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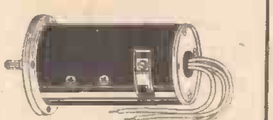
PRACTICAL MECHANICS

EDITOR : F. J. CAMM

JANUARY 1959

Contents



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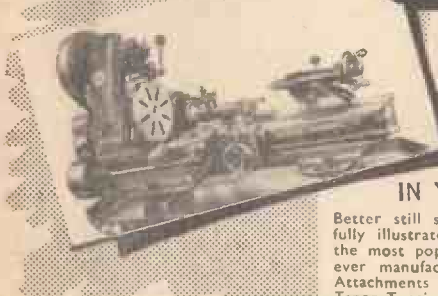

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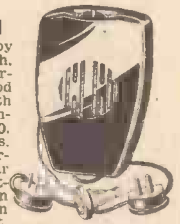

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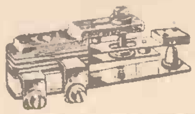

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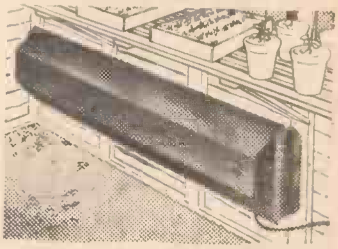

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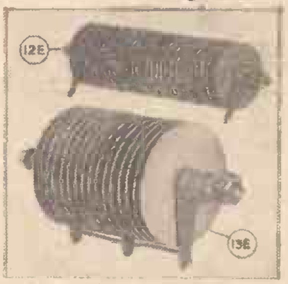

Selenium rectifier type 12, 500 v. ½ A. half-wave, easily rebuilt into full wave or multiple type, contains 30 35 mm. discs. Price 8/6, plus 1/6 post. Type 13, 36 volt 9 amp. easily rebuilt into six full wave charger rectifiers suitable for 6- or 12- volt batteries at 3 amp., contains 24 x 84 mm. discs. Real bargain at 19/6, plus 1/6 post.

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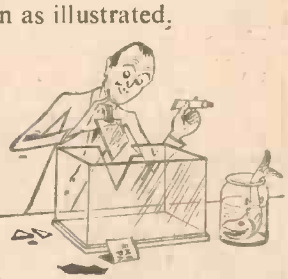

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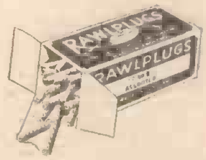

The established Rawlplug enthusiast usually has a set of various sizes of Rawltools and prefers to buy his Rawlplugs as he needs them. The handy 1/- boxes are a boon to him because they have various lengths of Rawlplug for screw gauges 6, 8, 10, 12 and 14. No more lost or mixed up Rawlplugs with these handy boxes.

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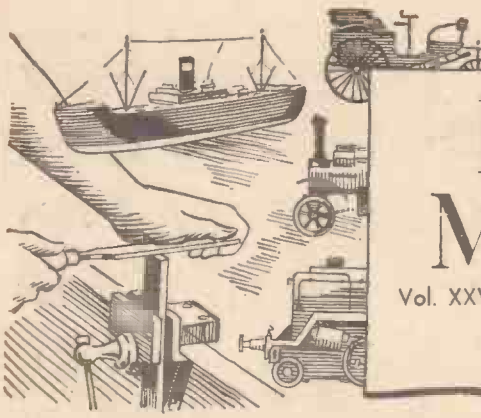

Practical Mechanics

Vol. XXVI. No. 299 JANUARY, 1959

"The Cyclist" and "Home Movies" are incorporated

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CONTENTS:

THE CYCLIST SECTION

CONTRIBUTIONS

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

FAIR COMMENT

MAN-POWERED FLIGHT ?

MANY years ago, a French aeronautical journal offered a prize for the first man to fly under his own power. The winner won the prize of 1,000 francs by making a hop against a strong wind on a bicycle equipped with wings. The problem boils itself down to making a machine which can be propelled by 1/5 h.p. approximately—the maximum which can be developed by a fit human being, and even then only for short periods. The idea of man-propelled flight has always attracted inventors, in spite of the fact that it is well known that it would be impossible to travel any distance on a machine propelled by human effort. Its speed could not be high, the wing loading would have to be ridiculously low and such a machine would be buffeted about and highly dangerous in even the lightest wind. However, Mr. B. S. Shenstone, F.R.Ae.S., recently read a paper on the subject before the Royal Aeronautical Society at Yeovil.

In 1936 in Germany a single-seat, man-powered aircraft made at least four flights over 200 yards, at an altitude between 3 ft. and 15 ft. The flights lasted 20 seconds.

Of course, the aerodynamical knowledge available in 1936 was very much less than it is now, but nothing has happened to suggest that man power is sufficient to maintain sustained flight. It will always be possible to flutter for a few yards, but a cross-country flight is quite out of the question. Speed is fundamentally related to loading per square foot of wing area. A heavily loaded wing needs to be driven at high speed in order to obtain lift. Where low power is available, loading per square foot must be light. All of this suggests that if man-powered flight is to be anything more than a qualified success, more than one person will be required to propel it. A minimum horse power of 3 is necessary. This suggests a team power unit of at least 15 people. Arm as well as leg power will be needed to develop full man power, except, of course, the pilot who must use his hands for controls. I disagree with the author when he suggests that the air screws should be of balsa and the drive by means of pedals, bicycle chains and bicycle sprockets. The transmission losses here would be considerable since the air screw would need to be geared up.

FREE TICKETS FOR OUR FILM SHOW

OUR companion journals, *Practical Wireless* and *Practical Television*, are organising a film show on Thursday, January 22nd, at the Caxton Hall, Caxton Street, London, S.W.1, at 7.30 p.m., under my chairmanship.

There will be three films and an interval for free refreshments. The films deal with the transistor, the manufacture of junction transistors and a colour film entitled, "The Conquest of the Atom." The lecture is being arranged in conjunction with Messrs. Mullard, Ltd.

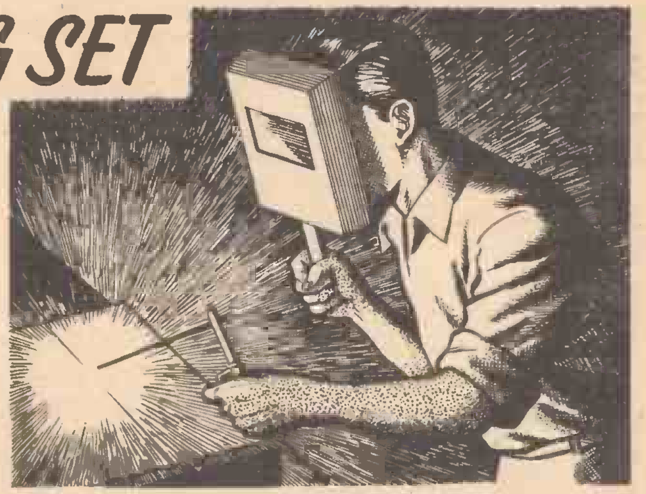
Send applications to the editor, PRACTICAL MECHANICS, address as on this page, marking the words "Caxton Hall" in the top left-hand corner.

THE "PRACTICAL HOUSEHOLDER" EXHIBITION

THE *Practical Householder* Exhibition, organised by our companion journal, takes place from February 18th to the 28th at Earls Court, London, S.W.1. The March issue of the *Practical Householder*, published at the beginning of February, contains a free ticket. The exhibition, specially designed for handymen, will be packed with exhibits of all the tools and materials available. There will be daily demonstrations of woodworking, painting, etc. We shall welcome readers at our stand No. 49. Make a note of the date.—F. J. C.

The February, 1959, issue will be published on January 30th. Order it now!

AN A.C. ARC WELDING SET



By J. L. Watts

It Will Weld ¼in. Thick Mild Steel

ELECTRIC arc welding is a well-established method of joining and repairing metal parts and an arc welding set has many uses in the home workshop. A static welder for use on a single-phase A.C. supply has two main components. A transformer is used to step down the mains supply to a suitable voltage for striking the arc; whilst a choke coil is used to reduce the voltage across the arc after this has been struck. The welding equipment to be described is suitable for use on a 50 cycle A.C. supply at 240 volts or, by simple modification of the primary winding of the transformer, for other supply voltages at 50 cycles. It requires a current of about 30 amps. from the mains when used on maximum load. It can be used with bare or coated electrodes of 1/16 to ⅛in. diameter for welding materials such as mild steel up to 3/16in. or ¼in. thick, or more.

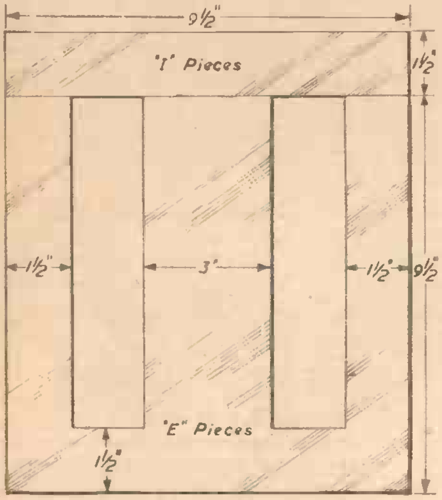


Fig. 1.—Dimensions of stalloy core stampings for the transformer and choke.

In order to simplify the construction the set has been designed so that the same size of stampings are required for both the transformer and the choke coil. Both cores are to be built up to 4¼in. thick, approximately 300 E and I stampings being required for the transformer, and the same number for the choke. The stampings should be of stalloy 0.014in. thick, which have been varnished on both sides to minimise eddy currents which cause unwanted heating of the core and loss of efficiency. Fig. 1 gives the dimensions of the stampings.

The Winding Former

The first step to making the transformer is to prepare a hardwood former on which the coils are to be wound. The dimensions of a suitable former are given in Fig. 2. The two ends are to be screwed to the centre piece so that the completed winding can be removed. The section of the centre piece is 3¼ × 4½in. at one end, and 3 9/32 × 4 17/32in. at the other end, the slight taper being provided to facilitate removal of the winding. It will be noted that two slots ⅝in. wide are to be cut in each end piece, these being for the coil leads. There are also eight slots ⅛in. wide in each end piece which line up with grooves cut ¼in. deep along the centre piece.

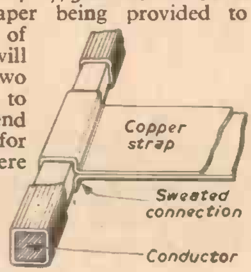


Fig. 3.—Method of making a tapping connection.

The completed former should be made quite smooth and should then be well rubbed over with french chalk, otherwise difficulty may be experienced in removing the coil after winding. A strip of leatheroid 0.010in. thick is cut to approximately 7⅝in. × 34in. This is first wrapped tightly round the centre piece twice, and over this is tightly wrapped three layers of 0.010in. empire cloth. This can be secured with a little Chatterton's Compound.

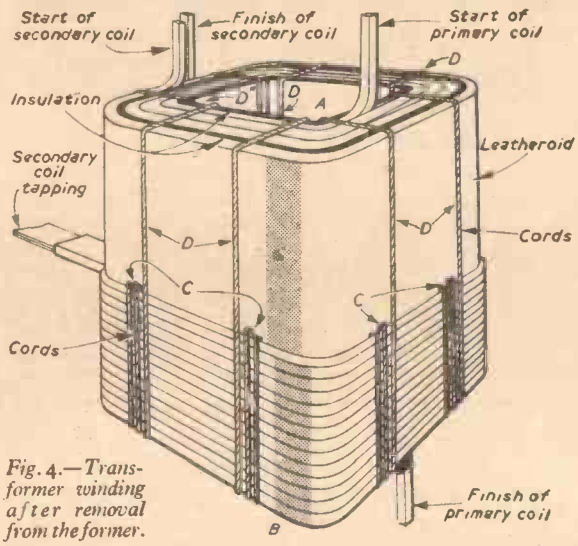


Fig. 4.—Transformer winding after removal from the former.

Winding the Transformer Primary

The primary coil is first wound on the former. This consists of double cotton-covered (D.C.C.) conductor having a cross sectional area of approximately 0.025 sq. in. 8 s.w.g. square-section conductor of soft copper may be used for this winding, the conductor being 0.16in. thick with slightly rounded corners. About 190ft. (19lb.) of this conductor will be required for the primary winding.

About 20in. of this conductor are passed through one of the wide slots in the end A of the former. this external lead is covered with a sleeve of systoflex which passes just inside the former. The end of the lead may be secured to the end piece. The former is then turned slowly and the winding commenced. The conductor must be kept as tight and laid as flat as possible, otherwise the coil may bulge in the centre and be too large for the stampings. The conductor should be given a contrary bend before each side is laid flat on the former. If necessary the conductors may be gently tapped between two wooden blocks, but care must be taken not to damage the cotton covering. Forty evenly-spaced turns may be wound on the first layer.

Over the first layer is tightly wrapped a

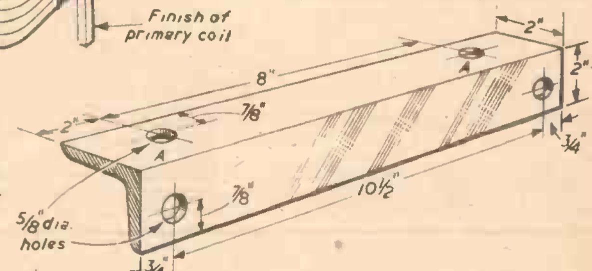


Fig. 5 (Right).—Angle iron clamping pieces for transformer and choke.

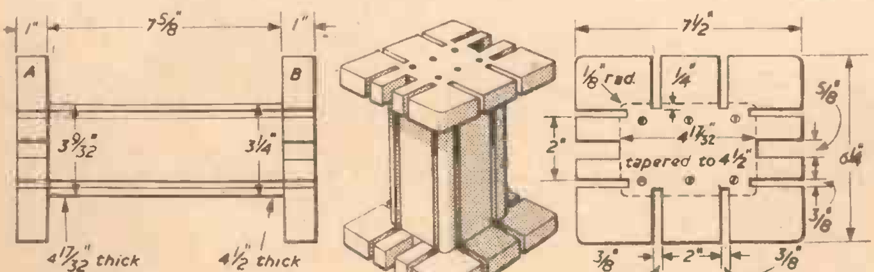


Fig. 2.—Side and end views of hardwood coil former.

layer of 0.010in. leatheroid, which may be secured with cotton thread before starting to wind the second layer back over the first. Forty turns are wound on the second layer, a layer of leatheroid being wrapped round before winding the third layer back over the second. One hundred and twenty turns may be wound in three layers for a 240 volt supply. If it is required to use the transformer on a lower voltage than 240 volts at 50 cycles a smaller number of primary turns should be used. Thus, for use on 220 volts at 50 cycles, 110 turns are required on the primary coil. The end of the primary winding should be brought out of the wide slot in the end B of the former opposite the starting end, as in Fig. 4. The end should be cut off, leaving about 20in. outside the former, a systoflex sleeve being slipped over the lead as at the starting end.

The Transformer Secondary

Over the primary winding should be tightly wrapped a double layer of 0.010in. leatheroid, and over this three layers of 0.010in. empire cloth, before winding the secondary coil. For this winding D.C.C. conductor having a cross sectional area of approximately 0.035 sq. in. is to be used. Six s.w.g. square-section conductor of soft copper may be used for the secondary, the conductor being 0.192in. thick with slightly rounded edges. One hundred and five feet (15lbs.) of this conductor will be required for the secondary winding.

A lead about 20in. long is passed outside the former through the end A on the opposite side of the end piece to the starting end of the primary winding, as in Fig. 4. Systoflex sleeve should be passed over the lead as before, and the winding commenced. About 34 turns can be accommodated on the first layer, over which a layer of 0.010in. leatheroid should be tightly wrapped. Two turns of strong, thin cord should be wrapped over this leatheroid axially and round the former through each of the eight narrow slots in the end pieces. These cords will later form the binders, shown at C in Fig. 4.

The second layer is then wound back over the first, and over the cords, until a total of 42 turns have been wound on the secondary. On the 42nd turn 1in. of the conductor is stripped of its insulation in the centre of the former on the same side that the secondary winding was started. A strip of soft copper ½in. wide by 1/32in. thick and about 8in. long is also cleaned at the centre and tinned. The strip is looped round the conductor, as in Fig. 3, and the connection sweated up. The strip should be wrapped with three layers of ½in. wide empire tape and the connection similarly insulated, the strip being brought out radially from the coil. The second layer is then continued, over the cords, until the secondary winding has a total of 52 turns. The cords are then cut through at the end A and turned over the turns on the third layer and tied to secure these turns, as at C in Fig. 4. The finishing end of the secondary coil is then brought out through the wide slot in the end A of the former where the starting end lies, the finishing end being cut off about 20in. long and insulated with systoflex sleeving.

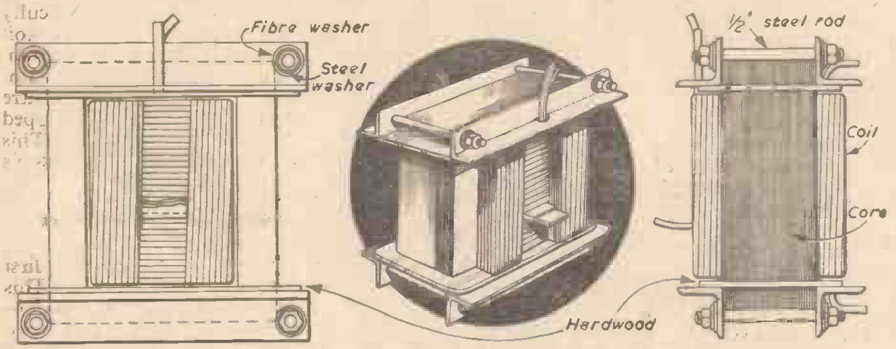


Fig. 7.—Transformer assembly.

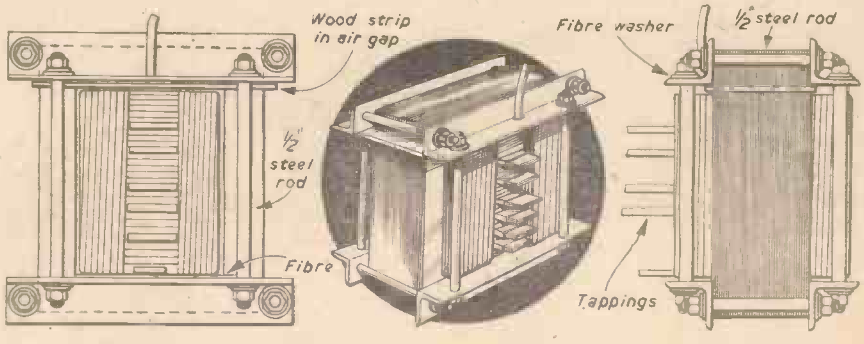


Fig. 8.—Choke coil assembly.

Finishing the Transformer Coils

Strong thin cord is then passed through the eight narrow slots from one end of the former to the other through the inside of the coil, this being passed round the outside of the coil and tied securely to form the binders shown at D in Fig. 4. The next step is to remove the end B of the former and remove the winding, when the coil should appear as in Fig. 4. The coil should then be dried out by suspending it in an oven which is maintained at a temperature of approximately 180°F. for a couple of hours. The temperature should be tested frequently and should not be allowed to exceed 200°F.

In the meantime a container should be prepared for impregnating the coil by immersion in insulating varnish such as Ohmaline or Armacell. Immediately the coil is removed from the oven it should be immersed in varnish and should remain completely immersed for about 5 hours. It should then be hung up to drain off, during which period it should be turned round occasionally in order to avoid varnish accumulating on any particular part of the winding. Care must be taken not to allow any naked lights in the vicinity of the varnish. If air-drying varnish has been used the coil should then be thoroughly dried in air. Stoving varnish will require the coil to be suspended in the oven for another 6 or 8 hours. Two layers of 0.010in. leatheroid are then wrapped round the outside of the coil and bound with cord. The whole coil is then bound with ½in. empire tape passed through the centre and round the coil to cover it completely. Over this may be wrapped cotton tape to finish off. The whole may then be given two coats of Pakyderm air-drying varnish.

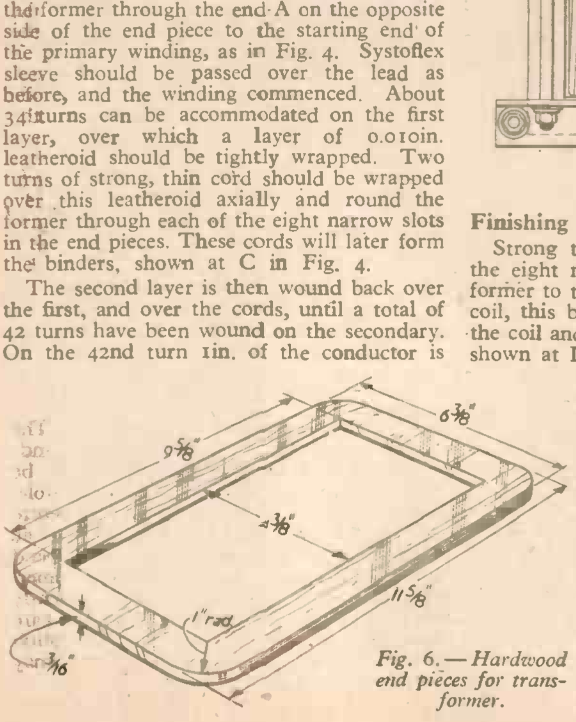


Fig. 6.—Hardwood end pieces for transformer.

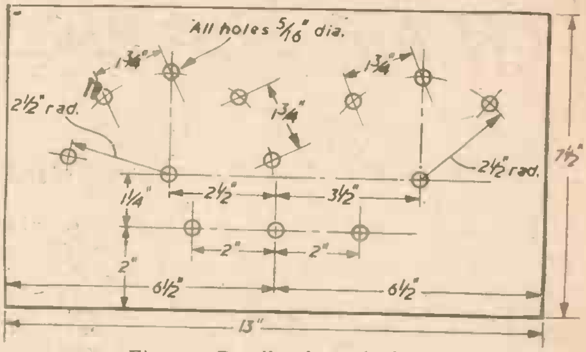


Fig. 9.—Details of terminal panel.

Assembling the Transformer

The coil may then be laid axially with its narrow side at the bottom to assemble the core stampings. A piece of wood may be laid across each end of the coil to support the stampings. The centre limb of an E stamping is passed through the centre of the coil, and an I stamping laid at the opposite end, as in Fig. 1. The next E stamping is passed through the coil from the opposite end, and the core thus built up with alternate E and I stampings so that the joints in one layer are covered by the next layer. It is most important that no air gap should be left in the core; if necessary the stampings may be lightly tapped together with a wooden mallet. The stampings should be built up to a thickness of 4¾in. and thin strips of hardwood used to make the coil tight on the core.

The transformer core must be tightly clamped. For this purpose four pieces of 2in. angle iron are prepared as in Fig. 5 with two hardwood pieces as in Fig. 6. The two ⅜in. holes A may be omitted from the angle iron transformer clamps, but are required in clamps for the choke. The

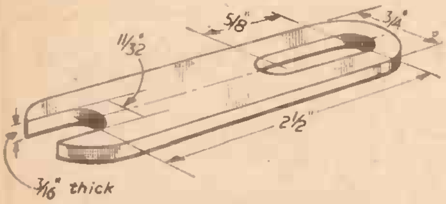


Fig. 10.—Copper connecting links.

other two ⅜in. holes in each angle piece must be insulated with fibre bushes of ½in. inside diameter. When fitting the ½in. screwed clamping rods fibre washers must be fitted under the steel washers so that the clamping rods are completely insulated from the angle iron in order to avoid eddy currents. For the same reason the clamping rods must not touch the stampings. Holes may then be drilled in the angle irons for the leads, and the core clamped up as in Fig. 7.

The Choke Coil

The choke coil may be wound on the same former that was used for the transformer winding. For the choke coil six s.w.g. D.C.C. square soft copper is used,

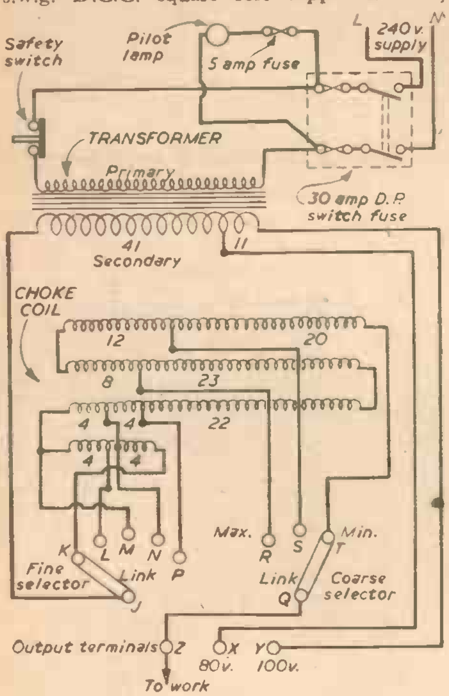


Fig. 11.—Connection diagram for welding set.

as for the transformer secondary. About 180ft. (26lb.) of conductor is needed for the choke coil. The method of winding is generally similar to that adopted for the choke coil. Two layers of leatheroid and three layers of 0.010 in empire cloth are first wrapped round the former. Start by passing out of the wide slot in the end A of the former a lead about 20in. long, which is insulated with a systoflex sleeve. Wind on 20 turns of conductor as tightly as possible. At the 20th turn bring out a tapping by connecting up a lead made of ½in. by 1/32in. soft copper strap as described for the secondary winding of the transformer. The lead and connection should be insulated with empire tape and brought out of the coil radially. Then wind on another 12 turns to complete the first layer of 32 turns before wrapping with a layer of 0.010 leatheroid and starting to wind the second layer back over the first.

After winding eight turns on the second layer make another tapping connection, which is also brought out of the coil radially; then wind on another 23 turns to complete the second layer of 31 turns. It will be noted that the second layer has to be wound on both sides of the tapping from the first layer. Wrap the second layer with leatheroid and, after winding 22 turns on the third layer, bring out another tapping radially. Wind on another four turns and bring out a further tapping radially. Four more turns completes the third layer of 30 turns. The conductor is then brought out of the wide slot in the end B of the former and passed into the same slot again, leaving a loop about 6in. long outside the former. This will later form a further tapping. The third layer is then wrapped with leatheroid and cords passed through the 8 narrow slots as was done over the first layer of the transformer secondary winding.

Then wind 4 turns on the fourth layer before making another tapping connection to copper strap, or looping the conductor radially out of the coil. A further 4 turns completes the fourth layer, which has only 8 turns. The cords may then be cut and looped back to secure the turns on the fourth layer, as was done for the transformer secondary. The finishing end of the winding is then brought out through the wide slot in the end A where the winding was started. Cords are then passed through the 8 narrow slots to secure the whole coil. The coil is then removed from the former, dried out, impregnated, drained and finished as described for the transformer winding.

Complete Choke Assembly

The core of the choke coil is arranged in a different manner to that of the transformer. All the I stampings are carefully laid and lined up in one stack, and the E stampings in another stack, the centre limbs of the E stampings being passed through the choke coil. Four angle pieces may be made as in Fig. 5, and the core clamped up as in Fig. 8. Each ½in. rod must be insulated from the angle iron by means of fibre bushes and washers, and must not be allowed to touch the stampings. In the case of the choke coil an air gap of approximately 0.18in. is to be left between the I and E stacks of stampings. A piece of hardboard is placed in the gap so that the two sections can be clamped together. If it is found necessary to do so, owing to the particular characteristics of the stampings used, or the way in which the coil has been wound, the choking effect can be adjusted by adjusting the length of air gap between the two core sections, a longer gap reducing the choking effect, and vice versa. A piece of 1/16in. or ⅛in. fibre should be placed between the coil and the lower angle irons.

Interconnecting Leads and Terminals

Connections between the copper strap tappings, and the square copper tapping loop(s), and the terminals on the set may be made with 6 s.w.g. square copper insulated with systoflex sleeving. The strap tappings may be cut off to a suitable length and drilled for ¼in. brass bolts. The ends should then be tinned, clamped with the brass bolts and nuts, and sweated to cable lugs into which the 6 s.w.g. connections are soldered.

