting the light value against the film speed requires the use of both hands, and is the intermediate step which is eliminated by the new aperture scale.

With a particular film and shutter speed a reading on the meter scale of 4 would require an aperture of f/2.8; 5 would require f/4; 6 would indicate f/5.6, and so on. It is thus possible to mark out a new scale, as shown in the photograph. It is then only necessary to direct the meter at the subject in the usual way, and set the camera aperture to the f-number indicated by the meter pointer. There is no intermediate stage requiring the use of two hands.



An unmodified meter (above) and meter with new scale added.

Choosing the Scale

The correct positions for the markings on the new scale are found by manipulation of the meter itself in the usual way, and they are chosen to suit the film generally employed. A good general purpose shutter speed is also selected, and apertures larger than those actually present on the camera are omitted. In the modified meter shown, calibration is for 34 deg. Sch. film, with 1/100th sec., i.e., from f/2.8 to f/32. The markings also apply for a 31 deg. Sch. film, with 1/50th second, or 28 deg. Sch. film, with 1/25th second.

In use the shutter speed is set to suit the film and not modified unless circumstances require. To take a shot it is only necessary to transfer the pointer reading to the camera aperture scale. If the new scale is suitably chosen, as explained, almost all readings will fall within the f/5.6 to f/22 range, when the meter is in use outdoors.

For interiors or poor light requiring longer exposures, the meter is used as before, the new scale being ignored. This also applies when small apertures a e wanted to secure great depth of field, or when very brief exposures, to arrest rapid movement, are desired.

Calibrating in Shutter Speeds

It will be observed that the new scale could be calibrated directly in shutter speeds, for a set aperture. This is a good method for a camera with eight-speed shutter, but not for simpler models with only three or four speeds. If a spee.' scale is used, it is marked for a useful average aperture such as f/8. The meter itself, manipulated in the usual way, will indicate where the various speed markings should lie.

To avoid opening the meter the new scale may be marked upon a narrow strip of thin paper lightly glued to the glass above the pointer. Its shape, size and best position will depend on the type of instrument.

BOOKS Received

Laboratory Distillation Practice. By E. A. Coulson, M.A., D.Sc. and E. F. G. Herington, D.Sc., A.R.C.S. 165 pages. Price 25s. net. Published by Geo. Newnes Ltd., Tower House, Southampton Street, London, W.C.2.

DISTILLATION is one of the basic laboratory processes, but is a technique which has, during the past 25 years, undergone extensive development. The aims of this book are, therefore, to provide the laboratory technician with some help in selecting the most suitable apparatus, to present the irreducible minimum of theoretical knowledge necessary, to describe the construction of a selected nge of equipment and to offer guidance on the application of distillation theory to batch operations. Special aspects of distillation are covered by separate chapters and the book is illustrated throughout with line drawings. An index is included.

Letters to the Editor

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

MAN-POWERED FLIGHT

SIR,—In your January issue I think your paragraph on "Man-powered Flight" in Fair Comment deserves looking into. You say "cross-country flight is out of the question." I strongly believe it is possible if you go about it in the right manner. If, for instance, the man who flew 200 yards in 20 seconds were to be a trained glider pilot with hill-soaring experience he would not have to travel more than a tenth of that distance to find strong upcurrents on the hill. From there he could attain more height for a normal cross-country flight which as you know can run to hundreds of miles. A check on gliding records would astound a large number of your readers.

Heights of over 40,000ft. have been attained and are not the maximum as they (or some of them) were limited because the pilots were not pressurised. I believe a pressurised glider is being built for heights of up to 60,000ft., which is said to be possible in a glider.

Ex-world champion Mr. Phillip Wills, O.B.E., actually climbed from something around 500ft. to close on 30,000ft., and if a cross-country cannot be done in a straight glide from that height, then I and thousands of gliding types are wasting our time.

You suggest a team of 15 people, but I say eight would get one airborne. There have been stories in the gliding world where *two* men lifted a glider on their shoulders into the hill lift. Also a German, a Dr. Horten I believe, designed a tailless glider where the pilot's legs were used for the take-off and landing.

Furthermore, what little assistance man-power can be, may be just the *edge* needed to stay in a thermal long enough to have better effect; many a glider pilot could have gone miles farther if he could have "flapped" or gained just a few valuable feet at a vital moment, especially if his strength could be wound up like a clock spring when he has easy minutes at good height and then be released at a determined time. Your basic, and I maintain only point, stands when "still or stable air conditions are present," everyone knows what our weather is like, however.—D. SPEED (Chester).

[*We were not referring to gliding but to man-powered flight not dependent on wind direction.*—ED.]

VELOCITY OF LIGHT

SIR,—Thos. H. Webster's comments in the January issue on the nature of light seem to me very fitting.

We are, indeed, asked to believe in waves without any medium in which they may exist.

One fact that is never mentioned in science is that all matter is characterised by the existence of boundaries without which nothing can be called physical. How then can we accept light as a wave in nothing, composed of nothing?

For any wave motion a particle medium is required or a wave system of particles arranged as a compression wave, so without particles to carry or act as waves it is difficult to see how light can be a wave motion.

Light has substance, it is energy, it can act as a wave and still exhibit the properties of a particle. All of these add up to bounded units or particles, which is confirmed by radiation effects, reflection, etc., and by the photo-electric exchanges of waves and particles.

Objections to the particle being ultimate have been based on interference and other optical phenomena which confirm the wave arrangement but which, it is said, cannot be explained by particles. This is not so.

By arrangement of the particles into waves none of these objections is valid, for all these phenomena can be accounted for quite naturally. The theory underlying this is complex but the fact that it explains this query of the nature of light in a way which fits in with other electro-magnetic effects should lend it authenticity.

If a wave is ultimate, it cannot be physical, since if it had boundaries it would be a particle.

We may, therefore, best understand light as consisting of countless numbers of particles arranged at intervals, the spacing being determined by the frequency of the source. If we think of a single stream of such particles then the aforementioned objections are valid, but if we think of the waves leaving a radiant source as a sequence of expanding shells or spheres no difficulties are to be found.

Perhaps other readers may have similar views on this confusing issue?—R. B. TAYLOR (Kent).

The Planeists Theory

SIR,—Your correspondent in the February issue, W. Mills, thinks that we live on a flat earth because "water finds its own level —horizontal." The full story is that when water (or any other liquid) is left to its own devices, the surface sets itself perpendicular to the direction in which gravity is acting. Thus if a body of spherical shape be surrounded with water, then the water will form a spherical layer round the body, since with a solid sphere the gravitational force at any point is directed towards the centre. Also, as the earth cooled from a molten state, the surface tension of the molten materials caused it to take up a shape which has the least surface area for a given volume. By means of the Calculus of Variations or intuition, it will be found that this shape is a sphere.

I should like to know how Mr. Mills explains the curved shadow of the earth on the surface of the moon during a lunar eclipse!—G. G. ALLWOOD (S.E.13).

Control Board for a Small Theatre—Correction

In the article "Control Board For a Small Theatre" in the January issue, we regret that the switches and fuses in the circuit given (Fig. 7) should not be in the neutral lead as shown.

In order to remedy this it is necessary to reverse the leads to the main switch fuse. This change will mean that the leads on all the power-points have to be reversed also, so that the live connection on each point is on the right-hand side. This is, of course, assuming that the power-points are viewed from the front.