A terminal panel of ⅜in. or ½in. bakelite may then be prepared as in Fig. 9. Into each of the 13 holes are to be fitted 5/16in. screwed brass rods. Nuts at the rear of the panel secure cable lugs into which the 6 s.w.g. connections are soldered. The rods are secured in the panel with brass washers and nuts, brass washers and brass wing nuts being used to secure the two copper links shown in Figs. 10 and 11, and the leads to the electrode and work. The transformer and the choke may be mounted side by side on an angle and strip iron

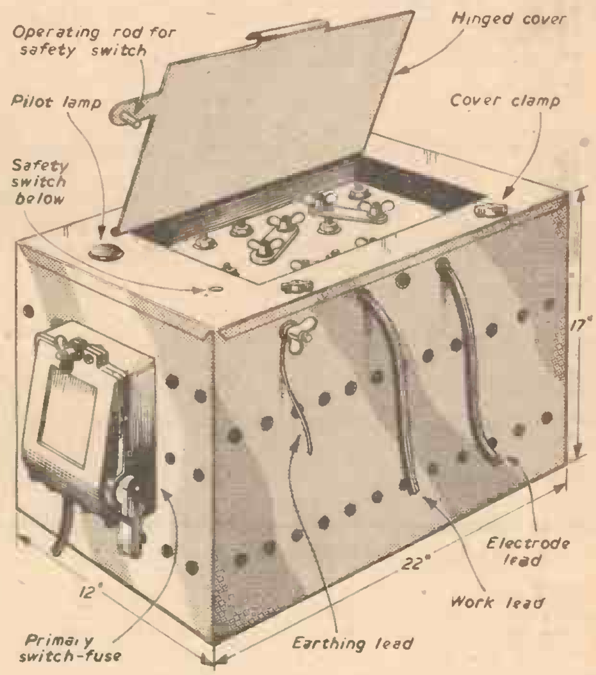


Fig. 12.—A perspective view showing general arrangement of an A.C. arc welding set.

base with the terminal panel mounted horizontally above. A sheet metal case may be made for the whole of the equipment, about 40 ½in. diameter holes being drilled round the lower part of the sides, and the same number round the upper part, for ventilation (see Fig. 12).

Controls and Connections

It is most important that no part of the conductors should be touched whilst the primary winding on the transformer is switched on. The primary winding is controlled by means of a double-pole 30 amp. 250-volt combined switch and fuse box mounted on the side of the case. It is advisable to connect a small pilot lamp in circuit (Figs. 11 and 12), to show when the main switch is on, this being protected by means of a 5 amp. Slydlok fuse in the "live" pole. The flexible cable to the work may be passed through a bushed hole in the casing and soldered into a spade terminal for connection to the terminal Z. The same method should be adopted for connecting the electrode lead to the terminal X or Y.

A hinged door may be provided in the top of the case above the terminal panel. It is best if this cover is interlocked with a switch so that access to the bakelite terminal panel is only possible when the supply is cut off. This can be arranged by fitting under the top of the case a 30 amp. single-pole switch (mains-voltage) which is connected in the "live" pole and is enclosed to prevent the possibility of it being touched. The switch should be spring controlled so that it is always "off" except when it is pressed closed by a rod or pin on the hinged cover passing through a hole in the top of the case.

(Concluded on page 202)

A Control Board for a Small Theatre

It Costs Far Less Than Its Commercial Equivalent

By A. J. M. SOANE

THIS control-board is suitable for a fairly small theatre or hall and may be built for far less than the cost of a comparable commercial model. The maximum capacity is eight 500-watt lights and the cost in the region of £35-£40. It is advisable, before proceeding far with the construction, to purchase most of the components, as various types are available and most of the drilling, etc., must be done before

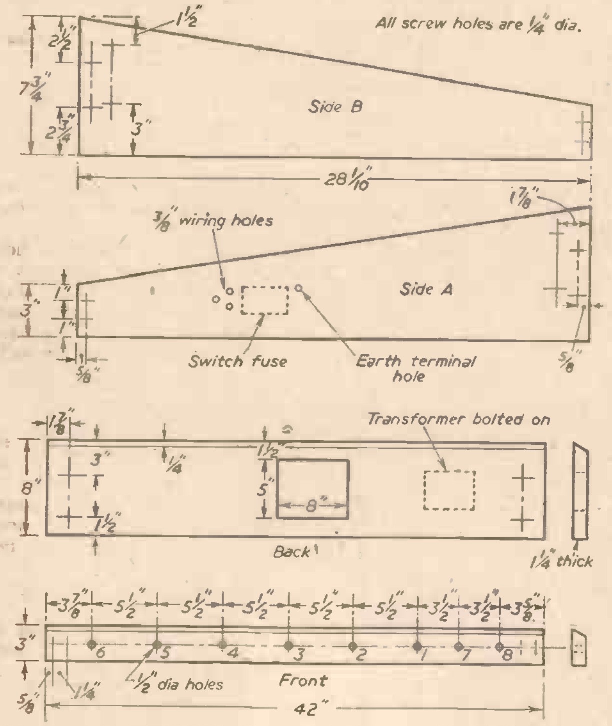


Fig. 1.—Dimensions and drilling details of the frame.

assembling any of the electrical equipment.

There are eight 3-pin sockets in the front into which are plugged the theatrical lights. Each power-point has a separate fuse and switch while six of them have 500-watt slide dimmers and, wired in parallel, 15-watt lamps mounted beside the dimmers. Thus the operator can see merely by looking at the panel how far his stage lights are dimmed. The other two points may be used either for lights or for accessories such as a tape-recorder. There is also a low-voltage circuit which is taken from a transformer.

On this circuit there is an ex-Government chartboard lamp to illuminate the lighting script, and also two miniature coloured panel-lights mounted on the board. The switches for these are two bell-pushes connected to the board by a long triple flex. Thus the stage manager may signal, in any simple code, to the lighting operator giving cues as necessary. This is useful when the operator's view is restricted or he is at some distance from the stage. On the original a multi-ratio transformer was used because a 24-volt power-point was required; however, a 6-volt power-point is useful for stage effects such as a doorbell. All the details are visible in the photograph of the completed panel, Fig. 2.

Frame

The two sides and the back and front should be cut from 1¼in. softwood and the top surfaces of the back and front planed down. as shown in Fig. 1. Holes for fixing screws are next drilled and countersunk. The ½in. holes in the front are for wires to pass through and if a large drill is not available they may be cut out with a chisel.

The douple-pole switch-fuse is mounted on side (A) and is placed in any convenient position. Bolt holes are drilled for this, and also three for wires and a ¼in. clearance hole for the common earth terminal. Holes are next drilled in the back for the transformer. To avoid any risk of overheating, ventilating holes are cut in the back and bottom. On the original,

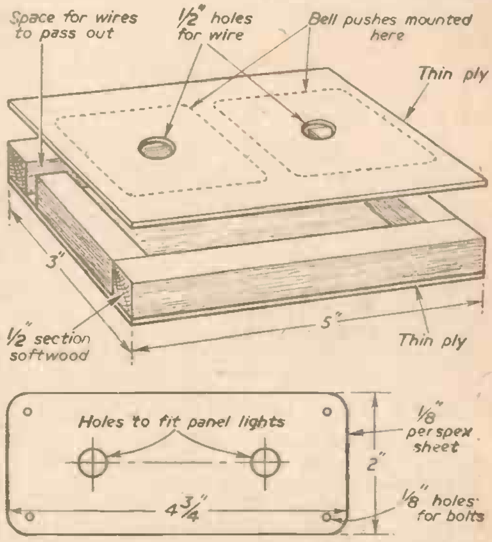


Fig. 3.—The box for mounting the bell-pushes and the plastic mount for signalling lights.

ex-Government ventilating panels were used to cover the holes. These, however, are difficult to obtain so wire gauze may be used instead.

The corners of the frame are reinforced with 1¼in. section blocks, the two at the back being 7in. high and those in the front 2½in. The frame may now be assembled using 2in. × No. 8 countersunk head screws and any strong glue. Care must be taken to ensure that the corners are at 90 deg. The completed frame is shown in Fig. 4.

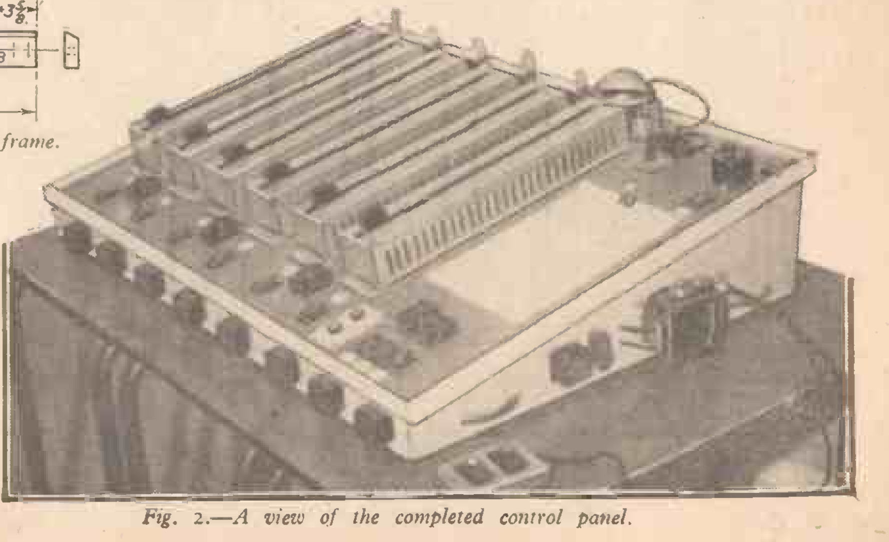


Fig. 2.—A view of the completed control panel.

A small box, as in Fig. 3, should be made from thin plywood and ½in. square section softwood. This is to take the two bell-pushes, which are mounted on top of it. The frame and small box may now be painted, using two coats of flat paint and one of hard gloss enamel.

The Top

This is made from ⅞in. thick blockboarding and the first step is to mark out the fixing positions of the components; Fig. 5 shows how this is done. The positions of the switches, fuse-holders and light sockets are given but the bolt and wiring holes will have to be marked out when the constructor has obtained the actual components. The recessed switches must be reasonably silent in action and be capable of taking a 5-amp. load. Suppliers of suitable types are given elsewhere. The light sockets should be Bakelite but if only brass ones are available then a bare copper wire should be fixed to one of the bolts holding each socket and taken to the common earth terminal. The fuse-holders are made of plastic and have cartridge-type fuses of 4 amps. each, either double or single holders may be employed.

The chartboard lamp will be found to have a large clip on the base. This is removed, leaving only the metal plate to which the rest of the lamp is riveted. Four ⅛in. holes are drilled in this and corresponding ones marked out on the top, together with a ½in. hole for wire.

If an L.V. power-point is to be incorporated, then fixing and wiring holes for a car-type 2-pin socket should be marked out. Where a 24-volt power-point is used then a 60-watt dimmer may be mounted beside the operator's lamp, as shown in the photographs. A switch is also fixed for the L.V. power-point. This may be of the recessed type but, in fact, any small switch will do.

The miniature panel lights are mounted on a piece of ⅛in. Perspex, as in Fig. 3, and a hole must be cut in the top to accommodate them. The Perspex is secured with ⅛in. bolts.

When the positions of all holes are marked out on the top they may be drilled and the ones round the edges countersunk. The various large holes are cut out with a fret-saw. The piece of blockboarding may now be treated with paint or a suitable wood polish. All the components for the top are mounted next, using 3/16in. × 1½in. bolts for the light sockets and dimmers, and ⅛in. × 1½in. bolts for all other parts except the switches which are fixed with ¾in. × No. 4 screws. All bolts and screws used are the roundhead type.

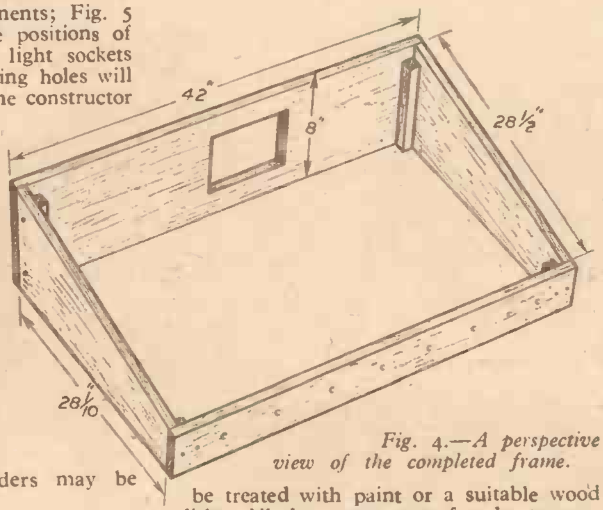


Fig. 4.—A perspective view of the completed frame.

Wiring

The wiring may now be tackled. Except where stated, all wire is 5-amp. P.V.C. covered. First wire side (A) of switches Nos. 1-9 to one side of the corresponding fuse-holders. The other terminal of the fuses Nos. 1-6 is connected to one side of each dimmer; on Nos. 7 and 8 a 12in. length of wire is fastened and the end left free, and on No. 9 a 30in. length is fixed. The second terminal on each dimmer is now dealt with. Two wires are connected to this; one goes to a terminal on each of the six light sockets and the other is a 36in.

LIST OF COMPONENTS

Electrical

6 500-watt slide dimmers.
9 5-amp. recessed switches.
1 double-pole 30-amp. switchfuse.
6 Bakelite flanged light sockets.
8 Bakelite 3-pin 5-amp. wall sockets.
6 15-watt clear bulbs.
9 Plastic single, cartridge-type fuse-holders or 4 plastic double, cartridge-type fuse-holders and 1 single fuse-holder.
9 4-amp. cartridge fuses.
1 6-volt low output transformer (see text).
1 ex-R.A.F. chartboard lamp.
2 Miniature panel lights: one red and one green.
1 Low voltage switch.
1 2-pin low voltage plug and socket (see text.)
1 60-watt dimmer.

Wire

3 yards 30-amp. heavy duty single cable.
12 yards 5-amp. P.V.C. covered single cable.
1½ yards 10-amp. single cable.
5 yards low voltage single flex.
Length of low voltage triple flex (see text).

Wood

1 piece 1½in. softwood 42in. × 3in.
1 piece 1½in. softwood 42in. × 8in.
2 pieces 1½in. softwood 28-1/10in. × 7¾in.
1 piece ⅞in. blockboarding 42in. × 31in.
1 piece thin plywood 42in. × 28-1/10 in.
1 30in. length ¾in. dia. dowel.
Various blocks and pieces of thin plywood.

Accessories

3 doz. 3/16in. × 1½in. roundhead bolts.
2½ doz. ⅛in. × 1½in. roundhead bolts.
3 doz. ¾in. × 4in. roundhead screws.
16 2in. × No. 8 countersunk head screws.
Various small screws depending on extras used (see text).
1 piece ⅛in. Perspex 4¾in. × 2in.
Plastic engraved numbers 1-9.
2 ¾in. Terry's clips.
1 2in. wide paper clip.
1 doz. rubber door stops.
Insulating tape.

Suppliers of Equipment

DIMMERS, price £3.18.0, from Major Equipment Ltd., 22 Gorst Road, London, N.W.10.

CHARTBOARD LAMP, price 14s. 11d., from Miller's Wireless Depot, 132, Leith Street, Edinburgh 1.

RECESSED SWITCHES, various prices, from London Wholesale Warehouse, 163-169, Queens Road, Peckham, S.E.15.

30-amp. double-pole switchfuse available from same supplier.

All other components available from household electrical stores and radio suppliers.

If a 60-watt dimmer is to be used then it may be obtained price 4s. 11d. from Brown's Wireless Depot, 45, George IV Bridge, Edinburgh 1.

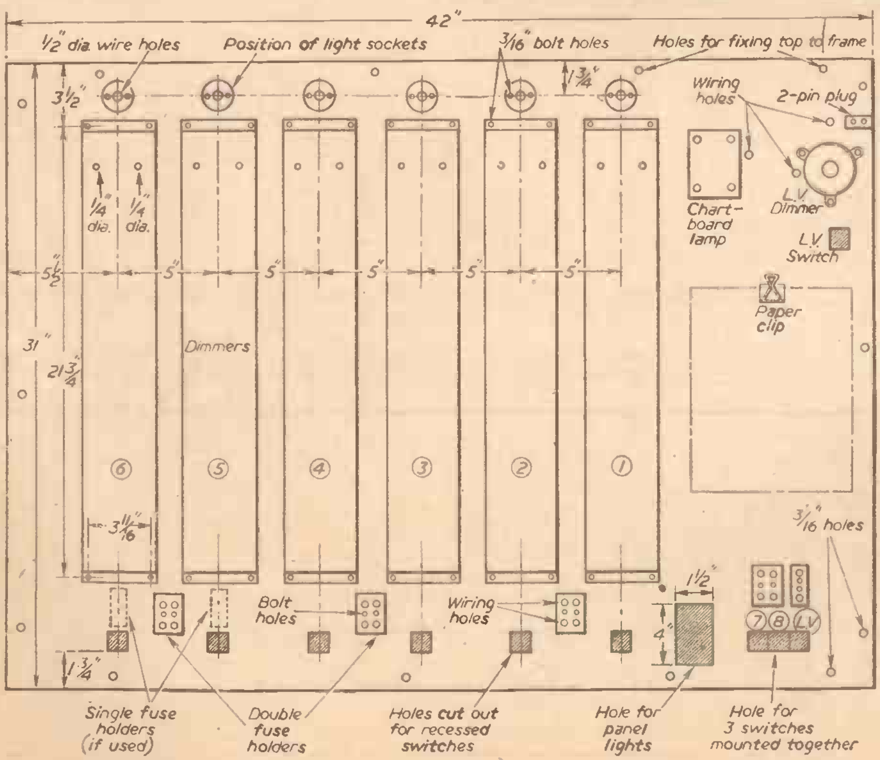


Fig. 5.—Dimensions, component layout and drilling details of the panel top.

length which will later go to the power-points.

Take a 7ft. piece of cable. Bare one end and then bare ½in. every 9½in. until there are six connectors. The bared end is put on to the free terminal on light socket No. 1 and then the wire is looped through the wiring holes in the top and a bare piece of wire connected to the other sockets in turn. The end is left free for the time being.

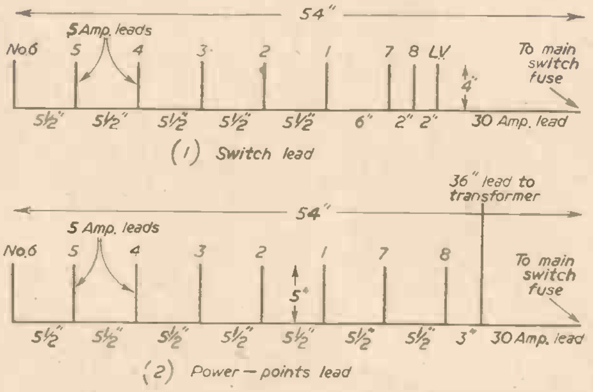
Three wiring harnesses must be made for the parallel feeds; two of these take the full load while the other is an earth wire for the power-points. The sizes of these harnesses are given in Fig. 6.

The main cables in the switch and power-point feeds must be capable of taking at least 30 amps., and the earth lead about 10 amps. The amount of wire to be bared in all cases is about ½in. The short feeder wires must be twisted or bound with fine tinned wire to the main cables, then soldered and well taped. The harness for the switches is next fixed in and the top screwed on to the frame with 2in. × No. 6 screws. At this point four large rubber door stops should be screwed to the back so that the board may rest on them while the wiring is finished. It is also handy to store the board resting on its back.

The power-points are now wired on, a feeder from the mains harness being taken to one side of each. The long lead from the light sockets is taken to point No. 6. To the other terminal on power-points Nos. 1-6 is connected the lead from the corresponding dimmer, and on points Nos. 7 and 8 this terminal is wired direct to the appropriate fuse-holder. When the earth harness has also been connected up, the power-points are screwed on to the front.

The long lead still left on the mains power-points harness is soldered to one side of the transformer and the lead from the L.V. fuse to the other. The ends of the mains feeds are taken to the D.P. switchfuse; while the earth from the power-points and, if there is one, the earth from the light sockets, are soldered to a large tag and fixed to a ¼in. × 2in. bolt which forms the common earth terminal. This bolt is not insulated.

The L.V. wiring should now be completed. The two wires from the operator's



(3) Earth lead for Power—points. Same as (2) but without the transformer lead

Fig. 6.—Details of the wiring harnesses.

lamp are soldered to the transformer along with the wires from the L.V. power-point. The circuit for the panel signalling light should be made from thin flex and soldered as shown in Fig. 7. The triple flex to the bell-pushes goes out the side of the box and is long enough to suit the theatre or hall where the control-board is to be used.

The bottom, which is made of thin ply, may now be screwed on after a ventilation hole has been cut and suitably covered. Eight rubber door stops are screwed on to the bottom, round the edges, in order to allow air to circulate.

The final accessories are now added.

To operate all six dimmers simultaneously a 30in. length of ⅜in. dia. dowel is used to push the slides up or down. This is kept on side (B) by means of two spring clips. Just below the chartboard lamp a 2in. wide paper clip is screwed on. This is to hold script sheets. In order to facilitate operating the board small plastic numbers may be fixed above each switch. These numbers are the same as those given in the drilling diagram (Fig. 1). Four strong carrying handles should be screwed to the sides if the board is to be transported frequently as it is rather awkward to carry.

Operation

When up to 2,500 watts of power are being taken from the board a 15-amp. mains power-point is suitable for operating from: however, if the full capacity of 4,000 watts is used, either a 30-amp. mains feed is required or two 15-amp. power-points taken in parallel. The main cable to the board should be heavy duty triple: the earth lead on it is soldered to a tag which is taken to the common earth terminal.

MECHANICAL HEART

An artificial heart has been used in experimental animals in the U.S.A. So far it has only taken the place of the right side of the heart, but the ultimate aim of the experiments is permanently to replace the heart inside the body. The device is an electrically driven pump, which weighs 3lb., is 7in. long and 2¾in. in diameter and is encased in plastic. When used on the experimental animals the electro-mechanical pump was placed in the abdomen as there it does not interfere with the respiratory function. A polyethylene tube leading from the heart to outside the body supplies the electricity which powers the pump that works at the rate of 40 to 180 strokes per minute. The rate is varied by changing the voltage. The artificial heart has a small cup-like lucite pump attached to a diaphragm constructed of rubber and stainless steel. The back and forth motion of the machine oscillates the rubber diaphragm against the rigid steel diaphragm.

So far the longest period for which the substitute heart has been used in an animal is 10½ hours.

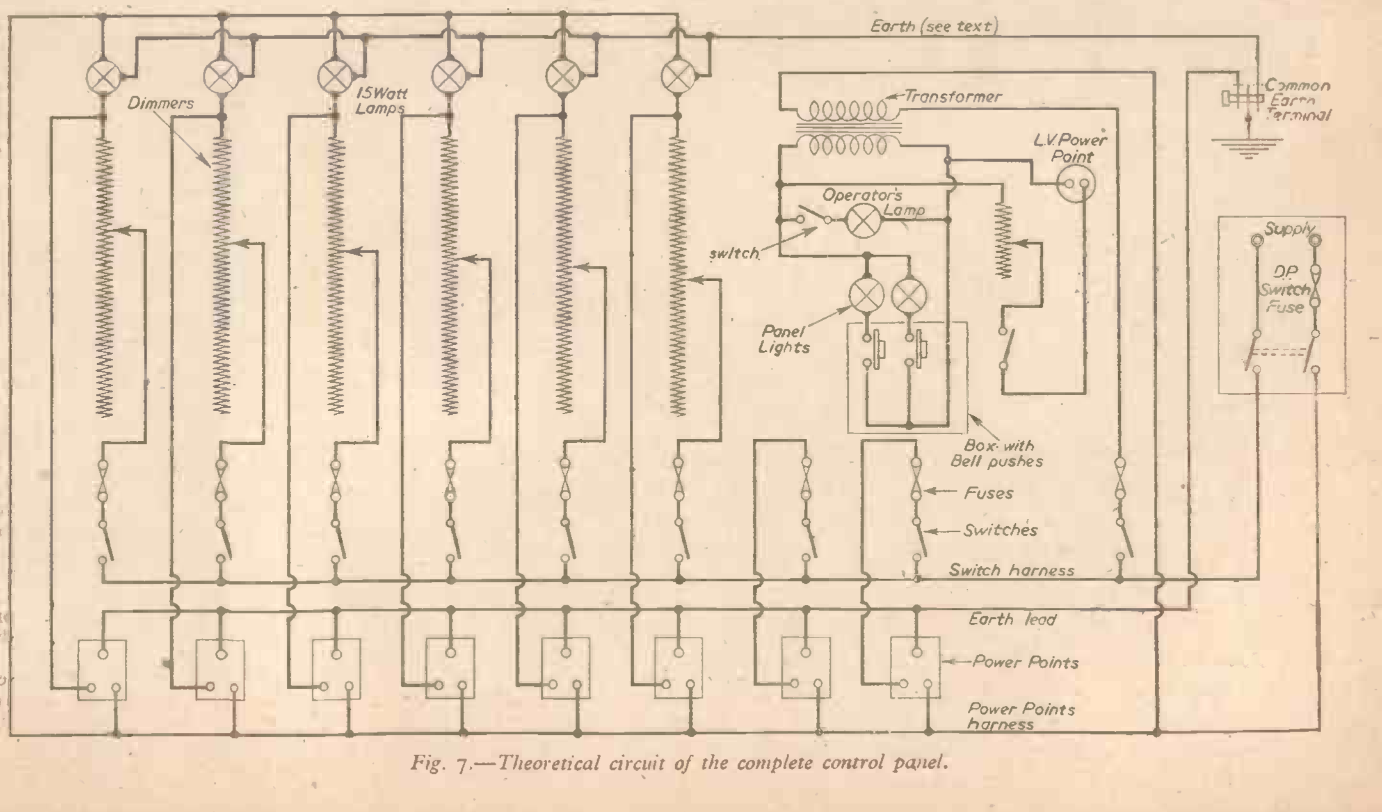


Fig. 7.—Theoretical circuit of the complete control panel.

A CINÉ TITLER

By J. Drummond

A Commercial Ciné Titler Which Costs Shillings Instead of Pounds

THE titler shown in Fig. 1 is completely made of wood and the sizes shown in the cutting list will give a guide only, as dimensions need not be strictly followed.

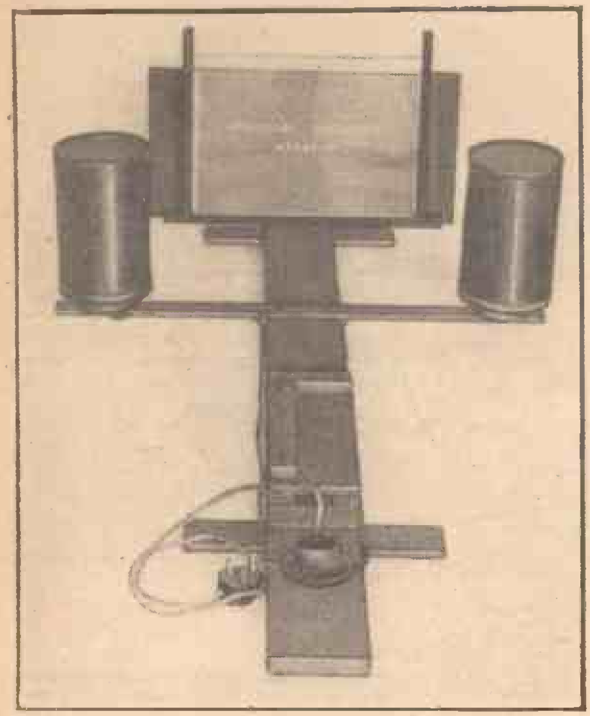


Fig. 1 (Left).—The completed titler.

Construction

The base was made from thick, seasoned wood in order to prevent warping and on its underside two crosspieces to form the feet were attached. These were put on so that rocking would not occur when the titler was placed on an uneven surface. A wooden block, approximately 2in. high, supports the camera; the other sizes depend on the type of camera. Alternatively a platform can be fitted with a fixing screw into the camera tripod bush. The distance of the platform from the title board in the prototype was 2ft. as this was the camera's lowest focusing distance. This will vary from camera to camera and also if a close-up lens is used.

WOOD CUTTING LIST

Base: 3½in. × ⅞in. × 36in.
Feet: 2in. × ⅞in. × 10in.—2 off.
Batten strip: 1½in. × ⅜in. × 22in.
Camera platform: 2in. high block.
Positioning pieces: Approx. 12in. of stripwood.
Title board support block: 1½in. sq. × 3½in.
Title board: 10in. × ⅜in. × 13in.
Approx. 32in. of 1in. × ½in. grooved stripwood.

The grooved stripwood (from a craftshop) was screwed to the title board, the distance between the vertical grooves being 12in. This gave ample clearance all round the title even using a 16mm. camera. An 8mm. user can make a smaller board. A block is fitted as a support to keep the title board vertical. A further strip to hold the batten-holders is fixed about 12in. from the title board. This strip, the board and camera platform should be squared off as they must all be exactly parallel to one another.

Electrical Equipment

Fig. 1 shows the strip supporting two battern-holders which have household tins—half cut away—as reflectors.

Fig. 3 shows the very simple electrical circuit which is essentially two lamps connected in parallel with a switch in circuit.

Every piece of the apparatus in front of the camera lens is painted with matt-black (obtainable from any photographic shop) in order to prevent reflection. The prototype titler was painted black to enhance its appearance but there is no photographic need for this.

Photofloods must be used for colour film titling otherwise under-exposure will result.

With experience you may wish to move the batten-holders nearer to the title or the reflectors farther in towards the centre of their support strip. It is therefore well worth while to run a few feet of old film through your camera to check your work.

Lining Up the Camera

The camera is placed on its platform, the lens being its working distance from the title board and centred with it. When this has been done stripwood is screwed into place on the camera platform, as shown in Fig. 2. This is all that is required for future placing of the camera in position.

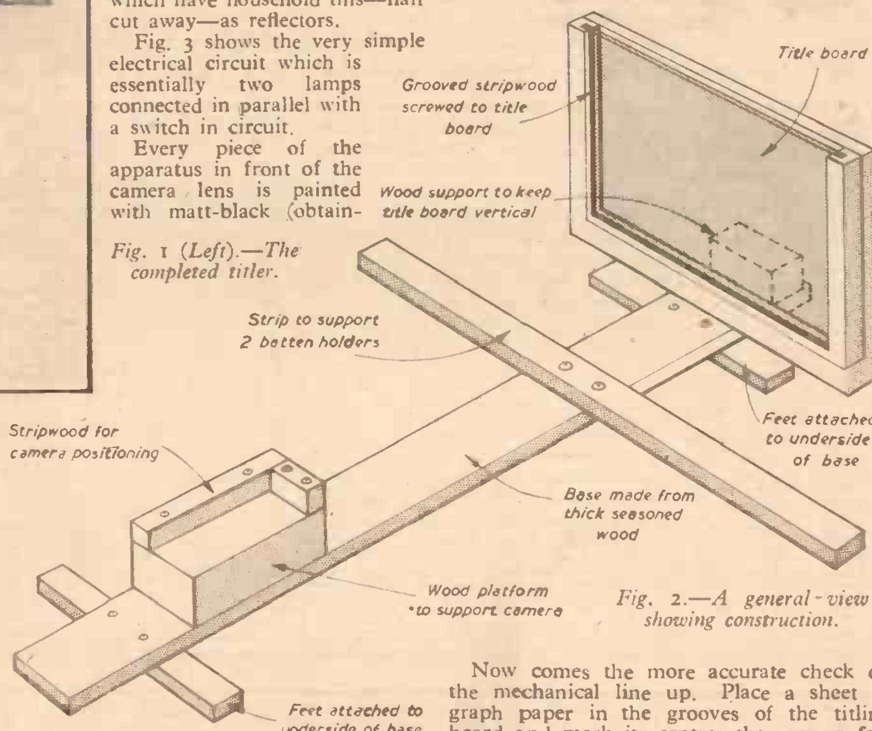


Fig. 2.—A general view showing construction.

Now comes the more accurate check on the mechanical line up. Place a sheet of graph paper in the grooves of the titling board and mark its centre; then run a few feet of film through the camera. The author used ex-W.D. negative stock. Roughly develop and fix the film then project the results. This will check your mechanical measurements. If the second centre is now found to be different from the original then mark off this new centre on the title baseboard.

The area covered by the camera is less than that shown on the screen by your projector due to masking. The test graph will guide you on this if distances are marked off from its centre and checked when screened.

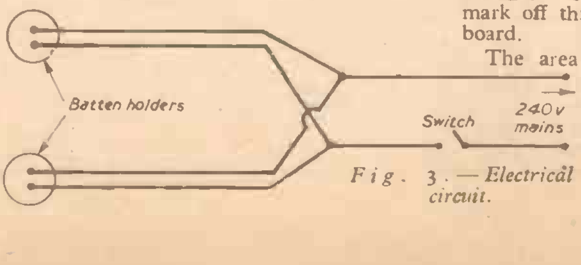


Fig. 3.—Electrical circuit.

Making a Sunclock

By E. Rolfe Hunter

A Simplified Version of an Extremely Accurate Type of Timepiece

Fig. 1.—An artist's impression of the completed sunclock.

SUNCLOCKS of this type were in use on some French railways as recently as the turn of the last century. Carefully machined and fitted with a vernier, they were extremely accurate. The type shown in Fig. 1 follows the general construction of these instruments, but is of simple design. The completed sunclock may be mounted on a brickwork or stone pedestal. The top of the pedestal must be level and when *in situ* the baseboard on which the instrument is mounted must be perfectly horizontal.

The Three Main Parts

There are three main parts: the meridian-arc, the hour-arc and the stylo wire. The meridian-arc is cut from a sheet of 3/16in. brass and filed to the measurements shown in Fig. 2. The partly circular portion is drilled to take a short length of ¼in. brass rod threaded to take a butterfly nut at each end. Each nut has a washer. This brass rod forms the pivot about which the meridian-arc can be tilted to the required latitude, i.e., the latitude of the site. The partly circular portion is graduated to read from a line scribed on the face of one of the supporting brackets, 90 deg. when the stylo wire is completely vertical to the base board, and corresponding angles between the limits of 50 deg. and 60 deg. (roughly the limits of the British Isles, in parallels of latitude). The ends of the arms of the meridian-arc carry narrow saw-cuts into which the stylo wire can be pressed and afterwards neatly sweated into place. The saw cuts should be no deeper than the thickness of the wire, and must be equidistant from the sides. In fitting the stylo wire, it must be stretched tautly across the space between each arm of the meridian-arc, first securing one end in the manner described. In effect, the stylo wire when in position exactly bisects the circle of which the meridian-arc forms one half, and the radius of which is 2½in. The wire should be as thin as practicable, and made of copper or brass.

The Hour-arc

The hour-arc is made of 1/16in. brass carefully formed into a curve of radius 2½in. The curved strip is laid upon a sheet of white cardboard on which has been drawn a similar curve divided into radii each of which is 15 deg. apart (see Fig. 3). These may be sub-divided into smaller units, remembering that 1 deg. of arc equals four minutes of time. The points where these radii cut the edge of the brass arc are then transferred to the brass arc and cut with a scribe or sharpened hacksaw blade in the form of vertical lines on the inner surface. The hour-arc should extend for a little beyond the two end incisions, i.e., beyond the 4 a.m. and 8 p.m. lines. The completed hour-arc is then fitted into the recess cut in the meridian-arc and sweated to two brass angle-pieces.

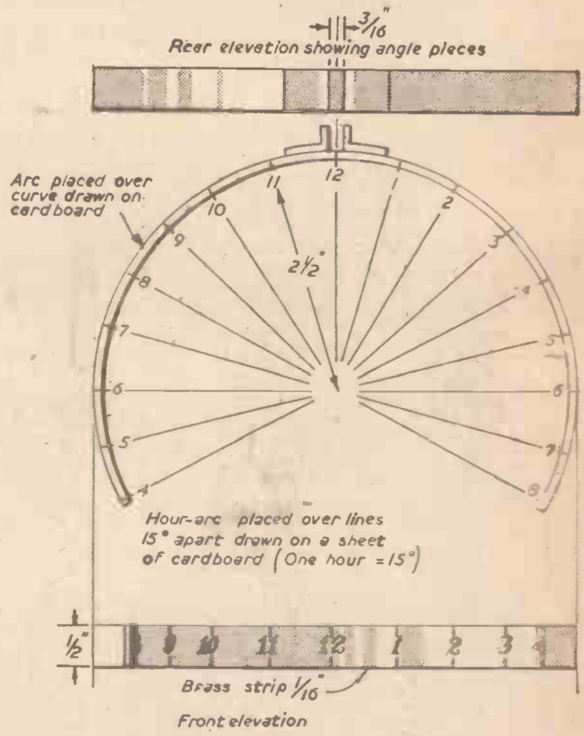


Fig. 3 (Right).—Three views of the hour-arc.

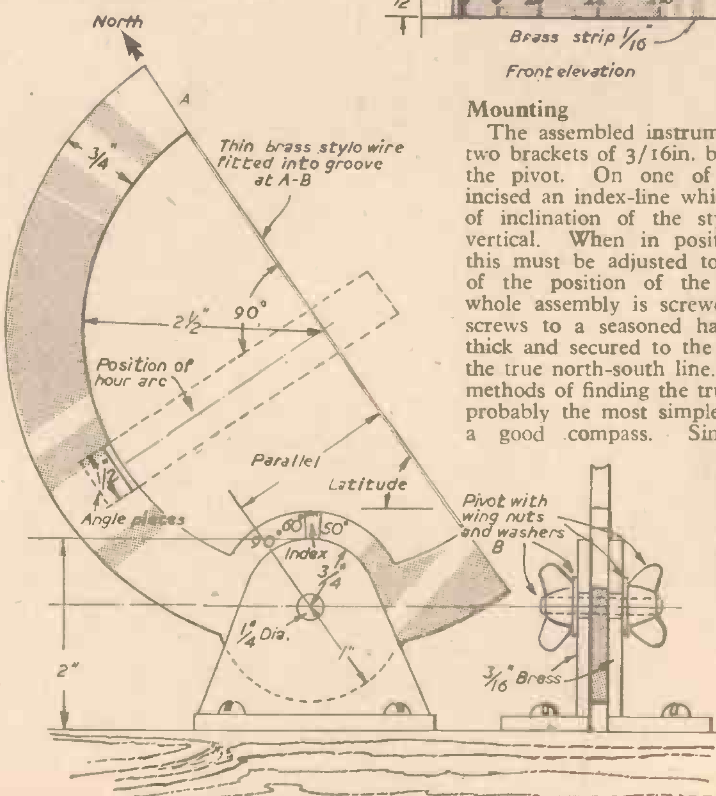


Fig. 2 (Left).—Details of the meridian-arc.

Mounting

The assembled instrument is mounted on two brackets of 3/16in. brass, drilled to take the pivot. On one of these brackets is incised an index-line which shows the angle of inclination of the stylo wire from the vertical. When in position ready for use this must be adjusted to show the latitude of the position of the instrument. The whole assembly is screwed with four wood screws to a seasoned hardwood base 1½in. thick and secured to the pedestal exactly in the true north-south line. There are several methods of finding the true north-south line, probably the most simple of these is to use a good compass. Since, however, the compass points to the *magnetic*, not the *true north*, a correction must be applied. This correction is called variation, and the amount of variation can be read from an ordnance survey map. As a matter of fact, in 1959 the variation in Great Britain will be 9½ deg. west. This simply means that the compass-needle or card lies with its north point 9½ deg. to the west of the true meridian. Thus the stylo wire must lie in a plane 9½ deg. to the east of the compass meridian.

It must be understood that the instrument here described, like all sunclocks (and there are at least half a dozen different types), shows local apparent time, or time by the true sun. Since the "movement" of the sun is not quite uniform from day to day, a correction must be applied to sunclock time to give local mean time—or time by the *mean* position of the sun. This correction is to be found in a copy of a nautical almanack drawn from your local reference library, it is shown from day to day throughout the year and is always plus or minus to sunclock time. It is called the "Equation of Time."

Having found local mean time, and wishing to calculate G.M.T., a further correction, equal to four minutes of time for every degree east or west of Greenwich, must be applied. This correction is *plus* to local mean time if the sunclock is east of Greenwich, and *minus* if the sunclock is to the west:

Example: Sunclock time 12.30 p.m. Date: May 2nd. Eq. of time (Nautical Almanack table) −3.1 minutes.

Equation of Time 00.3.1 (minus)	
Local Mean Time	12.26.9 p.m.
Longitude 1 degree 35 mins. West	00. 2.3 (minus)
G.M.T.	12.24.6 p.m.

From this simple calculation it will be seen that, working backwards, the same data may be used for finding the true meridian; given G.M.T. and comparing it with sunclock time. Another method of finding the meridian might be to rotate the meridian-arc in such a way that the stylo wire can be used to take a sight of the Pole Star by pointing it as accurately as possible at it.

MAXIMUM SPEED DEVELOPERS

H. A. Robinson Tells You What These Remarkable Developers Will Do

A GREAT weapon has been put in the hands of the amateur in his battle against poor lighting—"maximum speed" developers. These have the effect of making a film or plate, in effect, far more responsive to the light which falls on it than if developed in the usual solutions. Thus one of these preparations gives an increase in responsiveness of three to four times, five if one does not mind a slight dropping off in the quality of the negative.

Less Light Required

From a practical point of view this extra response means that a good picture can be obtained with three to four times *less* light than would be necessary if using ordinary developers. The light when exposing can be considered three or four times brighter than it actually is, or, again, the extra power can be regarded as making the film three or four times faster than its rated speed.

Solutions for giving a film or plate a "speed" it does not normally possess have been known for a long time, but their use has often resulted in poor quality negatives with graininess and a clogging of the highlights.

With the maximum speed developers these troubles have been overcome to a remarkable degree, and the products on the market give fine grain, good detail in the shadows and no clogging of the highlights. This is brought about by a property these developers have of building up the highlights just so far, and then stopping their action. Work on the shadow detail continues for quite a while longer and to a marked degree, for these developers are very energetic.

The net result of the actions is a negative well balanced and approximating to a better exposed film or plate developed in the usual way. With these outstanding traits maximum speed developers are ideal for times when negatives have, due to prevailing conditions, to be under-exposed.

Types Available

Four of these wonder-working developers are Capitol, Ergol, Promicrol and Microphen. Capitol is bought as a concentrated solution, but the three others are sold as powders. Capitol, Ergol and Microphen are regarded as a little more energetic than Promicrol, but all have their own characteristics.

Capitol gives most photographic emulsions a 200 per cent. to 300 per cent. increase in effective speed, while with certain films and plates a 400 per cent. to 500 per cent. increase can be obtained.

All maximum speed developers are best used in a tank where greater dilution is used and the times of immersion can be well followed. Also with a tank the development is in total darkness throughout which is a good point as the purpose of these developers is to reduce every bit of light-struck silver and dark-room lamps are not always as safe as they should be under conditions of high sensitivity.

The other developers named all fall more or less in line with Capitol inasmuch as they are finished articles and do not need any additions. Also they should not be used with desensitisers—another reason for always using a tank.

Maximum speed developers have the advantage of keeping well in concentrated forms, but a diluted bath should be thrown away after it has been once used. The main difference in the various brands is the difference in the additional speed given and degree of grain produced under similar conditions of working.

Characteristic Negative

A negative developed by these developers has a special look of its own. The overall appearance is that of good balance and even softness with some subjects. The shadows are well filled with printable details, while the highlights which so often go opaque in under-exposures are quite translucent and retain all the finer gradations of such parts.

The special characteristics of these developers can be put to other uses apart from bringing up absolute under-exposures. Thus for sports they allow of a much higher shutter speed being used for any particular light than that given by the charts, or, indeed, that would otherwise be even possible. Also if the light is good enough for a picture to be well exposed in the ordinary way then the extra developing power allows of putting in a smaller stop, so increasing the "depth of field" (the distance from the nearest to the farthest point of good definition) and improving the crispness of many less expensive lenses.

These developers also make possible the taking of indoor shots by normal room lighting. Indeed, excellent pictures have been obtained in well-lit rooms at 1/25 second exposure using films no faster than 29° Scheiner.

When used in conjunction with super speed film, the maximum speed developer can produce photographs by candle-light.

With Fast Film

Using super-speed film in the neighbourhood of 35 deg. to 37 deg. Scheiner and forcing development some rather remarkable results in the way of clipped light and clipped exposure pictures can be secured. Look at the accompanying photograph. This was taken by candle-light only, the candle being seen burning in the foreground. The exposure was 1/25 second, film speed 37 deg. Scheiner and stop f3.5. Development was extended to about twice the standard time, using Capitol.

This picture was, of course, only an experiment but it gives some idea of what maximum speed developers can do. Forced development is not recommended as a usual thing, but experiments show that films and plates can be left in these solutions for quite a long time without coming to harm if the exposure has been sufficiently short.

Night Street Scenes

Another use for these developers is to enable the photography of street scenes at night with a fast shutter speed so that moving items can be included. Maximum speed developers are essentially for "clipped" exposures and will make a film that is already well exposed, and which would come up in any ordinary developer, seem very badly over-exposed.

A Model Glass Fibre Catamaran

By T. C. Nicholls

Make This Model For Your Children !

AN overall length of 24in. was decided as convenient for handling, yet large enough to sail on fairly choppy water and photographs of a commercial full-size catamaran were scaled to give approximate working dimensions. These dimensions are given in Fig. 1.

The hull is of course hard chine which planes much more easily than the normal section and in the case of a catamaran which sails almost vertically, has every advantage.

The sides are parallel and the pattern, which is in two pieces, has its joint face $\frac{1}{8}$in. below the top of these vertical sides, this ensures a snug fit of the glass fibre decking on the $\frac{1}{4}$in. square longerons.

The Hulls

The two halves of the pattern can be made from any kind of timber, softwood is perfectly satisfactory, but the finish should be as smooth as possible as this governs the finish of the glass fibre hulls.

These hulls can be made, as the prototypes were made, direct from the patterns but the external finish will not be perfect due to overlapping of the laminations of glass fibre. If it is decided that a perfectly smooth external finish is worth the additional expense, one hull should be made up and the two sections, i.e., hull and decking, should then become the female mould, more glass fibre being applied to the inside. Fig. 2 shows a completed hulls.

The Keels

Two keel members should be made from $\frac{1}{4}$in. thick mild steel plate to the dimensions shown in Fig. 3 and the hull pattern should be slotted to a depth of $\frac{1}{2}$in. to receive these with an easy sliding fit. An easy way to cut this slot is to drill a series of $\frac{1}{4}$in. dia. holes using a piece of tubing over the drill as a depth gauge, and then traverse these with a $\frac{1}{4}$in. reamer in an electric drill.

The patterns should now be given two coats of varnish which when dry should be rubbed down with fine wet and dry emery paper to a perfectly smooth finish. They should then be well waxed using a tallow candle in order that the glass fibre resin will not adhere to them. This waxing must be carried out before each glass fibre component is applied.

It is suggested that if you are inexperienced in the use of glass fibre you start on the decking mould as this is the simpler of the two. Cut the glass cloth so that it overlaps the mould by about $\frac{1}{2}$in. all round and build up five laminations. This will

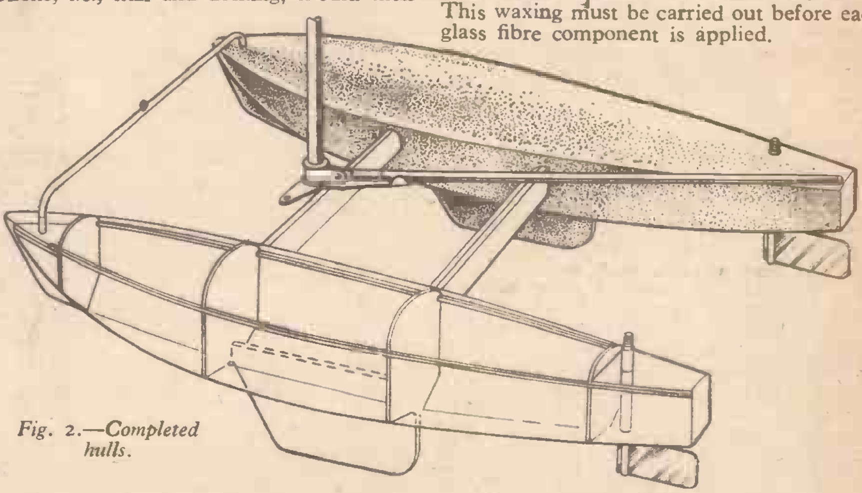


Fig. 2.—Completed hulls.

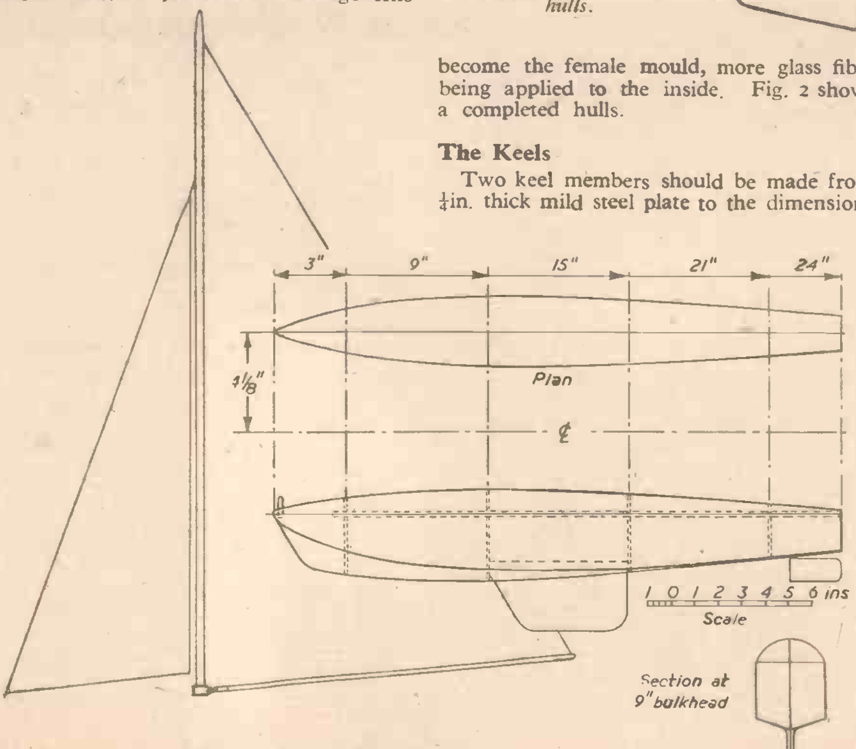


Fig. 1.—The working dimensions.

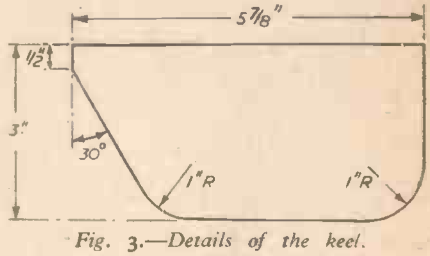


Fig. 3.—Details of the keel.

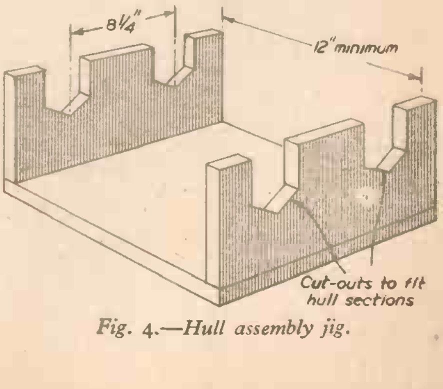


Fig. 4.—Hull assembly jig.

give a finished thickness of approximately .040in. using .007in. glass cloth and is of ample strength. When the component is completely hard; and the time this takes varies considerably with the type of resin used, the amount of the accelerator and the temperature; the overlapping portion can be cut off using tin snips, and the remainder trimmed absolutely flush with the face of the mould with a fairly smooth file. Light thumb pressure will now part the component from the mould.

The main hull should now be made in a similar manner except that one of the keels should be inserted in the slot and a fillet of modelling clay pressed round the joint between the mould and the keel. The glass fibre is moulded over the whole keel and the modelling clay can be scraped out when the hull is removed from the mould.

The whole procedure is then repeated for the second hull.

Bulkheads and Longerons

Bulkheads at stations 3in., 9in., 15in. and 21in. should now be made from 1/8in. thick plywood and these must be a good fit in the hull. The longerons are made from

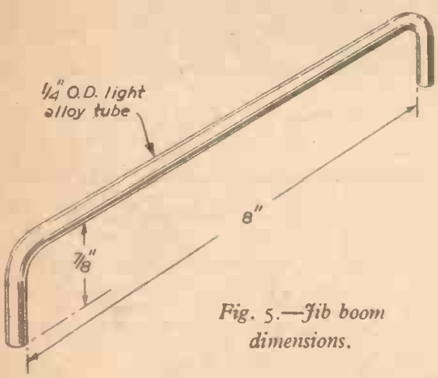


Fig. 5.—Jib boom dimensions.

1/4in. square hardwood and extend from the rear to 1/2in. forward of the front bulkhead. These are now fitted into the hull, using model aircraft cement. Small local deckings are to be made from 1/8in. thick plywood to extend forward from the front bulkhead and aft from the rear bulkhead. The front one is cemented under the longerons and the rear one on top of the longerons.

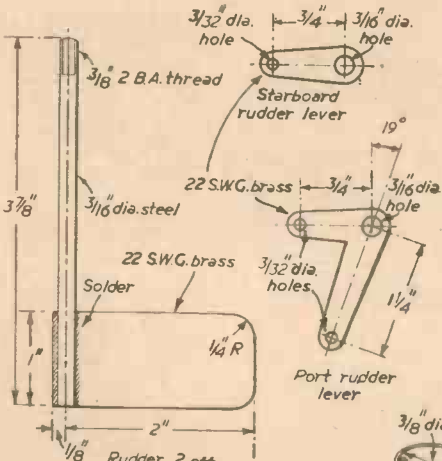


Fig. 6.—The starboard and port rudder levers.

Hull Assembly

The next step is to make the assembly jig shown in Fig. 4, and this is an absolute essential to ensure accurate alignment of the two hulls.

The two connecting booms are of laminated construction, consisting of 1/8in. thick plywood faced fore and aft with 3/8in. half round capping strips. The plywood section is fitted first, cemented to the forward face of the 9in. and 15in. bulkheads. The front capping strip is then cemented on the front face of the plywood strips.

All is now ready for the two decks to be fitted, but first their inboard sides must be cut away to clear the booms, this must be done carefully to leave as little clearance as possible.

The two decks are now fitted and after clamping down are cemented together using the resin compound. Fillets of glass cloth are cut and fitted round the joint between the booms and the decks.

The capping strip on the after faces of the booms can now be shaped to a snug fit round the decking and cemented in place.

The Jib Boom

This is made from 22 s.w.g. 1/4in. outside dia. light alloy tubing as shown in Fig. 5 and 1/4in. holes are drilled through both the glass fibre and plywood deckings 3/4in. back from the nose. This again should be cemented in place using the resin compound.

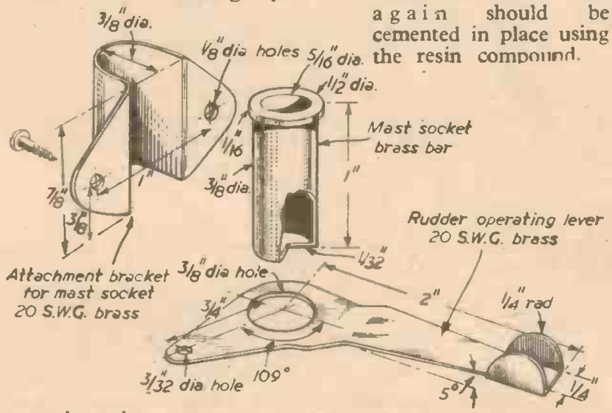


Fig. 7.—Details of the attachment bracket, mast socket and rudder operating lever. Assembly instructions: (1) Fit rudder operating lever on mast socket; (2) solder attachment bracket to mast socket, making sure lever rotates freely; (3) screw assembly to forward face of forward hull boom.