Wrought Iron or Mild Steel?

SIR,—In the August, 1958, issue, among other queries Mr. H. Lohmann wanted to know a simple method of telling wrought iron from steel. A method I have read about is to file the surface bright and apply a drop of pure nitric acid. After a minute or two, wash off with water. On wrought iron the spot will be a pale ash gray; on steel a brownish black, and on cast iron a deep black.—G. W. JUDSON (Birmingham, 27).

Rejuvenating Silica Gel

SIR,—In "Your Queries Answered" in the December, 1958, issue, H. Dickason asks how to rejuvenate silica gel. When this material is in need of rejuvenation it is pale pink. After drying, the crystals become a vivid blue. Ten hours in an oven at around 250°F. will be sufficient for about 2 to 3lb. spread out on a tray.—N. DON (Lancs).

New Theory of Gravitation

SIR,—In reply to J. F.'s letter in the December, 1958, issue I feel he would benefit by a little serious thought on what he means by "mass." In particular, I do not think he appreciates the difference in definition of inertial mass and gravitational mass.

We arbitrarily define the unit of mass (1 kilogramme) as the mass of a certain piece of platinum which is kept at the International Bureau of Weights and Measures at Sèvres, near Paris (other standards, such as the Imperial Standard Pound, also exist).

Suppose we want to make a replica of this mass out of some other material, which must also have a mass of one kilogramme.

In terms of inertial mass we choose this replica so that the acceleration under a given force is equal to the acceleration of the standard under the same force. This avoids the difficulty of definition of force, as we only have to make the forces equal, which is easy enough, by duplicating the conditions, i.e., to take a crude example, by ensuring that two readings on a spring balance are the same.

In terms of gravitational mass we choose our replica so that it exactly balances the standard when the replica is placed on one pan of a beam balance and the standard on the other. This avoids the difficulty of deciding what the value of the Earth's gravitational field is, as the experiment is a comparative one.

The question now arises as to whether these replicas are different according to whether the definition is in terms of inertial

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TRANSFORMERS. 230v. A.C. 3 x 6 v. 10 a., 30/-. 50 v. 20 a., £5.10.0. 8 v. 10 a., 21/-.

MASTER CONTACTORS. Clockwork. 2 impulses per sec. New. 15/- ea.

GYRO MOTORS. 6 v. to 12 v. A.C./D.C. Plat. contacts on speed governor. 10/- ea.

Ditto **BALL TYPE.** 3 phase. 15 v. in gymbals. 15/- ea.

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AMERICAN MIDGET ACCUMULATORS. 3 x 36 v. 1 x 6 v. in sealed tin. Ready charged, only need filling with acid. 15/- ea. (Set of 4).

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LEACH PATTERN RELAY. SPDT. 1,000 ohm. 8/6.

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SLYDLOCK FUSE HOLDERS. 5 a., 1/6 ea., 15/- doz.

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mass or gravitational mass, or whether one replica would satisfy both requirements.

There is, in fact, no simple argument based on classical mechanics and logic which can answer this question. To the reader who asserts that common sense tells him that the two definitions are obviously equal I will merely quote the late Dr. Albert Einstein. "Common sense is nothing more than a deposit of prejudices laid down prior to the age of 18." The rejection of common sense does not preclude the use of logic, however.

All this does not alter the fact that purely *experimental* evidence based on the hypothetical experiments that I suggested shows that the two definitions are precisely equivalent.

Einstein, with the aid of tensor calculus and his own genius was able to put this hitherto experimental fact on a sound theoretical footing. I would not advise J. F. to try to do likewise in naïve qualitative terms.

J. F. misunderstands the point of my criticism of Mr. Clayton's theory. I laid stress on the independence of gravitational attraction on shape and size, and the way in which Mr. Clayton's theory conflicted with this experimental fact rather than the way in which it conflicted with the mass-dependence. More important still is the disagreement with the inverse square law. Mr. Clayton seemed to be unaware that all material bodies, not only the Earth, exert gravitational influence on all others.

I would like to refer W. Mills, the flat-Earthist, to the several photographs which have been published, of the Earth, taken from high-altitude rockets sent up from different parts of the Earth, and which clearly illustrate the spherical nature of our planet.—J. R. PEVERLEY (York).

Hammer Heads and Sawing Stools

SIR,—Whilst preparing to bind Vol. 25 of PRACTICAL MECHANICS I re-read your January, 1958, Fair Comment about hammers. This is a matter which has troubled me for many years. As a joiner and then as a general foreman, I always thought I should like to do something about it but never did. Many times I have seen accidents or near ones through sledge and club hammer heads flying off. Sledge hammer heads should be fixed in the same way as pick heads. Club hammers are the hardest worked tools in the building trade and it is not long before the heads are loose, because the wedging is insufficient; also it needs a tubular metal strap to slip over the handle and fix over the head. Brick hammers need similar treatment.

Another improvement in the building trade would be a light tubular alloy version of the wooden sawing stool, with attachments for anchoring it to the floor and affixing a wooden top, it should also have side rails and a nail tray. These wooden stools are usually thrown about, used as steps, heavy timber is cut on them and they are generally misused which results in their becoming rickety and thus dangerous. Apart from the threat of personal injury, these various tools must cost the building trade many hundreds of pounds to repair and replace. It is time something was done to improve this situation.—D. RISK (Essex).

Extracting Hydrogen Gas From Water

SIR,—Re Mr. Seager's letter in the February issue.

He states that 1 amp. will liberate 1 gram of hydrogen from water in 96.470 seconds. This is not so, as 96,470 coulombs are required to liberate the gram-equivalent of any element. Thus 1 gram of hydrogen or 8 grams of oxygen would be set free by 1 amp. for 96,470 seconds, or 10 amps. for 9,647 seconds, etc. The true answer is worked as follows:

One gallon of water weighs 10lb. and 1lb. equals 453 grams. For each gram of hydrogen liberated 8 grams of oxygen are formed and thus 9 grams of water are decomposed. Thus the weight of freeable hydrogen in 1 gallon of water is $\frac{10 \times 453}{9}$ grams. The time taken to set free that amount is thus $\frac{10 \times 453 \times 96{,}470}{9 \times 60 \times 60}$ hours, or 13,491.78 hours, if the current is 1 amp. Thus I feel that 1 amp. would take 13,491.78 hours to decompose 1 gallon of water.

I have tried electrolysing dilute sulphuric acid with a pressure of 24 volts through a 6 amp. transformer and rectifier, and hydrogen and oxygen are evolved in great quantity, but this is, of course, not practicable with an accumulator.

As to what Mr. Seager says about the danger of electrolysing sodium chloride (salt) solution, I suggest he tries it for himself as I have done. There is, of course, no danger, as hydrogen and chlorine will not explode together at room temperature unless submitted to sunlight or energy of some kind. No oxygen is evolved until the solution is very weak.—PETER F. TAYLOR (Bristol).

The P.M. Dinghy Trailer

ONE of our readers has written to us to say that the 14in. × 3in. R.B. pneumatic T. wheels specified for the dinghy trailer described in the February issue, are only suitable for speeds up to 8 m.p.h.