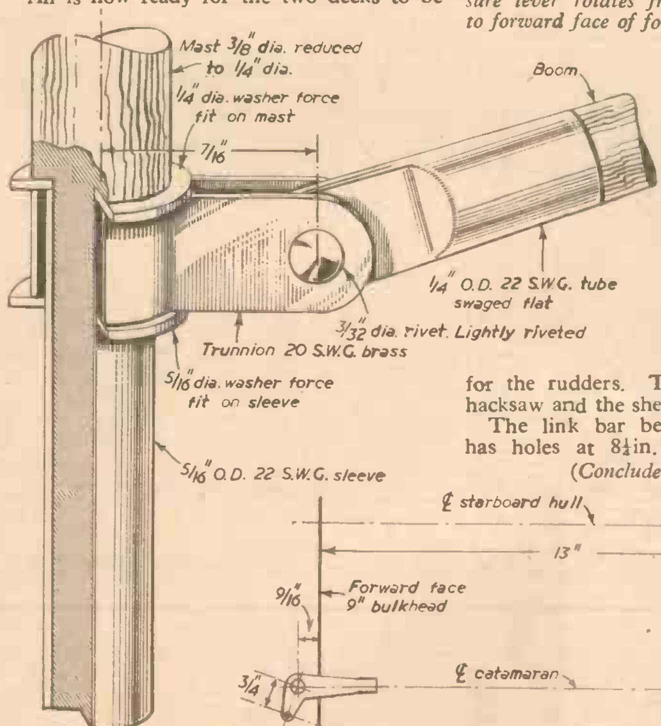


Fig. 9 (Above).—The swivel joint for the mainsail boom.

Fig. 10 (Left).—The finished model.

The Rudders

The two tubes for the twin rudders are made from 3/16in. bore brass or copper tubing and are fitted in a similar manner to the jib boom, projecting 1/8in. top and bottom.

The rudders are dimensioned as in Fig. 6, 3/16in. dia. mild steel rod being used for the posts and 22 s.w.g. brass sheet for the rudders. The posts are slit with a hacksaw and the sheet brass soldered in place.

The link bar between the rudder levers has holes at 8 1/4in. centres. The link bar

(Concluded on page 182)

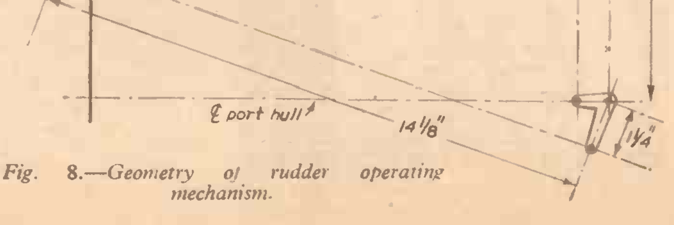


Fig. 8.—Geometry of rudder operating mechanism.

Moulding & Decorating with Paper

A Few of This Handicraft's Applications are Described By An Expert

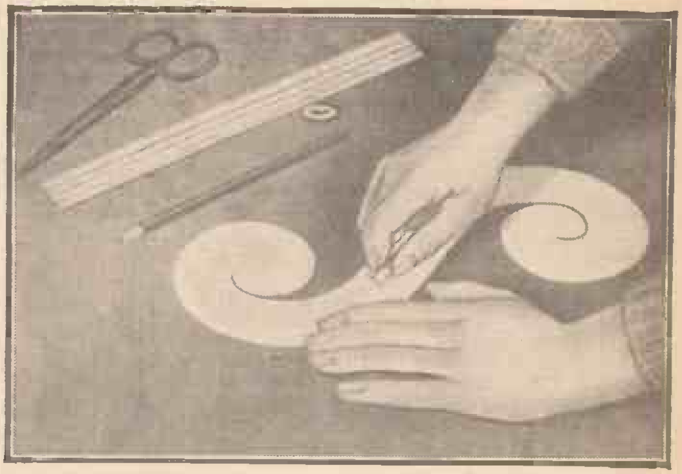


Fig. 1.—Scoring a cut-out paper scroll for decoration.

PAPER sculpture is the name given to the manipulation of paper, the results of which can be seen in display work, design and decoration. It is, perhaps, the least costly of the handicrafts, and while it has its foundation in paper or board, such items as lace paper, doyleys, paper serviettes, cake bands, gummed strip, fancy papers and other paper accessories, can all aid the worker engaged in paper sculpture.

Paper Manipulation or Treatment

Paper sculpture, as the name suggests, is the product of paper, fashioned and shaped to give dimension. This is obtained by bending, folding, rolling, scoring, corrugating, curling and pleating paper to give tone, effect, shape, highlight and life to the finished work. The main materials required are white or tinted paper of a thick variety such as cartridge, thin white board such as ivory or Bristol, corrugated paper, if available (otherwise it can be quickly made up in this fashion), a pair of scissors, a sharp knife, ruler and set square, some adhesive and sticky tape, pencil, rubber, pins and some form of decorative medium, i.e., crayons, paints, coloured paper or transfers.

Fig. 2.—The method of marking out two scroll designs and the results after cutting and moulding.

Certain effects are obtained by the use of a smooth surface, while papers with rough surfaces give an antique finish to the work. Small units or designs are best made up with thin paper while the larger display pieces may be made from thicker paper or thin board material. While the greater part of paper sculpture is produced from white paper, colour is sometimes introduced for some part of the motif, particularly in the case of decorative floral motifs.

While working with paper, particularly white, it can become soiled by the fingers, but there are certain types of paper which do not mark. Some are also damp-proof and waterproof, a feature required in outdoor display work. Such papers as flints, metal papers, foils, parchments, wood grain papers, matt surface poster papers, do not mark, are easy to manipulate and are readily obtainable in the handicraft stores. Papers are obtained in sheet or roll form, the latter being very useful for large jobs and decoration.

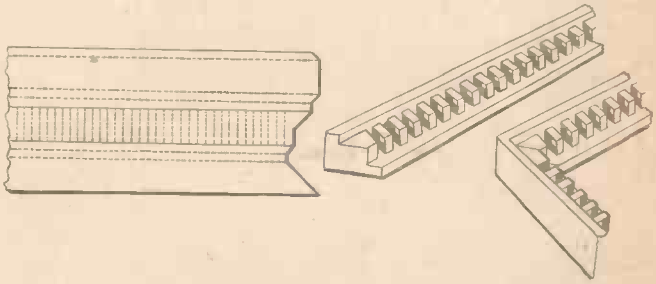


Fig. 3.—A paper moulded frame.

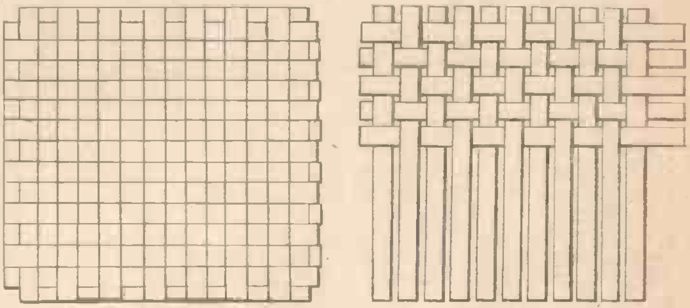


Fig. 4.—Thatching and weaving with ¾in. strips of white or multi-coloured paper.

Bending paper gives roundness to a finished shape while folding gives dimension. When bending paper it must be rolled in the direction of the grain of the material, otherwise a perfect roll may not be possible, and cracks or breaks may occur, or the paper may fold up in ridges. Paper may be bent to give an arc and may be folded to give transition from one level to another. A similar result is possible by scoring. Scoring and folding play an important part in paper sculpture and are the basis of many motifs. Corrugation is obtained by folding paper or thin card backwards and forwards; this gives effect and highlights. Curling is carried out by drawing paper under pressure (a ruler is ideal for the work) and pulling the cut strip upwards. Paper so treated is much more flexible to work and fashion. By repeating the pull under a ruler on the opposite side, a wavy effect is obtained. This is similar to the wavy corrugation seen in lampshades. The paper fan is a good example of first steps in paper sculpture. Here, a piece of paper 15 in. long × 9 in. wide is scored with vertical lines ½ in. apart. Pencil lines first drawn are a good guide and the score lines should not be pressed home too deeply as the paper will be weak at this point. When the paper is folded backwards and forwards the fan shape will be produced. Pinching one end of the pleated sheet will complete the popular fan.

Paper Scrolls

Paper curling and bending will assist in the making of tubes, cylinders, pillars and supports, which are often components of complete motifs or decoration. In the scrolls, curved lines are involved and a compass can help in forming a pattern or design. Such motifs may be used in connection with many kinds of ornamental work, the volute of the Ionic and Corinthian capitals and for ships' figureheads. Sometimes called Baroque shapes, such curves are most attractive. In the early stages of such motifs a pencil should be used to sketch out basic designs to follow for scoring (see Fig. 1), and finally bending to shape. Cutting is done freehand, thicker lines being taken as a guide. Dotted lines often help to distinguish between score and cutting lines. In the paper scroll the inner lines are lightly drawn as the paper is folded here. These points are illustrated in Fig. 2. It will be found that two hands are required, one to hold the paper and the other to design. Both will be used for folding. The shapes are finally moulded. Four of such motifs make first-class corner panels in a framed display.

Moulded Framing

Few pieces of paper sculpture are so effective as the moulded frame. Made from stiff paper or thin card it will stand up to considerable handling in display work. Such work could be used to represent the small blocks or projections in the bed moulding of the corbels of columns in stage and theatre work. In the planning of models of buildings and toy model stations the moulded style as used in the frame is appropriate. The work involves accurately drawn lines, clean cutting and shaping. This frame style is made in four pieces, and attention should be paid to the mitred corners and their joints so that a really good job will result. In Fig. 3 it will be seen that the material has been marked out with vertical lines and these are cut right through while horizontal lines crossing them must be half cut or deeply scored on alternate sides of the thick paper or board used. The material is bent or fashioned, after cutting, and it must be bent away from the half-cut or deeply scored surface. In phase two, it will be seen that in one section of the frame cutting has been finished after folding, the ends joined by staples fixed at both ends of the work.

The third phase of the work is the joining together of two separate sections at the mitred corners and using some reinforcing material to give added strength at these points. White adhesive tape to harmonise with the white paper used is best. Where a frame is being made up, four sides will be necessary and all four pieces or sections are fixed together with a plain stiff base-sheet or card at the bottom, thus making up the completed frame. All sides are fashioned or moulded carefully by hand after cutting, scoring and mitreing.

Finished frames of this kind can house floral decorations or cut out paper shapes.

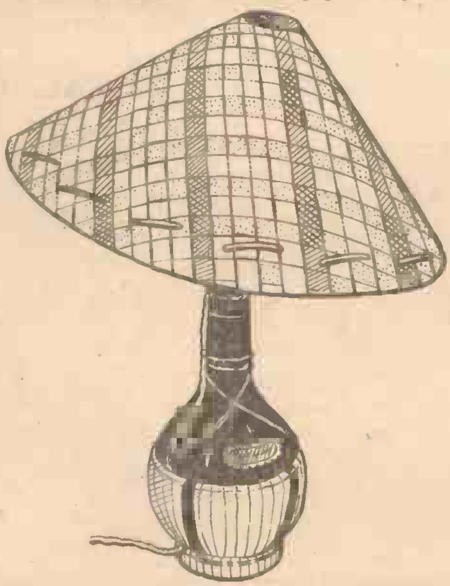


Fig. 5.—A thatched lampshade made up from paper strips, the shade matching the chianti bottle.

The frame may be part of a larger motif or be complete on its own. It may serve as a surround for a tableau, a window border or for panelling of an advanced kind. Certificates, illuminated addresses and other items may be framed, laurel leaves with Baroque shapes may be used as a complete decoration.

Paper Weaving and Thatching

This work is attractive and useful for lampshades and background displays or stage sheets. It may be carried out with white or coloured paper, colours being worked out in contrast or harmony as desired. Leather, strip metal or other materials may be used. A ¾in. strip is all that is necessary and the cut strips when ready are interlaced under and over alternately so that the thatched pattern is obtained, as shown in Fig. 4. Draw the pieces up closely together; the illustration has been purposely exaggerated to show the method of interlacing. It may be mentioned at this stage that cut strips of paper when scored and moulded may be used for lettering and figure work.

For those converting old wine bottles into table lamps, thatched shapes may be inexpensively made up to match in with the coloured raffia or straw used on Italian wine bottles. An example of this type of conversion is shown in Fig. 5. Wire frames are sold and the woven piece may be stitched on to the wire and held in position with fine cord or raffia as desired. In much the same way, waste paper baskets may be made up by thatching strong material. Finished thatched work may be pasted down on to plain boxes turning them into delightful caskets.

Seismic Waves Warning System

SEISMIC sea waves, travelling across the ocean at speeds of up to 600 miles per hour caused widespread havoc and many deaths in the Hawaiian Islands in 1946. The waves were caused by submarine earthquakes and as a result a warning system has been developed, by the U.S. Department of Commerce's Coast and Geodetic Survey, which covers practically the whole of the Pacific area. The system consists of some nine seismograph stations and 24 tide stations, which are located on the west coast of the United States, Alaska, the Hawaiian, Philippine and Pacific Islands, and in Peru and Japan.

After an earthquake, the stations immediately send their detection data to the Honolulu headquarters, the various stations also check for unusual sea activity. The centre of the earthquake is then located and warnings of a sea wave and expected time of arrival are transmitted. Seismic sea waves are not single huge waves but a series of waves that roll across the ocean about 20 minutes apart, the first seldom being the largest. Six or seven feet high crests pass ships in deep water unobserved and pile-up in shallow water, sometimes reaching a height of 100 feet and then crash against the shores. The Fiji Islands, Chile and Australia are also co-operating members of the system.

World Record

ON August 9th, 1958, at the Sovietskaya Antarctic base the Russians recorded the world's lowest temperature which was 124.1 degrees below zero Fahrenheit. The reason for the very low temperature was probably due to the fact that Sovietskaya is approximately 12,000 feet above sea level. Scientists calculate that this low temperature record is within six degrees of the coldest the earth might ever reach—minus 130 degrees Fahrenheit.

New Heart Surgery Discovery

ONE of the most dangerous problems of heart surgery has recently been overcome in America. An animal's heart, isolated and free from the influences of the rest of the body, was kept alive for 18 hours by connecting it to the circulation of a donor dog, so that the heart muscle could be studied more easily. The investigating team were able to study the ventricular fibrillation, the quivering of the heart muscle that fails to pump blood to the body because there is no co-ordinated contraction of the heart. In heart surgery performed under hypothermia, this is sometimes fatal.

It had previously been discovered that the level of magnesium ions in the blood returning from the heart was lower during hypothermia, indicating an increased concentration of magnesium in the cold heart. It was soon found that only a minute amount of magnesium was enough to cause ventricular fibrillation, even at normal temperatures. The tests were even more enlightening under hypothermia, the heart's tolerance for magnesium was 50 per cent. less than at normal temperatures.

Several disputed drugs were tested on the heart, to establish their effects on the muscle. It was discovered that tetraethylammonium-chloride coupled with electric shock could eliminate the danger of fibrillation during hypothermic surgery.

Nuclear Explosion Detector

NUCLEAR explosions can be detected on a seismograph, it was recently stated in America. There is a great similarity between natural and nuclear explosion-generated earthquake waves. A nuclear explosion can be detected on a seismograph when it takes place a third of a way around the earth.

A Model Glass Fibre Catamaran

(Concluded from page 180)

between the port rudder lever and the rudder operating lever has holes at 14⅛in. centres. The bars are made from 3/16in. O/D 22 s.w.g. brass tube swaged flat at the ends with 3/32in. dia. holes.

It was considered desirable to make the mast and sails quickly detachable for ease of transport so a combined socket and rudder operating lever was designed to take the mast and mainsail boom, this is illustrated, together with the rudder levers in detail in Fig. 7. The geometry of the rudder operating mechanism is shown in Fig. 9.

Mast and Boom

Three-eighth inch round dowel was used for the mast, ¼in. round dowel for the mainsail boom and a good quality waxed twine for the rigging, adjustment being made with small runner blocks cut from 20 s.w.g. brass ⅛in. wide × ⅜in. long with two 1/16in. dia. holes. Plated paper clip wire was used for the hooks and the eyelets fitted in the booms are the screwed type for use with spring curtain runners. The swivel joint for the mainsail boom is shown in detail in Fig. 8.

All that is now required is painting with two or three coats and the catamaran is ready for the water. A photograph of the finished model is shown in Fig. 10.

The Inventions of Professor Krankopff

By A. Lutman

Don't Take This Article Too Seriously!

NOT many of this famous man's inventions reached the Patent Office for the simple reason that most of them were bought up and suppressed by vested interests. He was a rich man by accident rather than design; though he often won-

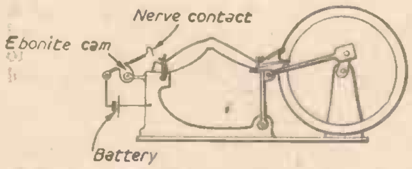


Fig. 1.—The Galvanic Impulse Engine.

dered what became of the best of his ideas. The truth is he had not the time to think ill of anyone and his active and trusting brain never suspected duplicity; besides, he was always off on some fresh tack and into the realms of some unexplored aspect of science.

Since his sad demise I have been fortunate enough to come into possession of his scientific papers, and I am now at liberty to publish these and so thwart the Combines and Monopolies.

One of his greatest inventions is surely The Galvanic Impulse Engine shown in Fig. 1. As many as twenty frogs' legs are mounted so as to impart powerful kicks to connecting rods and so actuate cranks and a flywheel. The electrical stimulus necessary is provided by a series of contacts worked by cams. It is interesting to note that he bred special frogs for this purpose, and by artificial selection produced some with legs eighteen inches or more in length having great electro-kicking propensities. Success, however, was phenomenal when he used ostriches. By judicious feeding the ingenious Professor could keep the birds alive for years. He made the astounding discovery that electrical stimulus was not necessary in the case of an ostrich; cam-operated needles being sufficient to provoke this power. The most puzzling aspect was a sudden increase in horse-power, almost 50 per cent., if the Professor stood behind the bird in its working position (Fig. 2). His kindly unsuspecting nature gave him no clue as to the reason, even when one of the birds had enough surplus energy to bite a piece out of his ear.

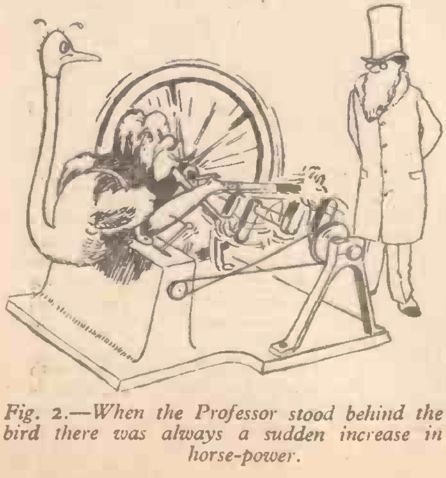


Fig. 2.—When the Professor stood behind the bird there was always a sudden increase in horse-power.

The Bump-propelled Bicycle

Krankopff was fond of cycling, and apart from his love of the countryside he favoured those roads which are less evenly surfaced, in fact, the rougher the better. A glance at Fig. 3 will show the reason. The saddle column is really a high-pressure pump which pumps air into a reservoir and thus works a compressed air engine. He tried riding to hounds but the horses and dogs did not like the machine. I have it on good authority that on one occasion the fox doubled back on its track and tagged on behind him a little distance in comparative safety.

The Cellini Bowl

No man goes through life without making mistakes, and we must blame excessive zeal on the part of the Professor when he announced that the transistor was known to Benvenuto Cellini. He cited the famous silver bowl at Florence.

Professor Baggstock, of Edinburgh, took up the challenge and pointed out that neither Professor Krankopff nor Benvenuto had need for such a device: mendacity being sufficient to amplify their capabilities. He hoped that Krankopff would recognise next time a pickle bowl when he saw one. Furthermore, he was certain that the Professor would need more than a silver fork or spear, or wriggling evasion to get himself out of the pickle he was in. The cause of these unfortunate events is shown in Fig. 4.

Krankopff as a Brilliant Speaker

The Professor made wonderful speeches at literary and scientific functions, though on one occasion his very sanity was questioned. This arose at a Royal Society dinner where he had enthralled his colleagues and famous guests of honour with a speech of unusual brilliance and wit. He was about to be introduced to The Duchess of Bellwater when he began his after dinner speech all over again. He retired in confusion to the toilets where behind a locked door he could still be heard speaking and scuffling about. The explanation can now be told, and like most mysteries, is simple. He prepared his speeches days before and recorded them on

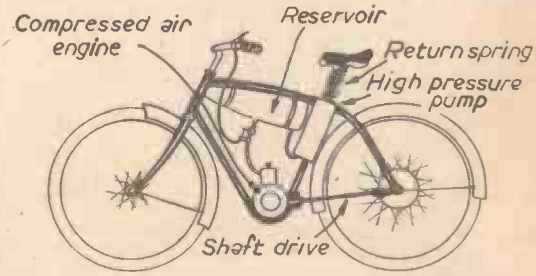


Fig. 3.—The bicycle complete with compressed air engine.

a tiny recorder of his own invention. Two small loudspeakers were concealed in his jacket pockets: all he had to do was to mouth the words. No doubt one of his large and expansive gestures had tipped the switch again to his great discomfiture.

Fig. 4.—The Cellini Bowl.

Krankopff's System of Radio Control

Krankopff was not without a sense of humour. Nearly everybody remembers the wonderful demonstration of radio control at a trade fair at Olympia. He sat at a table with the keys of a radio transmitter at his finger-tips whilst a tiny 2in. model of an

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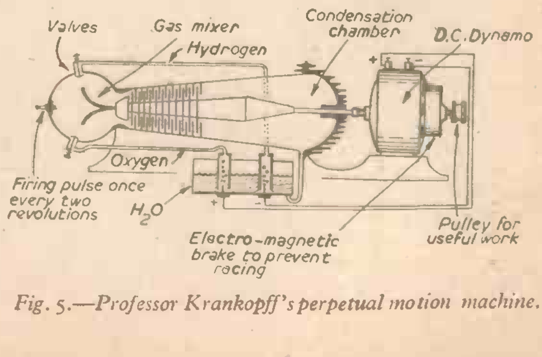


Fig. 5.—Professor Krankopff's perpetual motion machine.

Musical Instruments

This Article by F. Ho
Include a Wide Rang
I

Fig. 1.—A pipe soloist.

FROM earliest times man has had musical instruments of some kind, and these earliest instruments were no doubt fashioned from the natural material of the countryside and were in the form of simple drums and the pipe or flute.

As civilisation developed other wind instruments were invented such as the clarinet or oboe as we now know them which

Fig. 3.—A school orchestra with wind, string and percussion instruments made in the school workshop.

have reeds in the mouthpiece and produce a different type of sound to the flutes. With the use of metals the brass instruments of the orchestra such as the trumpet were gradually evolved. Of stringed instruments there grew a very wide range wherein the strings were either plucked, struck or bowed.

Fig. 2.—A duet for treble and tenor pipes in progress.

No doubt the most common type of instrument in all ages has been the simple pipe fashioned from the hollow stems of trees of various kinds. This type of instrument arrived at a high state of development in the recorder of the first Elizabethan Age.

During recent years there has been a great revival in the playing of these simple and inexpensive instruments. They may be played singly as the player is shown doing in Fig. 1. In harmony they may be played by two or more players, and Fig. 2 shows a duet for treble and tenor pipe in progress. Greater numbers may play together and combine with other instruments to form an orchestra as shown in Fig. 3.

There is a wide variety of music specially arranged for these instruments available from several publishers who have interested themselves in this revival of simple folk music but principally W. Paxton & Co. and J. B. Cramer & Co. of London. These firms, too, are able to supply the materials for the making of these instruments.

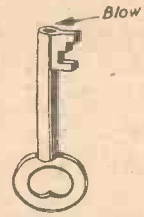


Fig. 4.—The hollow shank of a key can produce a high piercing note.

Theory

Before giving instructions dealing with the making of these instruments it will be of interest for the reader to know a little of the theory of how sound is produced from the pipe.

It is well known that blowing across the top of the hollow shank of a key will produce a high piercing note, the same method being used for playing a set of pan pipes (Figs. 4 and 5).

The blast of air passing across the top of the air column in the hollow of the key or across the various air columns in the pan pipes tends to draw out the air in the tubes as the latter air column temporarily attaches itself to the sharp stream of air directed across the top of the tube.

This action tends to create a vacuum within the pipe—a state which nature abhors—so that very soon the air in the column parts from the transverse stream of air and falls back into the tube. A similar phenomenon is the "pop" heard when the cork is withdrawn from the bottle of wine, an action which causes a vacuum within the neck of the bottle.

Once the state of equilibrium has been reached in the tube the process is repeated again and again. The air in the column behaving rather like a piece of elastic which is alternatively stretched and released. The frequency of these vibrations will determine the pitch of the sound which they cause. The speed of the cycle of operations thus described will vary with the length and width of the column of air in the tube and to a lesser extent by the intensity of the stream of air across the top of the tube (Fig. 6).

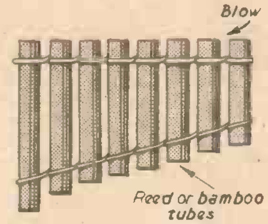


Fig. 5.—A set of pan pipes.

Fig.
Fig. 8 (T

The sound of a flute is produced in the same way. The difference is that the end of the tube is stopped with a plug and the player blows a stream of air across an oval hole bored in the side of the tube near to the stopped end (Fig. 7).

In the case of the bamboo pipes and recorders the effect is produced in a different way by the fipple head. In this case the stream of air is blown into the end of the tube and is deflected outwards through a rectangular opening with a sharp sloping edge. The internal column of air is set in vibration by a similar means as for the flute or pan pipe (Fig. 8).

The mouthpiece of these wooden instruments might be compared with the head of the flageolet or tin whistle. However, the tone of the two instruments is widely different; the whistle produces a piercing shrill tone, but the bamboo instrument produces a mellow round tone, very pleasing to the ear.

Types of Pipe

The basic instrument of the group of bamboo pipes is the treble pipe which is pitched in the key of D. With this delightful instrument a wide range of melodies can be played. A player using one of these instruments is shown in Fig. 1. There are six finger holes to the pipe and one thumb hole with which the player can play the scale of D major. However, the instrument is not restricted to this scale alone because all the intervening accidentals of the scale may be obtained by a system of "forked fingering" which will be described later. But in common with many other musical instruments this one has certain keys which are more congenial than others.

Other instruments in this group are the alto and tenor pipes which are pitched lower than the treble pipe. There is also a tiny pipe known as the soprano which has some

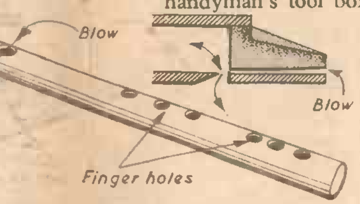
...made from Inexpensive Materials

...ok Begins a Series Which Will ...e of Woodwind and Percussion ...Instruments

uses too. All these instruments are shown in Fig. 9.

Tools

The making of bamboo pipes does not demand elaborate equipment and most of the tools needed will be found in an average handyman's tool box. A group of necessary tools is shown set out in Fig. 10. They include: a hacksaw and sawing block, a hand-drill with a few drills, a fine rasp and a second-cut file, a 6in. square taper file, a ¼in. and ⅛in. chisel, a pocket knife, a fine brad-awl, a long ½in. auger, an oil stone, glasspaper and a bottle brush for cleaning out the bore of the tubes.



...7 (Bottom).—Details of a flute. ...Top).—The action of a pipe mouthpiece.

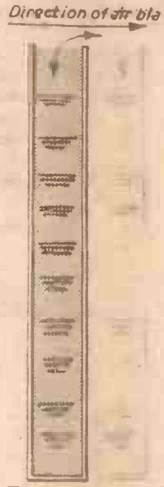


Fig. 6.—Air alternately drawn out and released back into the tube causes regions of high and low pressure, the frequency of which gives the pitch to the note produced.

A full description is given of all the processes connected with the making of the treble pipe. With succeeding instruments the instructions will be considerably abbreviated on the assumption that the reader will first of all have had experience with this treble pipe.

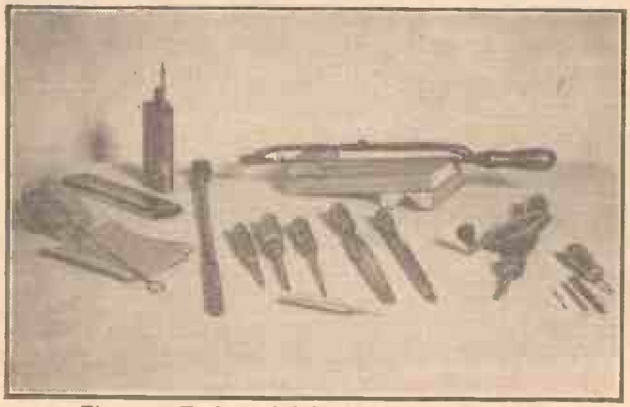


Fig. 10.—Tools needed for making bamboo pipes.

Materials

The material used for making the pipes is mottled bamboo. The poles of bamboo are very cheap and may be had from suppliers of handicraft material now as they are being put to decorative uses in the home. The music publishers already mentioned can supply pieces of bamboo already selected for making the various instruments.

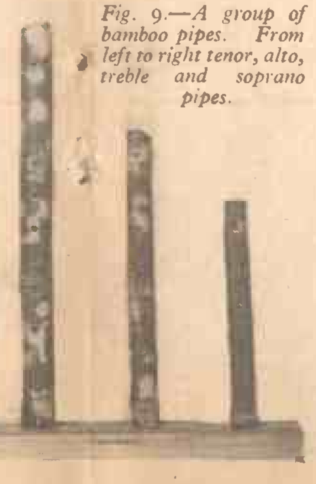


Fig. 9.—A group of bamboo pipes. From left to right tenor, alto, treble and soprano pipes.

Avoid tubes which have very thick walls or are extremely thin, an average of about ⅛in. is correct for the treble and alto pipes and 3/16in. for the tenor. Choose a tube which has an even bore as cylindrical as possible and which does not taper rapidly.

The nodes or joints in the tubes vary in distance apart and when making a treble or alto pipe it is better to choose the length of tube so that there is but one node in the length. In the treble pipe this joint should be about 2in. from the mouthpiece end of the tube and 3½in. for the alto and the tenor pipes.

Corks for making the mouthpiece should be 1½in. long. Due to the varying diameters of the tubes it is advisable to have a varied assortment of corks, e.g., ⅝in. and ¾in. for treble pipes, ⅞in. and 1in. for alto pipes, 1¼in. and 1½in. for tenor pipes.

Making a Treble Bamboo Pipe

Select a piece of bamboo tubing 12in. in length with a regular bore of between ¾in. and ⅞in. internal diameter and with wall thickness of about ⅛in. When cutting to length, arrange the node or joint in the bamboo to be about 2in. from the end that will be used for the mouthpiece. This is important. Having cut the tube to length, use the long ½in. auger to clear out the obstruction which grows across the tube at the node. Clear out the bore with the bottle cleaning brush.

With a pencil mark a line round the tube at the end where the node is situated at a distance of ⅝in. from the end. Hold the tube on the sawing board (Fig. 11) and saw a third of the way through the tube along the line. Then make an oblique cut downwards from the end of the tube to meet the first saw cut and leaving about a third of the circumference on the end of the tube (Fig. 12). Finish off smoothly with file and glasspaper.

In line with this remaining projection measure down 1in. from the end and drill a hole 5/32in. dia. (Figs. 13 and 14). This hole must be neatly made ¼in. wide and 3/16in. deep with square corners (Fig. 15). There is no better tool than a sharp pocket knife for this operation, but it is advisable to grind away the blade to the shape shown in Fig. 16.

Attention is now given to the inside of the mouthpiece and the wind-way is chiselled out as shown in Fig. 17. The width at the end is 5/16in. and narrows down to the width of the squared opening. The groove should be quite shallow, about 1/32in. Keep this wind-way clean of bamboo fibres and make sure it has sharp corners (Fig. 18).

On the outside of the tube, the lower side of the squared opening is now bevelled

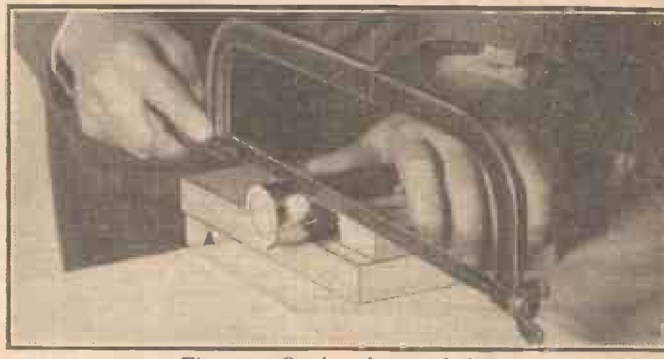


Fig. 11.—Sawing the mouthpiece.

off as the operator is doing in Fig. 19. A slicing action with the knife will leave the cut smooth. The slope should extend down the pipe about 3/16in. and the top edge should be slightly blunt and not cut to a sharp edge as can be seen in Fig. 20.

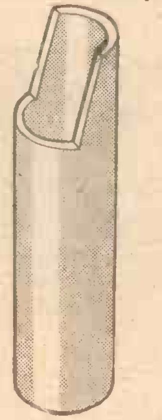


Fig. 12.—After cutting, about a third of the circumference should be left.

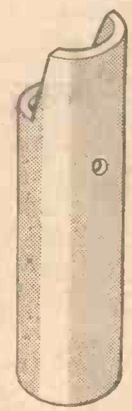


Fig. 14.—A 5/32in. dia. hole should be drilled 1in. from the end.

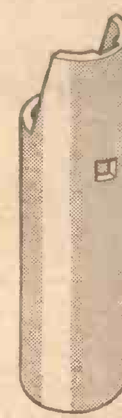


Fig. 15.—The hole must be made ¼in. wide and 3/16in. deep with square corners.

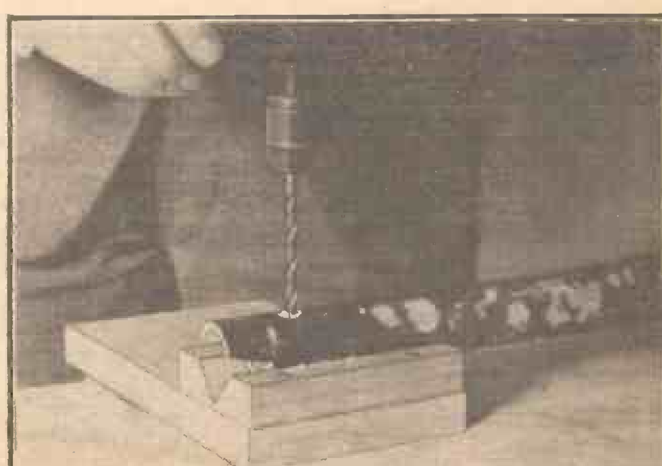


Fig. 13.—Drilling a 5/32in. dia. hole, 1in. from the end.

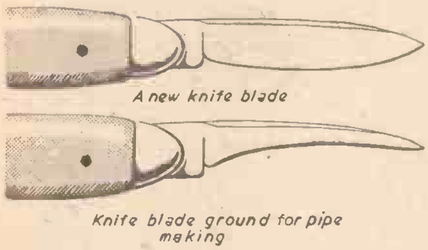


Fig. 16.—The knife blade should be ground to this shape.

Select a cork which is a tight push fit into the end of the tube. As the corks are tapered it will be necessary to file it down until the sides are parallel. Hold the cork as in Fig. 21. The cork should push in to the top side of the square opening. Cut the end of the cork level with the end of the tube (Fig. 22).

Remove the cork and file a flat on it as shown in Fig. 23. This operation is shown being carried out in Fig. 21. The "flat" should be about $\frac{3}{8}$in. wide at the end and narrowing to $\frac{1}{4}$in. at the other end (Fig. 23).

Push the cork back into position again and ensure that the flat on the cork registers with the wind-way on the inside of the pipe, the end of the cork to come flush with the top side of the square opening. Finally, bevel off the cork with a file so that the mouthpiece is comfortable between the lips. See Fig. 24.

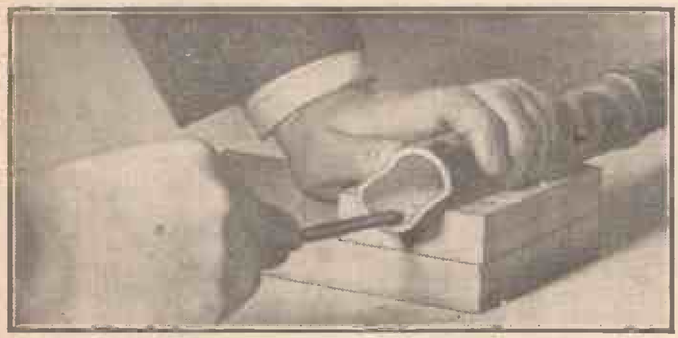


Fig. 17.—Chiselling the wind-way.

Tuning to the Fundamental Note

Now comes the moment of testing one's handiwork by blowing gently into the pipe to produce the first note. Probably a low note will result; a high one and one still higher will be produced, depending upon the strength of blowing. Concentrate upon the clear production of the lowest note. Rather soft blowing, so it will seem, is required. Compare the note produced with a correctly tuned piano and it will probably be found to be B above middle C.

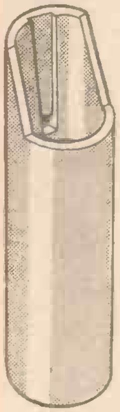


Fig. 18 (Above).—The corners of the wind-way should be sharp.

Fig. 19 (Right).—Bevelling the lower edge of the opening.

Small pieces must now be sawn from the end of the pipe so that the pitch of this fundamental note is raised to D. As a rough guide it may be said that half an inch removed from the length of the instrument will raise the pitch about a semi-tone. Extreme care should be taken not to remove too much at a time as it is necessary not to raise the pitch above the note D. Should such an error occur, rather than scrap the pipe there are methods of lowering the pitch slightly which will be mentioned later.

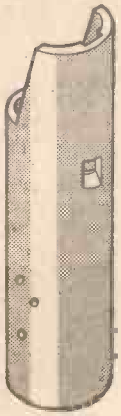


Fig. 20.—The top edge should be slightly blunt.

Fig. 22.—Cut the end of the cork level with the end of the tube.

Before starting to tune to this fundamental note drill three 1/16in. holes in the side of the instrument as indicated in Fig. 25. These holes should be about 1in. lower down the pipe than the mouthpiece opening. Space them about $\frac{1}{2}$in. apart. The effect of these holes is slightly to sharpen the pitch of the note produced. Should a fraction too much be sawn off the end of the pipe in tuning to the fundamental note one or more of these tuning holes may be plugged with a piece of pointed matchstick to lower the note to the correct pitch. These holes are to be used, too, later on when the instrument is finished as the overall pitch of the instrument is likely to vary due to atmospheric conditions from day to day. By putting in or taking out one or more of these tuning pegs the pitch can be easily rectified.

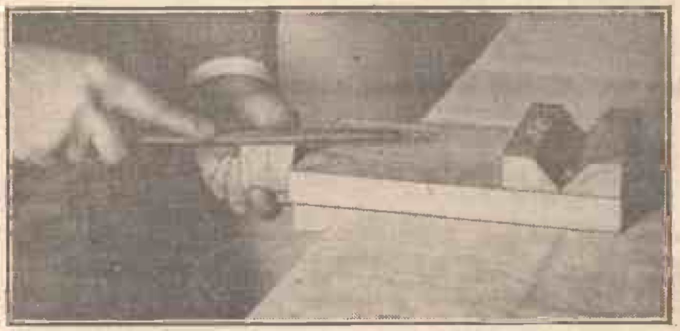


Fig. 21.—Filing a "flat" on the mouthpiece cork.

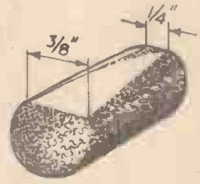


Fig. 23.—Details of the "flat" on the cork.

The method described in the previous paragraph is suitable for small variations of pitch only. Should quite a lot more than necessary be cut off when tuning to the fundamental note, something more drastic is needed.

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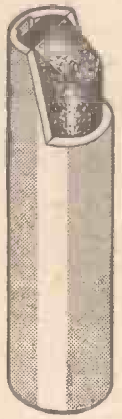


Fig. 24.—Bevel off the cork.

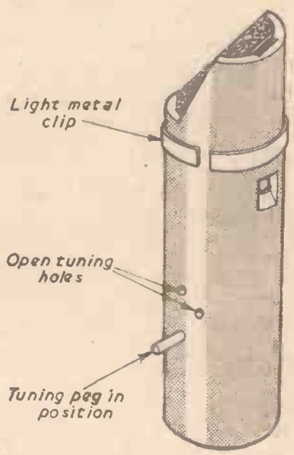
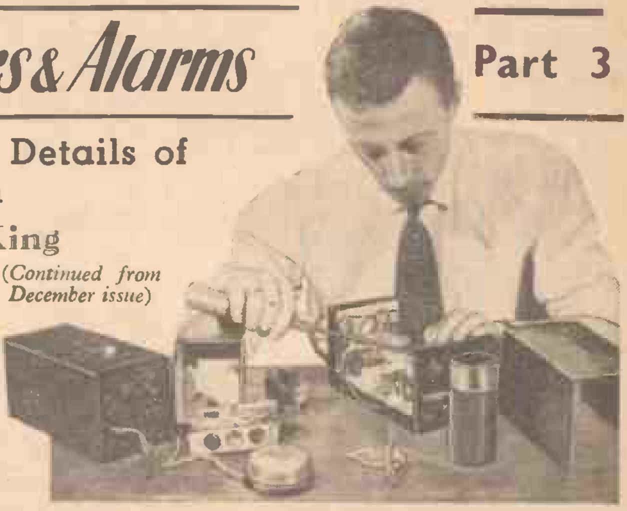


Fig. 25.—Drill three 1/16in. holes in the side.

Transistor-Operated Counters & Alarms

Part 3



Further Uses for the Photo-switch and Details of a Photo-transistor Burglar Alarm

By E. V. King

(Continued from December issue)

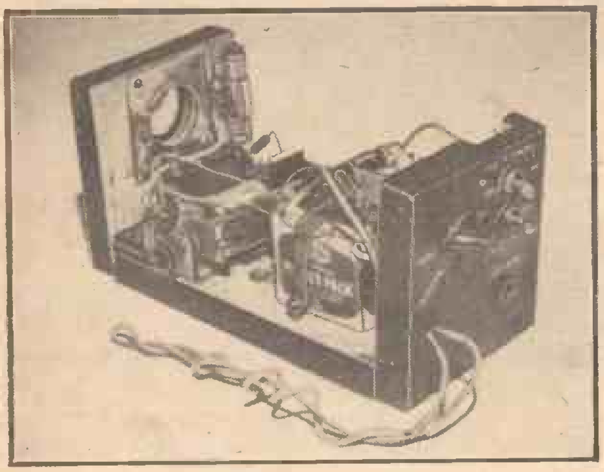
MANY shops are fitted with bells that ring when the door is opened, but in most cases the bell continues to ring if the door is fixed open in hot weather. It is far better to fit up the circuit in Fig. 25 (given last month), and place the beam so that people interrupt it as they enter but the door itself does not. This idea was installed in a local shop and it proved quite efficient, giving no trouble save for a burnt-out lamp.

A system of automatic warning was also tried at the front door. The beam was arranged to cross the porch in front of the door and a small switch was placed inside the door so that the bell circuit could be cut off when someone was being interviewed on the doorstep. After many experiments the author found that the optimum position for the beam was 3ft. above the ground and 1ft. 3in. from the front door. Warning is then given when anyone over about 11 years of age approaches the door. Details will be given later which allow the housewife to ascertain if anyone has called while she was absent.

The idea will work too for a garage warning system. Some garages use systems whereby the vehicle goes over a contact operating strip on their way in thus warning the petrol attendant. The system in Fig. 25 was installed in a drive. It was found that the beam is best placed about 4ft. above ground level; this recorded motor cycles but not small children. Details of a counter to be used in conjunction with these systems will be given later.

When fitting transistor-operated devices in the open it is a good idea to fit a hood (already described) on the lamp *and* the receiver, as if the sun should shine directly into the lens it would certainly overheat and ruin the transistor. The unit should be housed in a waterproof case, lagged with glass wool or other thermal insulator and the outside should be painted with silver paint. This will keep the internal ambient temperature low and the leakage current through the transistor will be low. Too high a temperature (say 100°F.) might cause the first relay to stick in and not release.

Readers will realise that infra-red may be used in daylight and is often advisable as small children love to interrupt a visible beam.



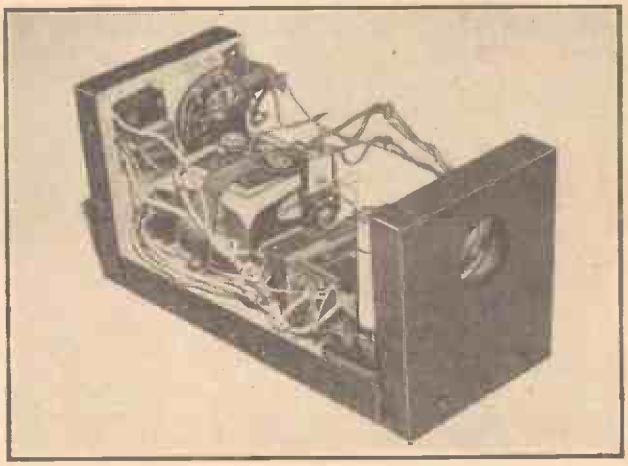


Fig. 26.—Two views of the completed photo-transistor burglar alarm.

A Party Game

Very small children can have great fun if they are told to try to pick up objects around the room, but that they must stop as soon as the bell rings. The more intelligent ones soon learn to crawl flat on the floor, etc., according to how the infra-red beam has been placed. This idea could be tried in the garden (no mains being used).

A Photo-transistor Burglar Alarm

Unlike the photo-switch, this little unit, which is derived from it, cannot be reset by moving out of the light beam. Once the beam has been interrupted one circuit remains switched on until such time as the operator resets the second relay.

The circuit of the unit is shown in Fig. 27, two views of the prototype in Fig. 26 and the panel layout of the prototype in Fig. 28. A top plan view of the component positions is given in Fig. 29.

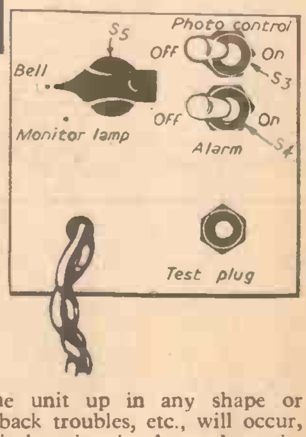


Fig. 28 (Right).—Panel layout of the prototype.

Readers may make the unit up in any shape or form; no feedback troubles, etc., will occur, the only critical point is that when the parallel light beam is shone into the lens the photo-transistor is at the focal point.

A PP1 battery is used for power, but a power pack will be described later. Both units could be housed in one container.

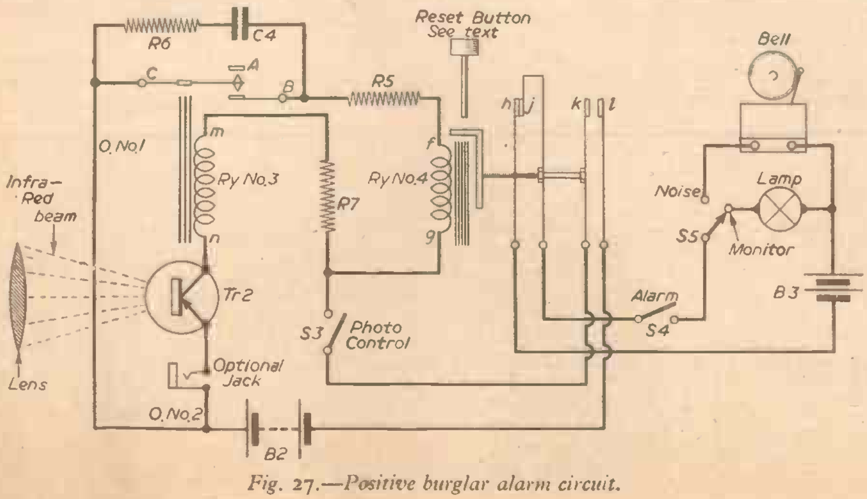


Fig. 27.—Positive burglar alarm circuit.

Readers are advised to build the unit for battery operation first.

How it Works

Refer to Fig. 27. The light beam makes Tr2 draw a heavy collector current and pull in Relay No. 3. Thus contact "C" is held away from contact "A," i.e., "C" is joined to "B" as long as the beam is not interrupted. Coil fg of Relay No. 4 is thus energised holding down the armature keeping k and l closed and h and j open. Should the light beam be interrupted "C" and "B" are broken and h and j contact completing another circuit, ringing the bell.

Readers will observe, however, that once the beam has been interrupted the contacts k and l will separate and that the main supply source to the transistor is thus cut off. Relay No. 3 is thus rendered inoperative until the armature of Relay No. 4 is reset closing kl. If the light beam is present, the armature will then remain in until it is again interrupted. A small push-type knob is fitted so that resetting is easy.

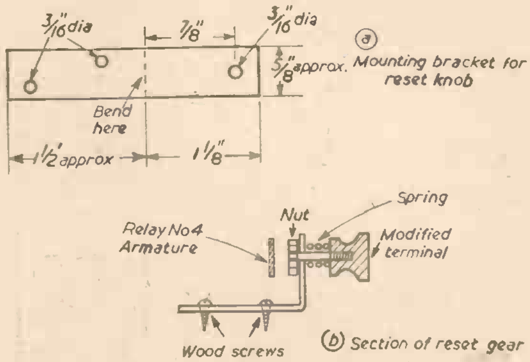


Fig. 30.—Details of the arrangement for resetting.

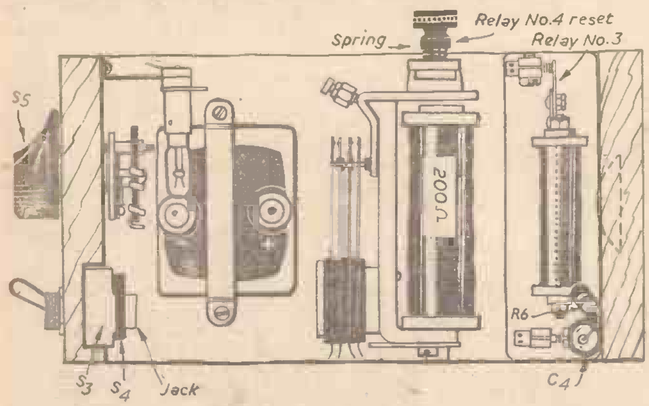


Fig. 29.—Plan view showing layout of components.

In addition to the above, S4 is fitted so that the bell may be switched off at S5. While setting up the instrument, a small warning light is used as a visual indicator (monitor) to save annoying neighbours, etc.

A jack plug is fitted as an optional extra. It is best to insert a 5 mA meter at this point when setting up the instrument in an infra-red beam. It is not indispensable but makes setting up very simple and quick. If shorting contacts are not fitted, a shorting jack must be used when the meter is not in circuit.

Construction and Layout

The basic case is made up of about ¾in. wood in exactly the same way as the photo-switch. The lens is mounted in the same position, but the layout of the back panel may have to be altered. The arrangement used in the prototype is shown in Fig. 28 but readers may alter this at will. The test plug is not essential and a 5 mA meter could be permanently mounted but was left on a trailing wire to be placed in the best position for aural indication, it was powered from the same PP1 battery in the instrument.

The positions of the relays have been altered. Fig. 29 shows Relay No. 3 (this is the sensitive one) up against the lens panel, the P.O. type 3,000 relay is in the middle and the battery near the back control panel. In the prototype a Siemans Relay, modified as already described, was originally used. Later, to see how it operated, a very sensitive relay obtained for 7s. 6d. surplus from Messrs. H. English of Brentwood, was fitted, with a 900Ω resistor in series. This is R7 of Fig. 27, and is not required if the Siemens Relay is used. This little relay was so satisfactory that it was left *in situ* and will be seen in Fig. 29 and in the photographs.

Relay No. 4 is mounted in the same way as No. 2 and with the same mounting bracket. Another similar bracket has to be made, as in Fig. 30, or one "U" shaped piece of metal strip could perform the work of both push button holder and relay mount. When cut, drilled and bent, as in Fig. 30, an old brass terminal is modified as follows. Unscrew and then damage the thread a little at one end and screw on a nut. This must be tight and not liable to shake off.

Now fit a light spring as is found on an old crystal detector or one may be made from some steel army telephone cable (as on prototype). The thread is then cut to a suitable length, damaged a little and the terminal head screwed on to such a point that these conditions apply: 1. When pushed in the relay armature will be pushed in also. 2. When left free the relay armature is also left completely free.

PARTS REQUIRED FOR BURGLAR ALARM

S3—On/off toggle switch.
S4—On/off toggle switch.
S5—Rotary or toggle, one pole two ways.
Tr2—OCP71 or converted red spot.
Relay No. 3—Same as relay No. 1 (modified Siemens H.S. type), described in December issue, page 128.
Relay No. 4—Same as relay No. 2 (P.O. type 3,000, coil 200Ω), described in December issue, page 128.
C4—.1μF. 500 v. working.
R6—47Ω ½ watt resistor.
R5—150Ω.
R7—See text, may not be required.
B2—Ever Ready 6 v. transistor type, PP1 and clips.
Lens as for the light source, described November issue.
Dial lamp holder, 6-volt .05 amp lamp and an electric bell.
P.O. type jack socket preferably with shorting contacts and a 5 mA meter fitted with the jack plug is an optional extra.
Wood and cover exactly as for the photo-switch already described.

The dial lamp is mounted on any convenient pillar of metal or wire somewhere over the battery. Two holes are then cut in the metal cover. One to allow the reset knob to protrude and the other to take the dial lamp glass fitting (above the bulb).

If ⅜in. wood is used for the back panel it may be necessary to countersink the controls. This wood was used on the prototype, it being very sturdy.

The OCP71 (or red spot converted) is mounted on a flexible copper mount as already described. It lies above and between the battery and Relay No. 4.

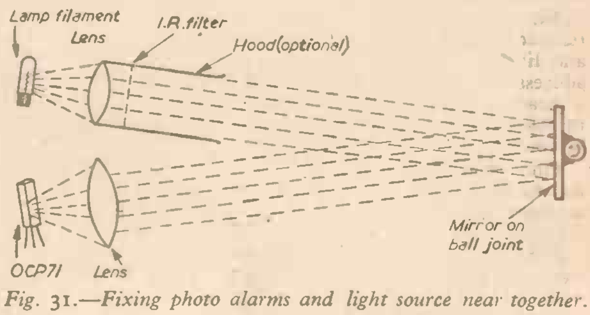


Fig. 31.—Fixing photo alarms and light source near together.

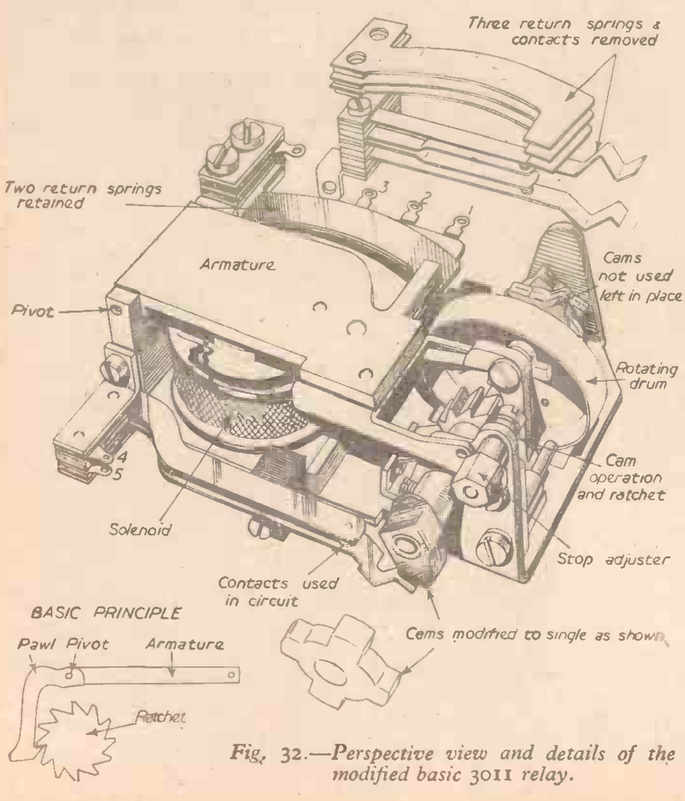


Fig. 32.—Perspective view and details of the modified basic 3011 relay.