The author regrets that this is the case, but the specified wheels, on a hardened shaft are quite suitable for trailing at moderate speeds for distances up to 100 miles. Wheels fitted with ball bearings are advised for trailing speeds up to 30 m.p.h. which is the legal limit in any case.

It is also regretted that the 14in. width dimension of the swinging arm frame in Fig. 6 should read 16in., as should also the reference in the text.

Thermo-plastic Manipulation

(*Continued from page 276*)

method is to pass the insert through the attachment and into the plastic in one operation. Several examples of the method are included in Fig. 7, where a number of articles, selected more or less at random, have been fitted by thermo-plastic methods to a small piece of the plastic. For instance, when fitting the small bracket, it was drilled to clearance size and the plastic drilled with undersize holes. With the bracket in place a hot insert was passed through one of its holes and embedded in the plastic. A second round-headed insert was fitted into the other hole in just the same way and the bracket was fixed securely and permanently. Screws were used for inserts because they were handy, but the thread is not needed; rivets, cut-down woodscrews; even nails, make excellent fastenings.

Other articles fitted in this way in Fig. 7 are: lampholder batten in white plastic; small disc in thermo-plastic material, firmly secured with a nail; a ceramic insulator and a hinge. Hinges are troublesome with cold fixing methods, for the frequent movement seems to loosen screws and nuts with annoying regularity.

The hinge shown was fitted with brass countersunk woodscrews cut down in length, but rivets could have been used. They were pressed into undersized holes with the tip of a hot soldering iron, then held down tight with a screwdriver until cold. The soldering iron is an excellent tool for heating small inserts. The use of undersized holes in the Perspex and clearance holes in the attachment through which the insert must first pass (Fig. 8) is, of course, the same as conventional screwing and riveting procedure.

It is often possible to dispense with the separate insert and use part of the fitting itself. In Fig. 7 the little ring is a screw-eye, heated and thrust directly into an undersized hole. A variation of this idea is to provide the fitting with tags like those used in toy-making: these are the insert portions

Fig. 9 (Below).—Tags used in fixing metal brackets.

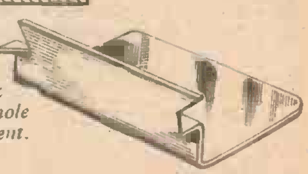


Fig. 8 (Above).—Showing an undersized hole in the Perspex and clearance hole in the attachment.

and make perfectly satisfactory connections. A ready-made brooch-pin has been fitted in this way among the examples in Fig. 7. Behind the pin is a metal bracket fitted with the aid of tags; the method of making the tags is shown in Fig. 9.

Also in Fig. 7 are two radio components, a resistor and a crystal diode, fitted at the corner near the lampholder batten. Perspex has good electrical properties which find many uses in radio, television, lighting and domestic apparatus. The anchoring of components and connections by embedding tags and wires is an aid to rapid assembly. The components in the photograph were fitted by heating the wire ends with the soldering iron and pushing them straight into the plastic, no holes being needed for wire. When soldering subsequent connections to inserts use a really hot iron so that the joint can be made quickly without the heat being conducted to the embedded portion and loosening it. It is not serious if it does, for it will become tight again on cooling.

SPACE TRAVEL PHYSICALLY POSSIBLE

MILITARY scientists in America late last year shot a monkey into space and throughout the whole length of his flight data regarding his heart rate, blood pressure, respiration, temperature, breath sound and body motion sound were measured. The length of his flight was 13 minutes, for nine of which he was in a weightless state. Irregular respiratory and heart rates were recorded, but only during the acceleration period, all returning to normal during the period of weightlessness.

Although it is too early to draw scientific conclusions, scientists regard the results of this test as an indication that space flight is physically possible for man also.

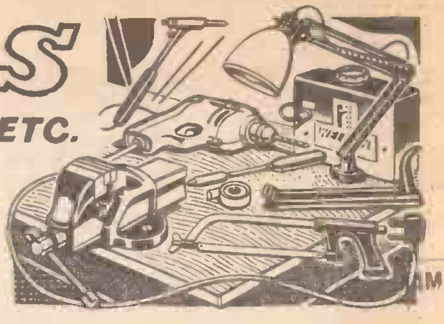
A South American Squirrel monkey was used and during the six weeks prior to the launching he was trained to make him familiar with the capsule in which he was to fly.

Among the problems which had to be solved so that the monkey could exist, were the supply of oxygen, removal of carbon dioxide and the maintenance of a constant temperature. This final difficulty was solved by means of a 7-watt electric light bulb.

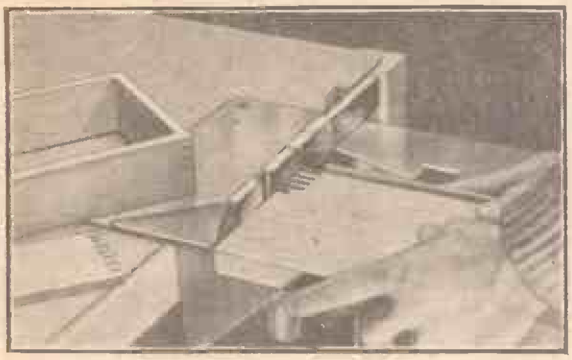
Although the monkey was not recovered, the data transmitted by radio throughout the entire flight has led scientists to regard the experiment as 98 per cent. successful.

Trade Notes

A REVIEW OF NEW TOOLS, EQUIPMENT ETC.



WOLF COMB JOINTER



The Wolf Comb Jointer in use.

A NEW attachment for the handyman has been produced by Wolf Electric Tools Ltd. This is the No. 20 Comb Jointer set, designed to be used in conjunction with the No. 16 jig saw, a power unit and either the universal saw table, or the new SP 105 Supa power saw table. The jig saw accommodates a special slotting blade which passes through an aperture in the table top; a cutting guide and guide index are fixed to the saw table straight edge. The slot width and spacing are variable by multiples of 3/16in. and mitred joints can also be made. The retail price is 34s. 6d.

The Tepco Dinghy

THE Tepco Reinforced Plastics Company, of 30-42, Woodfield Road, Leigh-on-Sea, Essex, have recently placed on the market an 8ft. dinghy constructed from bakelite polyester resin reinforced with glass fibre. The Tepco dinghy is made in seven different colours and has been designed for stability. It weighs only 85lb. and the manufacturers claim that it can be comfortably carried on top of a car.

For the do-it-yourself enthusiast, the hulls can be bought separately for £25. The complete dinghy (exclusive of oars and rowlocks) costs £45.

The Tepco dinghy.

Mini-Compressor Accessories

SOME new accessories have been produced by Gennar Ltd., 99, Old Street, London, E.C.1, for use with their Mini-Compressor. The Gennar Plug Cleaning Unit, costing 19s., it is claimed, will clean any plug in one minute. The Air/Gas Torch Unit is suitable for silver soldering, soft soldering, brazing, pipe fitting, denture manufacture, wire insulation removal, etc., and costs £2 9s. A new Air Blast Gun is useful for instrument cleaning, electric motor cleaning, typewriter maintenance and other jobs; it costs £2 3s. The Foggit Atomiser Unit has been designed for the intermittent and portable application of activated vapours in open or confined spaces, including deodorant liquids, insecticides, germicides, etc. Costing £3 18s., it is also suitable as a humidifier. The fifth accessory is an artists' Air Brush Pressure Container which includes a 2-gallon air container fitted with pressure regulating valve, two pressure gauges and union for artists' air brush work. The price of this is £10 10s. 6d.

Further information on these accessories is available from the makers at the above address.

Working Platforms

LENSON ENGINEERING COMPANY, of Churchill Road Extn., Thurmaston, Leicester, have introduced a new type of hydraulic adjustable mobile working platform —called the "H" type platform.

The photograph shows a platform designed to work between racking with a platform size of 6ft. × 2ft. and a variable lift of from 5-10ft. The load capacity is 6 cwt., and the upward travel takes 22 seconds. Access to the platform can be gained from either end by the support ladders.

This type of working platform can be made up to 12ft. long and the width, hand railing, etc., made to suit individual requirements.

Mobile working platform.

Dormer Drills

THE makers of Dormer drills, The Sheffield Twist Drill and Steel Co., Ltd., Summerfield Street, Sheffield, 11, have published a revised price list (Ref. 212) for their catalogue No. 11. Amendments are included to prices of drill sleeves, sockets and special length drills.

New Fraser Tools

THE FRASER TOOL CO., of 54, Park Lane, Croydon, Surrey, have recently placed on the market a new tool, the Fraser chisel and plane sharpener. It has been designed to obtain the correct angle for sharpening instantly and correct pressure is applied automatically. The sharpener is simple to use and costs £1. 8s. 6d.

Another new product of this company is a non-rusting paint mixer, with lid remover handle, which is suitable for distempers and colour mixing. The price is 1s. 9d. each.

ELECTRONIC KITS

THE well-known American Heathkits are being produced in England by Daystrom Limited, Glevum Hall, Gloucester. Included in the range of apparatus available is a transistor portable radio kit (£17 17s.), a hi-fi stereo amplifier kit (£25 5s. 6d.), and a printed circuit valve voltmeter (£15 14s.). The kits include all the components and materials required together with an instruction manual containing detailed information on construction with point-to-point wiring diagrams. The completed apparatus has a modern appearance as the photograph (right) of the transistor portable radio will show. This transistor set has a printed circuit for ease of assembly and consistency of results. The makers claim that it can be assembled in four to six hours. All enquiries should be sent to the above address.

Heathkit portable radio.

READERS' SALES AND WANTS

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

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670 ohms. D. Pole, D. Throw, 1/9. Relay 670 ohms 4 pole D. Throw, 2/9. Post 1/- each. Heavy duty relay 12V. D. Pole, D. throw. Suitable for H.T. and Aerial change over, 4/9. Post 2/-. FREE Catalogue.
P. P. COMPONENTS LTD. 219, Ilford Lane, Ilford, Essex. IL.F. 0295.

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TANNOY MICROPHONES. With switch and lead, 7/6 ea.
MAINS POWER PACKS. 250 v. 80 m/amp. or stabilized 150 v. 80 m/amp. with 6.3 v. winding, 30/-.
MORSE KEYS. Small, 2/-; medium, 3/-; larger, 3/6. Buzzers, 3/- ea.
MOTORS. 28 v., geared, 2½" x 1½" diam., 12/6 ea.; less gears, 10/- ea.
TORCH BULBS. Ever Ready. 3.5 v., 16/- per 100, 9/- per 50.
HEADPHONES. Moving iron, low impedence, 6/-; high, 9/-; balanced armature, low, 10/-; high, 15/-; moving coil, low only, 10/- per pair.
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SOUND POWERED TELEPHONE UNIT. Neon indicator, buzzer, built-in generator, self-contained. Ex-Admiralty. £5.0.0 per pair.
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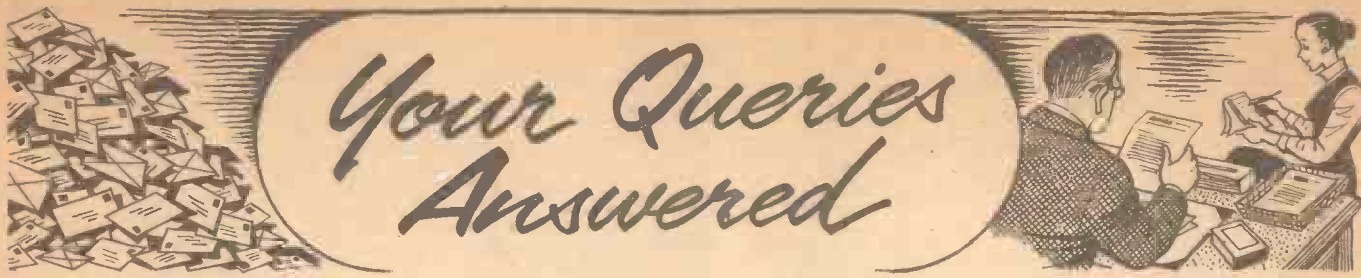
(Continued on next page)



Moulding With Rubber

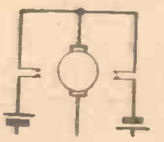
I WISH to carry out some moulding experiments with rubber, both hollow and solid objects, ranging from small toys dolls, etc., to other objects similar to hot water bottles in size and flexibility. I am also interested in hard rubber moulding for statuettes and models. Can moulding be carried out with plaster of Paris moulds?—D. H. Temple Rowell (Essex).

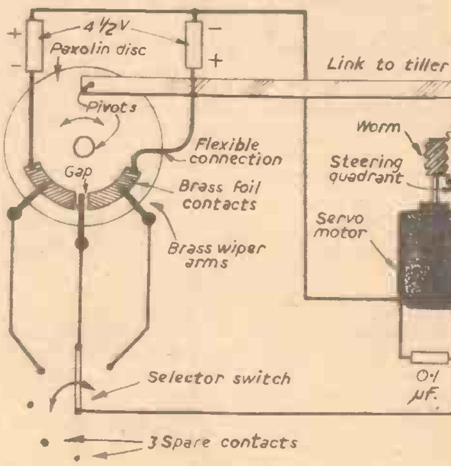
THE raw material for rubber moulding is raw crepe sheet, which is macerated in a machine rather like an oversize lawn-mower cutter revolving in a drum until it reaches a workable consistency. Hardeners, curing agents, inert fillers and other additives are mixed in, and the product is rolled into sheets. Pieces of appropriate form are sheared from the sheet and squeezed between two mould halves, mounted in an hydraulic press, while superheated steam is passed through the mould plates.

Rubber, as a material, offers you no prospects at all. Nor, unless you are prepared for a substantial outlay on presses and moulds, do any of the flexible plastic materials. The statuettes and models, on the other hand, do perhaps give you more scope; although vulcanised hard rubber is out of the question you could nevertheless produce such objects from one of the cold-setting casting resins. Even here, metal moulds ought to be used, but waxed plaster ones would suffice for experimental purposes. You may obtain details of suitable resins from Catalin Limited, Waltham Abbey, Essex.

Three-position Steering

I INTEND to control my radio-controlled boat employing a six-position selector mechanism (allocating three positions for steering). The problem concerns limit switches on the steering motor to allow independent sleection of any position. This circuit gives port and starboard (and reverse motor from either position) but how can a centre limit switch be incorporated? At the moment I am using the mark space system described in past issues of "Practical Mechanics" but do not like the idea of an oscillating relay and motor on 50/50 pulse for centre. Hence my choice of a new system.—C. Turner (Cheshire).