Wiring the Unit

This may be done in any order, using ordinary push-back polythene-covered wire. Beware of getting the iron near the transistor. No other special precautions are necessary. Long or short wires make no difference to the physical operation of the unit. It is a good idea to start on the right of the wiring diagram, i.e., with the bell and test each part as completed.

Testing the Completed Burglar Alarm

The lamp source, already described, is used. Employing white light at first, the beam is shone from about 4ft. or so into the lens of the burglar alarm. S3 is put on and if available a 5 mA meter is plugged in the jack. The light source is then adjusted to get the filament image coincident with the transistor junction. This condition will cause a big increase in current to between 3 and 5 mA. While doing this initial adjustment it will be necessary to press down the reset stud whenever it springs out. As long as 2 mA flows it will be held down. Now put S5 to lamp and S4 to on.

If your hand is now placed in the light beam the lamp will come on and will stay on whatever you do with your hand. Remove your hand and press down the reset stud. The lamp now goes out and remains out. Put S5 to "Bell." On breaking the light beam the bell will ring until you reset or switch off at S4.

Setting Up the Burglar Alarm

The alarm is best situated in a cupboard, with a hole to allow the beam to enter. The lamp may be in a similar situation and should be fitted with an infra-red filter and hood as already detailed. A typical arrangement was shown on the cover of the November issue.

Arrangements should be made to screw down both units once they have been aligned. The bell and its wiring should be hidden from view and be in such a position that the thief cannot stop the noise.

It is possible to have the lamp house and photo alarm unit adjacent (an inch or so apart to avoid heat transfer) by using the arrangement shown in Fig. 31. This is very hard to align using infra-red, but using white light first, very satisfactory results are possible. Using infra-red some intensity is lost, but with a 24 watt lamp and an OCP71 good results were obtained using a handbag mirror mounted on a car driving mirror ball joint, at a distance of twice 5ft.

No doubt ingenious readers with tape recorders could arrange the unit to switch on and lift the telephone receiver repeating the address and that an intruder is present. If a headpiece were fixed to the microphone instead of using a speaker the intruder would be unaware that the police had been called.

Once fitted in a suitable position all one has to do on leaving the house is to push in the reset knob and *then* put on S3 and S4. S5 is left permanently on "Bell." S3 and S4 are not ganged as this makes alignment much easier. S3 could well be ganged with the light source supply which can be adjacent, as in Fig. 31.

An Alternative System Using the Photo-switch

Another system which has been tried out, but not made into a compact transportable unit, uses the original photo-switch, described last month, wired as in Fig. 33. Here two PP1s are jointed in series to give 12 v. and a special ratchet-operated contactor device is used in lieu of the bell. A further circuit operated from the same cells controls the bell.

A robust inching relay, No. 3011 or 3011A, is obtainable for a few shillings from Messrs. K. R. Whiston, 8, Watford Bridge Road, New Mills, Stockport. This is the unit which will be described first, but another similar unit which seems equally suitable and is of stronger construction is obtainable from Messrs. H. W. English, Rayleigh Road, Hutton, Brentwood, Essex, it requires the same voltage and is listed as a "magnetic motor, solenoid operated" No. 685, but is fitted with contacts and is virtually a relay. The unit costs 8s. 6d.

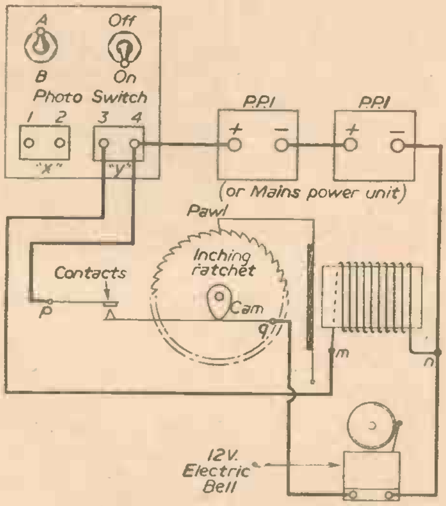


Fig. 33.—Complete circuit of alternative burglar alarm system.

Using the 3011A unit observe that when connected to a supply the armature moves down and rotates a drum with numbers on it. Note that a four-sided cam (Fig. 32) is also rotated and in turn it operates some contacts. Three sides of this cam are removed and the remaining cam filed a little so that one click of the relay will cause the contact to come on and another to come off. Details are given in Fig. 32, the modified cam being shown.

Looking at the other side of the relay, four contacts will be seen, these may be removed with tin snips or the fixing brackets may be removed and the little screw which holds the return spring tightened firmly. The return spring is modified by removing three of the five blades and the two contacts which are sometimes present. Two leaves will operate the unit very well from a 12 v. supply, otherwise 24 v. will be required.

There are four tags on the solenoid, numbers two and three only of Fig. 32 are used. The only contacts used are numbered 4 and 5 in Fig. 32.

If trouble occurs through the drum rotating on the "off" stroke a small rubber band acting as a friction brake round the spindle or a fibre washer on the shaft gripping the side slightly will cure it.

Each time the light beam is interrupted the drum will move round 30 degrees. The apparatus is set up and the light beam interrupted with the hand until the contacts are open. The burglar alarm is then set. When the beam is interrupted the drum turns, the contacts make and the bell rings. It will continue to ring until the beam has been interrupted eleven times *exactly*. No thief will know this.

If the dial is mounted so that it is visible it may be made black with the lettering "start" or "set" printed in the correct position (where the cam is opening the contacts). Setting the unit is thus simplified. Instead of interrupting the light beam the correct number of times a small push button switch could be depressed until the dial reads "set." (*To be continued*)

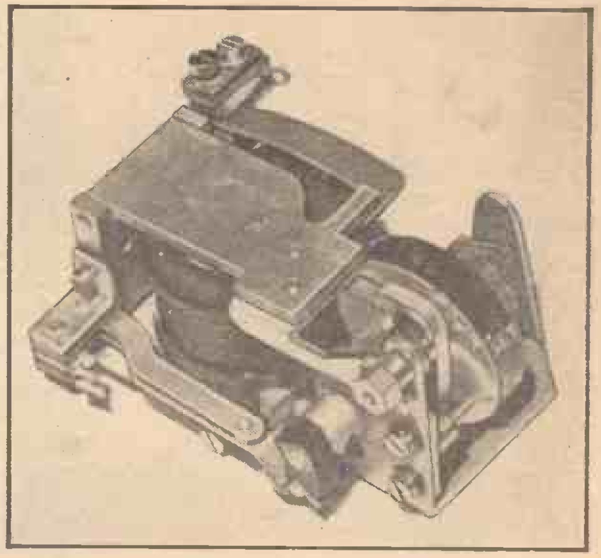


Fig. 34.—A photograph of the modified 3011 unit.

PUZZLE CORNER

1.—Mary's Age

If you write down Mary's age this year and what she was last year and the year before, then put down what she will be next year and the year after that, you will have five figures. On looking at these five figures you will notice that the largest is exactly $1\frac{1}{2}$ times the smallest. How old is Mary now?

2.—The Uses of Geometry

Robin was told by his father that if he were a good boy he could have a piece of chocolate. The boy asked how much chocolate that would be and his father told him that he could have as much as he could enclose by a piece of cotton 8in. long. Robin earned the chocolate and carved out his piece from a slab. The small boy knew a thing or two in geometry and he liked chocolate. What was the shape of the piece he carved for himself so that it gave him the maximum amount of chocolate?

3.—The Perfect Square

Re-arrange these figures so that they add up to 9, whether taken across, down or diagonally:

2	3	4
2	3	4
2	3	4

Answers

1.—The five ages are 8, 9, 10, 11 and 12, twelve being $1\frac{1}{2}$ times eight. Mary is now 10 years old.

2.—A circle.

3.—

3	4	2
2	3	4
4	2	3

How to Make a Lifelike Mask of Your Face Using Plaster of Paris

THE procedure for making a cast of your own or a friend's face is a simple one, if a little uncomfortable for the subject. The materials are cheap and easily obtained; they include plaster of paris, petroleum jelly, an old bathing cap, some straws, an old towel and a bowl for mixing the plaster.

Preparing the Subject

The first step is for the subject to don the bathing cap and grease his face, paying especial attention to the hair line, lips and eyelids and lashes. Apply the petroleum jelly with a liberal hand or difficulty will be encountered in removing the plaster mould.

The subject should lie down in a comfortable position on a settee or on the floor. The towel is draped over the shoulders to protect the clothing and the bathing cap completely covers the hair, as can be seen in Fig. 1. Straws are put into the nostrils, or perhaps pieces of polythene tubing would serve better if they are available, so that the subject can breathe when the plaster is in place.

Making the Mould

A mixing bowl from the kitchen may be used for the plaster and this should be of a consistency to enable it to be spooned into place without being so thin that it runs off. The mix must be made quickly and carried to the subject before it starts to set.

Spoon the wet plaster in place quickly, covering the whole face with a ½in. thick layer and making it thicker around the nostrils and mouth (see Fig. 2).

When the plaster is in place, the difficult part of the project begins for the subject. He must lay perfectly still with eyes closed and a heavy mass of plaster completely covering his face, breathing through straws, until the plaster sets. No difficulty should be encountered so long as the subject is comfortable and relaxed, but those affected by claustrophobia are advised not to try this project. It will be noticed that the plaster generates heat as it dries, but this should not become sufficiently noticeable as to cause discomfort.

When the plaster is dry it can be eased off by lifting one of the edges first and allowing the air to penetrate under the cast.

When the mould is free, the next step is to smooth any irregularities with sandpaper and fill any holes with plaster mixed for the purpose. If the mould is thin anywhere, it can be strengthened by the addition of plaster on the outside.

Fig. 3 (Above).—The completed mask and the original subject.

Fig. 1 (Left).—The subject laying down ready for the plaster to be applied.

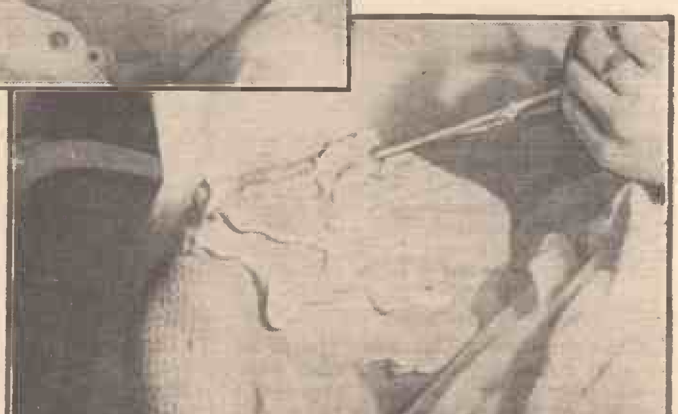


Fig. 2.—The plaster being spooned into place, while the subject breathes through straws.

Making the Mask

Grease the inside of the mould using petroleum jelly, paying particular attention to the nose and lips. Mix up a large quantity of plaster and pour it into the mould smoothing it off at the surface. If it is required to hang the mask as a wall decoration a ring or a hook must be pushed into the plaster while it is wet.

Leave the plaster to dry out thoroughly, if possible overnight or even longer. The next step is the removal of the cast from the mould and this can only be done by breaking the mould. Work from the edges first, tapping lightly with a small hammer and removing the mould piece by piece, until the cast is completely free. Wash the cast to remove traces of grease and clean up with sandpaper.

Painting

If the cast is to be used as a wall decoration, it should be painted and for this some colour far removed from life should be used, such as green or bronze. Before the paint is applied, the cast must be sealed by applying size. The best method of paint application is by means of a spray, the usual type included with the vacuum cleaner accessories, being ideal for the purpose.

The standard of likeness which can be achieved can be seen by comparing the photograph of the subject and the unpainted mask shown in Fig. 3.

LAMPSHADE MAKING AND PARCHMENTCRAFT

(*Concluded from the December issue*)

In His Second Article F. T. Day Describes How to Construct Various Lampshades

HERE is a suggestion for a novel type of lampshade made up from cardboard tube material such as is used for sending rolled printed material through the post. It is cut down as shown in Fig. 5a. Some chains

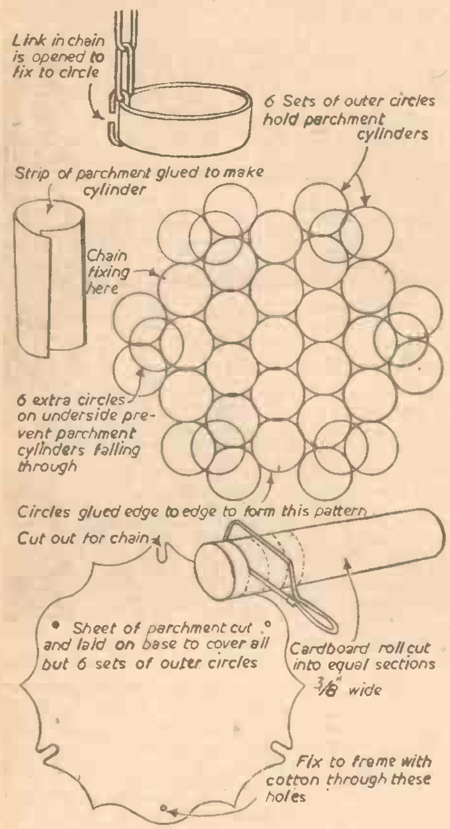


Fig. 5a.—Details of the tubular lampshade.

are required for the purpose of hanging the fitment when made up. A small handsaw may be used to cut the card tube into sections. The tubes vary in diameter but 2in. is a good standard to work with. Mark the cardboard tube out with a pencil in equal sections of $\frac{3}{8}$in. width. The number of circles will vary with the size required of the ultimate light fitting. When all pieces are cut a section of chain is fitted to three cardboard circles for the purpose of suspension. As shown in Fig. 5a, six corner sets of three actual parchment cylinders have been made up and at the base six outer groups of circles actually hold these cylinders, which are made secure by the application of circles on the underside of the made-up fitting which prevent the parchment cylinders from falling through.

All the actual cardboard circles which are cut from the original tube are firmly held together with a cement adhesive. When dried out cylinders of lampshade parchment are then inserted in the appropriate holes. The cylinders are simple to prepare, a suitable piece of parchment being cut and rolled into a cylinder to the desired circumference to fit into the cardboard circle and glued to shape. The whole fitment of cardboard circles and parchment is made even more secure by applying a cut-out piece of parchment to the base of the work and in this way six sets of outer circles may be covered, this is also shown in Fig. 5a. The completed work may be tinted to harmonise with interior decorations, but coloured parchment may be used if desired. The flex and electric lamp bulb are passed through the centre and this arrangement may be seen in Fig. 6.

Pleated Lampshades

Few can resist the appeal of the pleated lampshade (Fig. 7) and this charming style lends itself to parchment work. Pleated parchments may be obtained ready to use or the work of pleating, folding and thonging the necessary holes may be carried out by the home worker quite simply. All pleats must be accurate and evenly spaced. Thick tinted cartridge, sheepskin parchment and similar materials are ideal for this work. Polishing waxes are obtainable and thick paper may be suitably treated to render it washable and more durable.

The round ring will be selected for its size in proportion to the room. To make a standard shade, obtain two pieces 56in. in length × 12in. of the chosen material and two rings, one large, one small, the latter being 6in. for the top and the former 14in. in dia. for the bottom. Finally, 10$\frac{1}{2}$ft. of decorative cord or similar material will be required. As shown, the complete length of material used for the lampshade is twice the circumference of the largest circle or ring. The two rings are bound in the usual way with bias binding.

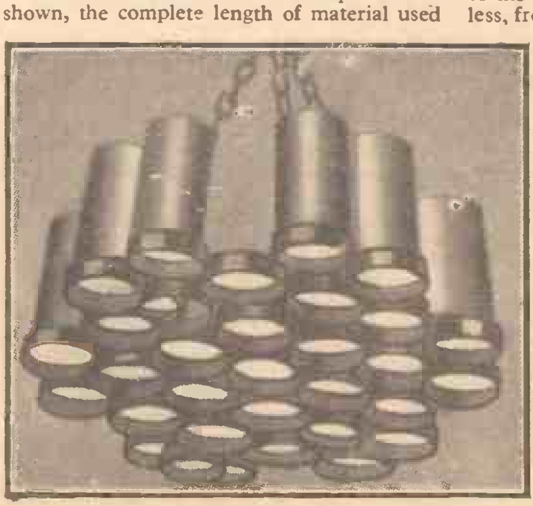


Fig. 6.—The completed tubular lampshade.

The two pieces of parchment or selected material are marked with a fine pencil mark at the top and bottom as a guide for the necessary creases. In this case, the dots are placed at 1in. intervals. The pleat is obtained by folding over the first inch and creasing the material firmly and evenly and this is followed by the second inch which is folded in the same way but under (this operation is shown in Fig. 8). In this way both pieces are pleated. The final join is obtained by bringing the two ends together, i.e., by placing the last fold of one over the first fold of the other.

The necessary holes should be punched at this stage—the ultimate shape hangs upon the accurate punching of these holes, which must be at equal distance apart. It is the cord which pulls the lampshade into its final

Fig. 7.—The pleated lampshade.

made-up shape. These holes should be approximately 1$\frac{1}{2}$in. from the top and bottom edges of the pleated folds and some $\frac{1}{2}$in., or a little less, from the front edges of the pleats. The holes which form the notches into which the ring rests should then be punched and these are at the same level except on the back of the edge of the pleats. The selected cord may now be threaded through both the top and bottom holes. Commence in the centre of a strip and leave the ends to be neatly tied after the bound rings have been placed in the prepared notches. The rings can, with advantage and for added strength, be stitched at intervals when the pleating has been suitably arranged.

The cords are then pulled together so that they fit the rings and they are finished off by means of tying two knots. At each end, a short length is left, the cords are knotted again and the ends are treated to form a decorative tassel. For greater security thread may be used to catch the lower cord to the lower ring.

In this case the pleats are evenly arranged around the frame. The finished pleated lampshade gives a sun-ray effect when illuminated. This pleated style is suitable for all sizes from 5in. chandeliers to some 36in. to be used as floor standards. The shape will vary with the diameter of the two rings between the styles known as empire and coolie. When working upon a definite shape or style, it will be found that by adjusting the pleats formed by folding the angle of the slope of the ultimate made-up shade is determined. The narrow end of inverted shades may be closed by fitting a cut-out circle of parchment or other material used and placing this in position to fill the centre.

The Frameless Lampshade

With the aid of a suitable gimbal or pendant ring for support a frameless lampshade may be made from scored and cut thick paper, lampshade parchment or sheepskin. The size of the sheet used for the work will depend upon the ultimate size of the finished shade, but in the main such shades are best employed as wall brackets (see Fig. 9) or hanging shades, which are, on average, some 22in. in length by an approximate depth of 8in.

The sheet of material chosen is pencil drawn as shown in Fig. 10, lightly scored lines being made with a blunt instrument horizontally. In between these two scored lines, cuts are made and when completed in their vertical length a fold is made at the middle along the horizontal length of the material. Sufficient end portions are left available for the final operation of gluing together to make up the circle. There are many variations possible in this form of shade, varying from single to double styles and these are obtained by two rows of cuts one on top of the other. This will need a double folded set of lines to produce the double pattern effect. Various types of cuts may be made, varying from quite straight ones to slits, narrow diamonds, ovals and other interesting patterns, taking care not to cut too much of the material away so that too much light is thrown out through the finished shade. Tinting or colouring plain material can give effective results, particularly in the case of graduated colouring. These shades may be produced very inexpensively as wire frame, trimmings and binding are not required.

Fig. 9.—The frameless type of lampshsade.

Alternative Applications

Other uses for this type of work are in connection with pie and cake frills, where cut materials of a fancy kind may be used to decorate cakes and pies at parties, etc. The addition of some fine cuts to give a fringed edge makes the job complete.

In the field of parchment, old bottles of a decorative shape may be covered by parchment cut to a suitably shaped size and thonged and stitched at the edges. One complete circle of parchment of a suitable diameter with one half circle stitched round half the diameter will make a good pochette for doyleys, the pattern of the doyley being seen in the half not covered. In the same way, a square of parchment with a triangular piece stitched half way across will make a good serviette holder. Old table mats may be re-covered with washable parchment and thus kept clean and hygienic. Two circles or other shapes as required, cut a quarter of an inch larger than the mat itself, thonged and bound around the edges, will cover the old mat and render it attractive and usable over a long period. All of this work may be decorated with transfers of the slide-off variety or otherwise treated with some form of tinting or decorative work. Where cork mats are used, they are inclined to break and crack at the edges and their life may be considerably lengthened at the onset by treatment with sheepskin parchment, which is very durable.

The artistic handicraft worker will find that most attractive work may be carried out on sheepskin parchment and anything from greetings cards to ornate certificate work may be carried out in full colour and cut and folded to shape as desired. Boxes may be covered with this parchment, the individual pieces being measured in size and cut a ¼in. larger for the purpose of edge binding. In addition to wastepaper baskets, fancy boxes for paper spills, gay needlework boxes, novel bookmarks and book covers, there are many items in the field of parchmentcraft itself. Care should be taken of off-cuts, which in some types of lampshade making may be quite big—as these are used for crafts of the kind outlined. Even the very smallest clippings come in for flags, place cards, sandwich flags and pendants. Always cut pieces used for covering purposes ¼in. larger to allow for a good strong binding edge. Use a thong and bind strongly without pulling the work out of shape. Hold any work together with clips or pegs until all thonging or stitching has been completed. White base pastes or adhesives are best for glued joints as they do not mark the white or light shades of parchments and thick papers.

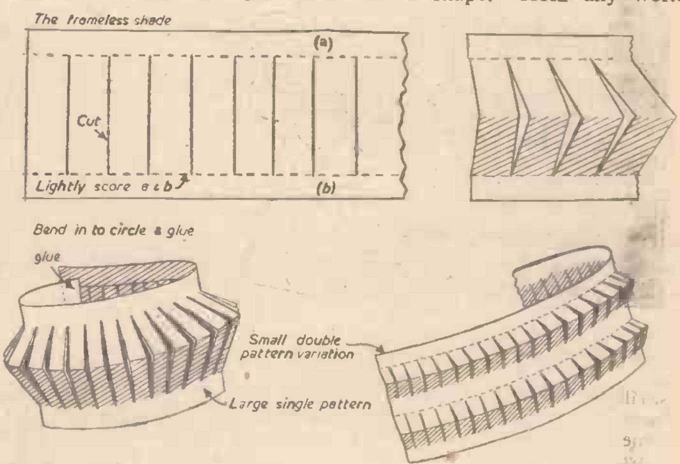


Fig. 10.—Marking out and folding the frameless lampshade.

It is also well to remember that sheepskin parchment lends itself to first-class stencil cutting where master patterns are required for mass production or a number of units. An outline is first drawn on the parchment and the figure, letter, design or motif is then accurately cut out. Oiled parchment is used for lettering wooden cases and designing on lampshades themselves.

Match the Room

When making up lampshades, the size must suit the room and the fittings to carry them. A large lampshade perched on a small table looks very odd in a small room and likewise, a small shade looks out of place in a large room unless there are a number of small units. Light reflection and the place where the light is really required are also important considerations.

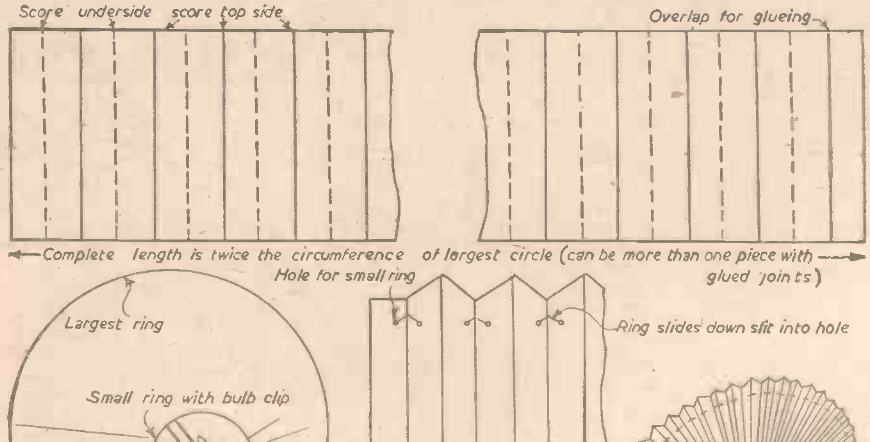
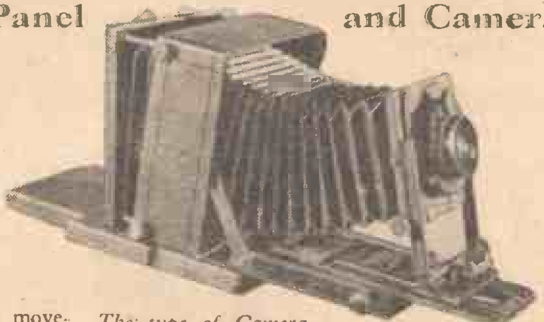


Fig. 8.—Working details of the pleated lampshade.

BASIC CAMERA MOVEMENTS

The Moving Lens Panel and Camera Back Explained

By E. Clements



The type of Camera possessing the movements described in the article

ALTHOUGH the vast majority of amateur photographers use a camera of what might be called the basic type, without the refinements of movement of lens panel and camera back, the occasion will sometimes arise when a really first-class record has to be made of an object or building and in these instances the use of camera movements will produce a much better picture both pictorially and technically. A camera having such versatility should then be begged or borrowed; it is in fact in only a very small minority of cases that even the very basic refinement of a rising front is unnecessary.

Fig. 1.—Using the dodge of tilting the lens panel forward to increase depth of focus.

Whatever the problem to be solved, the same basic corrections will be used. An angle shot of a can of paint will receive much the same treatment as that of a gasometer.

Minor Corrections

In many instances only a very small correction of either back or lens panel can effect a considerable improvement in the result. For instance a useful dodge, much used by commercial photographers, is to tilt the lens panel forward slightly when photographing a public dinner; this gives a far greater depth of focus, covering people quite near the camera and those at the back of the room. This achievement, using a large negative, is not always possible even with a small stop. This point is illustrated in Fig. 1, which was specially taken using a 13.5 cm. lens at full aperture of f/4.5 to show the great depth obtainable with this method. To achieve a similar result by stopping down would have meant using an aperture of about f/16. Note the sharpness of foreground plants and distant building. This technique is, of course, of greater value indoors where the use of a very small stop might be impracticable, owing to the long time exposure involved.

The Movements

The main camera movements are the two-way swing back (a back swinging about both the vertical and horizontal axis) and the swing front swinging about the horizontal axis. The use of all these movements naturally presupposes the aid of a tripod, for the effect of each degree of movement has to be observed on the ground-glass screen and the amount of movement in any given circumstances will, of course, depend upon the size of negative in use. A whole plate requires very much more movement than, say, a ¼ plate, where the normal depth of focus is greater.

In addition to the above there is also the rising front which is often used in combination with the swing back. This is used to maintain vertical lines parallel to each other whilst eliminating unwanted foreground and including more of the top of the subject; in fact, it obviates the necessity for tilting the camera (see Figs. 3 and 5).

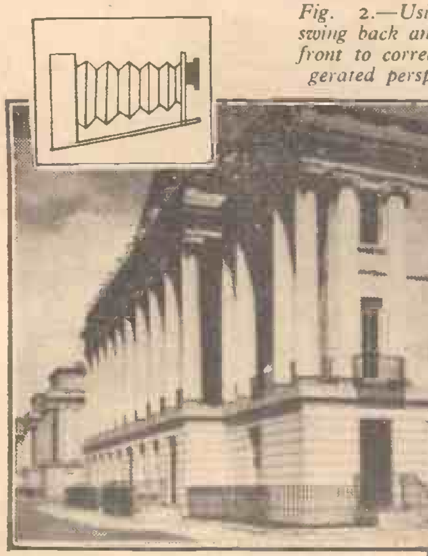


Fig. 3.—Using the rising front and swing back in order to obviate the necessity for tilting the camera. On the right is shown the sloping verticals which are the result of tilting the camera upwards.