Arrangement for three-position steering.

WE presume that you wish to use the three positions, which you have allocated for steering, to give rudder midships, port and starboard.

The simplest method of doing this is to use a mechanism based upon the details given in the illustration. The system is based upon a special contact assembly built up from paxolin sheet and employing two contacts of brass foil, as shown, with a gap between them. The gap must be just a little wider than the three springy wiper arms which press upon the contact assembly. If the gap is too narrow the steering batteries will be shorted and if too wide undue backlash will appear in the system.

The contact assembly bearing the contacts of foil must be pivoted and connected to the steering unit either by a link as shown or by the direct method of mounting on the rudder post. As the rudder turns the gap will pass under the three fixed brass wiper arms. Operation of the selector switch will then automatically cause the rudder to turn to the required position and then to switch itself off. If incorrect operation results, reverse the connections to the steering motor. (This must be a permanent magnet motor.)

More than three steering positions can be employed if desired by using additional fixed contacts and extra positions on the selector switch. Seven positions are usually adequate for accurate control giving rudder midships, 5, 10 and 30 degrees of helm on each side.

QUERY SERVICE RULES

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

Transparency Viewer and Projector

I SHOULD be glad if you could let me know where I can obtain the steel mirrors as mentioned in the article "A Transparency Viewer and Projector" in the October, 1958, issue. Also what approximately is the diameter of the lens used and about what price would one expect to pay for such a lens secondhand? What is the approximate diameter of the condenser used and its secondhand price? Do the lens and condenser have to be matched?—R. Robinson (Chester).

THE mirrors mentioned in the article do not require to be of steel, thin polished plate glass, say, 24oz. to 32oz. silvered on the front surface are quite suitable. These can be obtained from Automobile Glass Co. Ltd., of 40, Merrion Street, Leeds, 2. It is possible that most mirror makers or glass merchants could also supply these.

The diameter of the projection lens is not critical and can be anything between, say, ½in. and 1½in., but the focal length must be in the region of 2in. to 2¼in. For the cheaper lenses the full diameter of the lens probably cannot be used and will need stopping down to give the best results. The cost would be between 5s. and £1 depending on the source and the quality of the lens.

The condenser lens diameter must be 2in. at least, although a wider diameter will be quite suitable. Most photographic dealers can supply cheap cast glass condenser lenses which are quite suitable and cost only a few shillings each. A single short focus plano-convex lens can be used as a condenser provided the best distances between the lamp, condenser and projection lens are found by trial and error. The only matching that need be considered is the point mentioned above about correct distances.

Infra-red Monocular

I HAVE purchased a Government surplus infra-red monocular, using push-button zambonic pile power unit. Does this unit contain a battery and is it complete, or is some further apparatus needed to furnish infra-red light?—T. E. Cole (Workington).

ALL infra-red equipment that has been released so far from M.O.S. requires that the scene or object to be viewed be illuminated by infra-red light. This, of course, is invisible to the unaided eye.

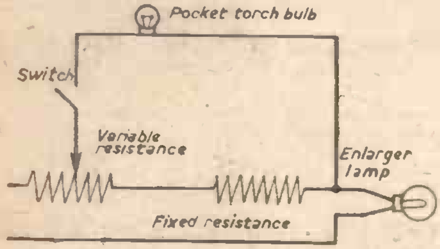
Zambonic piles are high voltage but very low current batteries. They operate the infra-red converter cell but have no connection with the illumination of the scene to be viewed. This must be lit by infra-red light from a separate source.

D.C. Photometer Circuit

AS I have D.C. mains in the house, could you please let me have an alternative circuit for the Enlarging Photometer described in December, 1958, "Practical Mechanics"?—E. Davis (Brighton).

ASSUMING you are using a 230 v. 100 watt enlarger lamp, you would require a fixed resistance of 1 Ω and a variable resistance of 2½ Ω (a 150-watt lamp would call for 0.7 Ω fixed and 1.8 Ω variable).

You should obtain a 2 oz. reel of silk covered or enamelled Eureka 22 s.w.g. resistance wire. (The enamelled is best for this



D.C. photometer circuit.

purpose.) This wire gives a resistance of 1 Ω per 33in.

The fixed resistance is made by winding 33in. of Eureka around a piece of wood about 2in. × ½in. × ¼in., scraping the ends of the wire clean.

The variable resistance can be made from a radio rheostat by removing the original wire from the former and winding on 7ft. of Eureka, spacing the turns evenly, and scraping the wire along the path of the moving contact.

The pocket lamp bulb used in the photometer must be rated at 1.5 v. 0.1 amp.

The photometer is wired up in circuit with the enlarger lamp, which also acts as a resistance.

From a suitable mains plug, run a piece of twin flex. One wire of the flex is soldered to one end of the fixed resistance. The other end of the fixed resistance is soldered to an outside terminal of the variable resistance. From the centre terminal (i.e., moving contact terminal) of the variable resistance, run a short piece of wire to one terminal of the pocket torch lamp. From the other side of the lamp, a wire is run to one side of the enlarger lamp, and to complete the circuit the other side of the enlarger lamp is connected to the mains by means of the second wire of the flex.

Silver Finish

COULD you please tell me the names of two colourless fluids which, when mixed together in a glass receptacle, will leave a silver deposit on the inside of the glass?—L. Branson (Cheshire).

THE two solutions are prepared as follows:

(1) Ten grams of silver nitrate are dissolved in a small quantity of water, and ammonia added until the precipitate first formed is dissolved. The liquid is then filtered and diluted up to one litre.

(2) Two grams of silver nitrate are dissolved in a litre of boiling water, and 1.66 grams of Rochelle salt (sodium potassium tartrate) are added and the liquid filtered and allowed to cool. Equal volumes of these two prepared solutions are poured into the glass vessel and allowed to stand. It is important that the glass surface is perfectly clean. In about 20 minutes the silver will have formed a brilliant mirror upon the glass.

Lost Wax Process

IS it possible to produce satisfactory small engine castings in aluminium alloy by the lost wax process, without an injection machine?—W. H. Parker (Blackpool).

AN injection machine is not absolutely essential for making the wax patterns used in the lost wax process; for small scale working you can melt the wax in a (metal) bicycle pump and squirt it into the metal pattern mould. Ordinary paraffin wax, or candle wax, is quite satisfactory for small work.

Plaster moulds should be used for all lost wax work except large statuary.

You may be interested in the article in our December, 1958, issue, describing a lost wax method of casting.

Removing Hardened Lime

I SHOULD be grateful if you would give me some advice as to a suitable method of removing several layers of hardened lime from a ceiling.

Is there any particular solution which will dissolve it? Hot water has no effect.—F. D. Daniels (Rotherham).

IT is a chemical fact that hot water has less effect on lime than cold water, but we do not recommend this mode of attack. The only effective method is a cold chisel and much hard labour.

Water Emulsion Wax Polish

I HAVE recently moved into a house fitted with Accolite floors and the makers state that they may only be cleaned with a water emulsion wax polish or an expensive proprietory polish. Could you please tell me how I could make a similar product?—M. Cox (Norfolk).

WE suggest that the following formula could be tried:

Carnauba Wax Emulsion

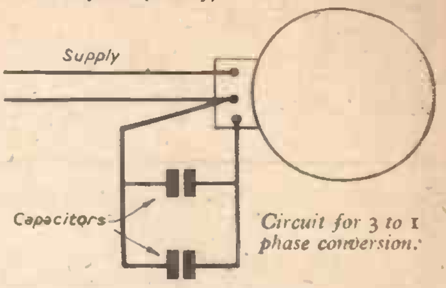
Parts by weight	Materials
87	Carnauba wax
9	Stearic acid
5	Triethanolamine
400	Water

Weigh out the stearic acid, water and triethanolamine and heat-mix in a metal vessel to 100°C. After the acid has melted completely and the solution is boiling gently, stir until a smooth soap solution is obtained. In a separate steam-heated container melt the carnauba wax until a temperature of 85-90°C. is reached. (If temperature rises above 95°C. it will darken.)

Now add the molten wax to the boiling soap solution and stir vigorously until an even dispersion of the wax results. Stir gently but continuously, until the emulsion has cooled to room temperature. This can be further diluted with water if required.

3-phase Motor on 1-phase Supply

I HAVE a ½ h.p. induction motor made by Morriflex, the ratings are, 200-220 v., 3-phase, 50 cycles. Is it possible to run this motor on 1-phase, 50 cycles and if so could you supply the circuit and data?—F. W. Lyons (Derby).



Circuit for 3 to 1 phase conversion.

WE suggest that you use the circuit shown above. The two capacitors could have a capacitance of about 12 μF and 8 μF respectively and should be connected as shown during starting only. When the motor is up to speed one of the capacitors should be switched out: you should leave in circuit whichever capacitor gives the best results. The horsepower and pull-out torque of the motor will be reduced somewhat below the values obtained on the normal 3-phase supply.

Bowl of Fire Trick

AS a magician I should like to produce a bowl of fire or flames. Also is it possible to produce puffs of harmless smoke by some easy means?—H. Woodford (S.E.7).

IF you add water to a bowl containing pure ether and pure metallic potassium, the water sets the potassium alight and this in turn sets fire to the intensely inflammable ether. We recommend 6½in. diameter glass bowls to be used (Pyrex glass). Not more than two teaspoonsful of ether are placed in the bowl and a piece of metallic potassium is placed on the ether. As soon as water is poured into the bowl the ether and potassium float to the top, the potassium catches fire and instantly ignites the ether, producing a fierce flame, which soon dies out.

For harmless puffs of smoke approach Messrs. Hamley's, of Regent Street, London, W.1, for flash paper. We do not recommend making this.

Be sure to have your main stock of ether (not more than a few ounces) in a well-stoppered bottle and in a separate room from the experiment.

Information Sought

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

A Silencer

I WISH to fit a silencer to a .22 rifle. Could you please tell me how one can be constructed?—A. LETHBRIDGE (Liverpool 4).

A Glitter Finish

HOW is the glitter finish obtained on dance band drums?—J. C. McFEETERS (Wilts).

Wire Straightener and Bender

I WISH to construct a wire straightener for 14 s.w.g. to 3/16in. M.S. wire from coils and also a wire bender for various radii from about 2in. to 24in. in same gauges as above. Can anyone tell me how to construct these?—F. G. LYONS (Manchester).

RAWLPLUG PRODUCTS

IN BIG DEMAND AT ALL TIMES

When you have a fixing job to do try the Rawlplug method. You make a hole in the masonry with a Rawltool, insert the appropriate size Rawlplug, offer up the fixture and drive the screw into the Rawlplug. The result is an absolutely firm safe fixing without mess or bother. You can buy a complete Outfit for as little as 3/- or larger Outfits with a better assortment as follows:—

Household 5/6
Handyman 11/9
Craftsman 12/9

A free 16 page booklet of instructions is included with every Rawlplug Outfit.

RAWLPLUGS IN HANDY 1/- BOXES

The established Rawlplug enthusiast usually has a set of various sizes of Rawltools and prefers to buy his Rawlplugs as he needs them. The handy 1/- boxes are a boon to him because they have various lengths to suit different jobs. Each size in a different box. No's 6, 8, 10, 12 and 14. Ask your dealer about them today.

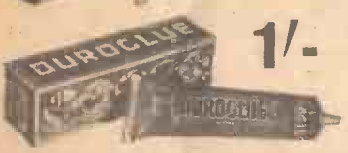
DUROFIX

In the new enlarged handy tube 1/- **1/-**

Larger tubes, 1/6d. The ideal all-purpose adhesive for instant repairs to crockery, glass, china, wood, metal, plastic and the thousand and one things handled by the hobbies enthusiast. Instant drying, waterproof, heatproof and insulating. Durofix is grand for electrical, sports and leather goods because it dries hard and non-tacky. **¼ lb. tins 2/9 1 lb. tins 10/6**

1/-

Real Wood in Putty Form. In dexterous fingers surprising things can be done with Rawlplug PLASTIC WOOD. Models can be made and coloured, intricate mouldings rebuilt, splits in wood made good and, what is more it will stick firmly to any non greasy surface—metal, glass, vulcanite, plastic, earthenware, etc. Can be cut planed and sanded to glass smooth finish. **¼-lb. tins 2/3 ½-lb. tins 3/9 1-lb. tins 6/6**



1/-

Animal glue of tremendous strength. This popular ready to use DUROGLUE is the handyman's friend. It can be used for that immediate need and replaced in the toolbox for another day. It is strong, reliable and for woodwork an ever ready aid to fixing and repairs. It is also suitable for many other materials but not for those washed in hot water. **½-lb. tins 2/6 1-lb. tins 4/9**

10½D

For quick easy repairs to Metalware. This scientific preparation in paste form can be applied in a few seconds and dries in a few minutes. Metal utensils in the house, garage or garden can be put into good condition again by the intelligent use of Rawlplug PLASTIC METAL without heat or soldering iron. Not suitable for wireless or electrical connections.

Rawlplug Tool Sets

4 in 1

For the craftsman and advanced handyman these tool sets are a boon. The Four-in-One enables four drills (8a, 10a, 12a, 14) to be used in the No. 14 holder. In a handy box it sells at 7/9 and in a strong roll-up wallet at 9/6.

POPULAR TOOL 1/8

A very cheap, sturdy tool for making holes for No. 8 Rawlplugs. Turn the tool as you tap it with a light hammer to make clean, round holes in masonry. It is a very handy tool for simple household fixing jobs.

8 in 1

The Universal Eight-in-One has an improved Knurled holder and takes eight drills Nos. 6/14 to 20/14. In a handy box it sells at 15/6 and in a strong roll-up wallet at 17/9.

RAWLPLUG METALIDE for masonry drilling *the easy way*

REGISTERED TRADE MARK

Each Metalide drill is packed with an instruction leaflet in a strong plastic wallet with transparent window.

Here is a cheap reliable masonry drill for the household handyman. Four sizes are made for use in a hand brace or suitable electric drill. Just what you need for that occasional domestic fixing job.