Tall Buildings

When working close to a tall building, however, a simple rising front may not be sufficient to include the top and in these instances the swing back is used; reference to Fig. 4 will show how the back is maintained in a vertical position whilst the camera is tilted upwards sufficiently. This method results in some loss of geometrical exactness but is nevertheless often unavoidable. When using the swing back in this manner it will be necessary to employ the smallest stop possible although tilting the lens panel forward will help in ensuring all-over sharpness. It should be remembered that the use of a rising front increases the effective area of negative that the lens is required to cover and it must be capable, therefore, of actually covering a plate considerably larger than that in use, otherwise the use of the rising front will cause cut off.

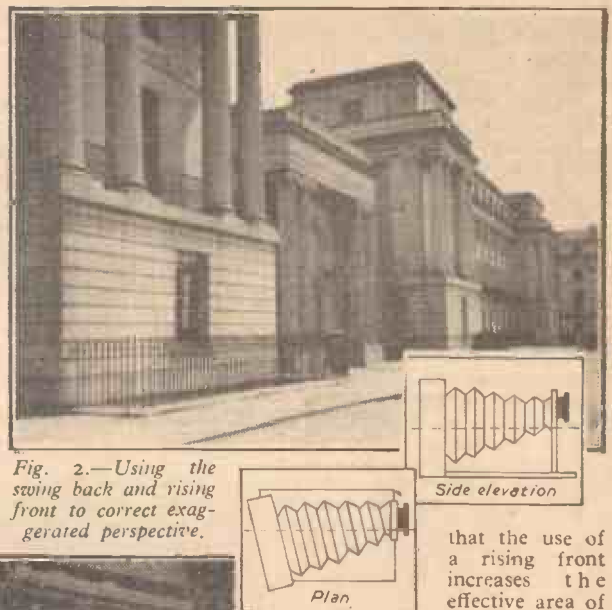


Fig. 2.—Using the swing back and rising front to correct exaggerated perspective.

The method of using the swing back to help correct exaggerated perspective in the length of a building or similar subject is illustrated in Fig. 2. This exaggeration is usually more pronounced when using a wide-

Fig. 4.—*The procedure used for photographing tall buildings from a close viewpoint, using the swing back with the front rising and tilted.*

angle lens, which is often required for this type of subject, and can be modified considerably as indicated. Apart from such correction this movement ensures maximum definition over the whole picture even when using large stops. It is an invaluable aid in all architectural work but also has uses in other types of photography. One could use it for instance at sports meetings when shooting from a static viewpoint such as hurdle races or jumping events to obtain sharp image of a number of athletes performing in line. In these instances the very high shutter speeds necessary call for large stops: therefore any dodge to obtain greater depth of field is extremely useful.

Portraiture

It is not perhaps generally realised that camera movements have their place in the portrait studio; for instance an effect of slimness in a model which may be carried to caricature lengths may be induced by tilting the camera downwards and then raising the lens panel to include the head in a suitable position on the negative (see Fig. 6). Also if a group of two or more people not in exactly the same plane is to be photographed then the use of the swing-back as in Fig. 1 will ensure a similar degree of sharpness over the whole group.

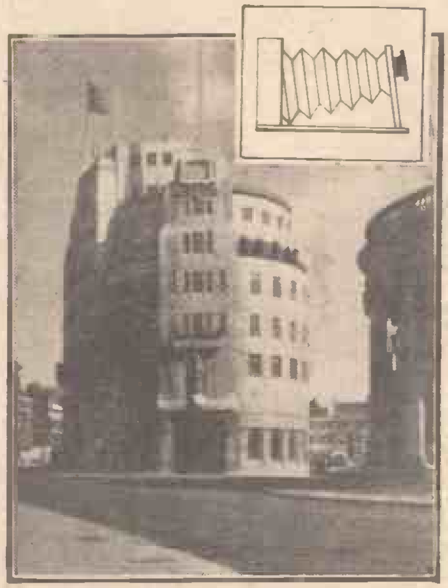


Fig. 5.—*Use of the rising front alone to avoid tilting the camera.*

Fig. 6.—*Using camera movements to emphasise slimness in a model.*

It is permissible to do all manner of things with the camera body and lens panel but provided that the back of the camera is maintained in a truly vertical position then all vertical lines will be parallel on the negative even if some geometrical distortion occurs.

Single Picture Stories

By H. W. Cull

PHOTOGRAPHERS often overlook the fact that in the word photographic, *graphic* is the operative section.

It is very difficult, adequately, to portray a subject in only one picture, and very much easier to take a series of pictures, but if you can give the complete story in a single print, the satisfaction is so much the greater.

Fig. 1 (*Right*).—*Round-Britain cycle race.*

Fig. 1 is a photograph which gives the whole story in one shot; a Round-Britain cycle race, organised by certain interests who were trying to popularise the drinking of milk. Of course, it was just luck that the man with the sign on his back should stop just where he did, but the " art " came in " seeing " the picture.

Fig. 2 was taken early last year. It depicts Mr. A. Gaertner and Miss Patricia Nettleton, two of New Zealand's tennis players, on tour in this country, playing in the finals of a mixed doubles match. The prize was the two cups in the foreground.

Fig. 2 (*Right*).—" *The prize in view.*"

The Inventions of Professor Krankopf

(*Concluded from page 183*)

Auster aircraft flew about the building avoiding all obstacles, doing every kind of aerobatic. Some apparent fault in the transmitter caused the model to disappear through a ventilator and so it was lost. Servo-mechanism firms offered the Professor large sums for his secrets but he refused to sell, saying, in his ponderous and grave manner, that the world was not ready for such inventions. The truth is that he had stuck a bluebottle or a bumble bee to the nose of the tiny craft.

I firmly believe that Professor Krankopff was the first man ever to make a success of perpetual motion. His machine was mysteriously destroyed by agents of an American corporation. I have no doubt that there will be some gnashing of dentures when these agents recognise the layout in Fig. 5. A special pulsating turbine drives a D.C. dynamo which supplies current to the electrolytic cell delivering oxygen and hydrogen to the turbine. Permanent magnets are used in the dynamo to conserve current and all other parts are heat insulated.

Space does not permit me to do more than touch upon this great man's other inventions, but he left me with a cigarette lighter of novel form, which, when I tried to use it gave a green flame—this went out and a jet of water squirted into my eye.

Letters to the Editor

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

Congratulations

SIR,—On the occasion of PRACTICAL MECHANICS' 25th anniversary, may I add my own sincere congratulations to the many you have undoubtedly received.

I bought my first PRACTICAL MECHANICS in 1938, and in a state of furious concentration, read it from cover to cover in one long session. Subsequent issues have never failed to increase my knowledge or to delight me with articles on "what makes things tick."

Thank you for many hours of pleasure and instruction and may I wish you success in the future.—A. L. BRODIE (Hants).

Velocity of Light

SIR,—With reference to Mr. B. A. King's letter in the September issue regarding my letter which appeared in the June issue relative to light. He corrects me by giving the velocity of light as 186,000 m.p. sec. in air and vacuo. If he had read my letter carefully he would have seen that I took 186,000 m.p. sec. as the velocity. My error is, therefore 000,000 miles per second. The discussion was not on the value of a physical constant, but on the means of conveyance of light.

[*The velocity of light is 186,282 m.p.s.*—ED.]

The experiments to which he refers were made on the surface of the earth moving at a velocity 18.5 m.p. sec. around a sun moving at about 200-250 m.p. sec.

If a person were to measure the velocity of sound in a railway saloon carriage moving at 60 miles per hour with the windows closed he would find the velocity to be 1,100ft. per sec. If, however, he put his measuring apparatus outside the window of the train he would find it to be 1,016ft. per sec. in the direction of the train's motion and 1,188ft. per sec. in the opposite direction. Measurement of the velocity of light on the earth's surface is in a like condition. Light is a wave motion. It used to be assumed that the motion was in a medium-waved ether, but the moderns, since the time of Einstein, have scrapped the idea of an ether and given us nothing in its place. The present state of the theory of light propagation is confused. Some say it is conveyed by photons which are imaginary wriggling snakes of energy shot off at 186,170 m.p. sec., which have no mass. Others say it is waves in a "something" (they fear to say ether). Some say it partakes of both photons and waves in a "something." The subject is very complicated as they also assert that each wave in the photon carries exactly one quarter of energy which is 6.6 × 10-27 erg./seconds.—THOS. H. WEBSTER, A.M.I.C.E. (Northumberland).

MADE ANYTHING FROM P.M. LATELY? We are interested to hear from any of our readers who have made any of the items described in "Practical Mechanics" recently, and will publish letters commenting on our designs and including a photograph. We pay 10s. 6d. or a guinea for every letter published.

Remote Control Camera

SIR,—In your November, 1958, issue, J. Matthews requested information on operating a camera by remote control. A method I have used incorporates a magnet and the hammer of an electric bell and a flat flashlight battery. I used a cable release and as I found only a small voltage was necessary, the whole unit was placed inside a small metal box with a U2 or similar small battery. This worked at over 20ft. A similar method to this is described in "Hints, Tips and Gadgets for the Amateur Photographer," published by Fountain Press. —J. D. WINK (Greenock).

Outboard Motor Boat

SIR,—I have pleasure in sending you a photograph of my completed outboard motor boat, which I built from your designs.

I am most satisfied with this and must compliment you on an excellent design and simple, easy-to-follow instructions. The boat rides well, is practically impossible to turn over (this makes it ideal for children to use for diving), it rows easily and with a load of six adults (approximately 70 stones) still has at least 3in. of freeboard. It will take plenty of hard knocks—I'm more than satisfied with this handy little boat.—R. SHARDLOW (Cheshire).

Mr. Shardlow's "Practical Mechanics" Outboard Motor Boat in use.

Piano Rattle

SIR,—In the September issue under "Information Sought" H. Bannister inquires about a rattle in his piano when the keys move.

This trouble could be caused by some of the circular felt discs on the pins on which the keys are pivoted being worn through or missing. Also, any of the felt used in the making of the moving parts worked by the keys may have worn through, or a wandering moth may have laid eggs somewhere, and the grubs caused the damage. Something may want lubricating with powdered graphite.

What is quite likely, however, is that as the piano is played, something slightly loose inside is caused to vibrate in sympathy with one or more notes, and the only thing to do here is to systematically go over the piano, first outside, then inside, touching everything likely to be loose, while the piano is being played. Having located the cause, it can soon be put right. Should all these rattle detectors fail, remove the keys in turn and examine them, also the other moving parts. M. M. DAWES (Kent).

Transfers

SIR,—Re Mr. Francis's query in the November, 1958, issue under "Information Sought" on how to make transfer numerals. These may be bought at most aero-model shops.

If a special size or colour is required, the transfers can be made as follows:

Take a sheet of gummed paper (the type that you moisten) and give it a coat of clear dope, as used on model aircraft, on the gummed side. The design is then painted on, using colour dope, after allowing the clear dope to dry thoroughly.

To apply, cut out each numeral on a piece of the backing paper and soak it in water until the transfer becomes loose. The transfer, complete with backing, is placed in the required position and the backing slid from under it. It should be pressed down with a damp cloth and varnished when dry. It is best to use them fresh, as they tend to crack on keeping, especially if bent.—S. R. BROADFOOT (Dunstable).

Ink for Plastics

SIR,—With regard to W. Montagu's request for information in the November, 1958, issue, on an ink for plastics. I discovered by accident that Joy Plane Cellulose dope is non spreading and deeply penetrating on plastic and I would suggest that he experiments with this. It is obtainable from most aero-model shops.—R. P. BAYLIE (Aldershot).

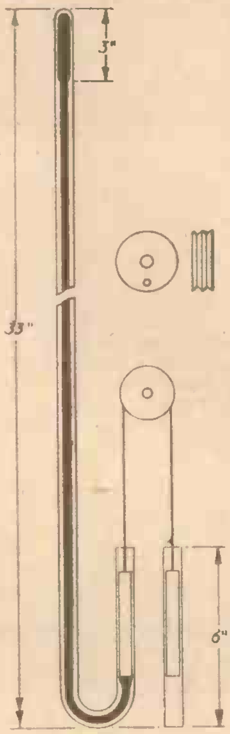
MERCURY U-TUBE BAROMETER

SIR,—In reply to the query in the November issue by W. M. Roberts under "Information Sought" about a mercury U-tube barometer, the reference made to "glass balances" makes me feel certain that he is really referring to an antique "wheel barometer." This instrument has glass weights that move the pointer round the dial via cords and a pulley wheel.

The barometer tube itself contains the usual 30in. or so of mercury in the long closed limb, but it is the height of mercury in the short open limb that must be correct, as it is here that the mercury works the pointer. The level should be adjusted, by adding or subtracting mercury, so that when the atmospheric pressure is known to be about 30in. about 1in. of mercury remains in the wide part of the short limb. The level can also be checked, after the weights are in place and the pointer correctly set, by gently tilting the instrument sideways and watching the pointer and mercury level.

It should be noted that a rise in atmospheric pressure will cause a fall in the mercury level in the short limb of the tube, and a fall in air pressure produces a corresponding rise at this point.

The weights themselves must be of glass; metal would contaminate the mercury. The one that slides down the open end of the barometer tube must do so with as little sideways movement as possible, and must have a flat bottom to rest squarely on the mercury, also an eye formed at the top to tie the thread to. The thread should pass at least once round one of the grooves in the double pulley and through a hole in the rim, where it is knotted. The other weight is made in the same way, and its thread is taken at least once round the other groove of the pulley in the opposite direction, and fastened there. This weight slides up and down a separate length of glass tube mounted next to the barometer tube, and must be just a little lighter than the weight resting on the mercury, so that when the mercury level falls, the weight will sink with it and pull the pointer round. The weights are from $1\frac{1}{2}$in. to 2in. long, and are readily made from glass rods of the right diameter, or from glass tubes with a little lead shot in each. The spindle carrying the pointer should be very free moving without shake, and the pointer itself counterbalanced.



U-tube barometer.

The aneroid barometer is a more difficult proposition, as it depends what is really wrong with it. If the only fault is the pointer reading too high or low, there is a hole at the back of the instrument, through which can be seen a screw which, when turned, will reset the pointer to the correct reading. The working element is not a diaphragm, but a flat, circular capsule exhausted of air, so that it expands and contracts as the outside air pressure varies. It is connected to a flat spring, and its movements are transmitted by levers to a fine steel chain that pulls the pointer round, this being caused to return as the chain slackens by a hairspring. The movement is very delicate and should be treated with the same respect as a watch. If the pointer does not move with the air pressure, the capsule may be punctured, or damp may have caused rust on any of the fine pivots of the levers, or on the steel chain. The hairspring may be broken from the same cause.

Close examination of the parts by carefully taking the movement to pieces may be necessary to find the fault.—M. DAWES (Kent).

SIR,—In reply to reader W. M. Roberts' query in the November issue. The balance weights are as follows: the one resting on mercury $\frac{1}{4}$oz. approx., and the counterweight is 1/10 oz. approx. (=1 farthing), the wheel is $\frac{1}{2}$in. dia. The total height of mercury is 33in. maximum (see illustration).—H. QUIRK (Middlesex).

Projection Screen from Old Map

SIR,—In reply to M. J. Feest's query in the November, 1958, issue. I would suggest that he paints the back of his map with two thin coats of flat, dove grey paint. When thoroughly dry and hard, repaint with aluminium silver paint. This should produce a satisfactory result for all practical purposes.—R. B. GARNISH (Ilfracombe).

THE EQUATION OF TIME

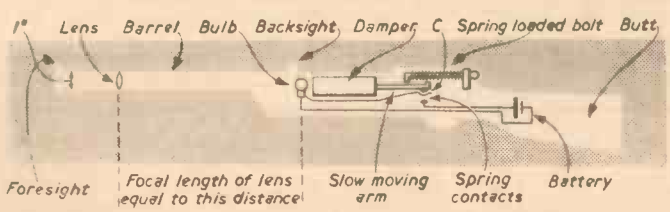
SIR,—The reply given by you on page 110 of your November, 1958, issue to Mr. E. Mason needs modification and, therefore, perhaps you will permit me to mention the following: (1) a sundial can only give *local* apparent time and, therefore, a time signal would have to be corrected for longitude and "equation of time" to arrive at "correct time" at place, (2) to read time by a sundial, access must at all times be available to the Nautical Almanac or other publication where the equation of time is given, i.e., plus or minus to apparent time, (3) there is no such direction as due north or due south. The correct description is true north or true south, i.e., the meridian lines as indicated on a Mercator's Chart.—E. W. L. EVANS (Captain, Foreign-going shipmaster).

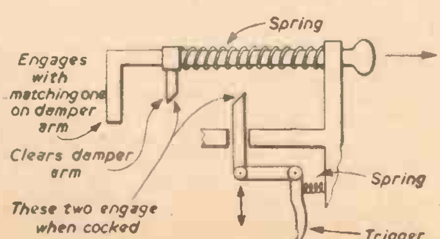
DETAILS OF THE ELECTRIC RIFLE

SIR,—Re Mr. Hummell's query regarding details of an electric rifle, which appeared in the October issue, I enclose a sketch of one which is in my possession.

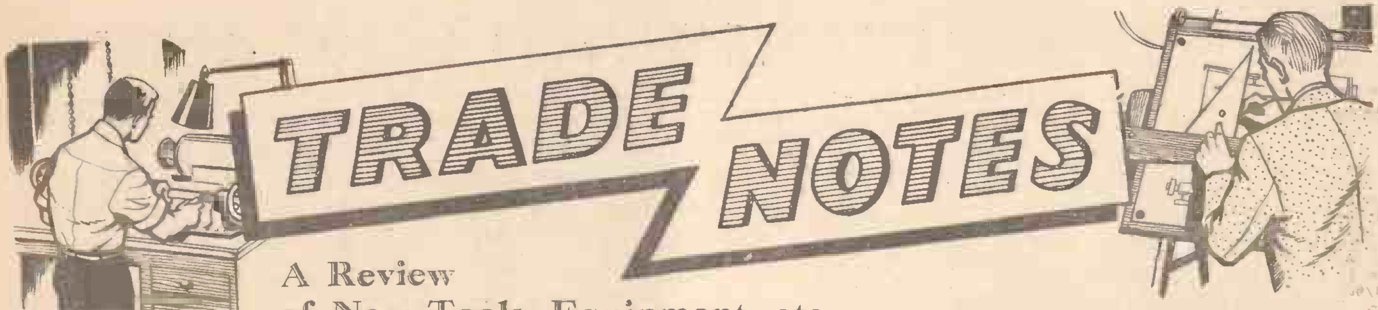
The bulb is an ordinary torch bulb and is mounted on a piece of insulating material fitted with screws for lateral and vertical adjustment. It is at the focus of the lens so that the light beam leaving the barrel is parallel-sided. For this purpose the lens is made so that it can be moved along the barrel.

To fire the rifle it is cocked by drawing back the bolt which is fitted with a catch (see illustration), this draws back the damper arm. When the trigger is pulled, the bolt shoots forward, but the damper arm takes 5 to 10 seconds. During this time the cam, marked C in the illustration, depresses the top contact, so lighting the bulb. The cam is so arranged that the bulb goes out when the plunger is fully cocked and when it is fully returned. The cam is made of insulating material to prevent accidental short-circuiting through the damper body.—S. R. BROADFOOT (Beds).





Details of electric rifle.

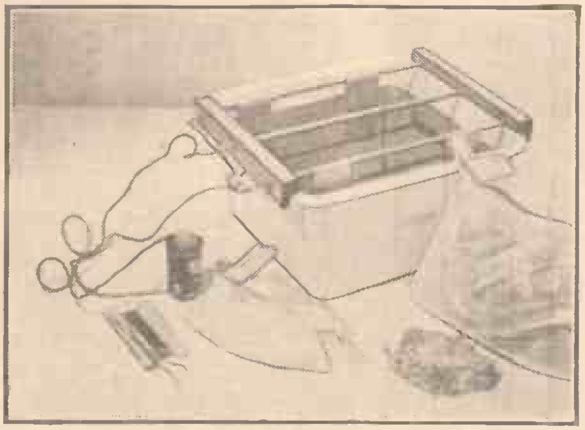


TRADE NOTES

A Review of New Tools, Equipment, etc.

HOME NICKEL PLATING KIT

THIS outfit is designed to produce work to commercial standard and is capable of production on a small scale. It consists of a special plastic tank, nickel anodes, rods for work and anodes, wooden support frames, connecting cables, nickel solution mixture, cleaning chemicals, copper wire, battery and instruction manual. This manual contains the information necessary for the amateur to start plating, including details of the plant and instructions for assembly. The kit is marketed by Leslie Dixon and Co., 214, Queenstown Road, Battersea, London, S.W.8, and costs 90s. plus 5s. postage.



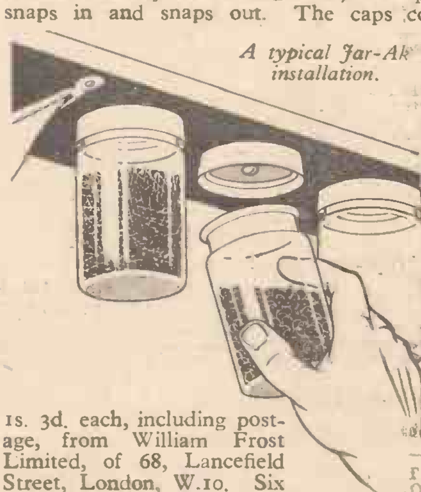
The new home plating kit.

Ultrafix Rapid Fixing Solution

JOHNSONS OF HENDON LTD. supply a new amateur size of their Ultrafix Rapid Fixing Solution. Two of the main features of this improved product are: its greater concentration, the dilution being one-to-four, and the fact that the hardener, previously sold as a separate solution, is now included as a powder packed in two separate polythene bags. This packing, making 1,200 ccs. for negatives or up to 1,700 ccs. for paper, retails at 5s. 6d., from local photographic suppliers and chemists.

Jar-Ak

THS rubber cap holds a 1lb. jam jar securely under shelves or benches. It provides extra storage space in workshops, etc. It is easy to fix and the jar simply snaps in and snaps out. The caps cost 1s. 3d. each, including postage, from William Frost Limited, of 68, Lancefield Street, London, W.10. Six cost 7s. including postage.



A typical Jar-Ak installation.

The "B.N.T. Slickbit"

JOS. TYZACK & SON LTD., of Sheffield, have placed on the market a kit which enables owners of ¼in. power drills to make swift clean holes from ½in. up to 1¼in. in hard- or soft-wood, wallboard and similar materials. The kit consists of six bits in a red plastic wallet, complete with a shank and Allen key. The bits are attached to the shank with the Allen screw and are instantly interchangeable. The complete B.N.T. Slickbit kit costs 10s. 6d. from ironmongers and tool merchants.

Two views of the "B.N.T. Slickbit."

Christmas Cracker Outfit

GAIETY CARNIVAL NOVELTIES, of Amen Corner, Tooting, London. S.W.17, supply for 5s., post free, a beginner's outfit for making Christmas crackers. Except for the formers, which can easily be made out of cardboard or bought at additional cost, the kit contains all the material necessary to make two dozen crackers. Gaiety Carnival Novelties also supply a large variety of fillings for crackers, which range from wire puzzles and fashion clip brooches, to assorted plastic charms. All the other necessary materials for Christmas crackers are also obtainable, such as already crimped crêpe paper, snaps and glitter powder for decorating the crackers and boxes for the finished product.

After practising with the beginner's outfit it could become a profitable pastime, it can also act as therapy treatment for invalids and physically handicapped people.

Correction

The photograph of the Myford mortising attachment in last month's Trade Notes inadvertently appeared in reverse. We apologise for this error.

NEW WOLF PAINT REMOVING ATTACHMENT

A NEW paint and varnish removing attachment has been introduced by Wolf Electric Tools Ltd. The manufacturers state that it is the quickest, cleanest and most economical way of removing paint and varnish from wood or hardboard without damage to the undersurface. The attachment can be used with all makes of ½in. home power tools and it consists of a 4½in. dia. perforated disc, cooling fan and arbor assembly. It can be used time and time again and will save a considerable amount of money normally spent on sanding discs. The perforations on the disc allow the paint or varnish to be taken away from the work without causing dust. The cooling fan lowers the temperature of the removed paint, thus avoiding clogging. The attachment retails at 4s. 9d. complete and is obtainable from most ironmongers, etc.

(Right).—The new paint and varnish removing attachment in use.

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.

ELECTRICAL

EXTRACTION FANS, 6in., silent shaded pole, no interference, A.C. only, price 20/-, post 2/-; also New 1/20th h.p. Universal 230v. Geared Motors, 10-1 reduction, suitable for food mixers, price 22/6, post 2/-; 1/6th h.p. Motors, all types, £2/10/-. Wheelhouse, 13, Bell Road, Hounslow.

CONVERT your ordinary Washboiler to electric. G.E.C. Circular Washboiler Elements, 200-250 volt, 2Kw., 9½in. diameter one hole fixing, 22/6 each, plus 1/9 p. and p. London Warehouse, 165, Queens Road, Peckham, S.E.15.

BRAND NEW
BROOK ELECTRIC MOTORS

Single Phase, ⅓ h.p. 1,500 r.p.m. £7.10 0
½ h.p. 1,500 r.p.m. £9.12.6
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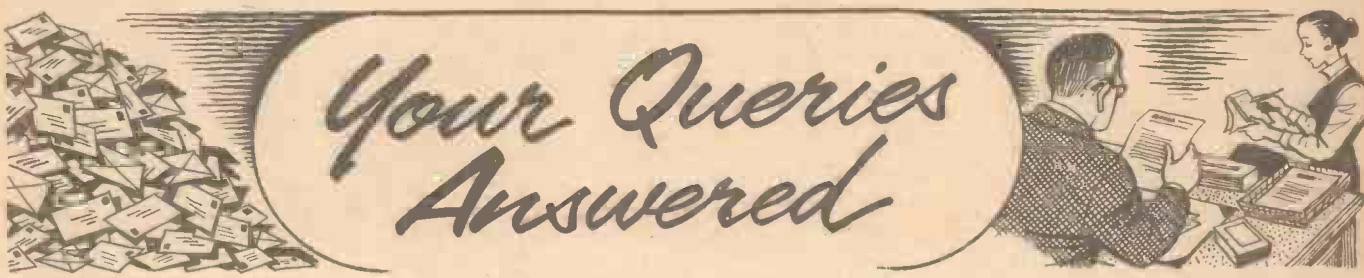


Your Queries Answered

Soft Water

I HAVE a cottage on Dartmoor with a supply of water piped from a spring nearby. The water is bacteriologically excellent in quality but is, however, very soft, and when tea is made it turns black.

I have boiled the plain water and it is perfectly all right, with no deposit. Can you suggest a reason and cure for this complaint? Would hardening the water help, and how is this possible? Has this soft water any effect on galvanised pipes?—J. Simpson (Devon).

VERY soft water has a solvent or eroding effect on many metals, particularly on lead, zinc and iron. The Dartmoor water to which you refer is not only exceptionally soft but is also slightly acidic in consequence of its absorption of peat acids. Consequently, it will possess quite a powerful degree of solvent activity on unprotected metals. It is readily able to extract tannins from vegetable materials. Hence the black, bad-tasting tea to which you refer. Such waters usually contain sulphur, which element also adds to the corrosive and eroding powers of the liquid.

The only cure for the trouble is to harden the water artificially by stirring a small quantity of lime into it, allowing it to settle, and then withdrawing to clear liquid above. Another method is to allow the water to flow over about 10 yards of broken limestone forming the bed of the water channel or conduit.

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.

Magnesite Floor

I REQUIRE a flooring material which does not encourage condensation and has a surface that permits a dull polish. I believe cement and sawdust are ingredients. Can you advise me of the formula and any other directions in the use of this material.—G. McBroom (Bristol).