No. 8 (3/16") Green Wallet	No. 10 (7/32") Blue Wallet	No. 12 (1/4") Brown Wallet	No. 14 (9/32") Grey Wallet
5/6	6/-	6/6	7/-

The most efficient, precision made, long lasting masonry drill is the Rawlplug DURIUM (with the free re-sharpening service). We strongly advise this drill for continuous drilling (such as industrial operation) 13 Sizes for drilling right through walls. Prices are from 9/6 each. For drilling glass use the special DURIUM GLASS DRILL. Made in nine sizes from ⅛" to ½" at 6/6 to 10/6 each. **Free Re-sharpening Voucher with each drill.**

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Editor : F. J. CAMM

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VOL. XXVII MARCH, 1959 No. 440

WHAT I THINK By F. J. C.

Another Change Wanted

NOW that the amalgamation of the two bodies concerned with cycling sport into the British Cycling Federation is complete (I am pleased to learn that I was helpful in bringing this about), and there seems reasonable chance of peace, it is time to direct our careful attention and thought to the other and the more important aspect of cycling, namely touring. Let us make no mistake about it—in the sphere of cycling the tail has been wagging the dog and altogether too much attention has been devoted to cycle sport which at the most interests 100,000 people out of a total cycling population of, say, 10 million. The touring side has been almost completely neglected. It cannot be said that the Cyclists' Touring Club is particularly active in promoting cycling touring, and its somewhat microscopic membership as compared with the total number of possible members would seem to suggest that cyclists of the non-militant type do not want it. To join is merely to lend support to its militant policy in the shaping of which members have very little to say, nor can they be expected to under the present constitution, where resolutions can be passed at an Annual General Meeting, but no notice need be taken of them. What is wanted is an entirely new cycle touring organisation with a more realistic constitution in keeping with 1959, and free from the preponderating and somewhat pugnacious attitude of those whose minds are still in the past. It is well known that the cycle industry has been passing through difficult times and more vigorous development of the touring side with a more amenable attitude and receptivity to change when such becomes necessary is what is urgently needed today. Much perfervid oratory supported by unconvincing arguments has been poured out by the self-appointed proprietors of the movement in their opposition to rear lights and other matters, which cyclists have accepted when legislation has been passed in spite of opposition.

This is a matter which I commend to the Secretary of the District Associations with intense sincerity. A change is necessary either in the general set-up of the C.T.C. or in the formation of a new body, and the District Associations should make it their business at the next A.G.M. to formulate a policy and to force it through. Obviously the power of the C.T.C. to veto any resolutions passed at an A.G.M. must be changed. There need to be changes in the organisation itself. It is altogether too complacent and its *raison d'être* seems to be overlooked. The policy in future should be one vigorously devoted to touring with only a modicum of politics interlarded—just enough to ensure that there is no infraction of tourists' rights. The sport has been reasonably cleaned up—now let us apply a similar process to cycle touring.

The Lone Hand

I THINK that the Road Time Trials Council which recently ratified its agreement with the N.C.U. and the B.L.R.C. on racing procedure makes a mistake in refusing to submerge its identity by amalgamation. Time trials are indeed more important than any other form of racing on the road, but it was only just over 20 years ago that cyclists, dissatisfied with the Road Racing Council which could only make recommendations and not enforce them, forced the issue from which emerged the Road Time Trials Council. That council, having spent a great deal of its time arguing about rules and making new ones has settled down now to a more or less routine conduct of time trials. It loses, however, in strength by remaining aloof from amalgamation. Its interests in many ways run parallel with those of other forms of racing and its policy of isolation cannot in the long run be good for it.

Decline in Cafés

THE number of cafés which specially cater for cyclists is rapidly declining, because it does not pay. No doubt the high and rising costs of food and the growth of picnicking has something to do with it. Another cause is the somewhat uncouth attitude of some cyclists who turn these cafés into bear gardens. The plain fact is, however, that it is impossible for café proprietors to put on a meal very much below the charges of a properly constituted and well-managed restaurant. Some of the recommended teahouses are insanitary hovels, the food is often badly cooked and unpalatably served, yet they are enabled to show the N.C.U. and C.T.C. sign. Little jurisdiction is exercised over them and it is doubtful once the appointment has been made whether the two organisations take any further interest in them beyond investigating an occasional complaint. Cyclists prefer to take their meals in happier surroundings where there is less likelihood of hooliganism.

The Cyclists' Road Club

JUST before the war, you will remember, we founded the Cyclists' Road Club, which had a larger membership than any of the existing organisations. It is true that the Cyclists' Touring Club did not like it, as is evinced by the report of an interview with the then secretary of the Club which was published in a contemporary journal. The C.T.C. opposition, however, did not affect the success of the Club which had far more to offer than the C.T.C. We gave a useful handbook of touring information, a badge, accident insurance, free legal advice bureau, and many other benefits for only just half the price of the C.T.C. annual subscription at that time. It was indeed a very lively club and local sections were started up all over the country. The suspension of *The Cyclist* in the early days of the war due to the paper situation caused a similar cessation of activities on the part of the club. We had learned, however, as a result of our experience, that such a club, divorced from cycling politics and non-militant, was wanted and the membership would have grown to very large proportions. *The Cyclist* had the largest circulation of any cycling periodical because it devoted its contents mainly to the pastime and relegated sport to four pages an issue

Naturally, the great success of these two ventures aroused jealousy among other organisations. *The Cyclist* had broken the monopoly accorded to a competitor under which advertisers were not permitted to advertise in any other journal. That naturally caused annoyance. The Cyclists' Road Club upset the C.T.C. and it was then that I began to learn of the furtive and underground methods adopted in the cycling movement which I spent years in combating, finally, forcing the opponents into law courts, with results which are now well known.

The Bull's Head, Strand-on-the-Green, a picturesque London riverside inn.

Fig. 1.—A typical toeclip in use.

Fitting Toeclips

Types; Shoeplates and Toestraps; Pedalling Action

TOECLIPS come in various shapes and sizes and it is a matter of individual preference which type is employed. The author's preference is for a steel clip (which will spring back to its proper shape if accidentally flattened by the foot) shaped to fit the shoe and cut away in the centre to enable the toe to protrude slightly (see Fig. 1).

The position of the foot on the pedal should be as shown, with the ball of the foot in the centre of the pedal; a toeclip must be chosen so that this position can be maintained. Most of the better toeclips are made in two or three sizes. Some others are adjustable. They are made in two parts, each of which is slotted and then the two are fitted together by means of a nut and bolt, thus enabling the length of the toeclip to be varied.

Shoeplates and Toestraps

When toeclips have been used for only a short while, it will be noticed that the pedal plates are wearing grooves in the sole of the shoe. To protect the leather and to help maintain the foot in its correct position, many riders fit shoeplates, as shown in Fig. 2. These are made of metal and when used in conjunction with toeclips and toestraps, provide a positive location for the foot. The disadvantage, according to some riders, is that in the event of a skid or some other accident the rider has to fall with his machine instead of being able to jump clear.

The same criticism can be applied to toestraps.