THE flooring material to which you refer is based on calcined magnesite. This material is made by mixing together calcined magnesite, sand and sawdust and by moistening the mixture with a solution made by dissolving 60 parts of magnesium chloride in 40 parts of water. The mixture takes the form of a paste which is spread like butter with a trowel. It hardens quickly and presents a dull finish. It can be coloured if required by a mixture of iron oxide, umber or other mineral colouring matter.

Aquarium Base

SEVERAL months ago I built an aquarium, 30in × 12 in. × 12in., using a 1in. angle-iron frame and 32oz. glass. The result has been perfectly satisfactory, but I have recently been told that 32oz. glass, while satisfactory for the sides, is not strong enough for the base of the tank.

I could replace the base with $\frac{1}{4}$in. plate glass but believe this is expensive and I do not want to reglaze if I can help it. Would a sheet window glass on top of the 32oz. base give a satisfactory result? Possibly securing this firmly to the base with a coating of putty would be preferable?— C. Butler (Bath).

THERE is no doubt that $\frac{1}{8}$in. plate glass would have more satisfactory strength, as well as better appearance, than 32oz. window glass. Window glass could not be brought up to satisfactory strength by cementing two sheets of it together with putty. Plate glass has, usually, a far more reliable strength than sheet glass, for which reason it should always be employed when maximum strength and maximum appearance are desirable. If you are dissatisfied with your existing aquarium glass, make use of plate glass, even although the latter may be obtained second-hand.

Woodwind Instrument Lubricant

PLEASE give me details of a cork grease preparation for lubricating clarinet joints, using beeswax and tallow.—J. W. Hayhaw (Romford).

YOU can make a lubricant for clarinet and other woodwind instrument joints by melting together equal quantities (volumes) of refined beeswax and high-grade tallow and by adding to the molten product about an equal bulk of medicinal paraffin. On cooling, the product should have the consistency of petroleum jelly, but its final consistency may be adjusted to any degree by adding more paraffin or more of the wax-tallow mixture. Tallow can be obtained from any large paint stores and it can sometimes be obtained from pharmacists and druggists.

We do not advise the use of a tallow-wax compound for cork-joint lubrication. The lubricant tends to dry up and to become sticky, to say nothing of developing mould. A very simple, cleanly, non-moulding, non-drying lubricant can readily be made by adding a few drops of medicinal paraffin to white petroleum jelly. These ingredients are cheap and are readily obtainable. A little of the mixture would last a long time.

Solder for Developing Tank

I INTEND building a developing tank of the drum type for 9.5 mm. ciné film. The material used will be stainless steel. Would the chemicals used corrode the soldered joints?—A. Jackson (Sheffield, 10).

ANY good tin-lead solder will suit your needs, a composition of about 50-50 tin-lead being most suitable. Ordinary developing chemicals and reagents will not prove corrosive, patricularly if the solutions are well washed away after use.

Denture Cleaner

PLEASE give me a formula for making a denture cleaner of the "soak" type, suitable for both vulcanite and acnylic types. —M. S. (Newcastle).

MIX together 1 part (by bulk) of common salt and 3 parts of either sodium perborate or sodium percarbonate. A few drops of oil of peppermint are added to the mixture during the stirring. The dry, white powder thus obtained is stored for use in tightly-corked bottles, and, preferably, in a dark cupboard. For use, dissolve a saltspoonful of the mixture in a tumblerful of cold water, and immerse the dentures therein overnight.

Sodium perborate and sodium percarbonate are not easy to obtain retail. They are manufactured by I.C.I. Ltd. London, S.W.1, and bv Laporte Chemicals, Ltd., Luton, Beds. It is probable that you will be able to obtain small quantities of either of them from a firm of laboratory chemical dealers. Of the two, sodium perborate is to be preferred, being rather more energetic than the percarbonate.

Fitting a Fireplace

I AM contemplating the removal of an old-fashioned iron fireplace of the suspended basket type, and replacing with

a tiled surround and the usual shaped fire-brick hearth. What is the best method of fixing the surround to the wall and also the method of filling in behind the firebrick?—D. J. Cooper (London, N.17).

YOU will find the surround has a couple or more iron straps for fixing, which are cemented into holes cut in the wall. Fill in behind your fireback with weak coarse concrete—about 7 parts ballast to 1 part cement—and use it only just moistened.

Chill-room Refrigeration System

I HAVE an outhouse which I would like to convert into a chill-room with a temperature of probably 26 or 27 deg. F. The room is at present 6ft. 6in. × 6ft 6in. with a sloping roof from 9ft. to 6ft. 6in. The walls are of stone and the roof, wood and slated. Can you let me know the outlines of a refrigeration system?—F. Bryson (Annan).

THE outhouse described will serve as a structure for a chill-room. It must, however, be insulated and provided with an insulated door. Four to six inches of slab cork should be sufficient and this should be affixed to the floor, walls and ceiling. All cork slabs should be set in bitumastic and walls and ceiling finished with expanded metal and plaster; the latter being suitably painted. The floors need waterproofing on the upper surface and finishing with very fine macadam, pitch, cement or a patent-flooring—gulleys being provided for washing-down.

Cooling would be by a direct-expansion refrigerating set, using ceiling, or ceiling and wall coils, inside the store. Given the size of store, method of insulation, probable inside and outside temperatures, commodities to be stored and probable number of entries to be made into the store each day, any known refrigeration machine manufacturers would specify a size of unit and its cost. These people are also fully conversant with suppliers and costs of the remainder of the equipment required.

Leaded Lights Repairs

PLEASE inform me if any cure can be effected to some leaded light windows. These over the years have bowed outwards and could prove dangerous in a strong wind or should the door, in which they are fitted, be slammed.

I do not wish to replace them. In the past some previous owners seem to have wired them to rods fitted across the back and sunk into the woodwork. These wires have also broken loose.—J. L. Spence (Goole).

IF you can take the lead lights out of the door frame and lay them on the table so as to get them level, clean the space between the lead-cames and the glass, fill with letharge (i.e., dry white lead and gold size and vegetable black in paste form) and press this in the space. All leaded lights have round rods or square rods let into the wood about ½in. and soldered on the lead-cames is copper wire, this in turn is tied to the rods in question, if that were not so the window would collapse.

Rolled Steel Joist Calculation

I HAVE to lift a load of six tons from the centre of a beam 26ft. span—the ends being free—not fixed in any way to rest on supporting steel work. Could you please tell me what size R.S.J. to use and the formula for working out this problem?—R. W. Winter (Chippenham).

MAXIMUM bending moment on a simply supported is:

$$\frac{\text{Central load} \times \text{Span}}{4}$$

The maximum stress induced by a moment M in a beam of section modulus S is M/S.

The allowable stress in mild steel is about seven tons per sq. in. for steady loads or about five for varying loads.

Here the maximum bending moment is:

$$\frac{6 \times 26 \times 12}{4} = 468 \text{ ton. in.}$$

The necessary section modulus is thus $468/5 = 94\text{in.}^3$ and an 18 × 6 rolled steel joist suffices for this.

The central deflection is:

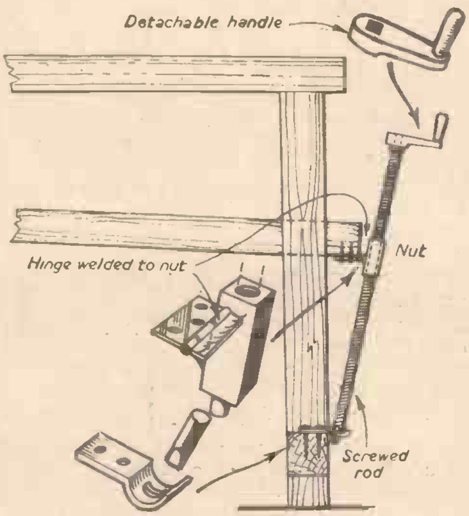
$$\frac{\text{Load} \times \text{Span}^3}{48 \times \text{Young's Modulus} \times \text{Second Moment of area of section}}$$

Here it is:

$$\frac{6 \times (26 \times 12)^3}{48 \times 13000 \times 842} = 0.35\text{in.}$$

Rise and Fall for Sawbench Bedplate

I HAVE made the sawbench described by J. Vose in "Practical Mechanics" for July, 1957. Can you suggest a method of making the bedplate rise and fall by mechanical means? I cannot obtain fine adjustment using the method described.—W. J. Osborne (Stratford-upon-Avon).



Rise and fall mechanism.

WE suggest that you fit a screw adjustment to the rise and fall table. The mechanism is quite simple and is shown in the sketch above. The long screw and nut are from a car jack of the type fitted to most modern cars and a search round the local motor car breaker's yard should reveal a selection of jacks suitable for this purpose. It would be necessary, or at any rate desirable, to retain the existing bolt and wing nut, to enable the rise and fall bedplate to be locked in the required position after adjustment by the screw.

Resurfacing a Drive

COULD I lay a new surface on my drive to prevent the deterioration now in progress?

The original surface is firm and hard, but small chippings detach themselves whenever I brush the drive, the original surface being tarmac, similar to that used on road surfaces. Would the bituminous emulsion mentioned in "Laying a Tennis Court" in the August '57 issue of "Practical Mechanics" form a suitable top dressing?—T. D. Weston (Stoke-on-Trent).

COLD bituminous emulsion of 60 per cent. bituminous content would be most suitable for top dressing your drive.

Brush off loose chippings and dust, if the surface is inclined to be dusty, apply a light spray of water.

Cold bituminous emulsion is available under trade names "Colas," "Coldcoat," etc., and can be purchased in drums from 5 galls. to 40 galls. Any leading builders' merchant should be able to obtain it for you.

Pour the emulsion on and brush it over the existing surface with a semi-stiff sweeping brush to allow one gallon to cover about 4 sq. yd. Within ten minutes of applying the emulsion, it should be covered over with small chippings, shingle or pea gravel at about 120 sq. yd. per ton; coloured chippings produce a pleasing surface.

Although not necessary, it provides a better surface to roll in the chippings with a heavy garden roller or better still, hire a 30 cwt. roller for an hour, from your local authority or local asphalt contractor.

The cost should not exceed 1s. 2d. per square yard in all.

Two days after completion, brush off all loose chippings.

Using Motor on Different Voltage

I HAVE an electric hand drill which is 200-210 v. and I wish to use it, for a short while, on 250 volts. How can this be done? Also, is it possible to reverse the motor?—B. Smith (Kent).

THE best method of using the drill would be through a step-down transformer. Provided the current rating of your transformer is adequate, and the transformer is designed for the same frequency as your supply, this could be used by simply connecting the 250 volt terminals to the supply and the 210 volt terminals to the drill.

AN A.C. ARC WELDING SET

(Concluded from page 172)

Fig. 11 shows the connections. 770/0.0076 flexible cables are advised for the leads to the electrode and work, a third cable being used to connect the work to the casing and the cores of the transformer and choke. The casing of the welder and the cores must be efficiently earthed, and the supply cables to the welding set should not be less than 7/0.036. An open-circuit voltage of 100 volts is available when the electrode lead is connected to terminal Y, 80 volts being available when the lead is connected to terminal X. For minimum welding current the link of the coarse tapping device is connected between the screwed brass rods Q and T, for medium current the link is connected between Q and S, and for maximum current the link is connected between Q and R. The link of the fine tapping device is used for intermediate welding currents between the tappings of the coarse selector. Absolute minimum current is obtained with the links connected between Q and T, and between J and K.

The user is advised to purchase or construct a spring type of electrode holder, which is easy to manipulate. A substantial clamp should be used to secure the flexible cable to the work, and this clamp must be tightly connected.

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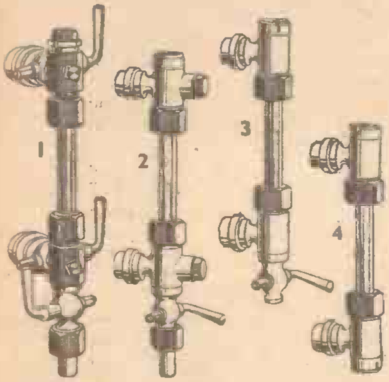

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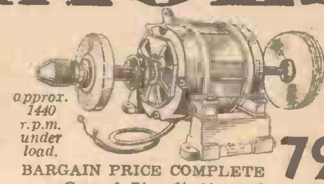

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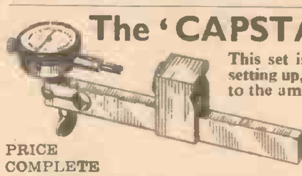

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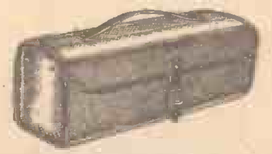

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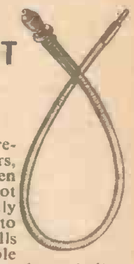

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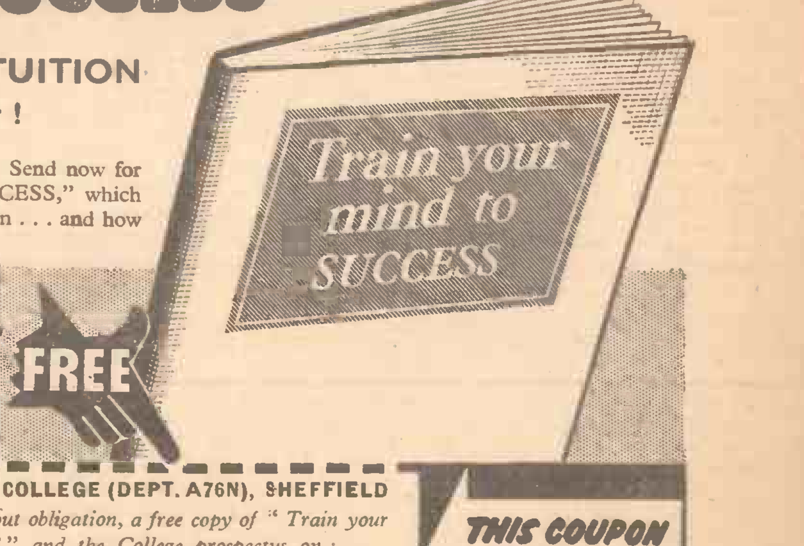

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WHAT I THINK By F. J. C.

Dog in the Manger

THE opening of the new Preston by-pass for the exclusive use of motorists provided the occasion for the C.T.C. to obtain a little cheap publicity for itself in the form of a letter by R. C. Shaw, Yorkshire-born secretary of the C.T.C., to the press in which he claimed that the C.T.C. were the first to advocate the construction of special roads for motorists. That statement is not true, although it is a matter of small moment who first mooted the idea. The fact is, however, that the C.T.C. has from time to time made such a recommendation, but not with the altruistic motive of making travel easy for motorists, but with the sole idea of making roads freer for themselves. When any suggestion has been made by the motoring movement for special ways for cyclists it has been bitterly opposed. The same dog in the manger spirit persisted for many years over the fitting of rear lights. Yet, in the early part of the present century the C.T.C. were pressing for compulsory rear lights for horse-drawn vehicles!

The C.T.C. policy does not necessarily reflect the opinion of its members. It is an office-made policy, not proposed and ratified at annual general meetings. This is a fact which the Minister of Transport should bear in mind when considering any recommendation the C.T.C. may make. My advice to the C.T.C. is to confine its attention to cycle touring and leave matters motoring and other topics with which they are not competent to deal to those who are. My advice to C.T.C. members is to take steps to make the club a truly democratic instead of an autocratic body. Then perhaps some notice may be taken of its views. Neither the public nor the Ministry is interested in the views of its secretary or president only.

London Travel Committee

THE M.O.T. has appointed another committee, this time the London Travel Committee, to advise on peak hour problems of overcrowded public transport and congested roads.

The Yorkshireman editor of a cycling periodical says, "Strangely enough, there are no representatives of the cycling or motoring organisations on the committee." I see no reason why cyclists should be represented in this committee, since their attitude towards motor vehicles is well known and there is no one on the C.T.C. who has sufficient experience of motoring and the congestion caused by it to express a worthwhile opinion anyway. They would merely inject venom into any debate on the subject. That there should be a representative of motorists on the committee is a matter upon which I agree with the writer since it is motor cars and not cycles which cause congestion in busy places. But then, the chairman of this new committee is also the chairman of the London Traffic Advisory Committee and presumably will bring his experience of causes of traffic congestion to the attention of the committee. This writer goes on to say, "Sooner or later, the bicycle, as a major solution to the traffic problem in big cities, will be recognised. The benefits of travel by cycle in streets is that it is today as quick as by car. The amount of road occupied is negligible, there are no obnoxious exhaust gases, and the cost to the user and the nation is nil." This fatuous and angelic, if not imbecilic, suggestion that we should all ride bicycles to the office cannot be taken seriously. Quite apart from the fact that large numbers of those who travel by car are long past their cycling years, most of them are in positions where they need to arrive in a reasonably clean condition without baggy trousers and dirty shoes. It is impossible to arrive at the office in a spruce condition, especially on a hot or a wet day. There is also the question of time. Many of the people who come to London in cars come from distances as far away as 60 miles or 120 miles a day. At an average touring speed of 12 miles an hour this would take 10 hours a day. I wonder if these cycling writers really believe what they write?

The British Cycling Federation

THE condominium of the B.L.R.C. and N.C.U. to be known as the British Cycling Federation has progressed a step further with the publication by the working committee of a statement on how it will work. It is to be administered by a company limited by guarantee, which will take over all the existing assets, liabilities, obligations and commitments of the two constituent bodies. The existing facilities offered to members of each body are to remain. Until the inaugural meeting of the Federation clubs should carry on working under their respective rules. Area boundary questions have been resolved. The Federation's policy will be controlled by a national council elected annually. The first election is to take place in January, 1960. The day-to-day business of the Federation will be carried on by a professional staff. The Federation is to be broken down into semi-autonominous financially self-supporting units called Divisions, and the Divisions will be managed by Division Councils, elected by clubs. It is recommended that offices be held by separate individuals and that there should not be plurality of office.

I should like also to suggest that this will provide a golden opportunity for infusing new blood into club life, and to get rid of the firebrands and the members of "anti-everythingdom" who have become the proprietors of the movement and who have caused much conflict in the past by their underhand and unsportsmanlike methods. Otherwise the old hates will be carried into the new body and the cycling movement will be back where it was. Cycling is a young man's pastime and it should not be controlled by old men living nostalgically in the past.

Draft Cycling Racing Regulations

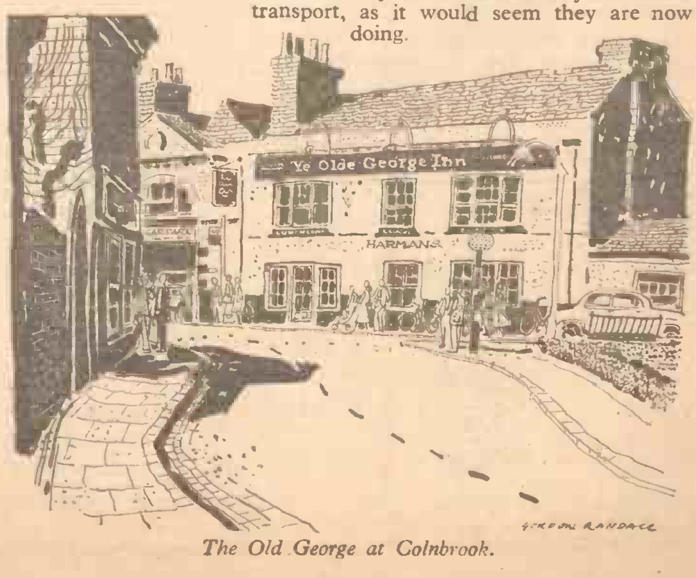
THE Ministry of Transport has circulated the draft cycling regulations to interested associations for comment. The Roadfarers' Club is submitting its own ideas as to how cycle racing should be run. The draft regulations may not be published at present whilst they are, so to speak, *sub judice.*

The Cycle Show

MOTOR cycles, mopeds and scooters dominated this year's Cycle Show. In fact, there were more such exhibits than there were of cycles. The attendances were poor. The removal of hire-purchase controls has had little effect on sales of bicycles and the president of the B.C. and M.C.I.A. expressed his conviction that the potential cycle market remains as good as ever it was but for the unduly heavy burden of purchase tax on a utilitarian product.

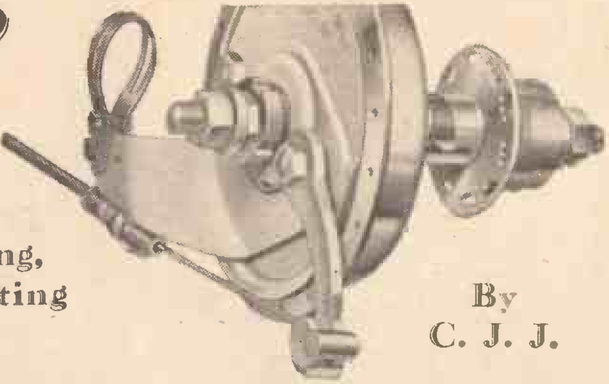
The Advance of Mopeds

RECENT figures show that at the present time there are approximately 300,000 mopeds on the roads of Great Britain, and the number is increasing rapidly. Will they in the distant future entirely replace the bicycle? The large majority of cyclists today are utilitarian, not interested in athletics, as is proved by the comparatively low membership of the sporting organisations. With the bigger wage packets now available they can afford to buy motorised transport, as it would seem they are now doing.



The Old George at Colnbrook.

THE HUB BRAKE



Dismantling, Replacing a Lining, Reassembly, Fitting and Adjustment

By C. J. J.

THE hub brake, or to give it its true name, the internal expanding brake, can be operated either by cable or by rod and lever. By one or other of these means the movement of the brake lever is transmitted to a cam lever on the outside of the hub shell. This arm is fitted by means of a square hole on to the squared shank of the operating cam. As can be seen from Fig. 1 rotation of this cam causes the two brake shoes with their linings to be forced apart against the inside of the brake drum. A spring or springs link the two shoes together and when pressure on the brake lever is released this spring returns the shoes to the "off" position.

Dismantling

The hub brakes made by Sturmey Archer are described here, but all these types of brake are constructed in basically the same way.

The first step in dismantling is to remove the locking nut and washers from the spindle, laying them by so that they can be replaced in the same order. This frees the brake arm complete with the cam lever, brake shoes and fulcrum. The remaining cone adjusters, ball cages, etc., on the spindle are similar in construction and fitting to most hubs and can be checked for wear and replacement in the usual way, without further reference to the hub brake mechanism.

To dismantle the brake shoes from the brake arm, remove first the nut holding the cam lever and slide the lever from its square shank. Next remove the fulcrum nut on the other side of the plate, and the shoes, fulcrum and cam can be lifted off.

Replacing Linings

There are two main occasions when lin-

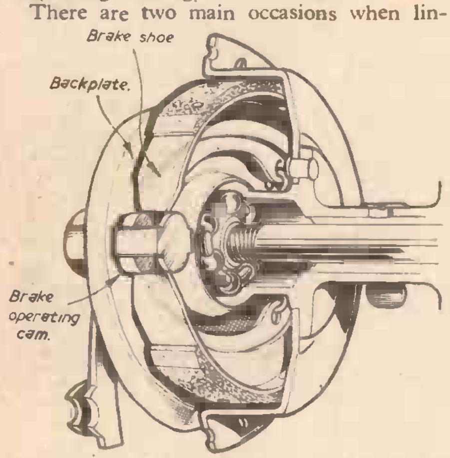


Fig. 1.—A cut-away view of the hub brake showing how it works.

ings need replacement, the first being when they have become contaminated with oil and grease and the second when they are badly worn. Oil soaked linings can sometimes be cleaned with petrol or tri-chlorithylene and a toothbrush, but usually it is better to replace the linings completely.

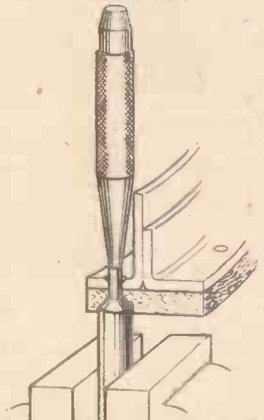


Fig. 2.—Using a piece of steel rod clamped in the vice of an anvil for fixing rivets.

The first step, of course, is to remove the old linings from the shoes, which is merely a matter of prising them free with an old screwdriver and then cutting the heads off the rivets with pliers. Replacement linings

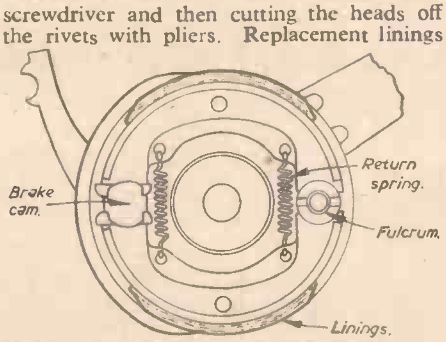


Fig. 3.—How the brake shoes, operating cam, fulcrum, etc., are mounted on the brake plate.

specially made for the brake being repaired can usually be obtained from the local cycle repair agent, but if none are available, plain linings of the correct size must be used. These, of course, must be drilled and countersunk, using the shoes as a pattern, and the ends bevelled to avoid "squealing."

Fig. 2 shows the method of actually fitting the rivets. A piece of steel rod is used as an anvil and held in the vice. The countersunk side of the linings, with the rivet in place, is placed over the anvil, making sure that the rivet head is below the surface of the lining. Finally, use a hammer and punch to burr over the end of the rivets.

Sometimes a squealing brake will be found to be caused by loose brake lining rivets and, of course, the set-up in Fig. 2 is again used to rectify this.

Reassembly

The brake shoes, operating cam and fulcrums are first assembled on the brake plate (Fig. 3), making sure that the side of the brake cam with the largest flat is towards the spindle. If the cam is not fitted correctly, only one of the brake linings will operate. Before replacing the cam bush it should be greased. When the cam lever and locking nut are fitted make sure that they line up with the operating cable or rod. The brake plate assembly is replaced over the spindle and the washers, spacers and locking nut are replaced in the same order from which they were removed.

Fitting a Brake

No especial difficulty should be encountered in fitting a new brake. The original brake levers can be used with both the cable and roller lever type. With the latter both bolt-on and clip-on bell crank fittings are available. For both front and rear brakes the handlebar lever should have a minimum travel of 3in. to 3½in. and at the centre of the front brake stirrup there should be a travel of at least 5/16in. For the rear brake there should be a minimum movement at the bell crank of ¼in.

Another important point is that the brake arm clips of both front and rear brakes should be fixed firmly.

Adjustment

When the brake has been finally fitted, adjustment should be made only at the proper points. These are on the cable, near where it is fitted to the cam arm; or in the case of rod-operated brakes, by means of the knurled nut which secures the rod to the cam arm (see Fig. 4). The method of adjustment is approximately the same in both cases. The locking nut is eased off and then the adjuster tightened until it can be felt that the brake shoes are rubbing on the inside of the drum. Pressure is eased off then until the shoes are just clear and the locknut retightened.

One last point to remember. There is a drainhole provided in the brake for surplus oil and this should always be kept clear; otherwise oil may find its way on to the linings and necessitate their replacement.

Cable Replacement

Cables should be replaced at the first sign of fraying of strands and this usually appears near the soldered nipples at the end of the wires. It is advisable, too, to keep the wires, where they are exposed to the atmosphere, lightly greased and occasionally to run a drop of oil down inside the outer cover.

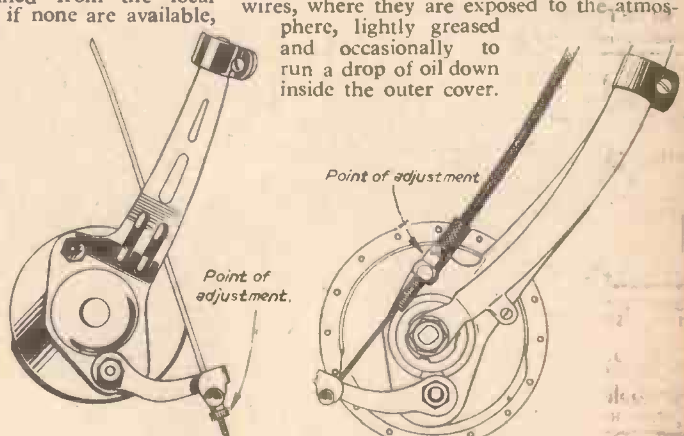


Fig. 4.—The two methods of brake adjustment for rod-operated and cable-operated types.

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