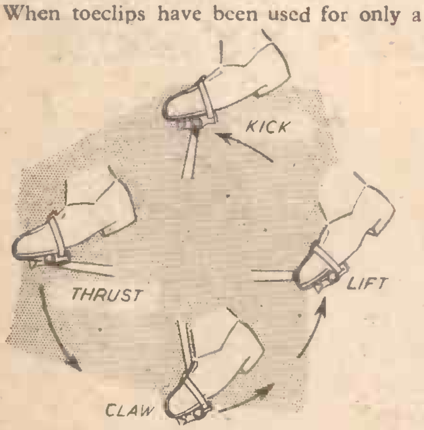

Fig. 3.—The position of the foot at four points of the pedalling circle when ankling.

Toeclips should be used in conjunction with cycling shoes, which are specially shaped and reinforced for comfort.

Pedalling Action

Cyclists will always argue about the efficacy of toe-clips and their effect on pedalling action. Some say pedalling is made more effective because, not only can the rider push down, but he can also pull up when the pedal is travelling round that part of the pedalling circle. Others say that the method known as "ankling" is the only way and that properly done this makes toeclips unnecessary. The clawing motion of the ankling movement can be seen in Fig. 3. Other riders say that toeclips make ankling easier, which may be true, but it is also true to say that many young riders who have always ridden with toeclips have a "toe-down" pedalling style and no trace of an ankling movement. Many of these points will depend upon the individual and the rider will have to make up his own mind about them, but there is one occasion where the use of toeclips is vitally necessary. This is where a low gear fixed wheel is in use. Going down hill, unless the brakes are used, the feet must turn at a great rate and toeclips must be used to stop the feet from flying off the pedals.

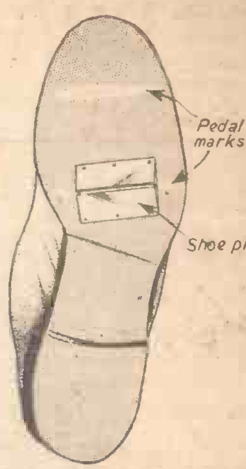

Fig. 2.—A cycle shoe fitted with metal plate.

The CYCLOMETER

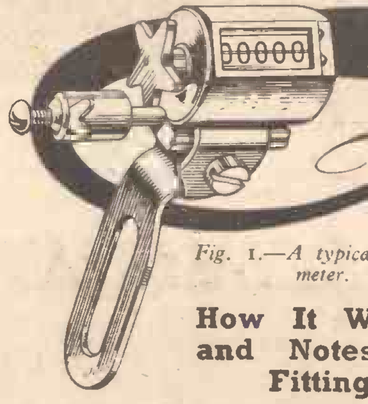

Fig. 1.—A typical cyclometer.

How It Works and Notes on Fitting

A TYPICAL cyclometer is shown in Fig. 1. Basically it is a revolution counter fitted to the hub of the front wheel and counting the revolutions of the wheel. The action of counting is achieved by a striker fitted to the spokes of the wheel hitting a five-pointed star wheel and rotating it one fifth of a turn, each time the road wheel revolves. Inside the cyclometer, this rotation of the five-pointed star wheel is converted by means of gear wheels to miles and tenths of a mile, shown as figures in a small glass window on top of the cyclometer. Some idea of the complexity of the internal mechanism can be seen in Fig. 2.

The Right Model

Each of the several types of cyclometer is designed for use with a front cycle wheel of a specific size. This, as will be realised, is due to the fact that a 28in. dia. wheel would travel farther in one revolution than would a 26in. dia. wheel. A 28in. wheel would travel 88in. in one revolution while a 26in. wheel would travel only 82in. approximately, a difference of 6in. Over a distance of a mile an error of 120-130 yards would be caused by using the wrong cyclometer for a given size of wheel. The cyclometer is designed to be used with a specific size of wheel and this size is only maintained when the tyre is pumped hard. Riding on a half-inflated tyre alters the effective diameter of the wheel and will cause the cyclometer to be slightly wrong in its reading.

Fitting

The mounting bracket fits over the front wheel spindle and is clamped in place by the spindle locking nut. The top of the bracket is formed into a shoe, into which the shaped base of the cyclometer itself is locked. The striker is fitted separately on one of the spokes by means of a grub screw provided. Both the striker and cyclometer are adjusted so that the striker hits the underside of the five-pointed wheel lightly on each revolution.

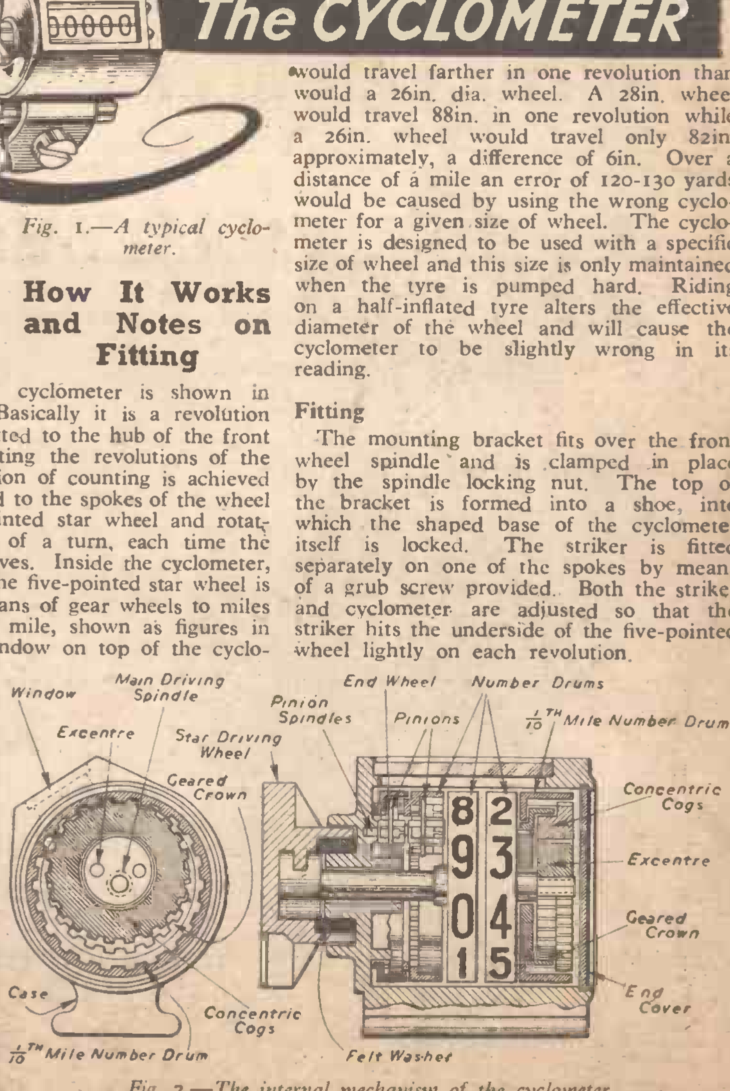

Fig. 2.—The internal mechanism of the cyclometer.

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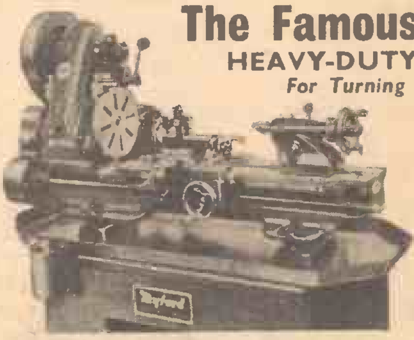

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